CHINA'S HIGH TECHNOLOGY DEVELOPMENT

HEARINGS

BEFORE THE

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

ONE HUNDRED NINTH CONGRESS

FIRST SESSION

APRIL 21 AND 22, 2005

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U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

The Commission was created in October 2000 by the Floyd D. Spence National Defense Authorization Act for 2001 sec. 1238, Public Law 106–398, 114 STAT. 1654A–334 (2000) (codified at 22 U.S.C. sec. 7002 (2001)), as amended, and the "Consolidated Appropriations Resolution of 2003," Public Law 108–7, dated February 20, 2003. Public Law 108–7 changed the Commission's title to U.S.-China Economic and Security Review Commission.

The Commission's full charter is available via the World Wide Web: http://www.uscc.gov.

The Commission's Statutory Mandate begins on page 334.

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

JUNE 29, 2005

The Honorable TED STEVENS,
President Pro Tempore of the U.S. Senate, Washington, D.C. 20510
The Honorable J. DENNIS HASTERT,
Speaker of the House of Representatives, Washington, D.C. 20515

DEAR SENATOR STEVENS AND SPEAKER HASTERT:

On behalf of the U.S.-China Economic and Security Review Commission, we are pleased to transmit the record of our April 21–22, 2005 public hearings held in Palo Alto, California. The hearing entitled "*China's High Technology Development*" provided revealing insights into China's advancement as both a technology producer and innovator, and into the related challenges to U.S. technology leadership. The Commission examined how these developments may affect the U.S. economy, standard of living and national security.

This venue was chosen because of Silicon Valley's role as the epicenter of the U.S. technology industry. The Commission heard from representatives of California technology and venture capital firms, leading trade associations for the electronics, semiconductor, and information technology industries, and specialists on China's technology development strategies and U.S. technology trends. The Commission also heard from senior officials from the State Department and the National Science Foundation who presented their agencies' official assessments of China's science and technology trajectory. Lastly, the Commission discussed China's ongoing weaknesses in protecting intellectual property rights (IPR) and the implications for U.S. industry and China's technology development with representatives of the California-based U.S. entertainment industry and observers of China's IPR developments. The Commission was honored that former Secretary of Defense William J. Perry began the hearing by offering his analysis of the close link between U.S. military superiority and U.S. technology leadership.

Over the two-day hearing, the Commission heard extensive testimony highlighting the following:

- China has become central to the global supply chain for technology goods of increasing sophistication, and its technology research and development activities are steadily and substantially expanding.
- China's production and export of advanced technology goods have produced a fast-growing surplus in trade with the U.S. in advanced technology products (ATP)[1] that reached $36 billion in 2004.

[1] The Commerce Department defines approximately 500 product codes as ATP. These products fall into 10 categories: biotechnology; life sciences; opto-electronics; information and communications; electronics; flexible manufacturing; advanced materials; aerospace; weapons; and nuclear technology.

- Advances in China's technology infrastructure and industries, along with similar advances in other developing countries, pose a significant competitive challenge that has begun to erode U.S. technology leadership.
- Maintaining U.S. technology leadership is vital to both U.S. global economic leadership and long-term U.S. military superiority.

The Importance of Technology Development to U.S. Economic and Security Interests

Panelists testified about the critical importance of technology development and innovation to the U.S. commercial and defense base, stating that technology improvements drive about half the U.S. GDP and two-thirds of its productivity gains.

Former Defense Secretary Perry expressed his concern about the decline in Department of Defense (DOD) spending for technology research and development (R&D), characterizing this as a national security concern that also adversely affects our commercial competitiveness. Dr. Perry noted that basic research (creating new technologies rather than applying existing technologies in new ways) is critical to generating future technological advances, but that nearly all R&D currently undertaken by industry is focused on product development. He recommended enhanced federal funding of basic research in order to maintain a strong national basic research environment.

U.S.-China Trade and Investment

In 1998, U.S.-China trade in items with the highest R&D and engineering content was roughly in balance. However, by 2004, the U.S. had amassed a trade deficit with China in ATP items of $36 billion. In the information technology and communications sector, the deficit was $39 billion, offset by small surpluses in semiconductors and commercial aircraft. The level of technology in China's exports also is increasing. Panelists testified that from 1995 to 2004, China's high and medium-high technology exports increased from 33 percent to 52 percent of overall technology trade, while low and medium-low technology exports were down from 67 percent to 48 percent.

The Commission was told that foreign investment in China continues to grow markedly, much of it drawn to technology sectors. Panelist Ernest Preeg of the Manufacturers Alliance advised the Commission that:

> "[F]oreign direct investment (FDI) in China was relatively low during the first stage of labor-intensive industrial growth, less than $5 billion per year through 1991. FDI then increased sharply, related to wide-ranging incentives for advanced technology investors, to $38 billion in 1995 and $62 billion in 2004. Seventy percent of FDI is in manufacturing, with heavy concentration in export-oriented companies and advanced technology sectors. In 2004, 57 percent of total Chinese exports were by foreign investors."

Dr. Preeg testified that Taiwan remains the largest foreign investor in China, accounting for about half of total FDI in China.

The U.S. moved to fourth place in 2003 behind South Korea and Japan. Last year, South Korea invested $6.2 billion in China, Japan invested $5.5 billion, and the U.S. invested $3.9 billion.

Private equity investments in China are also rising. Over the last two years, U.S. venture capital firms made over 100 investments in China. One panelist testified that venture capital in China will exceed $2 billion in 2005, with an additional $5 billion to $10 billion being raised for buyout funds and other forms of private equity. Gary Rieschel of Mobius Venture Capital testified that this type of investment is beginning to pour into China, as Chinese engineering talent increasingly demonstrates viable innovation capacity.

China's High Technology Strategies

According to several panelists, and consistent with the Commission's finding in its 2004 Report to Congress, the Chinese government continues to pursue a coordinated, sustainable vision for science and technology development. Official Chinese government statements at the highest level make clear the government's view that the primary drivers of economic growth and national strength are science and technology.

Panelists testified that China's technology advancement is derived from technology transfers achieved via foreign trade and obtained from the over 600 foreign-owned R&D centers in China and also from the growing innovative capacity of indigenous Chinese institutions. In recent years, the Chinese government has been undertaking extensive reforms in its R&D system in order to create a modern national system of innovation (NIS), a defining characteristic of which is the central role played by industrial enterprise in contrast to the controlling influence of government research institutes in the past. China's R&D expenditures have now reached 1.3 percent of GDP and it is now the third largest R&D spender in the world. Additionally, China is making great strides toward advanced technology power status by developing indigenous firms that have global brand recognition, reputations for producing quality products, and leading-edge R&D programs. Many Chinese technology firms have become globally competitive.

China is using strategic policies to achieve its technology advancement goals. For example, in the area of software, China maintains a policy that only domestic software or "qualifying foreign software" may be used by government entities. The criteria for receiving the designation of qualifying foreign software have yet to be defined. The absence of such criteria has inhibited U.S. manufacturers from securing government business and appears intended to exclude U.S. firms from this lucrative market. Because the rates of software piracy are so high for the Chinese market as a whole, cutting off foreign software suppliers from the Chinese government market—in which the piracy rates are at least slightly lower than in the Chinese markets as a whole—essentially cuts those suppliers off from the China market altogether.

Panelists told the Commission that the U.S. intelligence and defense community is not devoting sufficient resources to monitoring and analyzing China's technological growth, and the derivative benefits for its military. Current National Intelligence Estimates on China, and DOD reports such as its annual report to Congress on China's military power, do not include an assessment of China's technological development. This failure is particularly noteworthy when it is contrasted to the tremendous effort the U.S. and its allies exerted during the Cold War to ascertain the nature and extent of Soviet technological development. The Commission also was told that, although China has recently made high-level breakthroughs in nanotechnology, computer chip and semiconductor design, satellites, and supercomputing, the U.S. government does not currently produce an assessment of the implications of these advancements for China's overall technological development or its military growth.

Technology Standards

Developing technology standards is an important part of China's technology growth strategy. Industry participants identified China's use of technical standards as a serious and growing barrier to trade. The Commission heard testimony that, unlike most international standards, China's standards often do not reflect market competition, industry preference, or consumer choice, but rather are based on priorities of the Chinese government that often include the development and protection of domestic technology firms. Moreover, China has been able to use the leverage of access to its huge consumer market to promote its unique standards.

Additionally, analyst Kathleen Walsh of the Stimson Center testified that "emphasis on technology standards developed to Chinese specifications is expected to help reduce China's vulnerability to foreign supply, enhance China's competitiveness, and limit opportunities for possible hacking, backdoor programming, or sabotage by foreign agents." As commercial technologies are increasingly used in defense applications, the process of developing indigenous technology standards could also aid China in overcoming the hurdle of advanced systems integration, traditionally an obstacle for China's defense development efforts.

Challenges to U.S. Technology Leadership

The Commission heard dramatic testimony from leaders of the U.S. technology industry that the economic challenges posed by China and other developing countries may well erode the current position of the U.S. as the world's dominant technology innovator, absent a refocusing of attention and resources in the United States.

William T. Archey, President and CEO of the American Electronics Association, stated:

> "Let me be clear: it isn't that the United States is in decline. It's that others are advancing quickly from behind, putting all their economic resources into moving their countries forward. The problem is that even if the United States were doing everything right, the world still poses an unprecedented competitive challenge. Unfortunately, we aren't doing everything right, and this compounds the challenges that we face."

George Scalise, President of the Semiconductor Industry Association, said:

> "Given the critical importance of semiconductors in driving U.S. economic growth and ensuring our national security, maintaining a competitive semiconductor manufacturing capability and supporting ecosystems must be an important priority for America's federal and state governments. . . . [T]he U.S. needs a coordinated strategy to reduce the cost differential created by foreign government tax and incentive policies. . . . The investments and policy changes needed to allow U.S. manufacturers to compete in the face of foreign incentives designed to lure investment offshore are neither easy nor inexpensive, but it is vital that we make them."

Panelists testified that the keys to remaining a leader in high technology are strong investment in basic research, a steady supply of skilled scientists and engineers, a competitive investment and tax environment, and effective intellectual property (IP) protection. Dr. Perry and others also noted a need to review current U.S visa policy to find a better balance between the nation's security interests and the national need for foreign scientists and engineers in R&D sectors. Some panelists indicated that in technology sectors, tax policies rather than lower labor costs are often the key factor in corporate decisions to invest abroad, given the high capital intensity required for technology production, and therefore the U.S. needs to enact tax reforms that would enhance the competitiveness of domestic production. There was a general view that when the U.S. has faced a competitive challenge in the past, the federal government marshaled the vision, leadership, and money to address that challenge—such as when, in the post-Sputnik era, it took strong steps to encourage technology innovation and to rebuild the nation's educational system—and that such a national effort is needed to address today's challenge.

Ongoing Weaknesses in Protection of Intellectual Property Rights

China's failure to protect IPR remains a serious concern. The Commission heard testimony that China has made virtually no measurable progress in this area. While China has taken steps to build a legal framework for protection of intellectual property, enforcement remains ineffective. The Chinese government attitude appears complacent toward the huge losses to U.S. industry. Panelists testified that Chinese piracy rates for software are 90 percent, and for the motion picture industry they are 95 percent. The Business Software Alliance estimates that losses to the U.S. software industry due to Chinese piracy were $1.47 billion in 2004. The U.S. motion picture industry estimates its losses between 1998 and 2004 at over $1 billion. Furthermore, panelists testified that China is now exporting its pirated goods, which are reaching markets such as the U.S. and the United Kingdom.

While China's domestically produced films also suffer from piracy, there is considerable evidence that when the Chinese government has chosen to do so, it has been able to control piracy in certain areas. One panelist testified that in the case of domestic films where the government has a financial stake in the films or the theaters showing them, the government has been able to control piracy so the films can be viewed only in theaters, resulting in a large theater viewer ship that pirated films are unable to realize. This strongly suggests that the Chinese government has considerably more power to enforce IP protections than it has exerted to date.

Failure to protect IP can be a double-edged sword in the technology sector. While, initially, pirated IP provides cheap inputs to fuel further technological growth, as China develops its own technologies, domestic pressure will require better IP protection. But some analysts worry that as China's domestically designed technologies grow, the government may selectively protect domestic IP while providing inadequate resources to protect foreign IP.

Future Hearings

Given the issues and concerns raised in the hearing, the Commission intends to conduct an annual hearing in consultation with the White House Office of Science and Technology Policy, the Department of Defense, and the National Science Foundation, in both classified and unclassified sessions, on China's advancements in science and technology (S&T). Such a hearing will include an assessment of both commercial and military technology, the contribution of foreign investment to China's technological growth, and an analysis of implications for U.S. economic and national security.

Recommendations

1. As recommended in the Commission's 2004 Report to Congress, the U.S. government must develop a coordinated, comprehensive national technology competitiveness strategy designed to meet China's challenge to U.S. scientific and technological leadership. America's economic competitiveness, standard of living, and national security depend on such leadership. The Commission therefore recommends that Congress charge the Administration to develop and publish such a strategy in the same way it is presently required to develop and publish a national security strategy that deals with our military and political challenges around the world. Such a strategy should:

- Identify future technology base goals;
- Recommend policies for directing funds toward maintaining the U.S. technology base;
- Initiate a national educational program, similar to the programs developed in the post-Sputnik era to enhance the level of math and science education at the "K-through-12," undergraduate, and graduate levels in the U.S.;
- Recommend appropriate tax and investment policies to encourage high-technology-related research, development, and manufacturing activities in the U.S.

2. In establishing a national technology competitiveness strategy, it is critical to incorporate input from the U.S. technology industry to better align private-sector goals with national interests. To this end, the Commission recommends that the Congress create

a task force including representatives from the Office of Science and Technology Policy, the National Science Foundation, and the Departments of Education, Defense, State, Energy, Labor, and Commerce to consult on a regular basis with select private-sector leaders in key science and technology industries, and investment leaders, particularly venture capitalists, regarding development and implementation of the national strategy. The intent in initiating such a task force is to create a permanent structured dialogue between the federal government and the private sector on technology base issues that have a direct effect on U.S. economic and national security. The task force should be required to report its findings and recommendations to Congress on an annual basis.

3. Congress should increase intelligence community resources for collection and analysis focused on China's technology development. It is crucial that U.S. policy makers have access to current, accurate, and complete information on China's technological development.

4. Given the lack of progress to date in curbing IPR violations in China, the Congress should press the Administration to develop and pursue a series of discrete cases in the WTO aimed at addressing the most egregious violations of U.S. intellectual property rights in China.

5. The Commission recommends that a review of our nation's immigration policies regarding student visas and business travelers take place immediately. The review should be conducted with full recognition of the importance of promoting interaction and exchange as a way of enhancing U.S. values and interests in the world and also of promoting U.S. economic interests. Many business travelers who wish to expand trade relationships have experienced difficulty in traveling to the U.S. Foreign student participation in our nation's education system has declined. Both these trends facilitate the movement of innovation and economic capabilities offshore. At the same time, protecting our technological and economic base as well as our security interests is vital to our national interest and must be integrated into this policy review.

6. The Bureau of Economic Analysis currently compiles international trade data for each ATP product. Congress should direct the Department of Commerce to present more detailed ATP trade data in a user-friendly format in its monthly publication, *U.S. Trade in International Goods and Services.* The data should be presented in a table that quantifies U.S. trade in each of the ATP products with the U.S.'s top ten ATP trading partners (of which China is one). This table should present, for each of the ten countries: (1) the value of U.S. imports of each ATP product from the country; (2) the value of U.S. exports of each ATP product to the country; (3) the country's trade balance with the U.S. for each ATP product; and (4) the percentage of total U.S. imports of each ATP product accounted for by imports from that country. These data will facilitate analysis of the import dependency of the U.S. on spe-

cific ATP products and, more precisely, on specific ATP products from specific countries.

Sincerely,

C. Richard D'Amato
Chairman

Roger W. Robinson, Jr.
Vice Chairman

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THURSDAY, APRIL 21, 2005

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION,
Washington, D.C.

The Commission met in Stauffer Auditorium, Hoover Institute, at Stanford University, Stanford, California at 9:00 a.m., Chairman C. Richard D'Amato, Vice Chairman Roger W. Robinson, Jr., and Commissioner Patrick A. Mulloy (Hearing Cochair), presiding.

OPENING STATEMENT OF CHAIRMAN C. RICHARD D'AMATO

Chairman D'AMATO. Good morning and welcome to the U.S.-China Economic and Security Review Commission's hearing on "China's High Technology Development." Today's hearing in California's Silicon Valley continues our series of sessions around the country to take the pulse of how China's economic rise presents both opportunities and challenges to particular sectors and regions of the United States economy.

We are particularly interested in the views of the many firms, organizations and individuals in Silicon Valley who are in many ways on the front lines of this developing relationship with China, and whose insights and recommendations we value very highly.

We are grateful to Stanford University, particularly the Hoover Institution for its help in bringing the Commission to Northern California and to our former Commission colleague Ambassador Robert Ellsworth for his inspiration and guidance for this event.

This hearing will assess how far China has come as a center for technology manufacturing and, perhaps more importantly, as a center for research and development and technology innovation.

We will also be examining the role China plays in the global supply chain for technology goods and the contributions that U.S. and other foreign investment have made, and continue to make, to China's scientific and technology advancement. China is clearly focused on acquiring great economic power status as soon as possible. What strategies and practices does China use to entice the transfer of technology by U.S. and other firms to China, and how important is the accomplishment of superpower high technology status to her overall strategy?

These questions are essential to understanding the long-term challenges China pose to U.S. economic interests and go to the heart of our congressional mandate: To annually investigate the depth and breadth of U.S. technology and R&D transfers to China and the implications for U.S. economic and national security policy. Following our hearing we will present to Congress the key findings and policy recommendations on this issue.

We are honored to have former Secretary of Defense Dr. William Perry lead off our hearing today. Dr. Perry has a unique understanding of the geopolitical and security implications of China's economic and scientific trajectory. Indeed, I do not think it's an exaggeration to say there is probably no American more qualified to evaluate and understand China's technology, technological developments, America's role in that phenomenon, and the vulnerabilities and challenges we face as China grows into what one witness this afternoon will call a new technological superpower.

Dr. Perry has served in high positions in DOD in dealing with science and engineering and is himself a mathematician. He took upon himself the challenge of engaging the Chinese while he was Secretary of Defense. When he was Undersecretary in 1980, he led the first U.S. military delegation to China and established a military-to-military relationship with the PLA. He continues to speak and write prolifically and wisely on these issues.

Last week his op-ed piece (April 13, 2005) in the *New York Times* on the shortfalls in technology research in the current DOD budget submission was required reading for our Commissioners in preparation for this hearing. Dr. Perry is currently a Fellow at the Hoover Institution, a Professor at Stanford, and Co-Director of the Preventive Defense Project, a collaboration between Stanford and Harvard.

Before proceeding I'll turn the podium over to Vice Chairman Roger Robinson.

[The statement follows:]

Prepared Statement of Chairman C. Richard D'Amato

Good morning and welcome to the U.S.-China Economic and Security Review Commission's hearing on "China's High Technology Development." Today's hearing in California's Silicon Valley continues our series of sessions around the country to take the pulse of how China's economic rise presents both opportunities and challenges to particular sectors and regions of the U.S. economy. We are grateful to Stanford University, particularly the Hoover Institution and Stanford Law School, for all of their logistical help in bringing the Commission to Northern California and to our former Commission colleague, Ambassador Robert Ellsworth, for his inspiration and guidance for this event.

Our last hearing outside of Washington, DC was also on the West Coast. This past January we were in Seattle to assess the impact of U.S.-China trade on Pacific Northwest industries, including aerospace, software, agriculture, and shipping. The Pacific Northwest region is one highly reliant on trade with Asia, and we had expected to hear testimony on the significant benefits that this region was receiving from its trade with China. However, the Commission heard witness after witness testify to both the immediate and long-term competitive challenges to regional industries from China, ranging from the advanced fields of technology and software to timber and horticulture.

This hearing will assess how far China has come as a center for technology manufacturing and, perhaps more importantly, as a center for research and development and technology innovation. We will also be examining the role China plays in the global supply chain for technology goods and the contributions that U.S. and other foreign investment has made, and continues to make, to China's scientific and technology advancement development. These questions are essential to understanding China's long-term challenges to U.S. economic interests and go to the heart of our congressional mandate to annually investigate the depth and breadth of U.S. technology and R&D transfers to China and the associated implications for U.S. economic and national security. Following today's discussion, we will present Congress with key findings and policy recommendations on this issue.

A central question is to what extent and in what ways have the transfers of manufacturing capacity, R&D, and investment into China impacted the American economy? Is it possible to measure such impacts? Finally, what policy prescriptions should we recommend to Congress to deal with imbalances or shortfalls in R&D, education and other aspects of the U.S. economy central to our national health?

The nature of globalization has made these questions much broader than the issue of direct technology transfers. For example, what is the critical level of knowledge or technology that enables the U.S. to have an advantage in certain technology sectors? Once knowledge or technology at that level is shared, is there a risk the U.S. will lose its lead in that sector? This question becomes key, when one considers, what industries are necessary to maintain national security. Once identified, what is the critical level of employment to maintain the industries in the United States? What research and development positions need to remain in the U.S. in order to ensure that science and engineering college graduates are able to enter the field?

The February 2001 Report of The United States Commission on National Security/21st Century identified the declining condition of pre-college education in the United States as a critical national security problem. The National Science Foundation has echoed this concern in its reports as well. It is now 2005, what has been done to address this issue? We, here today, have the critical task to understand the scope of this concern and recommend to Congress actions that can be taken now to move the long-term trends into a positive direction.

The scope of our inquiry goes beyond the private sector to include government-to-government contacts. In 2002, this Commission recommended the establishment of a comprehensive inventory of official government-to-government science and technology (S&T) programs with China and a biennial report to Congress on the work being conducted under such programs. Congress adopted this recommendation and the latest report to be produced as a result was issued last week by the State Department. We look forward to hearing, tomorrow, from a representative of the Department about their conclusions as well as their assessment of all the avenues through which China gains access to U.S. technology.

We are honored to have former Secretary of Defense William Perry lead off our event today. Dr. Perry has a unique understanding of the geopolitical and security implications of China's economic and scientific trajectory. Moreover, we note that in a recent *New York Times* editorial, Dr. Perry cited concerns about the impact of declining funding for defense-based technology research and development. He stated that "If the Pentagon does not make the required investments today, America will not have dominant military technology tomorrow" and that "tech based activities have yielded advances in scientific and engineering knowledge that have given United States forces the technological superiority that is responsible in large measure for their current dominance in conventional military power."

Following Dr. Perry, we will hear testimony from U.S. corporate and investment leaders in the Silicon Valley region. James Morgan, Chairman of Applied Materials, George Scalise, President of the Semiconductor Industry Association, and Alan Wong, Senior Council for Nvidia Corporation are here to give their assessments of China's advancement as a technology leader. We are privileged to have their on-the-ground perspective of the U.S. corporate relationship with China. We also have with us Gary Rieschel of Mobius Venture Capital and Carl Everett of Accel Partners here to discuss both China as a destination of venture capital and the rise of U.S. micro-multinational start-ups.

In our second panel today, we will hear testimony from four scholars who have examined China's high-tech development strategies in depth. We are pleased to have Drs. Richard Suttmeier, Michael Pillsbury, Denis Simon, and Ms. Kate Walsh.

This afternoon, we will hear from Stanford's Henry Rowen, Ernest Preeg of the Manufacturers Alliance, Eamonn Fingleton, and Berkeley's John Zysman. These four panelists will discuss the U.S.-China high-tech relationship and larger implications of globalization on U.S. high-tech sectors.

Our last panel of the day will specifically examine challenges to U.S. high-tech leadership. We are pleased to have Bill Archey of the American Electronics Association, John Ciacchella of A.T. Kearney, and Rhett Dawson of the Information Technology Industry Council.

Tomorrow we'll hear from John Gage of Sun Microsystems as well as representatives from the State Department and National Science Foundation. We will then move to an important discussion of how China's continuing weak protections for intellectual property impact the U.S. entertainment industry in particular and may act as both a driver and inhibitor of its technology development. We'll have with us John Malcolm of the Motion Picture Association of America, Darcy Antonellis of Warner Bros., Pat Choate of the Manufacturing Policy Project and Ted Fishman, author of China Inc.

We look forward to a highly informative event.

OPENING STATEMENT OF VICE CHAIRMAN ROGER W. ROBINSON, JR.

Vice Chairman ROBINSON. Thank you, Mr. Chairman.

As the Chairman indicated, we're very pleased to be in California today to explore a topic of great importance to both our national, economic, and security interests. I also join the Chairman in extending the Commission's appreciation to all those who helped bring together such an esteemed group of panelists, particularly Ambassador Ellsworth for his continued support of the Commission's work.

We have before us two days of panels laid out to provide an array of perspectives on China's progress toward developing its technology production and innovation capabilities. We've assembled representatives of leading U.S. technology firms; industry associations; prominent venture capitalists; analysts of China's technology, development strategies, and policies; seasoned observers of U.S.-China high-tech trade; and senior officials of the State Department and the National Science Foundation.

The State Department and NSF have both been monitoring and reporting on China's technology advancements, and we're pleased to have them represented here today. Tomorrow we'll also hear from industry and outside experts on how China's poor and—some would even call them—pathetic intellectual property rights protections affects technology development and trade.

As we assess China's technology advancements, we must also remain mindful that they pose both military and security challenges in addition to economic ones. As the Commission noted in its 2004 Report to Congress, China has historically channeled high-technology research and development to the benefit of its defense industrial base. We made clear in that Report our view that "what China does with its growing technology capabilities—whether it converts them to military uses—is of direct national security concern to the United States."

Moreover, we in the United States must nurture our own technology base in order to maintain our defense capabilities, an argument, as the Chairman pointed out, eloquently presented by former Secretary of Defense Bill Perry, who we're honored to have with us today, in his *New York Times* piece of last week.

Accordingly, the assessments we'll be hearing today and tomorrow from U.S. industry leaders about the trends affecting U.S. technology competitiveness and the government policy changes needed to preserve and promote such competitiveness are vitally important.

I look forward to two days of rich and important testimony and will now turn over the proceedings to the hearing Cochairs, Chairman D'Amato and our colleague Commissioner Mulloy. Thank you.

[The statement follows:]

Prepared Statement of Vice Chairman Roger W. Robinson, Jr.

The Commission is pleased to be in California today exploring a topic of great importance to both our national economic and security interests. I join the Chairman in extending the Commission's appreciation to all those who helped bring together such an esteemed group of panelists, particularly Ambassador Ellsworth for his continued support of the Commission's work.

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Moreover, we in the United States must nurture our own technology base in order to maintain our defense capabilities, an argument eloquently presented by former Secretary of Defense William Perry, who we are honored to have with us today, in a *New York Times* editorial last week. Accordingly, the assessments we will be hearing today and tomorrow from U.S. industry leaders about the trends affecting U.S. technology competitiveness, and the government policy changes needed to preserve and promote such competitiveness, are vitally important.

I look forward to two days of rich and important testimony and turn the proceedings over to my colleagues and the hearing's Cochairs, Chairman D'Amato and Commissioner Mulloy.

Chairman D'AMATO. And thank you, Commissioner Robinson.

Dr. Perry, welcome. We look forward to your remarks.

I think the Secretary said he will be talking for ten or so minutes and then would be delighted to take questions from the panel.

Thank you very much, Dr. Perry.

INTRODUCTORY REMARKS—CHINA'S GROWING GLOBAL PRESENCE

STATEMENT OF THE HONORABLE WILLIAM J. PERRY, SENIOR FELLOW STANFORD INSTITUTE FOR INTERNATIONAL STUDIES STANFORD, CALIFORNIA

Dr. PERRY. Thank you very much, Mr. Chairman. It's a pleasure to be here to speak to this Commission on these very important issues. I'm going to focus my comments today on information technology. I'm doing that because that's a field I know something about. That's where my experience is.

I will start with a caveat, though, that the comments I make will not necessarily be applicable to other fields.

I want to start with a historical observation. Many years ago when I was the Undersecretary of Defense—this was in the late 1970s—as Undersecretary for Research and Engineering, we were faced with a major threat from the Soviet Union. That seemed like a long time ago, but it seemed like a very real problem then. At that time the Soviet Union was just beginning to equal us in strategic weapons and nuclear weapons. We had to face the fact that they had about a three times advantage in conventional weapons, three times as many tanks, three times as many men in their army, and so on.

So we were faced with an issue of what to do about that. The President at that time, as his predecessors all the way back to President Eisenhower, concluded we could not deal with that by trying to equal the Soviet Union in the number of men in their army. That would bankrupt our economy as, in fact, it eventually bankrupted their economy. But we saw it as a major problem.

So we set about to do something which we called the "Offset Strategy." The use of American technology to offset the quantitative advantage of the Soviet forces.

As the Undersecretary of Research and Engineering at the time it became my responsibility to try to implement that Offset Strategy. And I elected to use information technology as the primary tool for doing that because we had then, as we have now, a commanding lead in that field.

The key three items of the Offset Strategy were:

Developing greatly improved sensors so that we could locate enemy tanks, vehicles anywhere on the battlefield at any time.

The second came to be called Smart Weapons, was developing precision-guide munitions. Once we located an enemy unit a smart weapon could destroy it with one attempt, which is a dramatic difference from the firing accuracy, which had existed at that time and had been relevant in all earlier wars.

The third part of the Offset Strategy was to develop what came to be called Stealth, so that our vehicles, our airplanes, and our ships, and so on, would not be subject to the same kind of precision attack that we were inflicting on others.

So those were the three components of the Offset Strategy. All of them were embedded deeply in information technology, and our success depended on leadership in information technology. Those systems were developed in the late 1970s and the early 1980s. They saw their first use in warfare in Desert Storm, a decade after they were started, and they proved to be enormously successful. So they were developed in the late 1970s, and were applied for the first time in the late 1980s.

In the late 1990s they were used again, this time in Kosovo. It was interesting then, and I want to make this point very specifically, that even though the world had known for a full decade by then about not only what we had done but how effective it had been, by that time even our allies, even the industrial nations of the United Kingdom, and Germany and France were not equal to that capability. That turned out to be a disadvantage in Kosovo because we had to carry most of the burden of precision strikes ourselves because that capability did not exist in other countries to the same extent.

So that has been a real success story, but it did depend from the beginning and even to this day on our leadership in information technology.

I make this point so that I can underscore the appropriate question that you were asking here, and certainly in the information technology field at least there is very good evidence that our leadership in information technology played a key role in our national security. There is also ample evidence it's played a key role in bolstering our economy. That's another story that I'm not as qualified to talk about, but I think both of those points are well understood in the world.

Now the second story I would like to share with you that I think is relevant to this topic deals with a visit that I made to Shanghai a few years ago. I went over to visit a new company called The

Semiconductor Manufacturing International Corporation located in Shanghai.

They had been in business then one year, 12 months. I went over to tour their new factory, the factory for making semiconductor wafers that were close to the state of the art in semiconductor technology. The thing that amazed me was this plant was in operation, actually delivering product only 12 months after they started, only 12 months from when that same site had been a green field.

I was wondering how they were able to do this, so I asked a lot of questions. To oversimplify a rather complicated picture I will say I learned that the investments that had been made in that company had been one-third from the United States, one-third from China, and the other one-third, interestingly enough, was from Taiwan. The people who worked at that factory were about the same ratio: About a third came from Silicon Valley, about a third from Taiwan, and a third from China.

So this illustrates how technology transfer really occurs and the benefits of technology transfer to a country like China. It also illustrates why the American companies and engineers invested in this operation is because they wanted a major part of the Chinese, the burgeoning Chinese cell phone market, and that's what this factory was supplying, primarily.

Now having started with those two anecdotes that I think are relevant to the issues you're discussing, I want to make an observation and that is what I consider an existential reality that bears profoundly on this question. And that is that information technology is the ultimate global market. It is a global market, not a national market, to a much greater extent I think than any other industry.

I would illustrate that by observing this laptop here or any other laptop you may have. It will have a name on the front and this name is Sony, which suggests it's a Japanese product. But it might be IBM or it might be Samsung, suggesting it's an American or Korean product. But if you take the cover off and look inside of it, regardless of the name on the front, you will find components from Silicon Valley; you will find components from Taipei, from Tokyo, from Singapore, from Seoul, from Shanghai. It is a global product. And no company could make their laptops without buying products and components from all over the world.

Now in this global market then the United States is certainly a leader in the market, but we are not dominant and we are not able to control the market. That I consider is the existential reality that needs to be considered in dealing with the issues you are talking about today. Indeed, the United States information technology could not function effectively in isolation from other countries and from other markets.

So the question that is sometimes asked is whether the U.S. should control the flow-out of its technology in this industry or the flow-in of investments. I think my answer to that question would be there is no practical way we can do that.

So to me it's not an interesting question because there's no way of implementing it, even if you decided that you wanted to do.

Nevertheless, having said that, I want to also say that it is the very great interest of this nation, both from a national security point of view and from an economic point of view, for us to maintain a leadership position in information technology.

So the question then is: How do we maintain that leadership. And if we cannot do it by controlling the market, what should our strategy be for maintaining the leadership.

Now I think there are three components to doing that, and I'll comment briefly on each of them. The first is to do everything we can to maintain the efficiency of our companies in this industry.

Second, to do everything we can to maintain the advantage we now have in technology innovation.

And the third is do everything we can to protect the intellectual property of our companies. Those to me are the three issues. And I think every company that works in this industry in the United States tries to focus on those three issues.

And the government's role in this, it seems to me, should be to try to facilitate the companies' success in achieving those three objectives. I have a very brief comment about each of the three of them.

In terms of maintaining the efficiency of our companies, I think the main role of the government in to not restrict their ability to make an optimum exploitation of the international markets. They live on the international markets. And to the extent the government restricts their ability to deal in those markets, you are going to be impeding their abilities to succeed.

And, secondly, you should not restrict their ability to make an optimum exploitation of international capital. They need capital flowing in to run their business. Some of this comes from international sources and, therefore, they need to be able to access foreign direct investments in U.S. companies.

So from the government's point of view, then, it seems to me that the laws and the regulations dealing with those issues should put minimal restrictions on our companies if we want them to have maximum success.

The second point has to do with maintaining the advantage we have in technological innovation. This is really the mother's milk of Silicon Valley.

We have competition in all of these fields, in all of these products that we are developing today. In most of them, though, the competition is in what I would call a "tail chase," to use a term from the military. The competition is following us. They're trying to catch up. There's always a philosophical issue of what you do when you look back and you see somebody chasing you. And there's a temptation to try to find some way of slowing him down. And I've always believed that's the wrong approach. The right approach is to run faster.

And so we should focus on the laws and regulations that allow our companies to run faster, not try to find ways, which are usually ineffective, of trying to hobble the person who's trying to catch us.

The third issue is one of protecting intellectual property, about which I have less to say but which I believe is a very important issue. And I want to end by making a few comments about how we might do some of the things that I'm talking about, particularly in the area of technological innovation, which I think is the key to success here.

I start off by observing that you are sitting here in Stanford University, and it is typical of the reason Silicon Valley enjoys leadership role in the information technology industry. The United States has the best technological universities in the world today, and that has been a very key part of our success.

So one key thing we have to do, if we recognize that fact and want to maintain our leadership position, clearly you want to maintain the technical universities as being the best in the world today. So we have to find ways of sustaining the success of these universities. I'll be happy to entertain questions on that. I've spent a good many years of my life in this particular university. And when I was in the government I observed carefully quite a few other universities.

The U.S. Government plays a key role in these universities, by the way. And, in particular, it is one of the primary supporters of the research and development done at universities. So it's really quite important how the government interacts with universities in terms of our being able to maintain the leadership position we have today.

The second and a related point to that is the United States has traditionally made the largest investment of any country in the world in what I would call technological base.

Mr. Chairman, you referred to the op-ed piece that Dr. Deutch and I wrote in the *New York Times* last week. That is what we were talking about—is maintaining the technological base. I want to separate that from R&D.

People argue that we need to do more R&D. The companies in this country have a lot of R&D, but their R&D is focused almost entirely on product development, on the D part of R&D. They develop new products and those products make them successful in the market. But all of that product development draws on some base of technology. It's technology-based.

Most of the companies in this area, even the very enlightened companies like Hewlett-Packard, do not spend much of their dollars on increasing the technology base. This is the seed corn on which the new products are developed. That technology base has been supported traditionally in the United States by the United States Government and, for better or for worse, in the information technology at least mostly by the Defense Department. That was my basis for writing the op-ed piece.

I saw a decline in the spending for the technology base by the Department of Defense. That to me is more than a national security issue because, in fact, our commercial industry depends on that same technology-based development.

There was a time in this country when much of our technology base was done by the great research laboratories, like the Bell Laboratories and IBM. But if you haven't noticed, let me point out to you, those days are gone. IBM and Bell Laboratories no longer play that role in the nation today. We are still very much dependent on the Department of Defense for providing the technology base, and it's done primarily but not exclusively through our technical universities.

The third feature in maintaining our technological innovation is that we have in this country, not just in Silicon Valley but in the country what I would call a cultural advantage in innovation. I do not think the government can or should do much to try to influence that. That's an advantage we have that we should cherish and observe, but I don't think there's much we can do to affect it.

And, finally, we have developed the necessary support system for technological innovation. It is in many parts of the country, but it certainly developed first and most prominently here in Silicon Valley. The support system is such things as the venture capital, which provides the risk capital for new innovations, the legal, and the accounting work. All of those particular support systems are brought together uniquely in Silicon Valley and they have been modeled in other parts of this country. And that's a key part of our ability to do technological innovation. Now that's not duplicated to the same extent in any other country in the world. What do we do from a legislative point of view to facilitate that? I think what we are doing, in fact, is probably tending to hobble it, that the changes that are being undertaken now in accounting principles, particularly those that affect the ability to give company stock options is probably a step backwards in that direction.

So the things we could do to foster innovation, most of them are not things that the government can do, but the government can do some things to hobble innovation. And I think the regulation now underway in the accounting field is an example of that.

The final point, which is a very important point about which I do not have much to say, is intellectual property. I recognize the importance of maintaining intellectual property. I recognize the fact that it's being systematically abused in many countries in the world, not limited to China but certainly including China.

I do not have the expertise to advise you on what to do in that area except to suggest that this is such an important problem that I think the American Trade Representative ought to have as one of his highest priorities taking the actions that he can to try to protect the intellectual property of American companies in information technologies and in other fields as well.

This is an issue in China, it's an issue in other countries, but it's a particular issue in China. It's one that I'm sure your Commission will be addressing.

Now those are the opening comments I was going to make. Mr. Chairman. I would be happy to entertain questions or comments.

Introductory Remarks: Discussion, Questions and Answers

Chairman D'AMATO. Thank you very much, Mr. Secretary, for the very, very thoughtful presentation. A lot of the issues you discussed are issues that we are grappling with.

On the IPR question that you mentioned, we have looked at that extensively. And we recommended that the Trade Representative and the President take the Chinese to the dispute settlement mechanisms in WTO, which would use the very tool available to us in that organization. Let's use it and see what happens. That's the best that we can come up with at the moment.

I have a question on the technology questions that you mentioned. Your article in the op-ed piece in the *New York Times* last week with Mr. Deutch emphasized R&D funded by DOD. You also recognized the synergies between the commercial center and DOD.

My question is: Are we doing enough outside DOD that, if we were to bring the budget of DOD up in technology, robotics, nanotechnology, and so on, is that enough for us, or are we not investing enough as a nation in the research and development on high technology now? We have 700 or 750 commercial R&D centers that have been moved from the United States to China, for example. Does that have an impact on our technological base and our ability to innovate in the long run?

The question is: Do you have specific thoughts about what we might do beyond what we're doing today to maintain the long-term leadership of this country in technology and innovation in the base?

Dr. PERRY. The first point I would make is the one that we made in the op-ed piece, namely: Do not move backwards on the DOD support for technological base, because that has been an absolutely crucial element. I think you could get a hundred witnesses here who are in the informational technology industry and who are actually developing products and ask them that question, they will tell you how important that has been, starting back from the days when the Defense Department program called ARPA Net——

Chairman D'AMATO. Yes.

Dr. PERRY. —became the predecessor to the Internet today.

So I might say parenthetically on that that I was in the Defense Department back in the '70s when we were developing that. We had no idea that the Internet was going to develop from this. We were developing it for entirely different reasons. We wanted to provide a more effective means for Defense scientists around the country to communicate with each other. That was the purpose for setting up ARPA Net.

So I would like to say we had some sort of prescience on this, but we did not. We were doing it for a different reason. And it just stumbled out of the ARPA Net that we were doing. But without a doubt it was the DOD funding of that and carrying it through its infant years that allowed the Internet to develop first in this country, not in any other country. So that is very important.

Now there's no reason, there's no logical reason why we could not provide that kind of technological base support, particularly for the commercial field, in agencies other than the Department of Defense. And 10 to 15 years ago we set out to try to develop other government agencies for doing that. They have never been as successful as the Defense Department.

Chairman D'AMATO. No.

Dr. PERRY. So I don't argue that it has to be done in the Defense Department. I argue it is being done in the Defense Department. And until or unless we come up with a successor organization for providing that technological base for our commercial fields, we ought not to kill the goose that's laying the golden eggs.

I think the reason that it has been—it's just difficult to do this right. And through the years the Defense Department has evolved a system including ARPA, which does it right. Until, as I say, until we have set up in another organization, a civil organization, a way of demonstrating that we can successfully provide the technological base support, we should continue to do it in the Defense Department and we should not decrease the level of support in the Defense Department.

I would also like to see the environment created which would allow great scientific commercial laboratories like the Bell Laboratories, like the IBM Laboratories, being revivified. I don't know quite how to do that, and I don't know what the government can do to create the conditions where they can make that happen. But it is a fact that today that nearly all of the R&D that's being done in industry today is product-development oriented and very little of it is there to support the technology base.

And if we let that technology base go, you won't notice the difference this year or next year, but you'll notice a big difference five and ten years from now.

Chairman D'AMATO. Thank you.

Commissioner Wortzel.

Commissioner WORTZEL. Thank you very much, Secretary Perry. I focused on your statements about the need to let companies get in international capital and to be able to with minimal restrictions. I want to ask a question about how one might craft appropriate restrictions.

There are times when it's very difficult to know, particularly if we're dealing with China, but I can envision it with other countries, at times it's very difficult to know just who the partner is. Doing due diligence in China is a very difficult task and sometimes it means simply figuring out who's got the best relationship to the nearest Communist Party secretary. So should we be concerned that suddenly capital flows in and, lo and behold, our venture capitalist happens to be some clandestine research institute of the People's Liberation Army?

Dr. PERRY. I don't have a good answer to that question, Mr. Wortzel. I have had concerns in the past for outside investments in the U.S. technological industry way back in the early '90s when Japan was making heavy investments in the United States. I have a distinct recollection in the early '90s of being convinced that the Japanese investments in the United States industry were going to cause them to take over our industries. It did not happen. Indeed, most of those Japanese investments turned out to be bad investments for them.

I can still remember when we were so concerned about a different field but a related issue, about some of the Japanese investments in real estate in this country, thinking that they're taking over the country. It turned out to be a pretty good deal for us and not for them. Based on that experience, I would be reluctant to try to set up some sort of controls on this issue.

I don't mean to dismiss it. I think it's an issue that requires serious consideration. But on my own experience I haven't seen any reason for arguing that it's something that ought to be a major concern.

I do know from seeing the various companies around here that they're happy to get the capital from wherever they can get it. There's a lot of capital flowing into this country from China and East Asia, as you know better than I.

Chairman D'AMATO. Commissioner Robinson.

Vice Chairman ROBINSON. Yes. Thank you, Mr. Secretary. You have provided some very illuminating remarks.

Staying with the China side of the equation for a moment, you know that one of the principal mandates of our Commission is to look at some of the downside risks associated with the technology development dynamism of China, particularly its military relevance, which is your specialty.

And, as you also know, China has its own offset strategy, whether you call it asymmetric warfare, or the somewhat more colorful term, "assassin's mace." The bottom line being is that they have a very focused effort on some key regional objectives, one of which, of course, is to be able to prevail quickly in any kind of conflict in the Taiwan Strait. The other objective akin to it is the ability to successfully interdict any U.S. force that should try to intervene in that blitzkrieg-type conflict.

Now your Shanghai factory example I think is a good one, and the question is: Are the Chinese effectively closing that gap in information technology and other militarily-relevant capabilities to such a degree that in the next two or three years, when many estimate that they may feel confident in this kind of Taiwan scenario, that, the Chinese may be able to effectively pose not only a threat but a clear danger to our effort to defend Taiwan. What I'm getting at is the effectiveness of their own offensive power projection capability because of the rapidity with which they're able to close some of these key military technology gaps. So that's one question.

I think the effort to lift the EU arms embargo is relevant here and if you have an observation on that, I'd be interested.

A second question involves just a matter of broadening the lens a little bit, but you've been very visionary I think on the nuclear crisis on the Korean Peninsula.

China is a pivotal player in this crisis because of its unique leverage. And you also, I think, are aware that things aren't going very satisfactorily now as North Korea develops more and more nuclear weapons and ever longer-range ballistic missiles to deliver them. Frankly, it already looks like containment to me. I'm interested in your present feelings about whether we lost the bubble, so to speak, on the North Korean crisis when those 8,000 spent fuel rods were reprocessed?

Dr. PERRY. There are a lot of different questions inside that, all of which are interesting to me. If I don't answer all of them, please call me on it.

Let's take North Korea first since I just came back from Korea last week and I was there specifically to explore whether there is any possibility of bringing the allies, at least, together on how to deal with this issue.

When I worked this problem as a North Korea policy review in 1999, the first thing I did was go to Japan and go to South Korea to try to bring the three of us together. We have very different views on the problem, very different issues, and it was hard to get us together, but we finally did that.

So when I finally went to Pyong Yang in 1999 I went with a letter, not just from President Clinton but from President Kim Dae Jung and from Prime Minister Obuchi, saying, "Dr. Perry represents our countries as well as the United States." So we had a united front when we approached them. And the North Koreans were not able to drive wedges between us for that reason.

Now today that's not true. Today South Korea and the United States could not be further apart on this issue. And, of course, North Korea is busy driving wedges, but they don't have to. We're already far apart on that. I think it's going to be very difficult to get a successful strategy with North Korean when even the allies are not together, much less China.

So on the specific question of have we lost the bubble on that, I'm not quite sure what that means, but I think probably the answer is, yes. It was a major, major defeat for U.S. policy, I think, when the North Koreans reprocessed those fuel rods and made plutonium out of them.

When we dealt with this problem in 1994 we made reprocessing of plutonium a red line. We said to the North Koreans, "If you cross that line, you're going to be facing the United States in very serious ways." And we were busy reinforcing our troops in South Korea to make the point to them.

That led to the negotiation, which resolved that problem for a time. And the so-called agreed framework certainly did not solve the problem, but it delayed action on the problem for a good eight years, during which time the North Koreans could have made about 50 nuclear bombs, so it gained us something.

But they have now reprocessed those fuel rods. They made the plutonium. We have no idea where that plutonium is. It's very unlikely it's a Yongbyon. So even one of the strategies which was open to us in 1994, which is going in and taking out the facility, is no longer a relevant strategy because the plutonium's gone now. I think it was a major setback, allowing that to happen.

I have not given up, by any means, on this problem. I think it's such a serious threat to the United States, I think it's very important to us we resolve that problem. And I have recommended to the Administration the action I think they could still take and might have some chance of success on it. But I must say that the key here, if we look in a diplomatic negotiation that involves carrots and sticks, the United States really only has one carrot that it might be willing to use. And that carrot is the willingness to make some a statement of no hostile intent to North Korea, which is meaningful. I think we have the ability to do that if we choose to do it. And that is a carrot that I think is meaningful to North Koreans.

There's also an important stick. The American stick, the only one we have is a military power, and that's the one we really do not want to use. But the Chinese have a very big stick. They are responsible for more than 20 percent of the energy flow that goes in and much of the food that goes into North Korea today. And they have used that stick just once in a temporary way. Trying to get the talks going again, they reported they were having logistical problems delivering the fuel to North Korea, and they stopped the flow for about a week. And that had some remarkable effects on getting talks going again.

So there's no doubt that the Chinese have a stick if they choose to use it. So far they have not chosen to use it. So my view on getting those talks focused into action again is it requires the Americans being willing to use their big carrot and the Chinese willing to use their big stick. I think all of the other aspects in this problem are pretty incidental. But if those two things were to happen I think we, as a minimum, we could test whether or not the North Koreans are really willing to make a serious agreement on that.

Vice Chairman ROBINSON. Is that statistic on the Chinese supply of North Korean oil correct? We've been hearing as high as 90 percent dependency on Chinese fuel. You had 20 percent.

Dr. PERRY. Yes. I don't trust any percent figures, I must say, but I do believe that if they were to cut off the supply of fuel that it would strangle. That's the important point.

Vice Chairman ROBINSON. Yes. We agree on that perception.

Dr. PERRY. Thank you.

Vice Chairman ROBINSON. Thank you.

Chairman D'AMATO. Commissioner Reinsch.

Commissioner REINSCH. Thank you. Thank you for your statement, Dr. Perry. I hope we all take it to heart. It seems to me if you look at it historically you have the great gift that not very many people in Washington have, which is that you've been right more often than you've been wrong. And we ought to take your words to heart precisely for that reason.

On a personal note, I am particularly pleased to have your comments this morning because I invariably quote you when I give speeches on export controls. And you've given me some new ammunition, so I'm grateful for that.

I do have two questions. One, on the innovation issue, let me ask you about intellectual capital. The Administration has adopted a series of policies that have made it more difficult for students to come here from other countries, China. And also for foreign professional workers to come here, engineers and the like, to work here for two or three years.

Has this affected our ability to maintain innovation leadership?

Dr. PERRY. The short answer to that is yes. I'm sympathetic with the reasons that the Administration is paying stricter attention to and making more complicated the immigration. I think to the extent it's a response to 9/11, I understand why they're making that response. But the net effect of it has been to keep out of this country many people we would like to have in the country. I don't know that it has been successful in keeping terrorists out, but I do know it's been successful in keeping out some very bright students and some very good scientists. And I think that hurts us.

So I would like to find ways of doing what we need to do to restrict the flow of terrorists in this country and at the same time allowing the students and these scientists who want to visit here for conferences and come here for education to be able to do that.

This university is a very good example of that. In our Engineering School, Graduate School of Engineering, about half of the students are foreign. Most of those from Asia. Some of our best students. And they enrich the university by their being here.

I might comment parenthetically that we get in our Graduate Engineering School some of the best and brightest Americans in the country, but some of them come here just a little bit lazy. That is, they always were the best students in their high school, didn't have to work very hard. And they come here and they think they're not going to have to work very hard either, but then they come and they meet these Chinese students and Japanese students and Korean students, who work around the clock, and they—it just raises the bar for everybody. Everybody has to work harder. So I think it has enhanced the quality of our education by their being here.

Now many of them go home when they're done. Some of them stay, and the ones that stay also enrich our industry as well. Even the ones that go home end up working with American companies back here, and so I think we get benefits all around.

There's also the additional qualitative benefit that I don't know how to make much out of but I think is important, is that thousands of students who come to American universities, when they go home they go home with some American ideas and some American values. And over a longer period of time I think that's going to do a lot towards making modest transformations in China as well.

So for all those reasons I think the foreign students who are here in this country are a net benefit to the United States economy, to the United States security, and I would encourage that. And, therefore, to go back to your point, I am concerned when our visa complications, for example, not wanting to make it difficult for students to come, but have discouraged many of them from coming at all. So we're not starting to see a major shift of students from China, from Japan, from Korea to other countries, and I think that's not good for us.

Commissioner REINSCH. Which other countries?

Dr. PERRY. European countries, other Asian countries, too. But European countries primarily.

Commissioner REINSCH. Something you mentioned gave me a further thought, Dr. Perry. You referred to the Japanese real estate and investment issue. I think in the late 1980s and early 1990s we all shared the same concern that you articulated.

One of the things that Washington debates these days is the extent to which that model is applicable now to the Chinese. There are a number of people who will say, well, it's going to be the same thing. Why are we worried about the Chinese because we're going to have the same experience we had with the Japanese?

I think the sense of a lot of people in the Commission is that the analytical model isn't the same, and this case is different. Do you have a comment on that?

Dr. PERRY. No. I would not profess to be an expert in that field. I observed that history and I think about that, and I think you ought to look at that history when you consider it, but I will not argue that history is decisive.

Chairman D'AMATO. Thank you.

Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thank you very much. And thank you, Secretary Perry. It's always an honor and a privilege to listen to you. And thank you also for your many years of service to our nation.

Dr. PERRY. Thank you.

Commissioner BARTHOLOMEW. I worked for Congresswoman Pelosi for many years. And as we were trying to get the funding for the KEDO, I sat and listened to you many times over that experience.

I'm also struck by innovation. We are seated here in the birthplace of so much of this technological innovation. Ms. Pelosi always likes to say that the entrepreneurial spirit in Northern California is in the air that people breathe and the water that they drink. And how we move forward on that, I'm very interested also to hear your comments about FASB and the stock options.

One comment on Commissioner Reinsch, which is I think the reason there is concern about this model of Japan and China is that the Japanese government is a democratic government and the Chinese government is an authoritarian regime

And how the scenarios play out with different governments. But along those lines I'm interested in what you had to say about cultural innovation, too, sort of the cultural advantage that we have.

There is not freedom of speech in China The restrictions on Internet usage, restrictions on freedom of speech, how much will that restrict the ability of the Chinese people to do the kinds of innovations that would move IT forward, for example?

Dr. PERRY. I can only give you a judgment on that, subjective judgment. My judgment is it's decisive. It's a decisive factor. The free spirit we have here, the freedom we have I think is an integral and indispensable factor in the innovation area. That's what I meant when by speaking about the cultural advantage we have.

And it's not just the difference in a country like China with an authoritarian government. Even in Japan, which is a democracy, there is not the same encouragement to innovate; there is not the freedom to innovate. When a Japanese engineer leaves his graduate school here at Stanford and goes back to Japan, he's expected to go into a large company and fit a cog in that company. The thought that he would go out and start his own company is countercultural, really.

So there's a very big difference. And we didn't do anything in the industry to create that difference. We just took advantage of it. We just exploited it. And as I say that's not anything I think the government can do anything about, but we should cherish that difference and we should recognize it. And I do not think that we're going to have any substantial competition in technological innovation in the very early—from China or, for that matter, much from Japan either.

Commissioner BARTHOLOMEW. Interesting. Mr. Chairman, just one quick question, which is:

Secretary Perry, do you share the concerns of many of your colleagues about the state of our public school systems and what it means for our ability to do technology, do innovation 10, 15, 20 years down the road?

Dr. PERRY. I do on an abstract basis. I don't experience it. I'm here at Stanford and the students we get here from the public school system are amazingly bright and gifted and very well educated. So we get a very selected group of kids here, who have managed to rise up in spite of, I guess, the public school system.

Also the public school systems here in the Palo Alto and Los Altos area are much better than the average, so I don't experience the problem here. But I read about it, I study about it, and I very much believe that unless we can get the K to 12 right that we're not going to be a great nation over the long-term, yes.

Commissioner BARTHOLOMEW. Thank you.

Chairman D'AMATO. Thank you, Mr. Secretary. I have two quick questions; I think a hardball and a softball.

The hardball is: We're going to have someone testify here who's about to publish a book called "*The Emerging Chinese Technological Superstate*." And the question is when we read all of this assessment on technology development, the number of firms moving FDI and R&D into China, and are we really seeing technology development or product development? To the extent that the Chinese are being competitive with us, to what extent are they actually doing the basic research, the real research, the kind of research that brings the ten years of product development later?

I think the jury's out on that. We're getting conflicting testimony on that. I think it's easy to confuse product development with real basic research. To what extent do you think the Chinese are really getting into this kind of basic research?

The second question I have is: There are a number of people who are going to be testifying who come to the same conclusions on the inadequate relationship between Silicon Valley and the Federal Government. I'll just read you one comment by a panelist: "One recommendation I would have to leave you with is: The Federal Government must do a better job of engaging with Silicon Valley. And the two should work together to move beyond unbridled engagement with China toward an alignment of private sector business interests with national interests."

"Apart from hearings such as today's, the Federal Government's visibility in this region is surprisingly limited, particularly given that much of the technology subject to export controls giving rise to concerns about long-term competitiveness and proliferation originates within a 50-mile radius of this meeting. Except for the few individuals responsible for export control compliance within each company, there's very little appreciation in the private sector for the competitive, strategic, and national security threats inherent in technology transfer. For the U.S. to maintain scientific and technological leadership, strategists and policymakers in Washington must win the cooperation of Silicon Valley."

You've seen it from both sides, from obviously your long experience in Washington and now here at Stanford in Silicon Valley. Do you think that there needs to be a more structured kind of dialogue between the individuals and organizations, and Silicon Valley with the policymakers in Washington to try and come to some kind of a better mutual understanding and perception of where we're going?

Dr. PERRY. I think the answer to that question is yes. I'm not sure I could advise you on how to structure that, but I think it has to be a benefit.

On your first question, what I see from China today is product development. I have looked carefully in my various visits to China for examples of technology-based development. I don't find it. I don't think they have it. So I think they're deficient in two respects. First of all, they lack the technology base we have. And, secondly, they do not have the culture that supports the innovation that we have. I think that's going to be a fundamental problem that is going to hold them back. So if I'm right in that, they're always going to be in what I call a tail chase on the new products.

Chairman D'AMATO. So they're not going to be running as fast as we are, hopefully?

Dr. PERRY. They're not going to be running as fast as we are. I don't think there's much we can do to hobble them, but I think there is a lot we can do to make sure we keep running faster.

Chairman D'AMATO. Thank you, Mr. Secretary. You've been very generous with your time this morning.

Dr. PERRY. Thank you.

Chairman D'AMATO. We really appreciate it. Thank you very much.

We'll take a five-minute break.

[Recess.]

PANEL I: CHINA'S GLOBAL TECHNOLOGY COMPETITIVENESS I

Chairman D'AMATO. Our first panel this morning after Dr. Perry's presentation will be an attempt and evaluation of China's global technology competitiveness. We have a very full and interesting panel. From the left, James Morgan, Chairman, Board of Directors of Applied Materials; Mr. George Scalise, President of the Semiconductor Industry Association; Mr. Alan Wong, Senior Counsel from Nvidia Corporation, Santa Clara; Mr. Gary Rieschel, Co-Executive Managing Director, Mobius Venture Capital; and Mr. Carl Everett, Partner in Accel Partners, again from the Valley here.

The way we'll do it, we'll start from the left. Mr. Morgan will go first. And if each panelist would then summarize their remarks in about seven minutes, we'll go right down, and then we'll open it up to questions and answers. And we should have enough time to have a full series of questions and answers.

Mr. Morgan, go ahead. See if you can confine your remarks to about seven minutes. Thank you.

STATEMENT OF JAMES C. MORGAN
CHAIRMAN OF THE BOARD OF DIRECTORS
APPLIED MATERIALS, INC., SANTA CLARA, CALIFORNIA

Mr. MORGAN. Thank you, Mr. Chairman and Members of the Commission. I prepared a copy of my testimony to submit, so I've got a few remarks.

Chairman D'AMATO. We'll include the full testimony in the record from each of you.

Mr. MORGAN. So mostly I want to focus on how I see the competitiveness of the U.S. semiconductor equipment industry in regard to the rise of China, because I think it characterizes some aspects of the relationship that we have economically and in a broader sense with China.

I believe your topic is a good topic, particularly to hold hearings here in Silicon Valley. The emergence of China as a key player in the electronics industry is a topic on the minds of every CEO I know, and not just CEOs of American companies. When I travel in Japan, throughout Asia, or in Europe the topic of China consistently comes up.

As Vice Chairman of the President's Export Council I can tell you that China has been a large part of our focus in discussing strategies to help promote and develop export opportunities for American goods and services. Last year we even took the step of conducting a special trip to China for Commission Members led by Secretary of Commerce Don Evans.

The PEC has produced a number of letters of recommendation to the President regarding China. And I would respectfully suggest that the Commission Members review those recommendations as part of your work. I'd be glad to make them available to the Commission. They're available online as well. And we can get more information for you on that subject if you want.

One difficult issue we're struggling to address at the PEC is the answer to the question posed to us by China's Vice Premier Wu Yi. When we met with her in Beijing she assigned homework to PEC members. She had a reason for that. She noted that, according to her government figures, China's overall trade was roughly in balance and U.S. imports to China accounted for only 8.2 percent of the total. This is a smaller figure than that of Japan, Korea, or Europe, and she asked the PEC why.

Part of the answer can be linked to deficiencies in our U.S. export promotion activities versus those of our foreign competitors. Part of the answer can also be found in the barriers from the Chinese side, including undervalued currency, lack of regulatory and standard setting, transparency, rule of law, inadequate protection of intellectual property rights, discriminatory tax policies, subsidies, sectorial exclusions, and other derogations from WTO. National treatment rules places U.S. exporters at a disadvantage in the Chinese market.

The PEC analysis found that Minister Wu's basic proposition, however, was correct. European Union companies sell over 50 percent more goods and services in China than U.S. companies. Japanese companies sell over a hundred percent more than U.S. companies.

What I find interesting that among high-tech products the U.S. is doing better in penetrating the China market. American semiconductor equipment firms have been moderately successful so far in the China market, selling about 51 percent of the equipment in the front-end market with things like wafer fab, mask and radicals, wafer manufacturing, and factory automation equipment.

The situation's not as good in the back-end segment, i.e., what we call test and assembly, as U.S. firms account for only 29 percent of sales.

By way of background, Applied Materials is the world's largest supplier of manufacturing systems and related services to the global semiconductor industry. We supply wafer-fabrication systems that perform many of the steps in the manufacturing process to make semiconductor chip circuitry. We also manufacture systems to produce flat-panel displays, develop and sell manufacturing execution software, and provide a variety of other manufacturing-related services to the industry.

We are one of approximately 2,200 companies in the worldwide semiconductor equipment and materials industry represented by our trade association, Semiconductor Equipment and Materials International, or SEMI as it's frequently known.

About 1,000 of these companies are headquartered in the United States. Although Applied Materials had sales of just over $8 billion in our last fiscal year, about 85 percent of U.S.-based equipment and materials companies are small, privately-held companies with annual sales of less than 25 million. Many of these firms are part of a wide network of suppliers to largely publicly held companies such as Applied Materials that serve the global semiconductor industry.

SEMI companies spend an average of 15 percent of annual revenues on R&D, and I think that's a very important number for the Commission to keep clearly in mind. Applied Materials alone has spent $5 billion on R&D over the past five years.

To fund these R&D investments every sale is important. Increasingly, this means sales to markets outside the United States. Export revenues now account for more than 70 percent of sales for most leading U.S. companies in the semiconductor equipment industry. For Applied Materials in fiscal year 2004 it was even higher.

With so much of the semiconductor industry investment outside the U.S., maintaining a high market share in regional markets around the world is essential to ensuring the resources to fund continued R&D, innovation, and competitiveness. Thus access to overseas markets and the ability to compete in those markets with leading edge technology is absolutely vital to the long-term health of the U.S. semiconductor equipment and materials infrastructure. Asia, including Japan, now comprises almost 70 percent of the world's market for semiconductor equipment and materials.

Within the Asian market China is the fastest growing, growing about 130 percent from 2003 to '04, but part of the impressive growth stems from the fact the market's still relatively small: Less than three billion out of a global market of more than 43 billion.

Though still a relatively small market investment trends indicate China is a key strategic market and early access to the China market is crucial for downstream success. For a company like Applied Materials that make products for manufacturing plants, it's hard to overstate the importance of gaining the tool-of-record designation with a customer, since this means you have a good chance of being chosen to supply equipment for future manufacturing facilities over many, many years.

If the U.S. can gain that market share early in the development of China's semiconductor industry, we can defend that market share against erosion by foreign competition as the market grows. If we allow foreign equipment to be designed in at the early stage, displacing those competitors can be extremely difficult.

One of the lessons we learned in the '80s, when the U.S. faced stiff competition from Japan, is that competing effectively means competing for every customer in every market. Ceding market presence anywhere makes it that much more difficult to gain the margins to afford the R&D to stay competitive.

Applied Materials has been engaged in China for a long time. I made my first trip there in 1984, and this past year we celebrated our twentieth anniversary. From a handful of service center workers at the outset of '84, and at that time we weren't allowed to even hire our own employees, we've grown to more than 300 employees in five offices around the country. For the first 15 years revenues from China was negligible, but in 2000 as it became part of the global economy in earnest, we saw significant growth with almost 750 million from China in 2004—with the growth of the electronics industry in general and semiconductor, in particular, in China, we anticipate further market potential, driving a fivefold increase in semiconductor production over the next five years as a host of new fibs are built. The majority of these facilities are not anywhere near the cutting edge, but they don't need to be.

Currently, as China tries to increase their production of chips—they produce only 25 percent currently—they are going to try not to depend so heavily on imports, which is typical of almost all these countries.

So let's look at what's happening in the fact that only a small percentage of China's population has been touched by technology. They have several serious problems, most of these have been articulated. There are rural and urban dislocations; banking, finance; inefficient state enterprises, just to name a few.

The ability to generate genuine innovation in the absence of effective intellectual property protection is another real barrier to the ability to be a global technology leader. And while China's growing economic power, it also has a lot of competitors, who will not likely cede their economic or technological leadership. Applied, like many other companies, has strategies for engaging in China and remaining competitive for the future.

The key, I believe, is to focus really on the competitiveness of U.S. companies. In the end this is the only way we're going to win the high-tech industry. We can open markets and attract new consumers by bringing down the cost, and we're under intense cost pressure in our industry. That's why your cell phone today does twice as much and costs half of what you're old phone did. But with this in mind I think we see more and more companies exploring investment and partnerships with companies in China. In the end, America needs this kind of engagement in order to make sure we stay ahead of the curve.

So where do we go? Any policy response I think to China or anywhere else should target an overreaching goal: To make the United States a preferred place for investment from around the world. There is a China-oriented component of this strategy that largely involves enforcing China's WTO commitments, particularly its continued shortcomings in intellectual property and realignment of the currency. I've outlined some policy priorities in my written statement, so I won't repeat them here.

I think the semiconductor equipment industry, being technology-intensive, high value net exporting American success story is an industry where we can achieve a leadership position. And we intend to keep that hard-won place of international competitive leadership if we have the policy framework in the U.S. to do that.

I think collectively we must work diligently to make sure the U.S. is the top of the list of attractive places around the world in which to do business. This is the best way to assure job growth in the U.S. and the resulting income and taxes to invest in U.S. competitiveness.

Thank you very much.

[The statement follows:]

Prepared Statement of James C. Morgan
Chairman of the Board of Directors
Applied Materials, Inc., Santa Clara, California

Background

Applied Materials, Inc., is the world's largest supplier of manufacturing systems and related services to the global semiconductor industry. The company supplies wafer fabrication systems that perform many of the steps in the manufacturing process to make semiconductor chip circuitry. We also manufacture systems to produce flat-panel displays, develop and sell manufacturing-execution system software, and provide a variety of other manufacturing-related services to the industry. We are one of approximately 2,200 companies in the worldwide semiconductor equipment and materials industry represented by our trade association Semiconductor Equipment and Materials International (SEMI); about 1,000 of these companies are headquartered in the United States.

Although Applied Materials had sales of just over $8 billion in our last fiscal year, about 85 percent of U.S.-based equipment and materials companies are small, privately-held companies with annual sales of less than $25 million. Many of these firms are part of a wide network of suppliers to larger, publicly-held companies—such as Applied Materials—that serve the global semiconductor industry.

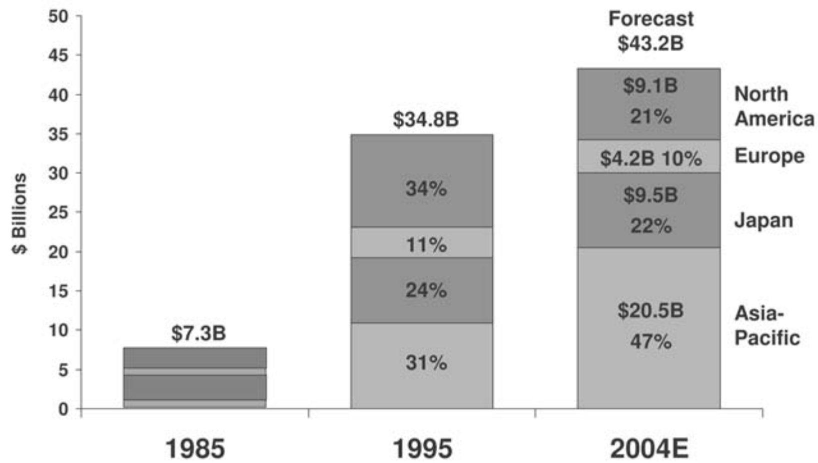
Applied Materials, like most companies in the industry, was once simply a provider of tools built to specifications handed to us by our customers. Today, our research and development (R&D) generates many of the strategic process advances that increase chip information density, reliability and yields. As a result, SEMI companies spend an average of 15 percent of annual revenues on R&D; Applied Materials alone has spent $5 billion on R&D over the past five years.

To fund these R&D investments, every sale is important. Increasingly, this means sales to markets outside the United States. Export revenues now account for more than 70 percent of sales for most leading U.S. companies in the semiconductor equipment industry. For Applied Materials in fiscal 2004, the figure was 83 percent. With so much of the semiconductor industry's investment outside the U.S., maintaining a high market share in regional markets around the world is essential to ensuring the resources to fund continued R&D, innovation and competitiveness. Thus, access to overseas markets and the ability to compete in these markets with leading-edge technology is absolutely vital to the long-term health of the U.S. semiconductor equipment and materials infrastructure.

The Emergence of Asia

As the chart below indicates, Asia has emerged as the largest market for semiconductor equipment and materials manufacturers. First came Japan, then Korea, Taiwan (as well as smaller markets in Singapore and Malaysia), and now China. As a result, the Asia market now comprises almost 70 percent of the world's market for semiconductor equipment and materials. Within the Asia market, China's is the fastest growing. But part of the impressive growth rate (130 percent from 2003–2004) stems from the fact the market is still relatively small: not quite $2.7 billion in 2004.

SEMICONDUCTOR CAPITAL INVESTMENT



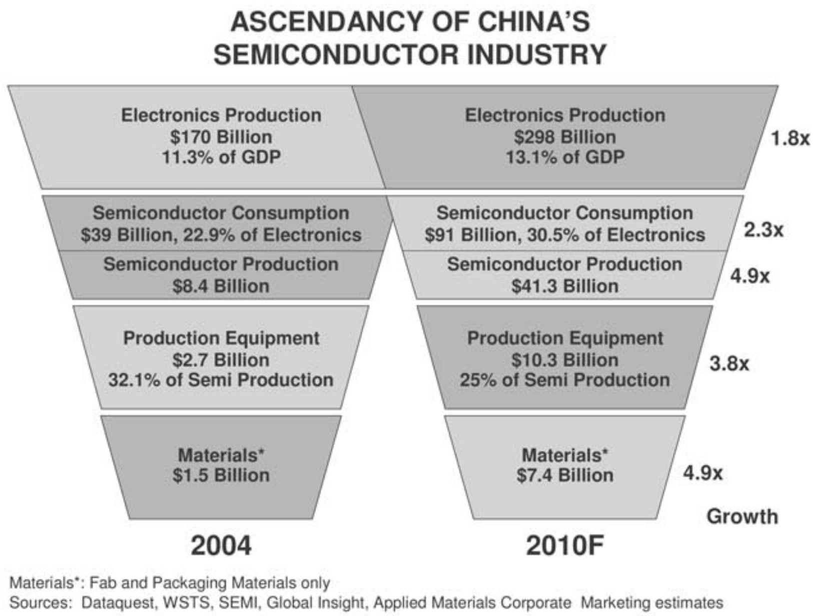
Note: Numbers may not add up due to rounding
Sources: Semi Fab Database, Companies' Announcements, ICE, Applied Materials

Though still a relatively small market, investment trends indicate that China is a key strategic market and early access to the China market is crucial for downstream success. It is hard to overstate the importance of gaining the "tool of record" designation with a customer, since this means the supplier companies likely will be a part of future manufacturing facilities. One of the lessons we learned in the 1980s when the U.S. faced stiff competition from Japan is that competing effectively means competing for *every* customer in *every* market. Ceding market presence anywhere makes it that much more difficult to afford the R&D to stay competitive.

American firms have been moderately successful so far in the China market, selling 51 percent of the equipment in the "front-end" market (*i.e.*, wafer fab, mask/reticle, wafer manufacturing and factory automation equipment). The situation is not as good in the "back-end" segment (*i.e.*, test and assembly), as U.S. firms account for only 29 percent of sales. In sum, U.S. producers face strong competition from Japan, Taiwan, Korea and Europe in markets around the world, and China is proving itself no different.

Applied Materials and China

In November 2004, Applied Materials celebrated the twentieth anniversary of our presence in China. From a handful of service center workers at the outset in 1984 (and at that time we were not allowed to even hire our own employees in China), we have grown to more than 300 employees in five offices around the country. For the first 15 years, revenues from China were negligible. It was not until 2000—as China became part of the global economy in earnest—that we really saw significant market growth. In 2004, Applied Materials had revenues in excess of $750 million from China. With the growth of the electronics industry in general, and of the semiconductor industry in particular, in China, we anticipate even further market potential. The chart below illustrates where we expect China's electronics industry to be in five years.



Driving the nearly five-fold increase in semiconductor production in China over the next five years is a host of expected new semiconductor fabrication facilities ("fabs"):

It is important to note that the majority of these facilities are not at the cutting edge of technology, largely because they do not need to be. For every customer such as an SMIC building a 12-inch (300mm) facility, there are several others building

8-inch or even smaller wafer-size production facilities. Currently, China produces only about 20 percent of the chips its domestic electronics industry consumes. China is aggressively moving to increase this figure, which has led to a building boom. As a result of this building boom, the percentage of consumption derived from domestic production will rise to about 45 percent in 2010, and the market for semiconductor chips is expected to double.

Despite China's impressive growth in some sectors, it is important to keep that country in perspective. Only a small percentage of China's population has been touched by technology, and several serious problems face the country: rural/urban dislocations and unemployment, scarce water resources and growing pollution, energy consumption and rising prices, an unstable banking/finance system, inefficient state-owned enterprises, and others. China's ability to generate genuine innovation in the absence of effective intellectual property protection is another real barrier to its ability to be a global technology leader. Given this host of looming challenges, it is not surprising that China was ranked 24th in the 2004 IMD "World Competitiveness Scoreboard" and 46th in the World Economic Forum's 2004 rankings. (The United States ranked 1st and 2nd, respectively, in these ratings.) The point is, while China is a growing economic power, it also has a lot of competitors around the world who are not likely to cede economic or technological leadership easily.

Applied Materials, like many other companies, has strategies for engaging with China and remaining competitive as China emerges as a significant semiconductor manufacturing player. On the one hand, it is a vibrant and growing market; on the other hand, we face the prospect of a domestic semiconductor equipment industry emerging to challenge us. Another issue we face is cost pressure from our customers. As some components and technologies become commoditized and prices drop, increased operations in China are often viewed as a solution to staying profitable and funding further R&D in the U.S. This raises the issue of intellectual property protection, which is haphazard at best in China. We spend considerable time and effort to safeguard our technology and corporate knowledge.

Policy Responses

Any policy response to the rise of global competition from China or anywhere else should target one overarching goal: to make the United States *the* preferred place for investment (of all types) from around the world. There is a China-oriented component of this strategy, which largely involves enforcement of China's WTO commitments (particularly its continued shortcomings in intellectual property protection) and a realignment of China's currency.

For the most part, however, the U.S. policy response should be focused less on China and more on challenges at home to our overall competitiveness. There are numerous elements that comprise this comprehensive policy program, few of which are easy, inexpensive or near-term. They include, but are not limited to:

- **Education**—We cannot expect to be an innovation- and technology-based economy if our students are deficient in math and science skills. This is true at both the grade level (*e.g.*, No Child Left Behind) as well as college and graduate levels (National Science Foundation funding).
- **Immigration/Visas**—With pipeline shortages of scientific and engineering talent, we should make it easier to attract and keep students from around the world in the United States.
- **R&D Funding**—Except for military and health sciences, Federal R&D spending has been stagnant for 15 years. The United States cannot coast forever on our R&D investments from decades gone by. The physical sciences are key drivers of an innovation-based economy and we are under-investing in those areas.
- **R&D Incentives**—The on-again, off-again R&D tax credit (not to mention its increasingly archaic structure and difficult compliance) is less and less of an incentive to perform R&D activities here in the United States.
- **Regulation**—The recent battle over stock options accounting (which will likely seriously diminish the use of this form of employee incentive) is a good example of how knee-jerk regulation with insufficient consideration leads us into blind alleys to no good purpose. The Gordian Knot of telecom regulation that retards broadband deployment in the United States is another type of entanglement that hamstrings U.S. competitiveness.
- **Export Controls**—There are multiple sources for everything these days, and making it more difficult for U.S. exporters to compete and gain market share does not advance our national security since technology companies require sales in all regions to have the financial return necessary for continued R&D funding to stay in the lead.

These and other issues will determine the macro-environment that will drive investment decisions in the years ahead. The economic reforms started by Deng Xiaoping and accelerated under Jiang Zemin were marked by a high degree of pragmatism and flexibility. This flexibility is one of the reasons that China has been able to achieve the surprising economic growth it has. We would do well to be as pragmatic in seeking and implementing our own policy solutions.

The U.S. semiconductor equipment industry is a technology-intensive, high value-added, net-exporting American success story. As an industry, we achieved a leadership position through a lot of hard work by a lot of smart people over a long time. And we intend to keep this hard-won place of international competitiveness leadership—if we have a policy framework that enables us to do so. We must work diligently to make sure the United States is at the top of the list of attractive places around the world in which to do business. This is the best way to assure job growth in the U.S. and the resulting income and taxes to invest in U.S. competitiveness.

Thank you.

During his testimony at the Commission's hearing on April 21, 2005, Mr. Morgan made the following additional statement:

> "As Vice Chairman of the President's Export Council, I can tell you that China has been a large part of our focus in discussing strategies to help promote and develop export opportunities for American goods and services. Last year, we even took the step of conducting a special trip to China for Commission Members—led by Secretary of Commerce Don Evans. The PEC has produced a number of letters of recommendation to the President regarding China, and I would respectfully suggest that the Commission Members review those recommendations as part of your work."

He submitted, for the record, copies of the following PEC documents:

THE PRESIDENT'S EXPORT COUNCIL

Select Letters of Recommendation to the President of the United States

December 17, 2004	Letter on Export Control Legislation
August 19, 2004	Report on the President's Export Council Trip to China
August 19, 2004	Annex to the Council Letter on China addressing U.S. Competitiveness in China
September 29, 2004	Letter on Export Controls
October 1, 2003	Letter on China

Copies of these letters of recommendation can be accessed on the webpage of the President's Export Council

http://www.ita.doc.gov/TD/PEC/letterspage.html

Chairman D'AMATO. Thank you very much, Mr. Morgan.

Mr. Scalise.

STATEMENT OF GEORGE M. SCALISE, PRESIDENT SEMICONDUCTOR INDUSTRY ASSOCIATION, SAN JOSE, CALIFORNIA

Mr. SCALISE. Thank you, Mr. Chairman. I'm George Scalise, President of the Semiconductor Industry Association, which represents the bulk of the industry here, about 85 to 90 percent of the industry in the U.S.

I also happen to be on the President's Council of Advisers on Science and Technology, and recently chaired a study dealing with information technology, manufacturing, and innovation. It deals with some of the concerns that you have here.

I, too, have submitted a written statement that will be a part of the record.

Again, I think this hearing is a good opportunity to deal with some of the important challenges that we're facing with regard to China. As a consequence, the Commission can help build a consensus among the U.S. policymakers to develop an effective response to this challenge. I think if there's one goal I would like to see you folks have is developing that effective response.

But before I begin I want to note that China can and should pursue its desire to have a strong microelectronics industry. We have no problem with that. They are developing a compelling and a very large market within the country. In fact, it's the fastest growing in the world and it's home to some very strong competitors or at least evolving strong competitors. We favor that competition.

We know that China will play the same role as Japan, Europe, Korea, and all the others that have come into this market. Net robust competition is what drives the investment, drives the technology development that has been the hallmark of this industry for the last 50 years. And, as a consequence, has enhanced the standard of living of peoples all around the world, not just here in the U.S. but all around the world.

Just a couple of notes that make this largely possible. Number one is that we reduce our prices every year. This is one of those industries where on average the price declines 25 to 30 percent a year. To just underscore that, if you look at the cost of a bit of memory in 1995 it would cost $1—and look at that same price today it would be about two cents. So we've reduced it by 98 percent over those years. As Jim just mentioned, it's for those reasons that you find greater and greater functionality, lower and lower costs for all kinds of products. Whether they're consumer or industrial or military, all of these things are being enhanced by this technology.

I'd like to also dispel a couple of myths that I think are floating around these days. First of all, that lower labor costs drive the decision to invest in China. That is probably true in some industries that are very labor-intensive, but when you look at the high-tech industry this is not true at all.

When we look at the cost structure in China versus here in the U.S., there is about a billion dollars' difference in the earnings that one can generate over 10 years—and you can define this in two different ways, but I'll just define it in one way for now, using a net present cost calculation.

Over a ten-year period you will generate about a billion dollars more in earnings in China than you will here in the U.S. for about a three-and-a-half-billion-dollar investment in a fab facility. Now the reason for that is not that their cost structure is better. It's because they have some very aggressive policies dealing with tax treatment, incentives, subsidies, grants, and a whole host of things.

The tax policy alone provides about 70 percent of the difference: Tax holidays, things of that nature. Another 20 percent is based on the grants and subsidies that are applied to the equipment that is purchased. Then there's ten percent left that is a variety of other things, and a part of that then is labor. So I think it's important to recognize that labor is not the issue when it comes to semiconductors.

The second myth is that China lags in terms of technology in a significant way. They certainly do lag. We in the U.S. certainly are the leaders. We continue to be the leaders. We think we can be for some number of years. If we do the right things. But China is becoming better and better and better. And they're narrowing the gap each and every month, so I think it's important to recognize that we have a very real competitor that is coming along behind us. And they are going to be innovators. They are going to be very effective as they go forward.

So what are the implications of all of this and what do we do about it? One of the key trends that's happened as a consequence of these incentives and this investment shift that is taking place, two-thirds of the new 300 millimeter factories, which are the most advanced wafer fabs that Jim was just alluding to, will be built in Asia by 2007, two-thirds. That projection is almost ten percent of the global semiconductor industry in China at that stage, starting out from zero just a very few years ago. And it's going to now continue to escalate at a very, very rapid rate.

Last year the foundry capacity in China doubled to approximately 500,000 wafers a year. That's a very sizable manufacturing capability.

There is a critical need to make certain that not all of that investment goes to China. We have no problem with whatever percentage of it, whatever reasonable percentage goes to China, or Taiwan, or Korea, or anywhere else. What is critical is that we maintain a critical mass here in the U.S. so that we can maintain the ecosystem that starts with the R&D in the universities that Dr. Perry was talking about a few minutes ago, moves on to the precompetitive research that takes place in consortia. And we, through the SIA, fund about $80 million a year of university research that is a combination of very basic research as well as precompetitive research that is somewhere between basic and commercialization.

Then we also invest about $15 billion a year here in the U.S. in commercialization research, and that is then backed up by the manufacturing that is a critical part of that ecosystem.

So the point we want to make here is that—and we're going to focus on this as opposed to some of the larger issues that could be addressed here today—maintaining that ecosystem and the manufacturing element of it is critical to our maintaining the leadership in technology that we enjoy today.

We have been leading the technology revolution that came upon us shortly after the Second World War, and semiconductors have driven it for the last 50 years. We can maintain it throughout the rest of what we call the ultimate CMOS era, which is about another 10 to 15 years, and into the nanotechnology era, which is going to be the successor to this technology. It will evolve starting about 15 to 20 years down the road.

But it is important to recognize that China is investing very heavily in the innovation ecosystem. And it's important that we recognize what they're doing. I think to the extent that they are WTO compliant, that's fine. When they're in violation of the WTO, then we have to do something about it. We did that last year with regard to their handling the value-added tax and WAPI, and we got those sorted out. We give them credit for having addressed those issues.

But now we have to address issues that are WTO compliant. I think that's the issue that needs to be addressed by the Commission as it hears testimony not only here but also in other venues.

When we look at the policies that they are applying and, therefore, what we should do about it, I think that it's very clear that if we can just address those policies and neutralize them, then we can deal with whatever we have to contend with.

Our manufacturing capability here in the U.S. is equal to anyone in the world—and probably better than anyone in the world. Whether it's cost, technology, innovation, product development, you name it, we are the best in the world. And we can compete with anyone on a cost basis.

So what are our recommendations? The recommendations that we would suggest to you to take a very hard look at: First of all, at the tax holidays to match the tax holidays offered by overseas competitors. Now if it isn't exactly that, something that is equivalent to that that allows that to be neutralized.

Make the R&D tax credit permanent. Enact enhancements to make it more effective. And, again, this is something we've talked about for a long time.

Allow companies to expense high-tech manufacturing equipment in order to improve cash flow and stimulate investment in new equipment.

Re-examine international taxation rules and consider alternatives to the current rules on taxing foreign-source income so that there is an incentive to invest here at home as opposed to leaving it overseas and invest money over there.

Enact significant tax rate reductions to make manufacturing costs in the U.S. more competitive with costs in other countries. And, again, a recent study shows us to be kind of at the bottom of the list when it comes to the taxes that companies are paying. If we're going to be at the bottom of that list, it's just that much harder to compete.

Free up the 20,000 H–1B visas that were part of the appropriations bill that was passed last year that has now come into question and, as a consequence, is being used for other things than the advanced degree holders who are coming out of our universities with technology and science degrees. That's what they were, this 20,000 visas, were designed to provide the opportunity for those folks to stay here. Again, as Dr. Perry talked a few minutes ago, we have to make sure that those visas are used for that.

Finally, enact the House bill on tax treatment of stock options, H.R. 913, the Broad-based Stock Option Transparency Act. Again, I think this is something that Dr. Perry talked about. We have to have the opportunity to hire these young people, provide them the incentives, the benefit that is afforded through stock options.

So I'll stop there. Thank you very much.

[The statement follows:]

Prepared Statement of George M. Scalise, President
Semiconductor Industry Association, San Jose, California

Introduction

Mr. Chairman, Members of the Commission, my name is George Scalise, I am President of the Semiconductor Industry Association. SIA represents the largest U.S. headquartered semiconductor companies. I also serve on the President's Council of Advisors on Science and Technology—the PCAST—where I recently chaired a Subcommittee on Information Technology and Manufacturing Competitiveness.

I want to start by thanking you for inviting me to testify here today. I think this hearing—with its focus on the opportunities and challenges that face the U.S. high technology industry vis-à-vis our Chinese competitors—is very timely. As I will explain in my testimony, Chinese government policies, and not lower labor costs, are the major contributor to 10 year, a $1 billion cost differential, between building and operating a semiconductor plant in China compared to the U.S. This Commission has a responsibility to help build the consensus among U.S. policymakers to develop an effective response to this challenge.

I would like to begin with a brief overview of the U.S. semiconductor industry and the mission of the SIA before going into more detail on the challenges presented by Chinese policies.

First, though, I want to note that China can and should pursue its desire for a strong microelectronics industry. China is a very compelling market for U.S. companies, and it is home to some very strong competitors. SIA has since its inception favored free and open trade, and the case of China is no exception—robust competition is what drives the industry to invest ever higher amounts in research and technological advances in order to stay ahead.

U.S. leadership in advanced technology is not guaranteed, and foreign competition is intensifying. Many other countries—including China—are aggressively pursuing policies to build technical capabilities and to attract semiconductor and other high tech investments. The issue before us today is to understand the competitive factors influencing our industry, ensure that competition is fair and unencumbered by government barriers or market distortions that prevent the best company from winning, and develop policies that will help us retain our leadership position in the years ahead.

Overview: The U.S. Industry

Today, the U.S. semiconductor industry is the most competitive in the world in terms of market share. U.S. chip companies account for almost half of the world market in terms of sales—more than any other country. Over three quarters of U.S.-owned wafer capacity is in this country despite the fact that three quarters of our sales are outside the U.S.; almost 80% of the U.S. industry's total labor compensation is in the U.S., while only 55% of our labor force is here.

The U.S. also has the lead in terms of technology and manufacturing capacity. U.S. semiconductor firms as a whole still account for the largest percentage of purchases of semiconductor manufacturing equipment, but that lead is diminishing. Purchases by American companies have gone from just over 43% in 2001 to roughly 25% last year. Chinese companies' share of equipment purchases grew from about 2.6% to over 8% over that same period. The second metric we look at is the geography where the equipment will be located. In terms of leading-edge capacity, the U.S. has declined from a high of 36% in 1999 to just over 20% in 2004, and that trend is continuing. Two-thirds of the world's new 300 mm fabs will be built in Asia.

These numbers represent a geographic shift, and also a structural shift from so-called integrated device manufacturers to foundries. Foundries manufacture product designed by others—Taiwan built its industry on the foundry model, and China appears to be following suit.

A large part of the reason for this dramatic shift, though, is cost based. As I mentioned previously, there is a $1-plus billion 10-year cost difference between building and operating a fab in Asia versus the U.S. About 70% of the cost difference is due to tax benefits, 20% due to capital grants, and only 10% due to lower labor costs. Operating costs such as lower utility costs or cheaper logistics are also slightly lower overseas.

As taxes represent 70 percent of cost differential, it is instructive to compare tax rates in specific countries. In the U.S., the Federal income tax rate is 35%, and state and local taxes typically equate to an additional 6% rate (after adjusting for the Federal deduction). In contrast, China offers a five-year income tax holiday, and an additional five years at half the tax rate. Singapore and Malaysia offer five- to 10-year tax holidays. Ireland has a 12% tax rate, which is still a third of the U.S. rate. Taiwan's tax holiday and accumulated tax credits have resulted in Taiwan chip companies reporting higher net profitability after rather than before taxes. These tax benefits often also apply for research, development, and design centers.

The mission of the SIA is to ensure that the U.S. retains its lead in terms of both market share and technology. Chip manufacturing, corporate R&D, product design, semiconductor equipment and materials producers, and university research are all key elements of the semiconductor technology ecosystem, and erosions in any one part affects the other parts. The data I've just shared with you makes clear that while we have a solid lead today, we face significant competitive threats that I believe must be dealt with quickly and forcefully if we are to retain our lead in the future.

China's Market

China's semiconductor market was estimated at $25 billion in 2003, with annual growth rates ranging from 15–20%. China today is the third-largest country market worldwide, and is predicted to become the second-largest overall market by 2010. China is already the world's largest mobile phone market, and second largest personal computer market. The demand for chips is driven by China's increasing role as an electronics manufacturing hub, producing everything from PCs and cellular phones to flat panel displays, digital cameras, and DVD players.

Semiconductors exports to China in 2003 were $2.4 billion and $2 billion for the first nine months of 2004—making them the second largest manufactured export from the U.S. to China. These figures may actually under-report the full value of U.S. semiconductor products exported to China, as the distributed nature of assembly and final testing in third-countries is not captured in U.S. export figures.

Chinese Government Incentives

This very rapid market growth is accompanied by a very ambitious policy agenda to foster the semiconductor industry in China. These policies range from direct incentives to manufacture in China to support for R&D, coupled with a willingness to utilize the standards setting process quite aggressively to favor specific firms. Some of these policies represent an effort to make rapid progress in an important industry. Others, unfortunately, represent violations of World Trade Organization (WTO) rules.

In 2004, the Office of the United States Trade Representative (USTR) brought the first WTO case against China on that country's Value Added Tax (VAT) rebate on semiconductors. In summary, that policy provided for rebates of 14% of the 17% VAT paid to companies who manufactured their semiconductors in China, while imposing the full 17% VAT on imported chips. This created a substantial incentive for Chinese chip purchasers to utilize domestically made product. The WTO case was always about more than fair market access—it was about making sure that investment decisions will be based on sound market factors and not government interference. The policy was very effective in skewing investment decisions and led to substantial increases in manufacturing capacity in China. In July 2004 the case was settled, and on March 31, 2005, all remaining elements of the program were halted. To its credit, the Chinese government implemented in full and on time all of the commitments made as part of the settlement agreement.

Following resolution of the VAT case, it appears that the focus is shifting to R&D. At the point in time the VAT replacement policy was to be announced, China issued "Temporary Measures of Special Funds in R&D in the Semiconductor Industry"—these measures will reportedly go into effect on April 30, 2005. The policy was jointly announced by the Ministry of Finance (MOF), the Ministry of Information Industries (MII) and the National Development and Reform Commission (NDRC). The notice itself does not indicate funding amounts, although press reports indicate that the fund may pay up to 50% of a firm's R&D costs. Press reports also indicated additional income tax breaks for semiconductor makers, reportedly lengthening tax breaks to five years exemption and five years at half rate, up from the current two-year exemption and three years at half rate that is granted to preferred companies. The SIA is actively seeking additional details regarding this policy, and would be happy to share them with the Commission when they become available.

In addition to these direct subsidies, the Chinese government has also shown an interest in utilizing the standards setting process to impact the market. I'm not going to spend much time on this issue here today, but would be happy to answer any questions you may have at the conclusion of my testimony.

Chinese Manufacturing Capacity and Technology Trends

The combined impact of China's compelling market opportunities and Chinese government subsidies has been noticeable. By 2007, the projection is that almost 10% of global semiconductor capacity will be in China—up from barely 2% only a few years ago.

Much of the investment going into China today is in the foundry area. In the year 2004 alone, foundry capacity in China doubled to approximately 500,000 wafer starts per month—revenues earned by Chinese foundries also doubled from 2003 to 2004 to approximately $1.8 billion. By 2006, Chinese foundry capacity at the 0.18 um node will be approximately 28% of world total.

While much of the capacity in China today is 200 mm and in some cases employs used equipment, experts project that there will be up to five 300 mm fabs operational in China by 2007. While the majority of Chinese capacity in 2004 continued to be at 0.5 um, the capability and capacity are rapidly expanding for more advanced nodes up to 0.13 um—and one foundry even announced that it will soon have available 90 nm (0.09 um) process technology.

Most Chinese foundries have entered into—or are in the process of entering into—process technology licensing agreements with leading semiconductor companies in Taiwan, U.S., Japan and Europe. Foreign companies also represent the bulk of the customer base for these foundries. Last year, foreigners accounted for approximately 80% of Chinese foundries revenues. However, Chinese fables companies are growing rapidly—their revenues are expected to quadruple between 2003–2008, to $1.2 billion. Although this is still a relatively small number, Chinese foundries expect that local design houses will drive demand for advanced manufacturing capabilities in the future.

Semiconductor technology has been making rapid strides in China by virtually any metric one can imagine. The determined resolve of the local authorities to build a strong local semiconductor industry, coupled with the attractiveness of China as a market, is acting as a powerful accelerator.

The decision to locate new capacity in China is not driven primarily by low labor costs—semiconductor fabs are capital and technology intensive and even an 80% differential in wage rates results in barely a 10% difference in final costs. The difference lies mainly in government incentives such as favorable taxation and other benefits.

Although China has chosen the low end of the foundry business as their entry vehicle into the global semiconductor industry, Chinese foundries are advancing rapidly to becoming world-class in leading-edge process technology. In addition, the Chinese government proactively supports an entire local ecosystem including fabless design houses, integrated device manufacturers (IDMs), contract manufacturers (EMS) and designers (ODMs), test and packaging houses, venture capital and start-up firms. The rapid growth of the Chinese electronics ecosystem is likely to make the global environment far more competitive than ever before.

Steps the U.S. Must Take: Technology Policy

Again, I believe that China can and will have a competitive semiconductor industry, and we welcome it as a competitor. That said, my concern is what the United States must do to ensure that we do not lose our position as technology leaders going forward. We must recognize that what is true for us in industry is true for the country as a whole—retaining our lead in this newly more globally competitive era will require a focused effort, and significant investments.

As I mentioned, I serve on the President's Council of Advisors on Science and Technology—the PCAST—and I recently chaired a Subcommittee on Information Technology and Manufacturing Competitiveness. We delivered our report to President Bush in January of last year. Among our key findings were:

- Manufacturing share of U.S. GDP and employment fell by half over 50 years, but productivity increases allowed output to remain steady.
- Technology improvements drive approximately half of U.S. GDP, and two-thirds of productivity gains. While IT-producing industries generate less than 5% of GDP, they accounted for nearly half the surge in productivity growth since 1995. Continued advances in information technology are the key to continued economic growth.
- There is growing international competition for leadership in high-tech fields—our foreign competitors aren't content to be low cost commodity suppliers anymore.
- Many of our competitors have low labor costs, and benefit from significant foreign government incentives; and finally, and I think most importantly,
- U.S. leadership is not guaranteed.

Retaining our technological leadership depends on the existence of a healthy innovation eco-system, and that in turn relies on a number of key components, including among other things:

- Strong investments in basic R&D
- Skilled scientists and engineers
- Laws and regulations that support domestic investment
- A competitive investor and tax environment
- A level playing field with effective IP protection

There are a number of government policies that support and help strengthen this eco-system. A cornerstone is supporting a strong and vibrant university R&D capability. Our university system is the best in the world, and Federal investment in university research is critical to retaining current leading-edge industries and also creating new ones.

Before addressing what I believe the government should do, let me make clear that the U.S. semiconductor industry invests heavily in this area. In recent years, semiconductor firms have invested between 19–22% of sales in R&D, for a total of $16 billion in 2004—more as a percentage of sales than virtually any other industry. Although much of this investment is on the product development side, basic university research and consortia activities represent important components, especially as we reach the physical limits of CMOS. Exclusive of consortia such as the SIA affiliated Semiconductor Research Corporation (SRC) and the SIA-founded Focus Center Research Program (FCRP), semiconductor companies contribute $50–60M annually to university research. In addition, industry consortia contributions to universities, SEMATECH and other programs totaled $320 million in 2003, tripled the level from $110M in 2001.

Federal funding for R&D as a percentage of GDP, though, declined from 1.2% in 1985, to only 0.7% in 2003. While the downward trend was slightly reversed from 2000–2003, it is important to return to the levels of the mid-1980s as a percentage of GDP. In addition to overall funding levels, we need to think about balance. Within university R&D, the physical sciences have remained largely flat, and engineering only recently showed modest increases. In 2005, overall Federal R&D investment was $132.2 billion, a 4.8% increase from the previous year. The Department of Defense (DoD) accounted for 80% of the increase.

The National Science Foundation Authorization Act of 2002 called for doubling the NSF budget over 6 years, but appropriations have not followed. In FY 2003, a 10.1% increase was a good start, but a 5% increase in FY 2004 fell well short of the goal—I believe this year it is imperative that the NSF receive at least a 7% increase in funding to keep up with technology demands. This would lead to doubling by 2014.

SIA has firsthand experience with the Federal funding challenge. The Focus Center Research Program (FCRP), jointly funded by SIA companies, equipment suppliers and DoD, sponsors university-based research across the country. Federal funds are leveraged through matching industry contributions. Due to budget constraints, the Administration has not been requesting its share of funding for this program in the last two years. Congress has added money to fund the program. Government funding for FY 2006 should be $20M, to be matched by $20M by industry. It is important to the continuity of research that this program has a predictable funding mechanism from our Federal partners.

These investments in R&D are as much economic policy as they are technology policy. It is not in our national interest to try to compete as a low labor cost supplier, and even if we did choose to compete on this level we could not compete against China. Our goal must be to create high wage jobs, which can only be achieved with higher productivity and products that command a premium in the marketplace.

A perfect emerging example can be found in the area of nanotechnology. The worldwide annual industrial production in the nanotechnology sectors is estimated to exceed $1 trillion in 10–15 years from now, which would require about 2 million nanotechnology workers. Recognizing the importance of this new area, the President signed the 21st Century Nanotechnology Research and Development Act in December 2003. Since FY 2001, Federal spending on nanotechnology has more than doubled, to a total of $1 billion in the FY 2005 request. In 2004, U.S. nanotechnology investment was estimated at nearly $1B. Yet, the EU, Japan, the combined total of Korea, China, and Taiwan, each invested at nearly the same levels, and their investments are growing.

SIA has proposed the Nanoelectronics Research Initiative to find the next foundation for information technology—the successor to CMOS—by the year 2020. The NRI will be a collaborative effort between the U.S. Government, industry, and academia. This year, SIA gained significant understanding of existing government programs in this area, and the NRI will continue to augment, link and accelerate these efforts.

Steps the U.S. Must Take: Tax Policy

In addition to technology policy, America's Federal and state governments need a coordinated strategy to reduce the cost differential created by foreign government tax and incentives policies. This strategy should include several elements, including competitive Federal tax policies, a permanent R&D tax credit, and other elements.

The Federal Government should match the tax holidays offered overseas and it must correct many of its misguided policies that discourage investment in the U.S.

and consider other measures to close the tax gap with our trading partners. Specifically Congress should:

- Make the R&D tax credit permanent, enact the Alternative Simplified Credit and other R&D credit enhancements such as those included in the Senate bill last year, and increase the credit rates so that the foreign tax cost differentials are eliminated. The credit is currently scheduled to expire at the end of 2005. Equally important, many companies invest significant sums on R&D yet cannot use the credit as currently structured.
- Allow companies to expense high technology equipment and thereby improve its cash flow and its ability to invest in new high technology equipment.
- Rethink international taxation rules and consider alternatives to the current rules on taxing foreign source income. Many of the companies that compete against the U.S. operate under territorial tax systems, or otherwise more favorably treat foreign income. The move toward contract manufacturing, a result of the escalating cost of chip factories, puts an additional burden on U.S. companies because their offshore income may be treated under Subpart F rather than as deferred income. Taxes on repatriated funds make it more likely that these funds will be reinvested overseas.
- Consider significant rate reductions to allow manufacturing to remain in the U.S. SIA is encouraged by last year's FSC/ETI resolution that will effectively reduce the rate for domestic production to 31.85 percent over five years. As a result of recent reductions in Europe, U.S. corporate tax rates also even now exceed most European nations.

State and local governments also have a role to play. They must ensure that their tax policies must take into account the capital intensity of the semiconductor industry. Sales and property taxes fall disproportionately on businesses that provide their workers with the expensive tools that drive productivity. To counter foreign tax holidays, states that have succeeded in attracting new facilities or retooling of existing fabs have adopted policies such as sales tax exemptions for machinery and equipment, property tax caps, R&D tax credits, business tax apportionment and ad valorem tax abatements. Successful states have also emphasized prompt and flexible environmental permitting to reduce cost and respond to the short product life cycles in the chip industry.

Conclusion

The question posed to me today by the panel was two-fold: the state of China's manufacturing and technology capabilities, and what the U.S. can do to address these challenges.

As noted, I believe the state of China's technological and manufacturing capabilities are rapidly increasing. They are able and talented competitors, who will increasingly pose a challenge to the U.S. I believe it is incumbent upon us not to seek to dampen this competition, but to embrace it fully while at the same time making the investments needed to retain the U.S. competitive lead. It is not in our interest to try to compete as a low labor cost supplier—our goal is to pay high wages which can only be justified with higher productivity and products that command a premium in the marketplace.

The U.S. competitive lead is ours to keep—or ours to lose. The investments and policy changes needed to achieve this goal are neither easy nor inexpensive, but it is vital that we make them.

Chairman D'AMATO. Thank you, Mr. Scalise, for that detailed testimony and recommendations.

Now we'll move on to Mr. Wong.

STATEMENT OF ALAN C. WONG, SENIOR COUNSEL NVIDIA CORPORATION, SANTA CLARA, CALIFORNIA

Mr. WONG. Thank you, Mr. Chairman. Let me begin by thanking the Members of the Commission and its staff for holding these hearings. I believe that the focus of this Commission is vitally important to the economic and strategic future of the United States. In my view, apart from terrorism and other violent threats, there is perhaps no greater long-term geopolitical challenge to this nation than the question of how to address, and co-exist and work with, the rising power of China.

I should preface my further remarks by saying that my views today are my own, and not those of my past or present employers.

In one of my past work lives as a State Department Foreign Service Officer, I often found myself an informal watcher of China. While posted in India and Japan, political and economic developments in China were of great strategic interest to both of those nations, as well as to the United States.

Today, my interest is more practical, and conditions in China impact my professional life on a daily basis. As in-house counsel at a large semiconductor company, I spend the bulk of my time managing legal matters overseas. In China, that has meant setting up several operating units to support market expansion and offshore research and development efforts.

One initial observation is that offshoring cutting-edge technology to China creates a Catch-22 situation. In an effort to reduce costs, find new engineering talent, and reach new markets, Western companies are inevitably creating greater competition for themselves. By transferring technological know-how and fueling demand for new technology and products, we are not necessarily creating new market opportunities solely for ourselves.

Take, for instance, the mobile phone industry, of which much has been said today already. The introduction of cellular technology into China has been stunningly quick in fueling demand that outpaces that of the United States. Yet that introduction of technology has also enabled a native Chinese cell phone industry that now accounts for over 40 percent of sales in China.

Likewise in the computer software and hardware industries, all bets are off. When major software, hardware, and PC makers first took their wares and know-how to China, it is likely they were hoping for a billion new customers. There is no denying that there remains plenty of market upside in China, and that Western companies continue to grow their business there. But it is also true that the demand for computer software and hardware, including advanced semiconductors, is increasingly filled by local Chinese producers.

It is becoming increasingly apparent that Chinese technology manufacturers will not be satisfied with the China market. Many are already working towards plans to, somewhat ironically, expand globally beyond China, perhaps starting first with other Asian markets, but no doubt with sights set on long-term goals that likely include Western markets.

Another aspect of offshoring technology work to China that's been touched on today is the problem of intellectual property risk. It is true that, at least on paper, there has been change for the better in Chinese legal structures for intellectual property protection and enforcement of patents, copyrights, and trademarks. But such progress is incremental, and in some instances meant mainly to mollify the concerns of foreign investors.

When it comes to keeping trade secrets secret, or enforcing nondisclosure agreements, there is little hope of credible recourse. From an information security perspective, companies can take precautions, including use of cameras in their facilities, firewalling computer systems, and encrypting data, but the risks remain high in an environment where encryption methods must be acceptable to the Chinese authorities and the host government must be given the encryption keys. The bottom-line is that companies going to China must be cautious, and they must limit and compartmentalize the technology they take there if they are to retain competitive advantages.

Getting started in China has required long lead-times and presents practical challenges on a daily basis. Procedures are always multilayered and complex, with little insight into the approval processes, and uncertain motivations on the part of the Chinese.

Most Western companies have been fortunate in that interests on both sides are apparently in sync. My experience is that offshoring has been welcomed in China because we have offered technology, expertise, employment, and overall investment deemed to be of high value to local and central government authorities.

In most instances government and quasi-governmental actors have been extremely helpful to us. To our advantage, entities such as technology parks and quasi-governmental promotion units are often stakeholders extremely motivated to assist and guide foreign companies through the maze of official and private requirements.

We cannot, however, lose track of the reality that China is a centrally-controlled playing field where much of what goes on is allowed simply because it is deemed to be of benefit to China's long-term goals, whatever those may be.

From our position as a democracy with a multitude of conflicting motivations within and outside of government, and in a post-Soviet era, when the idea of central control is becoming a dim memory in many parts of the world, it is sometimes difficult to keep in mind that central government control continues to exist, particularly in a country like China where every day brings greater and seemingly freer engagement at the business level. But at times, reasons for concern become clear.

For example, in an effort to assure Western companies that power sources and road access to a given site will be plentiful and well-maintained, Chinese promoters sometimes let slip that infrastructure in the area will receive consistent support and priority because the government wants to attract certain technologies that can be used in the Chinese defense and military industries.

So when the Commission's Report to Congress of last year asked "whether [China] converts [growing technology capabilities] to military uses and/or to control the free flow of information to its population," it seems to me that the question should be considered rhetorical and the answer more than clear that some interests at play are not in our national interest.

It seems that China is becoming master of the game of attracting foreign investment and technology, creating jobs, and rapidly raising standards of living for its own people. One visit to Shanghai is enough to convince most people that China lives in the modern age and is a force to be reckoned with. The very modernity one is greeted with adds to a sense of comfort for foreign investors. But while China welcomes foreign investment and marketeers, it does not really give up its domestic markets, and it retains complete control over regulations, market access, labor supply, and infrastructure.

Foreign companies create new markets within China, but, once demand is established, in almost every instance native Chinese producers take back a large chunk of that demand. So rather than a billion new customers for foreign companies, China presents only the market that China wants it to be.

Even for cutting-edge technology, open markets in China may be illusory and temporal. What China may really want is technology and know-how to take advantage of its own market potential, and in preparation for competition in and perhaps dominance of foreign markets.

In parallel, China seems to be getting its ducks in a row for the future, engaging internationally and creating channels of influence and resources in far-flung parts of the globe. One has to give China credit—it has created a winning strategy of attracting our investment, technology, and jobs, while for the most part placating fears, and simultaneously developing its own capabilities and resources.

U.S. technology companies need to also keep in mind that the cost benefits of offshoring and investing in China may at least in part be illusory. It is a challenge to find skilled and experienced engineers in China and then have to compete for them against other U.S. companies and multinationals. Though on a yearly basis China continues to produce many times the number of engineers as the U.S., demand, competition, and salaries for those individuals are rising at tremendous rates. By some accounts, salaries for skilled employees are rising as much as 20 percent per year, making retention all the more difficult, and steadily eroding cost advantages with respect to technology labor.

For the most experienced personnel, salaries and incentives such as stock options are already on a par with the U.S. Real estate costs are also rising, with rental rates per square foot in cities such as Shanghai already exceeding current rates here in the Bay Area. All of which is to say that the total cost of doing business in China is now much higher than anticipated.

I'm flattered that Chairman D'Amato has already stated some of my recommendations. I'll repeat them briefly. I believe the Federal Government must do a better job of engaging Silicon Valley, and that the two need to work together to move beyond unbridled engagement with China towards an alignment of private sector business interests with national interests.

We need to educate each other on an ongoing basis. Again, apart from hearings such as today's, the Federal Government's visibility in this region is surprisingly limited. I'm sure it's high for many of the people in this room today, but in general I would say it is not. Except for a few individuals responsible for export controls at each company, there is in my experience very little appreciation in the private sector for the competitive, strategic, and national security threats inherent in technology transfer and offshoring activity, particularly with respect to China.

For the U.S. to maintain scientific and technological leadership, strategists and policymakers in Washington must win the cooperation of Silicon Valley. Developing and publishing a national policy and strategy towards China, in itself, will not likely change or affect the views and behaviors of the private sector, particularly here in Silicon Valley. But moving beyond a D.C.-centric Federal Government and establishing a visible, ongoing, sophisticated, and non-threatening presence in this region could help.

To have effect beyond Washington, the dialogue must go beyond this forum—through the media, among corporate management, and at the level of technology workers, not just among the people in this room. The government will need to demonstrate that it understands what is driving companies overseas to places like China, and that it has insights to offer that can help companies make better decisions—insights not only with respect to risks, threats, and national security, but also at the practical level, by discussing overall return on investment, competition risk, long-term scenarios, and by counteracting hype and naiveté. By working more in concert, the Federal Government and the private sector can together encourage more deep thinking and discussion on the issue of China—leading, hopefully, to a more sophisticated normative understanding of what China means to the United States and to each business' competitive position.

Thank you.

[The statement follows:]

Prepared Statement of Alan C. Wong
Senior Counsel, Nvidia Corporation, Santa Clara, California

China's Global Technology Competitiveness: Recent Company Experience in China

- The Catch-22 of off-shoring to China: to stay competitive we enable our competitors; technology transfer and IP risk
- Getting started in China: multilayered complexity and lack of transparency, government control, regional variations, long lead-times
- Uncertain motivations: helpful actors in a black box; mutual interests apparently in synch; some interests against our national interests
- Masters of the Game: China's rising standards of living; creating a comfort zone for foreign investment
- The possibility of illusory benefits: competing for China's labor supply, rising wages, site challenges, stock options, total cost of doing business, temporal market opportunities
- Weighing the upside: shifts in policy, uncertain financial and legal structures; playing only in the market China wants it to be
- Moving Silicon Valley beyond engagement: alignment of business interests with national interests

Good morning. It's a pleasure to be here. Let me begin by thanking the Members of the Commission and its staff for holding these hearings and for inviting me to participate. I believe that the focus of this Commission is vitally important to the economic and strategic future of the United States. Apart from terrorism and other violent threats, there is perhaps no greater long-term geopolitical challenge to this nation at the beginning of this century than the question of how to address, and co-exist and work with, the rising power of China.

I should preface my further remarks by saying that my views today are my own, and not those of my past or present employers.

In one of my past work lives as a State Department Foreign Service officer, I often found myself an informal watcher of China. While posted in India and Japan, political and economic developments in China were of great strategic interest to both of those nations, as well as to the United States. Today, my interest is more practical, and conditions in China impact my professional life on a daily basis. As in-house counsel with primary responsibility for international legal affairs at a large semiconductor company, I spend the bulk of my time managing legal matters overseas. In China, that has meant setting up several operating units to support market expansion and off-shore research and development efforts. My recent experience may be of interest in the context of these hearings.

The Catch-22 of Offshoring to China: To Stay Competitive We Enable Our Competitors

One initial observation is that offshoring cutting-edge technology work to China creates a Catch-22 situation. In an effort to reduce costs, find new engineering talent, and reach new markets, Western companies are inevitably creating greater competition for themselves. By transferring technological know-how and fueling demand for new technology and products, we are not necessarily creating new market opportunities solely for ourselves. Take for instance the mobile phone industry. The introduction of cellular technology into China has been stunningly quick in fueling demand that outpaces that of the U.S. Yet that introduction of technology has also enabled a native Chinese cell phone industry that now accounts for over 40% of sales in China.

Likewise in the computer software and hardware industries, all bets are off. When major software, hardware, and PC makers first took their wares and know-how to China, it is likely that they were hoping for a billion new customers. There is no denying that there remains plenty of market upside in China, and that Western companies continue to grow their business there. But it is also true that demand for computer software and hardware, including advanced semiconductors, is increasingly filled by local Chinese producers (not to mention pirated software). And it is becoming apparent that Chinese technology manufacturers will not be satisfied with the China market—many are already working towards plans to, somewhat ironically, expand globally beyond China, perhaps starting first with other Asian markets, but no doubt with sights set on long-term goals that likely include Western markets.

Another aspect of the enablement of Chinese competition that results from offshoring technology work and technology transfer is the problem of intellectual property risk and blatant IP theft. It is true that, at least on paper, there has been change for the better in terms of legal structures in China for intellectual property protection and enforcement of patents, copyrights, and trademarks. But we need to keep in mind that such progress is incremental, and in some instances, meant mainly to mollify the concerns of foreign investors. When it comes to keeping trade secrets secret, or enforcing non-disclosure agreements against entities or individuals, there is little hope of credible recourse. From an information security perspective, companies can take precautions, including use of cameras, firewalled computer systems, and encrypted data, but the risks remain high in an environment where encryption methods must be acceptable to the local authorities and the host government must be given the encryption keys. The bottom-line is that companies going to China must be cautious, and they must limit and compartmentalize the technology they take there if they are to retain competitive advantages.

Getting Started in China: Multilayered Complexity and Lack of Transparency

Getting started in China presents practical challenges on a day-to-day basis. Setting up a new wholly-owned company is not the 7–10 day task that we take for granted in the U.S. Outside legal counsel and consultants typically recommend allowing at least 6 months to locate a site and come to terms on a lease, negotiate with government officials over scope of allowed business and incentives, prepare documentation, and obtain government approvals. Our experience is that timeframes can be shorter (though at other times they have taken as long as predicted), but the processes are always multilayered and complex, with little insight into the approval processes. Businesses entering China need to understand that approval processes are government controlled and lack transparency. Decisions can be arbitrary and unpredictable, and even private party processes such as lease negotiations may be subject to government approvals, and influenced by motivations we can only begin to guess at.

Procedures also vary considerably from region to region, and between technology parks in the same region. In Shanghai, Chinese and English versions of important documents are carefully crafted to closely match in meanings and may carry equal validity. In South China, only Chinese versions may be valid—English translations may be prepared by a company's own advisers, but may carry no legal weight. In some cases, the latter, more opaque situation may actually lead to quicker approvals, but with more uncertainty over exactly what the terms are and how they will be enforced. Additionally, the problem of transparency is heightened when a company considers engaging in a joint venture, licensing arrangement, or acquisition involving a Chinese entity. Performing due diligence will in almost all cases be difficult and will result in far fewer satisfactory answers and far less clarity than hoped for.

Uncertain Motivations: Interests Apparently in Synch; Some Interests Against Our National Interests

I've touched on the idea of uncertain motivations on the part of the Chinese. Most Western companies today are fortunate in that interests on both sides are apparently in synch. Central and local government actors find our presence beneficial in terms of technology and capital transfers, job creation, and increased supplies of goods and resources, all contributing to generally heightened standards of living. My experience is that offshoring and market outreach efforts in various regions have been welcomed because we have offered technology, expertise, employment, and overall investment deemed to be of high value both to local and central government authorities. In most instances, government and quasi-governmental actors have been extremely helpful to us. To our advantage, entities such as the technology parks and certain quasi-governmental promotion units, and most importantly individuals within those organizations, are often stakeholders who are extremely motivated to assist and guide foreign companies through the maze of official and private requirements. Individuals themselves are often paid bonuses for successfully recruiting foreign companies. On the surface at least, interests on all sides are finding common ground.

We cannot, however, lose track of the reality that China is a centrally-controlled playing field, where much of what goes on is allowed simply because it is deemed to be of benefit to China's long-term goals, whatever those may be. From our position as a democracy with a multitude of conflicting motivations within and outside of government, and in a post-Soviet era when the idea of central control is becoming a dim memory in many parts of the world, it is sometimes difficult to keep in mind that central government control continues to exist, particularly in a country like China where every day brings greater and seemingly freer engagement at the business level. But at times, reasons for greater concern become clear. For example, in an effort to assure Western companies that power sources and road access to a given site will be plentiful and well-maintained, Chinese promoters sometimes let slip that infrastructure in the area will receive consistent support and priority because the government wants to attract certain technologies that can be used in the Chinese defense and military industries. So when the Commission's report to Congress of last year asks "whether [China] converts [growing technology capabilities] to military uses and/or to control the free flow of information to its population," it seems to me that the question should be considered rhetorical and the answer more than clear. That we have at times seen the overt and covert transfer of dual use items, including turbine designs, precision machine tools, and other technology useful for the development of WMD and related delivery systems, makes it even clearer that some interests at play are not in our national interest.

Masters of the Game: Creating a Comfort Zone for Foreign Investment; Temporal Market Opportunities

It seems that China is becoming master of the game of attracting foreign investment and technology, creating jobs, and rapidly raising standards of living for its people. One visit to Shanghai is enough to convince most people that China lives in the modern age and is a force to be reckoned with. The very modernity one is greeted with adds to a sense of comfort for foreign investors. At the same time, China appears to have given up very little in terms of its own resources and markets. It continues to export finished goods at rates that far exceed imports. It welcomes foreign investment and marketeers, but it does not really give up its domestic markets, and it retains complete control over regulations, market access, labor supply, and infrastructure. Foreign companies create new markets within China—but, once demand is established, in almost every instance, native Chinese producers take back a large chunk of the demand. In some cases, the nature of demand may also be manipulated through the adoption of state-dictated standards in areas such as wireless technology and software. So rather than a billion new customers for foreign companies, China presents only the market that China wants it to be. Even for cutting-edge technology, open markets in China may be illusory and temporal. Some might argue that, rather than new goods, what China really wants is technology and know-how to take advantage of its own market potential, and in preparation for competition in and perhaps dominance of foreign markets. In parallel, China seems to be getting its ducks in a row for the future, engaging internationally and creating channels of influence and resources in far-flung parts of the globe. One has to give China credit—it has created a winning strategy of attracting our investment, technology, and jobs, while for the most part placating fears, and simultaneously developing its own capabilities and resources.

The Possibility of Illusory Benefits: The Rising Total Cost of Doing Business

U.S. technology companies need to also keep in mind that the cost benefits of offshoring and investing in China may at least in part be illusory. It is one thing to find cheap manufacturing labor and materials, it is a different challenge to find skilled and experienced hardware engineers in China, and then have to compete for them against other U.S. companies and multinationals. Though on a yearly basis China continues to produce many times the number of engineers as the U.S., demand, competition, and salaries for those individuals are rising at tremendous rates. By some accounts, salaries for skilled employees are rising as much as 20% per year, making retention all the more difficult, and steadily eroding cost advantages with respect to technology labor. For the most experienced personnel, salaries and incentives such as stock options are already on a par with the U.S. Real estate costs are also rising, with rental rates per square foot in cities such as Shanghai already exceeding current rates here in the Bay Area. All of which is to say that the total cost of doing business in China is now much higher than anticipated.

Weighing the Upside: Focusing on the Short-Term Rather Than the End Game

For better or worse, however, there does not seem to be a noticeable decrease in corporate plans to move more operations offshore. Despite election year battles over offshoring and outsourcing of U.S. jobs, it seems that boards, management, and institutional and individual investors continue to see offshore strategies in a positive, rose-colored light. Companies will continue to weigh the perceived upside against the risks of shifting economic and political policies in China, uncertain financial and legal structures, controlled markets, and rising costs. In my view, companies seem overly focused on short-term strategies and market potential, without imagining the end game and the possibility that they will lose their competitive advantage and/or be taken advantage of. How this will play out I leave to others more skilled at gaming the variables.

Moving Silicon Valley Beyond Engagement: Alignment of Business Interests With National Interests

The one recommendation that I would like to leave you with is this: that the Federal Government must do a better job of engaging with Silicon Valley, and that the two should work together to move beyond unbridled engagement with China towards an alignment of private sector business interests with national interests. To start to do that, we need to educate each other on an ongoing basis. Apart from hearings such as today's, the Federal Government's visibility in this region is surprisingly limited, particularly given that much of the technology subject to export controls and giving rise to concerns about long-term competitiveness and proliferation originates within a 50 mile radius of this meeting. And except for the few individuals responsible for export control compliance within each company, there is in my experience very little appreciation in the private sector for the competitive, strategic, and national security threats inherent in technology transfer and offshoring activity, particularly with respect to China. For the U.S. to maintain scientific and technological leadership, strategists and policymakers in Washington must win the cooperation of Silicon Valley. Developing and publishing a national policy and strategy towards China, by itself, will not likely change or affect the views and behaviors of the private sector, particularly here in Silicon Valley. But moving beyond a DC-centric Federal Government and establishing a visible, ongoing, sophisticated, cooperative, and non-threatening presence here could help. If the Commission agrees with some of these observations, and if it wants to have effect beyond Washington, the dialogue must go beyond this forum—through the media, among corporate management, and at the level of technology workers. The Commission will need to demonstrate that it understands what is driving companies overseas to places like China, and that it has insights to offer that can help companies make better decisions—insights not only with respect to risks, threats, and national security, but also at the practical level, by discussing overall return on investment, competition risk, long-term scenarios, and by counteracting hype and naiveté. By working more in concert, the Federal Government and the private sector can together encourage more deep thinking and discussion on the issue of China—leading, hopefully, to a more sophisticated normative understanding of what China means to the U.S. and to each business's competitive position. Thank you.

Chairman D'AMATO. Thank you very much, Mr. Wong.

And now we'll have Mr. Rieschel who is with Mobius Capital.

STATEMENT OF GARY EDWARD RIESCHEL EXECUTIVE MANAGING DIRECTOR MOBIUS VENTURE CAPITAL, PALO ALTO, CALIFORNIA

Mr. RIESCHEL. Yes. Good morning. Thank you for inviting me to present to the panel and the Commission.

The area that we've been asked to comment on today is the venture capital community impact on China's global technology competitiveness. There are three areas that I want to address.

One was China's competitiveness relative to the outsourcing of jobs from the U.S., Europe, and Japan.

Second, China's competitiveness as it relates to creating true technology innovation and becoming a world leader in establishing technology standards.

And, finally, China's competitiveness as it relates to access to capital, which I believe is absolutely critical to the achievement of real innovation.

A brief context for my comments is appropriate. I've been fortunate enough to be able to establish business operations in Europe, Japan, China, and India, as well as other countries during my career. I lived in Japan from '89 to '93. And I was two years as the head of the American Electronics Association's Industry Committee. At that time there was great concern in the U.S. technology sector, in the ranks, that the Japanese were going to overtake U.S. leadership in semiconductors, consumer electronics, large-scale computing, and ultimately software. Various projects such as the famous 5th Generation Computer Initiative and TRON were trumpeted with great fanfare by the Japanese ministries. All were unsuccessful commercially. I would make the statement that if China depended on central control for innovation and technology, we would have nothing to be concerned about.

It's important to put the development we see in China over the last 25 years in the proper historical context. There are numerous historical references to China's innovations through the centuries that we don't need to recreate here. But suffice it to say that Chinese culture and society have consistently been world leaders in the creation and adoption of technology. And there's absolutely no reason to believe that with unlimited access to risk and human capital this won't continue for the foreseeable future.

As relates to outsourcing, virtually all computers, cell phones, televisions, DVD players, tool and die equipment, and simple chemical reagents used in the U.S. today are now manufactured offshore. And if involves silicon, the odds are it's manufactured in a Chinese facility.

The first wave of manufacturing outsourcing worldwide has been estimated to total over $400 billion and represents the value associated with primarily labor-intensive items. China and India have been the most talked about beneficiaries of this wave, which is motivated primarily based on a country's cost competitiveness on labor and an available talented pool of workers. The return on equity, which dominated the equation, was a return on financial equity.

Many U.S. companies have taken advantage of this wave and they were clearly thinking initially of cost savings. They were originally driven to compete by the highly efficient Japanese manufacturing combines of the late '80s and early '90s. And they helped put into business the companies such as Flextronics, Solectron, Quanta, TSMC, among others, as manufacturing partners that are really becoming dominate players today.

Those players were not satisfied with just low level manufacturing operations and began to look at what the next level of innovation was for them. And that entered the world of design. Today throughout the manufacturing plants in Szhenzen, Hangzhou, Shanghai, and Fujian, there's not only simple manufacturing but also a significant amount of real original design work. This is obvious when you look at the current key designers of laptop computers, Quanta in Taiwan; cell phones in China; and digital television chips.

The dollars associated with the next wave of outsourcing will be measured in trillions. It will focus on skill-intensive manufacturing and return on intellectual capital. It will be marked by reducing the time to market of new products and services and even tighter integration across the supply chain.

What enabled these companies to so rapidly evolve into leading design houses in China was an extremely aggressive focus by the Chinese government in the 1980s to establish world-class technology education centers across the university system.

Second, technology markets have evolved from being driven by enterprise buying to being driven by consumer buying. China will be for the foreseeable future the largest consumer market in the world for technology products.

Technology product cycle times have decreased from 18 to 24 months in the 1995 timeframe to nine to 12 months today. This has serious implications for design efficiency and time to market of new products.

Standardization of products. A larger and larger percentage of products are based in the technology sector have become standard based, which facilitates design at the edge of a product or technology around a standardized core. The standardized core becomes available very rapidly worldwide. The design tools are also now available on a worldwide basis. The Internet has been a powerful enabling force.

China and India both have basically had a free ride on billions and billions of dollars on a massive telecommunications overbuild to give them basically free access to moving bits around the world, whereas having to do that on their own nickel would have been prohibitively expensive.

And, finally, the economics. It's just very attractive to move up the value chain from simple packaging and assembly to design.

Another major difference between China and other countries, as we address these issues, is that the other countries that have developed a strong contract manufacturing base, is that that China itself a large and attractive market, which creates great incentives for Chinese firms to pursue the domestic market directly.

The Chinese domestic market is large enough to provide an extraordinary base for companies in the consumer market to leverage that base into a leading global competitive position. Haier is doing this in consumer electronics with over $10 billion in sales; Huawei is doing this in telecommunications. And the acquisition of IBM's PC business by Lenovo is an excellent example of a Chinese manufacturing powerhouse now extending its brand overseas. This is just the tip of the iceberg.

When you then address major investments by U.S. and European companies in China, you have to focus on their R&D investments that they're making. Philips will have 1,300 R&D staff in China by the end of 2006. General Electric will have 1200 global R&D engineers in China by the end of '06 and another 1,000 by '08. These are not people doing designs for the Chinese market. These are global R&D facilities leveraging their overall channels worldwide, but much of the core development in those companies is moving into the Chinese market.

In total, over 700 R&D facilities exist today in China funded primarily by the U.S., Japan, Europe, and Taiwan. These R&D centers will employ over half a million researchers and engineers when fully operational.

So to recap you have the following ingredients in China to foster innovation: A strong history of technical innovation; an excellent educational infrastructure; a strong base of companies that grew up in a brutally competitive cost-driven market; and huge financial incentives to establish—to expand the value chain from brand to brand from design and manufacturing.

You have many technologies becoming more standard based, enabling greater innovation off that base, and rewarding rapid time to market. You have a very rapid domestic market. And you have Chinese companies now accepted as brands in the technology market worldwide, which was definitely not the case ten years ago.

It is worth commenting further on education and its impact on China's increasing competitiveness. There have been a lot of articles, comments made already this morning. I think one of the key issues we do have to address is that the U.S. is losing its position as being both the employer of choice after foreign students come here for school and also not becoming the place where foreign students would like to go to school. We're making it difficult for them, and that's a terrible mistake for us.

If you look at just the engineers, as Alan mentioned, China's going to graduate 325,000 engineers this year: Five times the number in the U.S.

The education is not just in the technical area. One of the most surprising things for me has been to discover that 250 million Chinese study English as a foreign language. This is not in school. They're paying money to study English as a foreign language, which puts us in the position of there will be more English-speaking people in China than the United States within a few years.

The final catalyst to real innovation is access to capital, particularly venture capital. Venture capitalists do not invest in me-too products. What we do is we look for places where you really can find innovation. And the real innovative products that have been created over the years, whether you look at Intel, whether you look at Cisco, Microsoft, and so on, many of those companies were funded with venture capital.

Venture capital is now flowing into China at an increasingly rapid rate. There will be several billion dollars raised this year, specifically on China's specific funds to invest in the Chinese market. And that's not because all of us look at China as a me-too manufacturing market. We look at it from the standpoint of the engineering talent and the infrastructure that's been built up from the outsourcing base that is now really capable of doing some interesting innovation. So that's why the dollars are now flowing to China in a very large scale.

Finally, to not run over the time too much, the issue of intellectual property I think is a very real issue. And it's something that we take to heart in looking at any investments; something that does need to be addressed by China, has not been addressed satisfactorily to date. But it's also instructive to look back at—historically countries typically didn't really embrace intellectual property until they created it.

And so I think that what you will see over time is you will see over time China becoming more focused on protecting intellectual property, but largely because it will be developing it internally and the local business people are the ones who are driving the real adoption of intellectual property protection, because it's starting to impact their own businesses.

Thank you very much.

[The statement follows:]

Prepared Statement of Gary Edward Rieschel
Executive Managing Director, Mobius Venture Capital, Palo Alto, California

Thank you for inviting me to present to you this morning.

The area that we have been asked to comment on today is China's global technology competitiveness. This is a daunting subject to tackle in any bounded way, so I decided to summarize my thoughts on three main areas of China's competitiveness.

a. China's competitiveness relative to the outsourcing of technology jobs from the U.S., Europe and Japan to China, particularly in manufacturing.
b. China's competitiveness as it relates to creating true technology innovations and becoming a world leader in establishing technology standards.
c. China's competitiveness as it relates to access to capital, both foreign direct investment and liquidity in the local financial markets. This is absolutely critical to the achievement of real innovation.

I will address each of these in turn. First, let me provide you a brief context for my comments.

My career in the technology industry dates to 1979, and I have been fortunate to be able to establish business operations in Europe, Japan, China, India, and other countries during my career. While I lived in Japan from 1989 to 1993, I spent two years as the head of the American Electronics Association's Industry Committee. At that time, there was great concern in the U.S. technology ranks that the Japanese were going to overtake U.S. leadership in semiconductors, consumer electronics, large-scale computing, and ultimately software. Various projects such as the 5th Generation Computing Project and TRON were trumpeted with great fanfare by the Japanese ministries.

It is instructive to look at Japan, if only to understand the clear differences between the threat to U.S. competitiveness that Japan represented in 1990 and that China represents today and in the future. The Japanese threat was primarily due to an extreme level of vertical integration in huge corporations such as NEC, Hitachi, Fujitsu, Sony, Matsushita, and their excellence in driving costs down in areas such as semiconductor memory, storage devices, display screens, as well as a very large market in Japan based entirely on proprietary computer architectures. This was still a world where technology existed in "walled gardens" that a large company (IBM, Fujitsu, and DEC) could dominate vertically with proprietary systems. While this helped the large Japanese companies in Japan, it greatly limited their ability to export many of their complex products and systems.

Clearly, the Japanese did not come to dominate the world's technology landscape, although many Japanese companies today are major players in technology. The overall growth of the technology markets and their rate of change made it difficult for the Japanese companies that specialized in large-scale process manufacturing to be nimble enough to respond to market changes. As the technology sector has become more consumer-driven and less enterprise-driven, you are now seeing the resurgence of several of the large Japanese technology providers, but again, primarily in complex process-driven market segments.

Fifteen years later, the "walled gardens" of the computer industry have largely been torn down. While there are certain technology franchises that continue to dominate a particular area (Microsoft, Intel are the classic examples), the vast majority of the rest of the technology industry now must innovate around a series of "standards" established by either standards body (IEEE), or the market (Apple's Ipod). The market today favors the nimble and the ability to take a standard and relentlessly innovate at the edge of that standard. Many of the factors that lead to the original form of outsourcing were in response to Japanese advantages in large-scale production and cost efficiencies. The next wave of outsourcing, product design and development, is driven by the dramatically reduced cycle time that a company has today to make a product profitable.

Now let's turn to China specifically.

First of all, it is important to put the rapid development that we see in China over the last 25 years in the proper historical context. There are numerous historical references to China's innovations through the centuries that I will not attempt to recreate here. Suffice it to say that the Chinese culture and society have consistently been world leaders in the creation and adoption of technology and there is absolutely no reason to believe that with unlimited access to risk and human capital this won't continue for the foreseeable future.

China's Competitiveness in Outsourcing

As it relates to the outsourcing of technology jobs, virtually all of the computers, cell phones, televisions, DVD players, tool and die equipment, and simple chemical reagents used in the U.S. are now manufactured offshore, and if it involves silicon, the odds are it is manufactured in a Chinese facility. The first wave of manufacturing outsourcing worldwide has been estimated to total over $400 billion and represents the value associated with primarily labor-intensive items. China and India have been the most talked about beneficiaries of this wave which was motivated primarily based on a country's cost competitiveness on labor and an available, talented, pool of workers. The return on equity which dominated the equation was a return on financial equity.

The many U.S. companies that have taken greatest advantage of this wave were clearly thinking initially of cost savings, many of them driven to compete with highly efficient Japanese manufacturers as mentioned above. They actually helped put into business the companies such as Flextronics, Solectron, Quanta, TSMC, among many others, as manufacturing partners. The idea was that these "partners" would focus on cost reduction and that the large brand name companies such as IBM, Compaq, HP, and Cisco would continue to create original reference designs and transfer those designs to these "partners" for manufacturing. But these partners did not stand still and were not satisfied with the low gross margins and price competitiveness of historical contract manufacturing. They began to identify other places in the value chain of the technology world where they might best add value. The answer was product design.

From Manufacturing to Design and Ultimately—Brand

Today, throughout the manufacturing plants in Szhenzen, Hangzhou, Shanghai, and Fujian, there is not only simple manufacturing, but a significant amount of real original design work. This is obvious when you look at the current key designers of laptop computers (Quanta in Taipei, Taiwan), cell phones (Cellon—China, Flextronics—China, Bird—China), digital television chips (Grace, SMIC—China), among dozens of other industries. The dollars associated with the next wave of outsourcing will be measured in trillions and will focus on skill-intensive manufacturing and return on intellectual capital. It will be marked by reducing the time to market of new products and services and even tighter integration across the supply chain.

The reasons for this should not be a major surprise. The traditional contract manufacturing companies operate at gross margins between 2 and 8%, depending on their product mix and efficiency. Design work yields gross margins between 7 and 14%, again depending on the product line and market. The migration from contract manufacturing to product design is inevitable due to the much better economics.

A couple of examples here are instructive. Quanta, a Taiwanese company, started life as a motherboard manufacturer. Over time, Quanta evolved to an integrated supplier of laptop computers, estimated to manufacture nearly 25% of the world's laptop computers. Quanta moved up the value chain into design, with over 1,500 designers in Taiwan and China and plans to go to over 7,000 within a few years. The laptop computer "brands" of IBM, HP, and Dell (for computers sold under the Dell label in China) are examples of the laptops that Quanta produces.

Another excellent example of a major company that those outside of the technology industry are not familiar with is Flextronics. Flextronics has evolved from a pure U.S-based contract manufacturer in the 1980s to a global force in the design and manufacture of cell phones and other high value consumer devices. Over 2,000 design engineers work in the Flextronics facilities in China, designing products for companies such as Motorola, Sony, Ericsson, and Siemens. For the first time this year, Nokia has begun to outsource both design and manufacturing of a portion of its cell phone line. It is estimated that Flextronics is now the second largest manufacturer of cell phones and the third largest designer of mobile devices in the world.

What enabled these companies to so rapidly evolve into leading design houses from a base in contract manufacturing? Several key factors were critical for this, not necessarily listed in priority order:

a. An extremely aggressive focus by the Chinese government in the 1980s to establish world class technology education centers across the Chinese university system.
b. Technology markets have evolved from being driven by the enterprise to being driven by consumers (this has huge further implications for China's competitiveness that will be discussed later).
c. Technology product cycle time has decreased dramatically causing firms to release new products into the market on 9 to 12 month cycles from what was every 18 to 24 months in the 1995 timeframe. This has serious implications for design efficiency and time to market of new products.
d. Standardization of products. A larger and larger percentage of products in the technology sector have become standard-based products which facilitates design at the edge of a product or technology around a standardized core.
e. Increasingly sophisticated design tools. The increasing capability of CAD/CAM design tools and their ubiquity has allowed many organizations to quickly come up the curve on design. The larger branded companies have perfected design transfer to their supply chain which also facilitates the ability of new players to add value in the design process.
f. Internet. The Internet has been a powerful enabling force. China and India were able to leverage the massive telecommunications overbuild into a "free ride" on the modernization train, since the Internet broke down and eliminated many geographic barriers for human collaboration.
g. Economics. The attractive economics of moving up the value chain to design from simple packaging and assembly drove job creation and influenced government policy.

Now that you have these companies participating in the design and manufacturing phases of the value chain, the end user brand becomes primarily a marketing and sales channel organization. Again, this is where a great deal of value exists, and so it should be no surprise that we see a number of companies moving from manufacturing and design to marketing their own brands and creating their distribution channels. We have started to see the first major Chinese companies establish global brands from an initial base in contract manufacturing. Haier, the leading Chinese consumer electronics firm, is the best example. They started as an OEM manufacturer for several Japanese electronics firms, evolved into TV and DVD design, and are now marketing as a branded entity in the U.S. and Europe. They have become the world's fifth largest supplier of consumer electronics equipment from a cold start in 1984.

The major difference between China and other countries that have developed a strong contract manufacturing base is that China itself is a large and attractive market which creates great incentive for the Chinese firms to pursue the domestic market directly. The Chinese domestic market is large enough to provide an extraordinary base for companies in the consumer market to leverage that base into a leading global competitive position. Haier is clearly doing this in consumer electronics, and Huawei is doing this in telecommunications. The acquisition of IBM's PC business by Lenovo is an excellent example of a Chinese manufacturing powerhouse now extending its brand reach overseas. This is just the tip of the iceberg.

In addition, there have been major investments by leading U.S. and European companies in China, focused not on local R&D specific to the Chinese market, but rather global R&D. Philips Electronics will have 1,300 R&D staff in China by the end of 2006. General Electric will have 1,200 global R&D engineers in China by the end of 2006 and another 1,000 by 2008. Dow Chemical has launched a 2,500 person global R&D facility in the Shanghai area for completion in 2007. In total, over 700 foreign R&D facilities exist today in China, funded primarily by the U.S., Japan, Europe, and Taiwan. These R&D centers will employ over 500,000 researchers and engineers when fully operational.

So to recap thus far, you have the following ingredients in China to foster innovation:

a. A strong history of technical innovation.
b. Excellent educational infrastructure with a heavy emphasis on technical skills (as an anecdote, Bill Gates of Microsoft will say that if you want to find the smartest people in Microsoft you have to visit Microsoft's Beijing research center).
c. A strong base of companies that grew up in a brutally competitive cost-driven market.
d. Huge financial incentives to expand in the value chain to brand from design and manufacturing.
e. Many technologies becoming more standards-based enabling greater innovation off that base and rewarding rapid time to market.
f. A domestic market that is fast growing and wealthy enough to create and sustain world class companies.
g. Chinese companies being accepted as "brands" in the technology markets worldwide.

It is worth commenting further on education and its impact on China's increasing competitiveness. There is no end of articles detailing the high percentage of Chinese and Indian students in technical studies in U.S. universities. Many of the leading U.S. companies today would be lost without the foreign students that came to the U.S. to study and then stayed to start careers and seek their fortunes. For the first time the U.S. has real competition in being the most attractive market for those graduates to pursue their dreams. This is a profound change in how the best and the brightest graduates of the U.S. university system see their futures.

More important is the impact of the sheer numbers of talented, highly trained technical graduates leaving Chinese universities. In 2005, China will graduate over 325,000 engineers, roughly five times the number in the U.S. There are currently more than twice as many researchers in Chinese national laboratories as in the U.S. equivalent institutions.

But the educational advantages that China is leveraging are not only in the technical areas. China today has over two hundred and fifty million people paying to take English-as-a-second-language coursework, a number that is expected to grow to three hundred and fifty million people by 2008. Every Chinese student studies English from first grade through high school. It is somewhat ironic that there will be far more English-speaking people in China than in the U.S. within several years.

A comprehensive discussion on the ills of the U.S. education infrastructure is beyond the scope of this paper. However, it must be recognized that without addressing how we educate our children in the U.S. that our global competitiveness will inevitably decline, and far more rapidly than we would like to believe.

The Final Catalyst—Access to Venture Capital

There has been a great deal written about the Chinese culture and its tolerance for risk and failure, attributes that have been lauded consistently in the U.S. for the past 50 years. The U.S. has certainly benefited from this in the technology area, as initially there was no particular reason why so many breakthrough technologies were created in the U.S. instead of in Europe. However, the great flexibility of the U.S. markets, and their tolerance for risk were unique and really stood apart on the world stage. Other countries that offered this tolerance of risk such as Singapore, Taiwan, and Israel, were simply too small to have a major impact on the world's technology markets, with relatively few exceptions (such as foundries in Taiwan such as UMC, TSMC).

China is different. It is a very large country with vast intellectual resources and a middle class that by some estimates now totals over 100 million Chinese families which places it second only to the U.S. In addition, the impact of the overseas Chinese populations ability to provide capital, jobs, and inspiration, cannot be overestimated. The educational infrastructure that has been created in the last 30 years alone is impressive. Nearly 1.2 million Chinese students applied in 2004 to take the national examination for graduate programs in China. It is estimated that over 200,000 graduate students will complete their coursework this year in China's universities.

The supply of intellectual capital combined with a huge and growing domestic market makes for an intoxicating mix. With the entry to WTO, China has also been making significant improvements to its financial markets and accounting transparency, which is enabling the final major ingredient to an explosion of innovation to come into China—Risk Capital.

Risk Capital, or Venture Capital, has been one of the U.S.'s secret weapons for several decades. Other countries have tried to create incentives for a similar capital structure, focused on the "cult of the entrepreneur" to flourish, but with very few exceptions, this has failed. It will not fail in China.

Total Venture Capital raised for investment in China will exceed $2B in 2005 representing approximately 10% of the total amount of venture capital expected to be raised this year. This does not include the additional $5 to $10 billion being raised to invest in buyout funds and other forms of private equity in China. This also doesn't include the very robust amount of capital from overseas Chinese that is being transferred back into investments in China. The Venture Capital dollars will continue to increase for the next few years. To put these numbers in context, in 1995, the total Venture Capital raised for investments in U.S. companies in the technology area was approximately $10B. We expect to see the investment level of venture capital funds for China reach 1995 U.S. levels within 10 years. Venture Capital has funded many of the innovative technologies that we take for granted today. Intel, Cisco, Apple, Microsoft, Oracle, PeopleSoft, Juniper, Qualcomm, Yahoo, Google, AOL, Verisign, Network Appliance, and Broadcom would not exist without venture capital financing. The external source of capital and the internal granting of ownership through stock options in these companies is what have attracted the best and brightest in U.S. industry to the technology sector during the past 30 years.

This money is now being targeted toward creating the next generation of great Chinese companies, using U.S. pension and endowment dollars. Over 300 U.S. venture capitalists visited China in 2004, and over 100 investments have been made by U.S. venture firms in Chinese companies (mostly through offshore entities) in the last two years. The "China story" has been well accepted by the U.S. capital markets with 20% of the NASDAQ IPOs last year being Chinese companies. However, now many Chinese companies are considering initial listings on the Hong Kong or Shanghai Stock Exchanges. This is another area that is beyond the scope of this paper to thoroughly discuss, but there are significant implications for the U.S. capital markets should a credible alternative to the NYSE and NASDAQ emerge in China.

This does not mean to imply that it is either easy to raise money to invest in China at this time, or to successfully deploy the capital into local Chinese companies. What the capital flows do reflect is a growing appreciation for China's ability to innovate at a global level and increasing comfort with both the financial risk in the market and the execution risk of the business. The financial risk is being mitigated by the efforts of the Chinese government, and the execution risk by the large number of Chinese returning from overseas to either start companies or join the management of existing Chinese companies. This now numbers in the thousands of highly experienced Chinese executives each year.

It is my opinion that China must be encouraged to continue to make reforms and move toward being a full member in word and action of the global technology market. We have to acknowledge that given the size of the domestic Chinese market that they will want to have a say in establishing standards for that market. We should expect this and simultaneously encourage their participation in standards bodies around the world. We can also expect over time for the Chinese to have greater appreciation and adherence to intellectual property laws as they begin to create their own proprietary intellectual property and their local entrepreneurs push the government to enforce the laws.

In summary, China sits at the first table of the world's innovators today. The combination of the market opportunity, the education system and extremely talented and well-trained workforce, and the emerging access to virtually unlimited venture capital and private equity dollars, guarantees that China will become a major innovative force in the global economy.

Thank you again for the opportunity to present to this panel.

Chairman D'AMATO. Thank you very much, Mr. Rieschel.
Mr. Everett.

STATEMENT OF G. CARL EVERETT
PARTNER, ACCEL PARTNERS, PALO ALTO, CALIFORNIA

Mr. EVERETT. Mr. Chairman, Members of the Commission, I'm pleased to submit my response to the four questions asked by the Commission. I really appreciate the opportunity to comment on this important topic here today. It's an honor to appear before you with my fellow panelist here.

The first question was: What role does foreign investment, particularly venture capital, play in the expansion of advanced technology research and development in China? What technology sectors are garnering the most private capital?

Last year venture capital investment and investors outside China kicked in nearly $1.3 billion into 253 Chinese companies, according to a report by Zero2IPO, a Beijing-based data service that is focused on the venture capital industry in China.

I've included a copy of their survey with my testimony today.

The funds invested rose 28 percent in 2003, and the number of deals surged 43 percent. Semiconductor investments attracted one-third of the dollars, and the leading city by a wide margin was Shanghai. To date, China has contributed very little in terms of advanced R&D breakthroughs. There simply are not many, if any, new technologies that can claim their genesis in China. In semiconductors, networking, and computing technology China has been expert in cost down and mass volume production of existing products, enabling lower price points and market expansions.

An example of a new product from an advanced research product would be IBM's recent announcement of the CELL processor, a multicore microprocessor aimed at the consumer space. The home of the IBM project is Austin, Texas. I would also note that for the last 12 years, since 1993, IBM Corporation, a worldwide R&D development activity, has led the U.S. in patent filings and all countries in the number of patents filed at the U.S. Patent Office.

There was an interesting article recently in the *New York Times* about IBM's new intellectual property strategy, which I would reference to you for further information. China has yet to produce such an event, and there's no doubt that China will play a key role in delivering mass volumes of the CELL-based computers to the world marketplace.

Private venture capital and corporate investment in design and development activities in China lend important support to directing the vast resources available toward creating new and larger markets for knowledge-intensive products. The intellectual resources available in the world to work on information-processing products are in an oversupply status. A short 20 years ago Silicon Valley leaders regularly opined that there was a permanent shortage of electrical engineers to do the work necessary to advance the computing industry. It should be no surprise that someone listened and responded to the call.

This new generation of Chinese engineering talent will use the crucible of "cost down" and high-volume manufacturing as their training ground to hone skills that will enable China to contribute breakthrough product advances in the future. We have to have the confidence that the overcapacity can be soaked up by larger world markets. We have only history to reference in support of the markets materializing. However, I can assure you anyone in our industry during 1985 who would have dared forecast a PC market approaching 200 million units in 2005 of a semiconductor market valued at 200 billion this year would have been dispatched to run a factory in Milpitas.

The next big bet is China will step up to become a U.S.-caliber marketplace for knowledge-intensive consumer and business products.

The second question was: To what degree is the Chinese government directly involved in technology ventures. Well, rather than to just look for a dollar amount invested by the Chinese government, my opinion is the direct aid to technical ventures by China is amplified by enabling investments in kind to help bootstrap a new venture.

Examples of investments of kind I'm referring to are:

Free office and factory space in the regional science parks and technology development areas located in the various provinces;

Providing priority access to university professors and the ability to recruit top-notch students into particular projects;

Preferential access to state-controlled telecom marketplace providers, is also readily available;

Finally, another example is interest-free loans with no term and unsecured that are being granted to support strategic projects in China.

These attributes go hand in hand with low cost for employees to make a very competitive company. In many ways investments in kind deserve more credit to the success of a company than just the absolute dollars plowed into the treasury of a company. This soft dollar resource infusion helps ensure a return on the hard dollars invested.

The third question was: What role does venture capital play in the growing trend of multinational start-ups in China?

The venture industry adds its own value to the China effort. In addition to bringing capital, each firm brings its own particular value-add to a project. This is important in the multinational marketplace that our companies compete in. Since R&D capital is not the resource in short supply today, it comes down to the people, contacts, and the building of the investor-entrepreneur trust relationship during the investment process the development of a company that makes a difference in value creation. Because of this reality, China will also make the venture industry more competitive over time. The good venture capitalists must also make investments in kind, not just capital.

The fourth and final question was: What are the trends with regard to return on investment for venture capital investments in Chinese technology sectors? And what is the degree of risk of such ventures?

I expect the returns will be good where investments are leveraging Chinese capabilities. Early results are already visible at SMIC, for example. SMIC quickly became the number three wafer foundry company in the world with advanced technology in wafer costs projected lower than what we see from the traditional foundry leaders in Taiwan. SMIC created the largest share value at IPO for a 2004 offering by a factor of 6X at over $600 million and, therefore, presented the opportunity for venture returns.

In addition to all the traditional risk of a new venture, China presents many additional risks and operating challenges of its own. The first risk is the first rule. The government can change the rules suddenly and without recourse. China is a communist country. Even Sarbanes-Oxley does not wield such a return changing force as being on the wrong side of a public policy shift in China. Respect for this reality is a front-of-mind issue when investing in any particular sector. What will the government position be? What will their position be during the life of the investment?

It is also very important to achieve transparency on the structure and the financial hygiene of the venture. Setting in place excellent operating people and controls from the start is key to achieving a return on any investment in China.

And, finally, until intellectual property respect becomes a value important to the China technology community as well as the Chinese government, the current environment is an extreme risk to building knowledge-intensive products that are unique and defensible.

Thank you.

[The statement follows:]

Prepared Statement of G. Carl Everett
Partner, Accel Partners, Palo Alto, California

Mr. Chairman, I am pleased to submit my response to the questions asked by the Commission. I appreciate the opportunity to comment on this important topic. It is an honor to appear before you as a panelist.

1. What role is foreign investment, particularly venture capital, playing in the expansion of advanced technology research and development in China? What technology sectors are garnering the most private capital?

Last year venture capital investors outside China kicked in nearly $1.3 billion into 253 Chinese companies according to a report by Zero2IPO, a Beijing based data service focused upon venture capital in China. The funds invested rose 28% from 2003, while the number of deals surged 43%. Semiconductor investments attracted one-third of the dollars and the leading city by a wide margin was Shanghai.

To date China has contributed very little in terms of advanced R&D breakthroughs. There simply are not many of any new technologies that can claim their genesis as China. In semiconductors, networking and computing technology China has been expert in "cost down" and mass volume production of existing products enabling lower price points and market expansion. An example of a new product from an advanced research project would be IBM's announcement of the CELL processor, a multicore microprocessor aimed at the consumer space. The home of the IBM project is Austin, TX. China has yet to produce such an event however there is no doubt China will play a key role in delivering mass volume of CELL based computers to the world market.

Private venture capital and corporate investment in design and development activities in China lend important support to directing the vast resources available toward creating new and larger markets for knowledge intensive products. The intellectual resources available in the world to work on information processing products are in over supply status. A short 20 years ago Silicon Valley leaders regularly opined there was a permanent shortage of electrical engineers to do the work necessary to advance the computing industry. It should be no surprise that someone listened and responded to the call. The new generation of Chinese engineering talent will use the crucible of "cost down" and high volume manufacturing as their training ground to hone skills that will enable China to contribute breakthrough product advances in the future. We have to have the confidence that the overcapacity can be soaked up by larger world markets. We have only history to reference in support of the markets materializing; however I can assure you anyone in our industry during 1985 who would have dared to forecast a PC market approaching 200 million units in 2005 or a semiconductor market valued at $200 billion this year would have been dispatched to run a factory in Milpitas. The next big bet is China will step up to become a U.S. caliber marketplace for knowledge intensive consumer and business products.

2. To what degree is the Chinese government directly involved in technology ventures?

Rather than just look for a dollar amount invested by the Chinese government, my opinion is the direct aid to technology ventures by China is amplified by enabling investments in kind to help bootstrap a new venture. Examples of investments in kind are:

Free office and factory space in the regional science and technology parks located in the provinces.
Priority access to university professors and the ability to recruit top notch students into a project.
Preferential access to the state controlled telecom marketplace providers.
Interest free loans with no term and unsecured are being granted to support strategic projects.

These attributes go hand in hand with low cost for employees to make a very competitive company. In many ways investments in kind deserve more credit to the success of a company than just the absolute dollars plowed into the treasury. The soft dollar resource infusion help insure a return on the hard dollars invested.

3. What role does venture capital play in the growing trend of multinational start-ups in China?

The venture industry adds its own value to the China effort. In addition to bringing capital each firm brings its own particular value add to a project. This is important in the multinational marketplace our companies compete in. Since raw capital is not the resource in short supply today it comes down to the people contacts and the building of the investor entrepreneur trust relationship during the development of a company that makes a difference in value creation. Because of this reality China will also make the venture industry more competitive over time. The good venture capitalist must also make investments in kind, not just capital.

4. What are the trends with regard to return on investment for venture capital investments in Chinese technology sectors? What is the degree of risk of such ventures?

I expect returns will be good where investments are leveraging China's capabilities. Early results are already visible at SMIC. For example, SMIC quickly became the number 3 wafer foundry company in the world with advanced technology and wafer cost projected lower than what we see from the traditional leaders in Taiwan. SMIC created the largest share value at IPO for a 2004 offering by a factor of 6X and therefore presented the opportunity for venture returns.

In addition to all the traditional risk of a new venture China presents many additional risks and operating challenges of its own. The first risk is the first rule. The government can change the rules suddenly and without recourse. China is a communist country; even Sarbanes Oxley does not wield such a return changing force as being on the wrong side of a public policy shift in China. Respect for this reality is a front of mind issue when investing in any particular sector. What will the government position be? What will their position be during the life of the investment? It is very important to achieve transparency on the structure and the financial hygiene of the venture. Setting in place excellent operating people and controls from the start is key to achieving a return on the investment. Finally until intellectual property respect becomes a value important to the China technology community and the Chinese government the current environment is an extreme risk to building knowledge intensive products that are unique and defensible.

Panel I: Discussion, Questions and Answers

Chairman D'AMATO. Thank you very much, Mr. Everett.

Now we'll open up to Q&A, and try to limit your questions to five minutes for the Q&A.

Commissioner Reinsch.

Commissioner REINSCH. I have two questions.

I think Mr. Rieschel's testimony, in particular, was interesting because he essentially said in looking at this maybe we ought to follow the money. And you're suggesting that venture capital money is going to China and not because they perceive the development of me-too products, as you put it, but they see it becoming an innovation center.

The first question is: Do the rest of you agree with that? Not with respect to the money. Do the rest of you agree that China is going to within some medium term timeframe become an innovation center of its own?

George is shaking his head yes. Anybody want to comment? Mr. Morgan is shaking his head maybe yes.

Mr. MORGAN. I think kind of the bottom line is, is that you're rapidly moving to where you can do almost anything that you do elsewhere in China in terms of the level of capability. It's not exact, but in limited quantities you can get almost anything done effectively there.

Commissioner REINSCH. Okay. George.

Mr. SCALISE. I think there is another point to this that is very, very unique. And I have established a lot of operations around the world. And typically you would establish it with anywhere from two to five ex-patriots coming in to help get it established and then use local talent.

Some of the investments in China, to get them off the ground, have had as many as 25 percent of their employees that have been trained, worked here in the U.S. by and large; some of them came from Europe and some from Taiwan, other places. But the number of ex-patriots in one company I know, I've seen them talk with the manager, they have 3,000 employees, 700 of them are ex-patriots, which is phenomenal.

So when you talk about how quickly they can come up the learning curve and become leading-edge innovators, in large part it's because of this. Now I don't minimize for the moment the indigenous capability that's evolving. It's going to become very good, but a lot of that capability is because of the ex-patriots that have gone over with this great reservoir of understanding that helps to make that happen.

Commissioner REINSCH. Okay. Let me ask the second question before my time is up, because it's related to this. And that is for those of you that were here early enough to have heard Dr. Perry this morning. He made a distinction between basic research and essentially R&D on product development.

I think from the D.C. point of view you were really focusing on the latter rather than the former, which is what investors would do. But Dr. Perry's other point was, at least as far as the United States was concerned: Don't look at companies to be the source of basic fundamental research, but look to the government, in this case, primarily the Defense Department to provide that foundation on which companies will then build.

From the Commission's point of view, from a national security point of view, that's sort of a very important issue. If the Chinese become the world's leader in cell phone manufacture, that's one thing, which may or may not be a good thing. But if they become an innovation leader in fundamental research that leads them to a whole set of defense innovations, that raises a whole set of other implications.

My assumption has been, and maybe—correct me if I'm wrong—that's part one, is that if there's going to be a groundswell, if you will, of basic research in China, that too may be led by the government or by government-sponsored think tanks, the Academy of Science, whatever it is, as opposed to companies. So one part of the question is: Is that right?

But second, more important: Is it likely that the Chinese government is going to be smart enough to figure that out and undertake to spend a significant part of its resources to do that kind of thing or not?

Mr. EVERETT. I think there's a good likelihood it's well underway today in the government, to focus on the research efforts. My sense is there's a careful balance between research and development that's important from a political and economic standpoint in China. From a development standpoint, the product development engine, there's a cost-down structure that's there, is a very important contributor to employment of the Chinese people, which is a political issue. They want to maintain a low unemployment rate, which would be very desirable. And there are all kinds of economic structure that's put in place in support of that, the tying of the R&D to the dollar, and so forth, that you can go look at. Those are development-oriented activities.

On the other hand, the university system is well cultivated, well financed, well funded, well directed by the Chinese government in a very efficient and focused area. And they're putting in those capabilities. So I think they have probably broke the code, if you will, on what they need to do to run both development-oriented activity and a research-oriented activity.

Commissioner REINSCH. Mr. Rieschel.

Mr. RIESCHEL. If I could comment in one particular area that has been an area of focus for me for the last couple years. In the area of energy there's probably 30 fuel cell projects right now in the Chinese national universities and labs.

And I know of about 50 solar and other energy-related projects. And they're really at fundamental levels of research. These are not product-oriented. These are really fundamentally improving underlying material science for the energy market, which makes sense, given China's somewhat insatiable demand for electricity and other sources of energy, but that area is absolutely one where I haven't seen quite the same level yet in the U.S. educational infrastructure that I've actually seen in China.

Commissioner REINSCH. Mr. Wong.

Mr. WONG. Yes, I'd like to add also that there's a crossover point between product development and basic research, particularly when you're looking at something like semiconductors. If you're meeting or exceeding Moore's Law, you're coming very close to doing something dramatic in terms of research when you're just trying to develop the next generation product to remain competitive with your competitors. And that really ups the capability of semiconductors. It also ups the capability that it offers for doing something like nuclear modeling or something like that, as you well know.

So I do think that they are innovators in the sense that, as they develop products that are at the high end, they're necessarily going to be getting closer to the cutting edge of research and development.

Plus I would say that I've noticed, when we've been out there, that the government and the technology parks are really making an effort to create what they call incubation spaces for small innovative Chinese technology companies—where these guys are renting time on design tools so they don't have to invest in them themselves, trying to get them to ramp up and be very innovative and entrepreneurial. So I think that everything is going on—State-sponsored big projects as well as little projects.

Commissioner REINSCH. Thank you.

Chairman D'AMATO. Thank you. I have two quick questions.

Mr. Rieschel, mentioning alternative energy sources, do you notice Chinese venture capital—I'm not talking about American venture capitalists, but Chinese venture capitalists—going into things like alternative energy investments and research?

Mr. RIESCHEL. Yes.

Chairman D'AMATO. You do?

Mr. RIESCHEL. And there are two primary sources. There is a great deal of informal venture capital there that's—we would call it here "angel money."

Chairman D'AMATO. Yes.

Mr. RIESCHEL. And there it's primarily the large family institutions that literally have hundreds of millions of dollars of assets. And those groups have been quite aggressive in starting the seed financing of a number of these projects. And there's also a great deal of Taiwanese money that is now not really investing that much in Taiwan but is really moving into the mainland from an investment perspective quite aggressively. So I think there is quite a bit of capital there.

Chairman D'AMATO. You're citing about $2 billion in U.S. venture capital going in this last year. How would you compare the macro? Is there a way that you could have a feel?

Mr. RIESCHEL. It's much larger than what the institutional venture capital investments have been, but I can't give you a calibration on whether it's twice as large or five times as large.

Chairman D'AMATO. Thank you.

Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thank you, Mr. Chairman. And thank you to all of our panelists. This is very interesting. It's always useful for us to hear from and talk to people who are actually doing things on the ground. We get a better understanding of the complete picture.

I keep thinking about the tail-chasing metaphor that Secretary Perry used this morning. I'm not sure if you all heard, but it's apt, but it also talks about the world in a particular way. And I wonder whether the world exists that way anymore.

In other words, if you are chasing some other dog's tail in front of you but, as Mr. Everett said, that there's a government, for example, that can change the rules at once. So if you end up leashed in a way, the person who's chasing after you can get to you sooner or the rules of the road might not be what they have always been before. I think that's one of the things we're always trying to understand in terms of dealing with the Chinese government. Are they playing by the rules, want to comply, all of these issues.

In that context I'm really trying to understand the issue about the training of foreign students here. If we acknowledge that part of our competitive edge has come from our universities, and I'll stipulate by saying that I believe in the free flow of ideas, and the free flow of people is very important to the free flow of ideas. But how is it in our U.S. national interest, not so much the interest of your individual companies or your individual sectors, if we are bringing the best and brightest from other countries here and training them, and then they're going back home to work competitively with the companies that we have here for American workers; how does that ultimately advance our economic interests and our national security interests? I'm just having a little bit of trouble understanding that.

Mr. SCALISE. Well, let me just take a cut at that.

First of all, one of the recommendations we have is that we staple a green card to every advanced degree in science and technology that comes out of our universities and give those students the opportunity to become a citizen now.

Commissioner BARTHOLOMEW. That's right.

Mr. SCALISE. Yes. And I think it's a very good idea, but beyond that we have always had a very open attitude. As I say, we fund a lot of research. We have no requirements with regard to those students, where they go to work. The challenge is for our people, our companies to work as mentors, be a part of those university research efforts, and to make it attractive for those young people to come here. We get about 70 to 75 percent of those students to come into our companies. The other 25 have other ideas, and that's fine.

So I think it's a good idea to have that free flow of students coming in. And we should get our share, more than our share, if we just do the right things to engage with them as they're going through the programs and make it attractive for them to come and work with us.

Commissioner BARTHOLOMEW. Mr. Scalise, just a question on that. When you say 75 percent of the people come into your companies, are these people who are based here in the United States doing work of American companies? As U.S. companies become more multinational, and that is what it is, again, you have a set of looking after the interests of your companies, but there are people who need to be looking at what are the economic interests of American workers and what is happening here in the United States.

Mr. SCALISE. No. We have over 75 percent of our employees here in the U.S., even though 70 to 75 percent of our sales are outside the U.S. The vast majority of our employees, and especially the high-technology folks, the ones we're talking about here, are based here in the U.S.

Now some of them are overseas, and there are things happening where we're developing more of that activity, but it's by and large here. We think it will stay here as long as we have the leading-edge technology being developed at our universities and those students coming out of our universities want to stay here and work. We can be competitive, as I pointed out earlier. That's not an issue.

Commissioner BARTHOLOMEW. Mr. Morgan.

Mr. MORGAN. Can I just add one thing? I think I agree with everything that George said. I think it goes back to the key point, and I think even Bill made it, too, this morning, is the investment climate in the U.S. has to be attractive, because if they come here to get the education, they stay here because there's good opportunities here. But as we discourage opportunities in the U.S., then they got better opportunities elsewhere in the world. And so they go back to those places, whereas they would stay. So the thing I think that we have to focus on as far as staying ahead is our investment climate.

Commissioner BARTHOLOMEW. And I'd note, of course, that Secretary Perry was talking about how having the foreign students here makes our own students more competitive because they have to work harder to keep up.

Mr. Everett, did you have a comment?

Mr. EVERETT. Yes. I strongly believe we should never waste a mind. And I think by embracing the concepts that Mr. Scalise is talking about here and providing opportunities and the government stepping up and making the investments in kind to keep American companies or Americans fully employed in new technology ventures is probably the right thing to do here.

It's immaterial in my opinion where the intellectual talents comes from as long as it's deployed toward growing the marketplace for knowledge-intensive products.

Commissioner BARTHOLOMEW. Mr. Wong.

Mr. WONG. Yes, one thing that I wanted to add was that I agree with what George said about creating a good environment here in the U.S. for keeping businesses here. But at the same time I think there is a perception on the part of companies still that they cut costs in terms of labor by going overseas, even at the high end. I mean I have to hear this all day long—that we can hire three heads for every one that we hire in Silicon Valley.

So with respect to your question, I think one of the ironic things is that we now often see people encouraging U.S.-trained students and engineers to go back and start offshore operations. So we're actually encouraging them to go back to their countries, and there's no guarantee we're going to retain them more than a year, or two years, or whatnot.

Commissioner BARTHOLOMEW. Thanks.

Mr. Chairman, just one comment and that is, of course, here we are in the home of all of this technology. Although we're not really talking about nanotechnology very much or biotechnology, I think we also need to visit the implications of some of the social restrictions that are being put on technology and what that means for future innovation here. Thanks.

Chairman D'AMATO. Thank you.

Commissioner Dreyer.

Commissioner DREYER. I was interested in what Secretary Perry had to say about not being particularly concerned because the Chinese intellectual climate does not favor technological innovation. I seem to hear you all saying something different. Is that correct? I see you nodding collectively.

It occurred to me that Secretary Perry is assuming that the climate at the top, which he correctly characterizes, also characterizes the climate at the bottom. I think that's where I would disagree with him. The Chinese have a saying that heaven is high and the emperor is far away, meaning that at ground level one can do what one wants, so long as the emperor is unlikely to find out.

It seems to me that I see a good deal of technological innovation happening at the lower level. So far, I see three people nodding and two people not saying—do you want to expand on this?

Mr. EVERETT. Yes. I'll make a comment on that. I do believe that there's a pattern to recognize here, and it's probably really apparent in the semiconductor industry. If you'd roll it back to the late '70s or mid '70s, a lot of people came here on visas, got educated, and learned the business. One of the more prominent examples was Morris Chang who spent a considerable amount of time at Texas Instruments and went on to found TSMC.

Commissioner DREYER. But he's Taiwanese.

Mr. EVERETT. He's Taiwanese. But I would just want to point to a pattern here of how things develop and how I project things may develop in China in the future. So it takes a period of time for this knowledge to accumulate, be transferred, taken back, and planted in an industry to bloom.

So my prediction, and it's simply that, is in the future China will provide a substantial amount of innovation to our industry because they are being trained today, okay, just as the Taiwanese were trained in the '70s and went back. So I think this is the process and a pattern to recognize. It's also been healthy for our industry and our business because it's enabled huge markets for goods and services and been a great deployment of the intellectual talent those people were born with.

Mr. SCALISE. One comment that I think is relevant to this: If we continue to fund the university research programs at the levels we are today, we will begin to lose ground relative to our competitor universities across the world, and especially those in China that are becoming aggressive to become good research universities.

However, if we address that issue, get back to where we were 25, 35 years ago and fund at the levels we must to maintain robust research at our universities—and, incidentally, the way we see that today, we are not going to create a new Bell Labs or a new Xerox Park. What we are doing now and the way we're working it, as I say, we fund about $80 million of research at universities, we're doing it through a consortia arrangement and it's a virtual research laboratory. We have five of these across the country: One at Berkeley, one at UCLA, Carnegie-Mellon, Georgia Tech, and MIT. But we also engage another 35 universities as a part of that consortia to do basic research. We're funding basic research here.

As long as we do that we will still attract a very large percentage of the very bright students from outside the U.S. and many of those will want to stay here. And I think we ought to continue to focus on that: Fund the research at the universities; make sure we're at the leading edge so if there is something that attracts these young people, why they want to come here as opposed University A, B, and C in some other part of the world; and then we'll get our share of them here if we have the right investment policies and programs that make it a viable opportunity to run a business here.

Mr. RIESCHEL. If I could have one comment. I think there's an interesting example of how and why you need to separate the ideology and the value system that people appreciate. So I think Mr. Scalise's comments on people coming here and getting an education having the ability to stay here, even if they choose not here, is absolutely—is absolutely huge.

If you look at the fact that my family's currently living in the Shanghai area, there's 700,000 Taiwanese nationals living in Shanghai in one metropolitan area. They're not there because they embrace the culture and value system of the Chinese government. They're there because they can make money.

And so, as these students come here, if they don't have the incentive and if we aren't allowed to structure the companies in such a way to provide the incentives, to keep the best and the brightest people that come out of our educational system here, they will go someplace to start that career. And that's just fundamentally, fundamentally at the very basis, I think, of everything that we have to do.

Chairman D'AMATO. Mr. Wong.

Mr. WONG. Well, one thing that I've been struck by is that we seem to be giving a lot of credit here and making assumptions that everything's always aboveboard. I don't profess to have any particular great secret knowledge here, but I mean one thing we need to keep in mind is that not everyone's happy about the way things have gone.

For instance, we laud the fact that the Shanghai foundry industry has come up so quickly, maybe not up to the best wafer fab technology they can do in Taiwan or at IBM, but very quickly, within a year's time. But at the same time TSMC last year sued SMIC because they alleged that they stole all their trade secrets, and that's how you could do it in a year. They didn't win, but they settled it for $175 million. So there are some very interesting pleadings in that case that are publicly available, and I would recommend that people look at those, because it's certainly something that, whatever the truth is there, you need to be aware of when you're a U.S. company and you're going overseas, not only with your own operations but also in terms of who you're partnering with.

Chairman D'AMATO. Yes.

Mr. MORGAN. I want to add a point. I think it's very important that our ambassador and consul capabilities in a place like China be quite strong, and we have some good people there. I'm not sure we have enough of them and enough of a charter, but I found in Japan, let's take as a example in the '80s when there was a lot of issues, intellectual property, getting squeezed out, different things. The government people there, by their ability to communicate with their government people, you don't want to go court in Japan nor do you want to go to court in China, but you can get a lot accomplished if your government understands your challenges and the issues that you have and can weigh in with you, so it's important to have good people involved in these things, and it helps a lot. I don't want to underestimate how helpful that is.

Chairman D'AMATO. Thank you. I have two quick questions.

Mr. Rieschel, this whole question of IPR theft, doesn't that put a chilling effect on some of the activities of venture capitalists that are worried about going in there and, Wild West, and you come out with nothing and somebody else owns your stuff? Isn't that a big factor and a chilling effect, or is it not?

Mr. RIESCHEL. I think it is and so you don't invest in areas where that's easily accomplished. I don't think we would be making any investments in the package software business in China, whereas you would invest in a software company where the software is hosted on the cellular infrastructure and it's an application that people are buying and selling through the cell phone; because then what you have to do is you—there's no package to actually replicate. There's nothing to steal. It also puts you on the wrong side of trying to steal from China Telecom, China Unicom, and China Mobile, who the government's far more likely to be supportive of.

And so I think you have to pick the areas that you're going to invest in. If it's a product—software, in particular, has been a challenge. The more complex the software the less theft. But at the same time, the more complex the software the less successful it's been in the market. That is not at all been a successful market for large complex applications over the last 20 years or so.

Chairman D'AMATO. Thank you.

And I have another question on the question of deterrent and chilling effects. There are some people who argue that essentially what Mr. Wong calls the Chinese government or Chinese are master of the game of attracting foreign investment, but once you're in there you have this very nationalistic government which has certain very—they're very centrally directed toward building a strong China and building strong Chinese industries.

Now you've been in there 20 years. So I think it would be interesting to hear your perception of to what extent you can survive in China despite the fact that the Chinese obviously want to train and build their own domestic industries with the technologies that you're bringing in. How do you cope with that?

Mr. MORGAN. Well, you know a lot of that was also true in Japan. I was a venture capitalist at one time and had a very small company in the '70s that grew quite a bit over the years. You know one of the problems with intellectual property was right here in the Valley. Now you do have a court of law that can help you in that sense, but you didn't have that in Japan.

But you have to take a really proactive stance to protect your technology. That just has to be a strategy from the beginning. There's going to be some leakage. You have to assume that. So you pick and choose your fights.

You use all your resources and the resources are potential legal characteristics where most of these markets aren't for—a lot of products are global markets nowadays, so you can sometimes protect yourself in another marketplace because they have to go outside to build their business. PR, I mean the ability to have bad publicity is not a good thing for a lot of these companies trying to get started there.

The third thing is the government. In other words, your government is there asking questions, concerned about this sort of thing. In a lot of cases their government will respond. Now they'll drag their feet and they'll do all the sort of normal things that people do to do what they continue to do, what they want to do. But if you really have your focus on it and they know that, then they're going to work—they'll help more or they'll help solve some of those problems.

So I think it's just a major part of your whole strategic and tactical day-in and day-out effort to protect your property.

Chairman D'AMATO. Thank you.

Commissioner Mulloy.

Cochair MULLOY. I want to thank you all for taking time to be here today. Mr. Wong, I particularly enjoyed reading your testimony, which I found very interesting. S one who began his own career in the Foreign Service, I welcomed your insights very much.

Mr. Scalise, you say in your testimony that it's not in our national interest to try to compete as a low-cost supplier because then there aren't high-paying jobs for our people, right? Our goal must be to create high-wage jobs here, which can only be achieved with higher productivity, and products that command a premium in the marketplace. But what worries me from what I'm hearing here and from other testimony, the Chinese have a clear sense of national mission of what they're about in building this high-tech strategy. I don't see any vision in the United States about what we're doing.

Mr. Wong tells me you can hire three R&D people in China for what you can get here. I'm told that some of our own American-born students are less inclined to go into these fields because they sense that, too, that this is moving, and that why should they go into a profession that may be moving. Yet it's essential for us that we have our own students get into this field.

We had testimony last year that the Chinese offer incentives to bring the Chinese-trained students that we have trained and brought up and invested in, taxpayer money invested in, give them a good education, the Chinese government is offering them real incentives to bring them back to China.

So when you look at all of that you begin to say, we've got to bring more and more foreign students in and educate them. I was here in the 1950s when Sputnik went up and we put a lot of money and we had American students who learned science and math and could do it. Is there something inherently wrong with our own students, or is it that we don't give them the proper incentives? We're not telling our people what is really going on here and what's the inevitable conclusion if we stay on the road that we're presently on.

That's what I'm hearing and that's what I'm getting. I'm hearing the venture capitalists are now moving the money that might be invested here, hiring people here. It's now going there. With a $700 billion current account deficit, I say where is all this headed and what does it mean?

So I just throw that out for anybody who wants to make an observation.

Mr. SCALISE. Let me make a comment on that. First of all, when you go back and look at the period after the Second World War—remember, we were the last country standing.

Cochair MULLOY. Yes.

Mr. SCALISE. Everyone else was flat on their flat back trying to figure out where they were going to go next. We had a 15-year advantage on the rest of the world to get the technology into place, get our university research programs. We established the National Science Foundation. We did a lot of very visionary and creative things at that stage. And we've led that parade now for 50 years.

Today we have a number of competitors out there, and they're getting better. Their universities, their research universities are not up to our standards. There are probably some around the world that are close to being competitive, maybe even competitive, but when you look at the full complexion of the U.S. university research system, it's by far the best in the world.

As long as we maintain that and we maintain the student-flow through those universities and get our share of the students, wherever they come from in the world, it doesn't matter. We need the best and the brightest, wherever they come from. But then we have to have, as I said a few minutes ago, the investment policies here that allow those young people to then exercise that capability that they've taken from these universities, that knowledge that they have accrued and put it to work here as opposed to somewhere else where they're trying to make it more attractive.

That's why we focused on just one element of this thing today, and that is the manufacturing part of it, because when it comes to the research—our research is still the best. The innovative products we're coming out with, yes, there are competitors, but we still have, by and large, the best innovative products around. And we can maintain that as long as we keep that best and brightest coming through our university system.

So if this ecosystem that needs to be nurtured, you can't look at just a piece. We're not worried about how much we pay these very bright people, the payback is very, very high. Our average income here in the U.S. is $96,000 for each employee, and we have about 75 percent of our labor compensation here. We pay on average, yes, 25,000 or 26,000 overseas. So Alan's comment about three to one, that's true. But they are not necessarily quite the same engineer as this engineer we're talking about that's coming out of MIT and Stanford and a whole host of other great research universities. They're good.

As they come out of IIT in India in certain specific areas, they are exceptionally good. So it's not a one-in-zero here. It's a very complex set of issues. But when you look at it in its broadest context, we can be very, very competitive with very good jobs and all the second- and third-order effects that flow through that if we maintain leadership in these technologies that are evolving, no question.

Cochair MULLOY. Mr. Morgan, you're involved on the President's Export Council and in a science and technology program with the President?

Mr. MORGAN. No, just the Export Council, but I've been on the previous President's Trade and Export Commission and Semiconductor——

Cochair MULLOY. Do you sense, from your contacts around the Administration, that they understand what is really going on here in terms of China having a national vision?

Mr. MORGAN. Yes, frankly, I do. The problem is there are only a few people in any part of the government that has much of an appreciation, is one of the challenges. We had really an excellent trip with Secretary Evans last June and met with the top leaders there. Of course, I've watched this for 20 years, known closely some of the key people there. They just have an experience that we don't have.

Most of their political leaders have run cities. Many of them have run industrial operations. Now they're a communist kind of plan set, kind of mindset in the old days that's changing, but they understand what it takes to make an organization and a strategy work. It's not quite as political in that sense.

Where we have difficulty I think is we don't have enough people in the supporting areas throughout the government, particularly in the legislative side, to have spent time in these places and understand the issues. Most of them are pretty focused on their locale, and I think that's just the way it is. I've thought about how to change that. I've actually gone and spent dinners, offered to invite the staff and spend an evening with some of their staff, but you know most of them have other issues that they'd rather spend time on than China and Japan most days. So they're just ahead of us in that sense.

Cochair MULLOY. Thank you.

Chairman D'AMATO. Let's see. We have Commissioner Wortzel.

Commissioner WORTZEL. Gentlemen, thank you very much for being here and sharing your time with us.

Mr. Wong, I would like to draw you out, if I could, on a particular aspect. On page 2 of your testimony you talk about "the risks remaining high in an environment where encryption methods must be acceptable to the local authorities and the host government must be given the encryption keys" when you're dealing with software, and that creates particular risks.

As I look ahead, Professor Henry Rowen later today is going to talk to us about central government, ownership, and involvement in technology and technology development. He says and he's quoting someone—1950 to 1978, the Chinese Academy of Sciences owned all the technology, and since reforms, post 1978, 40,000 products were passed on to companies. By 1987 the Academy had spun out several dozen high-tech companies, including computer companies, Legend or Lenovo, and China Daheng, information technology. So we've got this situation where the central government is at a certain point really doing all the research and parsing out things to go into development, where it wants it to go for the reasons it wants.

Now supposedly this is all changed and there are private companies, foreign investment. But you seem to imply that there continues to be collusion between parts of the central government and local governments and private companies to actually gather technology and to bypass technology controls as part of this government effort. Is that what you're implying?

Mr. WONG. Well, I wouldn't say that I'm implying it as something that I know. It's something that I fear. With respect to encryption, what I am worried about is not software encryption, we're worried about our own information. When we want to be connected here, we want to have our server, all the data in it, encrypted and sent back to here or through our other servers somewhere else in the world.

Commissioner WORTZEL. A business practice.

Mr. WONG. Exactly. And this is what our information security people would want typically, whether we were in France or wherever. Well, here you would just use whatever you feel like, whatever system you feel is most secure. And, of course, you would feel that, as long as you have a high level of confidence in it, it's not vulnerable to attack by your competitors or by any authorities.

Well, there we were told that you could use certain methods and that you needed to give them the key to it. So my assumption is that anything you put in there they can have if they want, at least as far as the authorities go. So to what extent they do, I don't know, but it makes us concerned that you better be darned careful of what you put in there. And we are. Other companies are too.

There are companies where all the printers in a facility are in a locked room and only two people have the key. There are no USB ports. There are no disk drives to copy anything. In many cases, I mean you really just have to think—where am I going to locate the data? Are the people onsite there only going to be able to enter data, can they get data out, to what extent can they get data out?

As far as collusion goes, I don't have any hard facts. I've worked for the government before. I mean I've heard things. You've all heard things, I'm sure. But one thing I think is public knowledge is that we keep making a comparison between Japan and China. I think it's publicly known, although not that often talked about, that there are in excess of 2,000 front companies here in the United States that are either run by or affiliated with the PLA.

Those are companies that are trying to deal with, partner with U.S. companies, and get around export controls. My assumption would be that if you've got that many here in the U.S., that the level of involvement with companies in China would be higher. Which companies those would be, I don't know. Whether there's anything covert, I don't know. But our assumption is that it's a different environment here—if there's a venture-driven company and the government wants something, they're going to basically tell them to go away unless they invest in them.

But in China, if you're a company and the government comes to you and says, "We'd like some information either on your partner or on what you're doing," what do you say to them? Sure, it's an environment where I think more and more people are happy living good lives. They want to make money. They want to own nice cars, which they do in Shanghai obviously, but I don't think it's the kind of environment where you can say "no" to the government.

Chairman D'AMATO. Thank you.

Commissioner Robinson.

Vice Chairman ROBINSON. Thank you, Mr. Chairman.

Well, we're still trying to get a handle on that issue of the Chinese PLA or defense industrial base companies. We learned the hard way that if you ask the question the wrong way to our intelligence community, you get a very different type of answer.

In any event, we are impressed that some of the better known Chinese companies that have sustained remarkably large growth rates, such as Huawei, are to some of us on the Commission questionable. This is not just because of the nature of their activities with the military and intelligence services of China, which in some cases is a formidable one. It also involves their overseas activities, whether it's building a command-and-control and air defense system for Saddam Hussein or whether it's doing similar work on a communications network for the Taliban in Afghanistan.

In other words, we're alert as part of our mandate to look at some of the downside risks associated with firms like Huawei that are popular partners for some of America's largest telecommunications companies.

I was impressed by Commissioner Mulloy's intervention earlier. We are grappling with a big picture issue here and Mr. Scalise and Mr. Morgan have talked to this. We certainly buy the notion that we need to retain, in effect, our share of the brightest and best students moving through our advanced university research facilities.

And I think we're likewise impressed by the extent to which China is trying to foster an environment and an incentive system to recapture that talent and to ensure that it's, to the extent possible, retained by them.

I have at a visceral level the same kind of reservations that Commissioner Mulloy and others have along the lines of "What the hell's going on here?" In other words, this does not smack of fairness and an even playing field. China has a national program to do this.

The question posed to you, Mr. Morgan, was, do we have something comparable. Do we even have a national recognition of the problem, much less a set of our own incentives that compete head to head with a country like China to ensure that we retain this kind of talent, including the stapling of a green card on their diploma or something along those lines. I happen to think that's a good idea.

But what I'm really trying to get to here is that we're trying to fashion a set of recommendations for the Congress. I think one of them should be how we might bolster national recognition of the fact that this is not just an economic matter and a competitiveness matter but it's a national security issue for the U.S.

And, second, how we can perhaps build a database on what other nations are doing to retain or to capture this talent versus ourselves and see if we can, on some systematic basis, determine how we can bring up our incentive system to match those of other nations more effectively. I think this is an urgent matter and we would value your help if you have additional thoughts on the crafting of a recommendation from this Commission to the Congress. And I don't guarantee that all of my fellow Commissioners are going to agree with this, but I think that we would very much like to review, at minimum, how the Congress could play a constructive role in, in effect, fixing this problem because the stakes are so high.

You know if we get this wrong we are going to lose that technological scientific lead that has been the lifeblood of this country's competitiveness both economically and militarily.

So anything you might offer in terms of a dialogue with the Commission would be greatly appreciated. And if you'd like to react to whether I'm exaggerating this concern or whether you think that it is possible to get our arms around achievable recommendations of this kind, I'd be interested in your views.

Mr. WONG. Commissioner, one thing that goes back to a question I think Commissioner Bartholomew had mentioned before—and I think it's very important to your focus here—is that we need to invest more, I think, in public grade school and high school education, because at the higher level we are always going to be competitive—at MIT, at Stanford, CalTech, whatnot. But more and more of those students are going to be foreign students at the top level if you don't have students with the capabilities to get in there.

And we take for granted that we just innately have the ability and that's all we need, but it's not true. I grew up going to grade school here in California in the '60s. At that time it was one of the best public educational systems in the nation, in the world. I don't think I'd want to go to my grade school or my high school today. I'd be more worried about my safety than anything else. I mean it's different if you go to school in Palo Alto, but I didn't.

So I would say that if you really want to look at the long-term, it may seem like a remote issue, but it really is tied in closely to the future of our competitiveness and our national security.

Mr. RIESCHEL. Let me make one comment.

Chairman D'AMATO. Mr. Rieschel.

Mr. RIESCHEL. I think the observation that you just made is really important and also Secretary Perry's comments this morning. If we try to prevent someone else from doing what's really in their best national interest or actually in the interest of their people, because one of the problems that China's dealing with is the broadest spectrum or the broadest disparity between poor and wealth of any country in the world, two orders of magnitude greater than the United States, and we get criticized for that fairly broadly.

So if you're focused on preventing that, then I think that's a terrible mistake. So the spirit of the conversation on what do we need to do proactively to maintain that is such a refreshing thing to hear and it's not something that comes across in the press and the media very often, because it's always about how do you prevent someone from being successful. And as long as—the global pie has a lot of room to grow if we get ourselves together with the right partners to make that happen. And I just want to comment that that's such a refreshing feeling coming across from the panel this morning. I really appreciate that.

Mr. SCALISE. I would just add one comment here. When we did the study for the President's Council of Advisors on Science and Technology on IT innovation and manufacturing, we went back and looked at what we did in the 1940s to set the stage for this great revolution that we have been the beneficiary of. And you know Vannevar Bush laid out some very, very insightful and courageous thoughts. And that vision was the foundation for a lot of the things that happened.

But in addition to that the Congress then had the will to go ahead and invest in it in a way that allowed it to unfold. I think that's something that needs to happen again, and it has to be a bipartisan thing. It can't be squabbling about every word in every sentence in every document that comes out. It has to be a decision on the part of the Congress to say: This is something we must do and we're going to come together and do it, and allow the National Science Foundation to have the funding that it needs, a doubling of the science and technology. The physical sciences part of the National Science Foundation is critically important today. We've allowed that to lag for so long.

We're doing a wonderful job on the other side of the equation as far as the research is concerned through the NIH and so on, but the physical sciences, we've just let it lag far behind. We can't allow that to continue. So getting the vision, getting the leadership, and having the Congress come together and say: We're going to be the ones that are going to make this happen now, is what really, in my view, has to occur.

Mr. MORGAN. I just might make one point. I really appreciate the opportunity to participate, and I was glad to see the perspective of many of the Commission Members.

I would encourage you, as I think many of the people have, is that really the investment climate in the U.S. is the key, in addition to building the support issues that we've talked about, is the key to keeping the jobs and opportunities here.

The things that, of course, all of us know in the past few years that are going against that, we really I think need to highlight that early in your report, that it's important to look at it from that way. That leads you to several conclusions that you've got better research than I have to do, but if you take it as a way that we're going to somehow block the development of China, I think you got a disaster. You got a train wreck. So that's my major point.

Chairman D'AMATO. I think that's what Dr. Perry was saying this morning about running faster, running faster in place. We also appreciate your recommendations on the tax side, because that's an area that we think we need to look at again.

Cochair MULLOY. May I just make the request, because I know, Mr. Scalise, you gave us some very good recommendations, if any of you in light of this talk about a national vision or strategy if it strikes you that there's something that we ought to think about, we would invite you to submit those to us in writing. That would be most helpful.

Commissioner BARTHOLOMEW. Mr. Chairman, I'm sorry. Just one more comment, which is it's interesting to hear—I can't resist this one—at the same time we have people talking about reducing taxes and increasing spending. And, of course, this is a terrible set of priorities that our entire fiscal situation has gotten into, where we have had reductions, tax cuts in certain places, increases of spending in other places. We have the largest deficit that we are confronting. I couldn't let that opportunity pass, that it's not an easy thing to do, is it, to cut——

Mr. EVERETT. It is a huge challenge, but I have one final recommendation to make in this, and it's right to your point, Commissioner. The Administration had promised an increase in the funding of the National Science Foundation, which directly addresses the K-through-12 program in science in our schools. That's a small amount of money in the grand scheme of things, but it is yet to be done.

And if there is any single action that would put us on a path to get to a plan that Commissioner Mulloy talked about, that would be a great beacon to see that National Science Foundation funded by the government, as it should be.

Chairman D'AMATO. Thank you very much.

That will conclude this panel. We'll take a five-minute break.

[Recess.]

PANEL II: CHINA'S HIGH-TECH DEVELOPMENT STRATEGIES

Chairman D'AMATO. The Committee will come to order.

Our next panel this morning will look at the question of China's development strategies, high-tech development strategies, what they're trying to do. We have a number of experts here. From left to right: Dr. Richard Suttmeier, Professor at the University of Oregon; and on his left Dr. Michael Pillsbury from Washington, D.C.; and to his left Dr. Denis Simon, Provost of the State University of New York in Albany; and then on his left Ms. Kathleen Walsh, Senior Associate at the Henry Stimson Center in Boston.

We'll go from left to right. And if you would try to confine and summarize your remarks, your presentations will all be in the record in full, to about seven minutes. And then we'll have time for Q&A. Why don't we go ahead left to right and start with Dr. Suttmeier.

STATEMENT OF RICHARD P. SUTTMEIER
PROFESSOR OF POLITICAL SCIENCE
UNIVERSITY OF OREGON, EUGENE, OREGON

Dr. SUTTMEIER. Thank you, Mr. Chairman. It's a pleasure to be here with you today. Seven minutes doesn't give us too much time to cover a big subject. As a result I want to just make a couple quick remarks. I think they'll come up in other presentations as well.

I'd like to start, borrowing from Charles Dickens with the observation that China is experiencing "the best of times and the worst of times," with regard to its science and technology. As the previous panel pointed out, yes, indeed we do have national purpose and national programs in China. But I think that we have to remember is national programs of that sort both accomplish things but also don't accomplish things and produce lots and lots of problems.

So part of my position here today is to be a little bit dissenting about the China juggernaut phenomenon and point to some of the weaknesses that I see as a result of years of looking at these issues.

So in terms of the best of times, this we can see fairly easily. In many ways the Chinese are reaping the achievements of 25 years of planning, reform, major changes in their national system of innovation, very significant increases in funding in the last five or six years in terms of funding of R&D with some impressive consequences: increasing publications in leading scientific and engineering journals, the creation of a high-quality manpower pool and a very good educational system, and now the commitment to a 15-year science-and-technology development plan, which will shape S&T to the year 2020.

But I also want to call attention to the "worst of times," as these are perceived by a number of officials and scientists and others in China. And these I've tried to address under the general rubric of China's "technology trap."

The idea here is that so much of China's rapid economic growth, its rapid movement up the value-added chain, has been the result, basically of technology coming in from abroad. And, as a result, there is a growing sense of frustration in the Chinese technical community with the fact that so much of what China produces doesn't incorporate Chinese intellectual property, Chinese innovations. And that, in turn, has consequences for the overall performance and profitability of Chinese industry.

This, it seems to me, centers particularly on what I've called in the paper China's "enterprise problem." And the enterprise problem is basically the problem of not having your national innovation system being centered in industrial organization, industrial corporations or companies. The enterprise sector coming out of the traditions of the Soviet model has been, in fact, quite weak as a center of innovation and arguably still is—although we're seeing lots and lots of very contradictory data on that point, something we could talk about a little bit further if you want to in Q&A.

But I think that most of the Chinese policy analysts would conclude that you don't look to Chinese enterprises as the source of technological innovation in China. Instead you have to look at what had been the traditional strengths of the innovation system, i.e., government research institutes—especially the Chinese Academy of Sciences and, more recently, universities.

These research institutes and universities have, I think, done very well in the course of the reform era. Enterprises somewhat less so. In my written testimony I give you a little bit of data on these questions, for instance, on R&D intensity in industry.

If you look at where Chinese R&D intensity in enterprises is, as one measure of innovative activity, it lags notably behind that of most of the OECD countries. As a result, as Chinese enterprises, I think, as they face this new world of market competition and globalization are themselves becoming increasingly interested in outsourcing R&D. In other words, they are outsourcing a great deal of their innovation activity, rather like the way that Mr. Scalise was referring to, I think, in terms of the creation of virtual innovation networks in this country. That is, enterprise-research institute, and enterprise-university relationships I think have become more important and are going to become even considerably more important in the future.

I would urge the Commission not to be taken in by talk of Chinas as the new technology superpower and to remember that there are a number of the very significant vulnerabilities, as well as achievements, that we can see in the Chinese innovation system.

Now, of course, the Chinese government is aware of these and attempts to do something about them through its technology policy. There are many different things we could talk about with regard to a Chinese technology policy. I will just focus on one, which the staff had asked me to address: the question of China's initiation of a national standard strategy.

As one looks at this strategy, there is some literature cited in the footnotes for your reference, we can see that the initiation of this standard strategy comes very much out of either the consequences of WTO membership and the sense that Chinese industry is disadvantaged in relative gains terms as a result of its deeper integration into the international economy. In other words, Chinese industry has done very well in a lot of ways, but relative to many of its multinational partners maybe not as well as it thinks it should.

Now as a result of we have begun to see a growing attention to standards starting in the late 1990s and on up to the present. And, of course, this all broke into our consciousness last year as a result of the WAPI issue, which I think Mr. Dawson will also address a bit.

But again, if we look at this national strategy, it appears in the first instance to be rather troublesome. It appears to be the working out of a big national industrial policy with all kinds of techno nationalist overtones. However, I think as one begins to look at it more carefully, it's considerably more complex. There are a large number of actors involved, and they do not all have the same preferences and the same interests in it. There is also considerable variation in the politics of standard setting from standard to standard.

We were learning in the work that we've been doing on this is that for a variety of reasons it's been very difficult for China to actually pull together a cohesive national strategy. China is now working on a national strategy document that many foreign companies have commented on; a review of that document reveals many of the problems they are having.

Let me point out that the standards area is one where recommendations to Congress from the Commission might be warranted, especially in light of what the EU is doing with China with regard to standards. Everybody understands, I think, that standards have become very, very important in the global economy; the EU has become very aggressive in trying to win the Chinese over to their views. They've put money into it, and so forth.

On the U.S. side there has been a response as well, documented a little bit in my testimony, but I think everybody who has looked at this issue would agree that considerably more can be and should be done if the U.S. is going to try to engage China on standards issues in ways that will gradually take China's formative mentality, or formative culture of standards, which is where it is in China at the moment, and turn these more towards a U.S. view how to approach standards rather than have the European view prevail.

In conclusion, let me just note that there's no question—as we look down the road—that China's importance in the science-based industries of the future is growing rapidly. The R&D strategies that are now in course will make China, or and has already has made China, an important player in some areas of science-based industry.

That said, one also has to recognize continuing fundamental endemic institutional problems that identify in my written testimony as limitations on what China can achieve.

I would just conclude with one final thought, because I was interested this morning in the extent to which we may be seeing a growing divergence of interest in the United States on how science in China and in the U.S. fit together in the international economy and its global innovation networks. Increasingly, from my point of view, after looking at these issues for a number of years, but certainly in the last five or eight years, it seems as if American universities, higher education systems, American high-technology companies in general, and the technical agencies of the U.S. Government have all done serious assessments of what China means for them. They have all taken China very, very seriously in an informed way and I think have incorporated "the China factor" into their longer-term sense of strategy and projections of their future.

One gets the sense, however, that political authorities in the United States haven't quite gotten it, and that they increasingly see the world differently from the institutions, above, who are the major sources of American innovation. If true, I think it is a very worrisome development to have the nation's political authorities seeing the world so differently from the nation's innovation leaders. I would encourage the Commission to give this some thought: Is there, in fact, a very serious divergence of interest between those who are doing the research, the scientific discoveries and the innovation in American society, and the American state which is understandably concerned about security and shorter term economic issues? Are the latter leading to government actions which work against the more innovative sectors of the society such that effective coordination at the national level to advance the nation's competitiveness being lost?

Thank you.

[The statement follows:]

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China's "Technology Trap" and the Reconstruction of the Chinese National Innovation System

"The Strategy for Technological Innovation Determines the Future of China"

In a series of revealing commentaries in China's official *People's Daily* this January, some of the most critical issues affecting its China's technological aspirations for the 21st century were brought to the attention of Chinese readers. A brief review of the claims made is a suitable point of departure for our discussion.

Entitled "Giving Full Play to Scientific, Technical Progress," the five-part series begins with a critique of China's rapid growth experience, emphasizing in particular its failure to break fully with an "extensive growth" model characterized by over-investment and inefficient resource utilization. While movement towards a more "intensive growth" approach (based on technological innovation, efficient resource utilization and productivity gains) has been an objective throughout the past 25 years of reform, success has been slow, with the lack of progress becoming more evident as the environmental costs of growth have soared and the relative scarcity of resources and environmental services have become more alarming. While the solution to the problems of extensive growth are not simply technological, the commentary calls for a refocusing of Chinese science and technology policies to address the critical challenges of resource availability and environmental degradation which threaten the course of Chinese modernization.

In the second installment, attention is called to the problems of indigenous innovation in China, in both industry and agriculture. Reiterating themes that have appeared in Chinese policy discussions since China's accession to WTO, and in recent foreign studies of Chinese industry, the commentary bemoans the fact that domestic technological innovation has been disappointing, and has tended to make Chinese industry subordinate to global technology leaders. In the words of the commentary,

> "We should . . . understand that the overall size of Chinese industry, and the overall scale of China's economy are big, but China's industries' technological level and their abilities in self dependent innovation are still low. . . . Chinese companies lack core technology, depend on foreign companies for crucial parts, are at the lower end or the middle range of the global industrial chain, rely on multinational companies for technological support and rely on the global sales chain. . . ."

To remedy this situation, the commentary calls for a strengthening of the nation's research and development and the need to "... support enterprises in developing self-owned crucial technology, in creating famous brands and in improving their abilities in research and development."

The importance of industrial enterprises as centers of innovation is the theme of the third part of a series. China has become very interested in the problems of technological innovation in recent years and in the concept of a national system of innovation (NIS). It has undertaken extensive reforms in its R&D system in order to create what it believes to be a modern NIS, a defining characteristic of which is the central role to be played by industrial enterprises, rather than government research institutes (GRIs), as had been the case under the central planning system of the past. The development of an industrial innovation tradition, especially effective industrial R&D, in an economy which lacked such a tradition, has become a major challenge for reforms in science and technology. Central objectives have included extensive reforms in the GRIs and the building of R&D capabilities within Chinese companies, one important approach to which (which has had mixed success) has been the marrying of GRI and enterprise. The central message of the commentary is that the building of an effective national system of innovation, which will be necessary for launching China on the path to intensive growth and allow for China to control the technological terms of its participation in the global economy, are tasks of cardinal importance at the moment, and that the key to an effective NIS is to have industry playing the lead role. A sense of the urgency of all of this is captured at the end of this third part in the assertion that "*The strategy for technological innovation determines the future of China*" (emphasis added).

Two other matters affecting China's technological development are taken up in the final two parts of the commentary. In part four, the discussion turns to the importance of human resources and the effective cultivation, utilization, and rewarding of technical talent. The commentary notes that China's technical community is already quite large by international standards and is growing in quality and quantity. It also notes the growth in output from this technical community as measured in publications in international journals, but also recognizes that the originality of this output has been disappointing and that even though the number of Chinese publications is growing, citations to them have not ("... the number of significant original achievements is still small and China's international scientific and technological competitiveness is still mired at the lower-middle level.").[1] On a funding per researcher basis, the Chinese contingent of professional manpower is still supported at low levels by international standards and there is much that members of the technical community must learn about the importance of interdisciplinary cooperation in the face of exciting new research challenges which cross disciplinary and organizational boundaries.

The final installment takes up an especially sensitive issue that has been a central part of technology policy debates since the initiation of the open-door policy of the late 1970s—the role of foreign technology in China and the consequences of technology transfers from abroad for the development of the domestic NIS. China has imported vast amounts of foreign technology over the past 20 years and this has contributed in no small way to the quality and rapidly increasing technological sophistication of Chinese exports. This technology transfer experience, though, has affected the NIS negatively in two ways. Unlike Japan, and later Korea, China has devoted considerably less energy towards assimilating foreign technology, with the result that the technological dependency bemoaned in part two of the commentary has, if anything, worsened. In addition, foreign technology has enjoyed a privileged position in Chinese industry relative to domestically developed technology due both to the often superior performance characteristics of the foreign technology, the failures of the domestic technology diffusion system, and psychological and cultural orientations reflecting the belief in the superiority of foreign technology. Whereas Chinese manufacturers have approached the use of foreign technology pragmatically, to improve business performance, the commentary laments the fact that there has not been a strong tradition of using technology imports for technological learning. As the commentary puts it, "we should not pay attention only to increasing manufacturing capacity and neglect technological innovation ... the target for (technological) imports is innovation and the creation of new self-owned technology."

[1] While this Chinese assessment is consistent with that of foreign observers, recent work by Ping Zhou and Loet Leydesdorff examining Chinese publication trends points to a notable growth in citations to Chinese-authored papers. Ping Zhou and Loet Leydesdorff. "The Emergence of China As a Leading Nation in Science." Available at http://www.leydesdorff.net/ChinaScience.

Best of Times/Worst of Times?

In spite of the *People's Daily's* laments, there is no question that there has been great progress in Chinese scientific and technological development. Taking advantage of an unusual 25 years of political quiescence—long by the standards of 20th-century Chinese political history—the Chinese government has put in place a series of policies and reform measures which have allowed it to reconstruct the national innovation system into one intended to make Chinese science and technology internationally competitive during the 21st century. Over the past decade, the quality of higher education has improved dramatically, expenditures on research and development have been rising rapidly, and Chinese researchers have captured a notably increasing share of publications in international science and engineering journals.[2] China's successful entry into the world of manned space flight symbolizes the possession of a concentration of technological capabilities which have attracted international attention, and plans are in course to significantly enhance China's profile as a power in science and technology by the year 2020 with the initiation of an important new 15 year science and technology development plan. While these and other such developments can be taken as evidence that Chinese science and technology are experiencing "the best of times," anxieties and frustrations about Chinese technological capabilities are also growing, as alluded to above, even as the best of times are savored. It might be appropriate, therefore, to suggest (borrowing from Charles Dickens) that for China's science and technology, these are "the best of times and the worst of times."

Following the *People's Daily*, we can locate the source of these anxieties and frustrations in what can be described as China's "technology trap." Thus, in spite of progress on a number of dimensions of scientific and technological development, China finds itself struggling to escape from a series of enduring conditions which have long frustrated its hopes for indigenous technological progress. There are a number of indicators of the problem. China's patenting activity is disappointing and it is rare that Chinese products incorporate indigenous intellectual property. Instead, China's remarkable growth as a center of manufacturing, and its emergence as a significant exporter of high technology goods, have involved a dependence on foreign technologies which seemingly has deepened as a result of its accession to WTO. A number of factors contribute to this condition.

First, the legacy of the pre-reform era has not been completely overcome. Inspired by the Soviet system, Chinese institutions for research and innovation were characterized by the centralization of R&D in government research institutes (GRIs), with little attention given to developing R&D capabilities within enterprises. In spite of beliefs that effective coordination between the activities of GRIs and enterprises could be effectuated by central planning, the organizational differences between the two were rarely overcome. Great efforts have been made since the beginning of the reform era to rectify the situation, but the results have been mixed.[3]

As economic reforms have taken hold, and as China has become more integrated with the global economy, the need for technological innovation in Chinese enterprises has risen and has created a demand for new technology in Chinese enterprises that was rarely in evidence under the old central planning system. The creation of this demand might be expected to stimulate China's domestic R&D system and lead to expanded industrial research and more intimate relations between Chinese enterprises, and GRIs and universities. While there have been changes in this direction, as discussed further below, problems remain.

Chinese enterprises have long tended to regard technology originating from the domestic research system as immature and, when available, have preferred foreign technology. In a number of industries, therefore, Chinese firms wind up paying substantial license fees for this know-how, payments which cut into already rather slim profit margins. At the same time, this bias towards foreign technology does nothing to stimulate the domestic research system. These interacting factors—weak enterprise R&D capabilities, relatively strong government research institutes with weak connections to industry, a high degree of dependence on foreign technology, and the unattractive terms required to pay for that technology set the conditions for China's "technology trap." Unfortunately, market oriented enterprise responses to life in the trap are often characterized by the widespread pirating of intellectual property, a response which weakens China's efforts to build a strong IPR regime. As a result,

[2] Growing an average of 17.35% per year since 1998, China's GERD/GDP reached 1.31% in 2003. In 2003, China ranked 5th in the world in terms of publications catalogued by SCI, EI, and ISTP. Ministry of Science and Technology. *2004 STS DATA BOOK.*

[3] These have included attempts to reform several hundred GRIs by merging them with enterprises, or by having them become enterprises themselves. There are number of indications that these reforms have not gone smoothly.

the efforts of China's indigenous innovators to lift China out of the technology trap are compromised by a lack of intellectual property protection, thus perpetuating the trap.[4] Structural biases in the financial system make the funding of new ventures difficult, and unresolved problems in China's social safety net also work against indigenous innovators, which also makes it difficult to escape the trap.

The Enterprise Problem

Efforts to make the industrial enterprise the center of the national innovation system, as in the developed capitalist countries, have been strenuous over the past decade. Understanding the consequences of those efforts, however, is not easy. The changing nature of industrial R&D in China, for instance, is poorly understood and has led to a variety of often conflicting interpretations.[5] As recently as 1996, industrial enterprises accounted for only 37% of the nation's R&D. This had risen to 60% in 2000, and has remained above 60% since then (it was 62.4% in 2003). While there *is* widespread agreement that there is much more innovation related activities occurring in Chinese enterprises, the extent and significance of it remains somewhat puzzling. The rapid rise in the share of national R&D performed by industry must therefore be interpreted with care. It is difficult to see how the enterprise sector of the national R&D accounts could change so dramatically in four years without considering the effects of the transformation of several hundred government research institutes into enterprises (thus counting their research activities in the "enterprise" category rather than the "government" category), the consequences of changing definitions of innovation related activities within enterprises as these affect the reporting of statistics, and an increase in support from government for industrial R&D.[6]

Problems with indigenous innovation in Chinese enterprises is also evident in considering the relatively low research intensity of Chinese firms as measured by R&D expenditures as a percentage of value added. Although research intensity is increasing, for Chinese high technology industries as a whole, this percentage stood at only 4.2% in 2003 (up from 3.6% in 1999) which was notably below the average of over 20% in selected OECD countries (22.5% in the U.S. in 2000).[7] It was only in the aerospace industry (15.8%) that this measure of research intensity approached that of high tech industries in the OECD countries. The sector reporting the largest single amount of R&D expenditures, electronic and telecommunications equipment, had an R&D intensity of only 5.39% in 2003. When the R&D/value added measure is applied to Chinese industry as a whole, and not just to the high-tech sector, the percentage falls to 3.4% in 2003 (up from 2.3% in 1999, in contrast to the 8.2% in the U.S. in 2000).[8]

The discussion above indicates that the building of a strong industrial R&D tradition in Chinese enterprises will be a long-term affair. This suggests that Chinese firms will continue to seek new technologies from sources outside the firm, which implies that technologies from abroad (when available) will continue to be important, but also that relations with Chinese GRIs and universities need to be reconsidered. It is useful in this context to compare China with some of the more technologically advanced OECD countries. Increasingly, industrial enterprises in such countries no longer seek sources of talent and ideas for high technology and science based industrial innovations solely from within the boundaries of their own firms. Instead, with regard to research and innovation, "the boundary of the firm" has become quite porous with many different kinds of relationships with other centers of knowledge creation—other companies, government research institutes, and universities—becoming common. As we know, this "outsourcing of innovation" extends beyond national borders as well, and is one of the main characteristics of "the globalization of innovation."

We have noted above that persistent problems between Chinese enterprises and government research institutes and universities have been a defining feature of Chi-

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[4] Anne Stevenson-Yang and Ken DeWoskin. "China Destroys the IP Paradigm." *Far Eastern Economic Review*. V. 168, #3 (March 2005). Pp. 9–18.

[5] Cf., Erik Baark. "Hype and Hope: Evaluating China's Science and Technology Future." Available at http://www.axess.se/english/currentissue/theme__baark.php#top and Cong Cao. "Challenges for Technological Development in China's Industry." *China Perspectives* 54:4–16 (2004) with Albert G.Z. Hu and Gary H. Jefferson. "Science and Technology in China." Unpublished paper prepared for the conference on "China's Economic Transition: Origins, Mechanisms, and Consequences." Pittsburgh, PA, November 5–7, 2004.

[6] Baark reports that enterprises have become increasingly active in China's national programs, participating in 10,000 of the 14,202 projects carried out under the six major Chinese research programs in 2003, including participation as prime contractor for 14% of the projects conducted under the 863 Program, for example. Baark. "Hype and Hope. . . ."

[7] China's 2003 High-Tech Industry Almanac, compiled by the National Development and Reform Commission reports a R&D/value-added ratio of 7.1% in 2002.

[8] Ministry of Science and Technology, various.

na's "technology trap." Clearly, however, incentives on both sides of the enterprise-research center divide have changed, and the capabilities of many GRIs (especially the institutes of the Chinese Academy of Sciences)[9] and universities have been notably enhanced as a result of the infusion of highly trained research staff from both foreign and domestic graduate programs, significant increases in funding for research, and major, modernizing institutional reforms. In addition, with such new policy instruments as the 1996 Technology Transfer Promotion Act and the 1998 Regulations on Technology Transfer for GRIs, the Chinese government is encouraging new approaches to overcoming this important feature of the technology trap.[10] It is thus quite possible that China's still evolving NIS will be characterized less by the centrality of the enterprise than by active GRI-industry and university-industry relations. The ways in which Chinese enterprises approach the "boundary of the firm" issue and the outsourcing of research and innovation are likely to become increasingly important factors in the future Chinese high technology, and thus warrant our careful attention. Studies which have been conducted on the subject suggest that outsourcing to domestic research centers (GRIs and universities) is increasing,[11] but so is interest in outsourcing to more scientifically and technologically advanced venues outside of China.[12]

Standards

There are a number of other important aspects of China's technology policy, and strategy for escaping the technology trap, but time and space do not permit our pursuing them here.[13] Instead, I would like to address one particular aspect of technology policy in which the Commission has expressed an interest, i.e., China's growing interest in technical standards.[14]

China's efforts to develop a national standards strategy nicely illustrate the various influences which converge in contemporary Chinese technology policy. The interest in standards, in the first instance, is rooted in long-held aspirations for Chinese technology and the belief that through technological development, China can reclaim a position of wealth and power lost to technologically superior countries over the course of the past 150 years. As a great country, in this sense, China should of course have its own technical standards.

The experiences of the past two decades with domestic reforms and integration into the international economy constitute a second source of influence. In subjecting Chinese industry to market forces, these experiences have illustrated the significance of technological progress for sustained market success. Along with other players in the global high technology economy, China has become intensely aware of the increasing importance of technical standards in corporate strategy and national industrial well-being. Its entry into the WTO is a third influence which, by facilitating the business operations in China of multinational corporations who often control standards and international standard setting, has reinforced the lesson that standards matter a great deal. In addition, though, China's obligations under WTO include the modernization of its own domestic standards regime to bring it into conformity with international norms, a process still in progress. Thus, the deeper integration with the international economy resulting from WTO accession has both obligated China to redesign its own domestic standards regime, but has also provided incentives to pursue distinctive Chinese technical standards in its technology policy as a way of managing the increasing competition from foreign firms. Efforts to integrate these two objectives are now in course within the Chinese government

[9] The Academy's "Knowledge Innovation Program" over the past 6 years has strengthened and reoriented the work of CAS institutes in ways that will make it an especially important part of the changing Chinese NIS.

[10] Kazuyuki Motohashi and Xiao Yun. "China's Innovation System Reform and Growing Industry and Science Linkages." University of Tokyo, Research Institute of Economy Trade and Industry (RIETI). RIETI Discussion Paper Series 05–E–011.

[11] Motohashi and Yun. "China's Innovation System. . . ."

[12] Chen Jin. "R&D Internationalization and the Reconstruction of China's R&D System." Paper presented at the conference on "Globalization and China's Development in Science and Technology," East Asian Institute, National University of Singapore, November 5, 2004.

[13] For instance, as China attempts to build new science based industries, the extent and quality of its basic research will become more important. At the moment, its basic research expenditures (only about 5% of its national R&D total) are rather low in comparison with OECD countries. Although this is expected to grow towards 15–20% during the course of the 2005–2020 planning period, there is a growing debate inside and outside of China about the effectiveness of China's large national R&D spending programs for stimulating truly creative and original research.

[14] This subject is treated in greater depth in Richard P. Suttmeier and Yao Xiangkui. *China's Post-WTO Technology Policy: Standards, Software, and the Changing Nature of Techno-Nationalism*. NBR Special Report. Seattle. National Bureau of Asian Research, May 2004.

as it prepares the final draft of a Chinese standards strategy document.[15] As we try to interpret the challenges posed by China's use of standards in technology policy, it will be useful to keep in mind the following points:

—*Motivations*. In devising a national standards strategy, the Chinese have had to reconcile a variety of considerations stemming from the different functions of standards in modern societies and a diversity of motivations at work as we move from standard to standard and technology to technology. For instance, with regard to technical standards in particular, these include concerns over information security—evident, for instance, in the controversial WAPI case[16] and in the promotion of Linux based alternatives to Windows—while economic considerations figure more prominently in other cases, especially in consumer electronics. As noted in the *People's Daily* series cited above, China is unhappy with the royalties its firms must pay for licensing technologies and the impact these have on profits. Unhappiness vis-à-vis specific products is reflected in a broader dissatisfaction with the relative gains coming to China from its participation in the global economy as a result of its position in the value chains of various industries. In other cases, finding standards that make possible technologies which are more congenial to Chinese language, cultural preferences and tastes may be an issue. More generally, China's growing technological capability, and the belief that it is now in a much better position, technologically, to set standards, motivates standard setting initiatives, and resonates nicely with a deeper techno-nationalism which has its roots in modern Chinese history. We should recognize, therefore, that within a still inchoate, vaguely defined national standards strategy, there is no single motivation which drives standards development in all technologies.

—*Puzzles*. The incorporation of a standards strategy into Chinese technology policy warrants our close attention, and the WAPI case certainly elicited it. However, WAPI may not be typical of Chinese standards initiatives and it, along with the strategy as a whole, present us with a series of puzzles about China's approach to standards. In the first instance, China's standards system is still quite new, as is interest in using standards as a technology policy tool. The game of standards, thus, is a new one for China, and there are a number of signs that neither the rules, nor the skills needed for winning, are entirely clear. While there *is* a growing confidence in China's ability to set standards, it remains to be seen whether China has the capabilities, technologically, to set standards which will be winning on performance grounds. This then points to a second, but related puzzle—that of the role of market power in Chinese thinking. While appeals to market power might compensate for technological deficiencies, they also carry their own uncertainties. Foreign observers remain puzzled whether China is mainly interested in establishing Chinese standards for the Chinese market, or whether it wants to use Chinese standards in the Chinese market in order to lead to the propagation of Chinese standards in international markets. There is clearly a danger, in spite of China's market size, that the promotion of standards for the Chinese market, without due regard to international markets, runs the risk of reducing the relevance of Chinese standards internationally.

—*Actors*. A third puzzle, again, relating to the consistency of motivations at work concerns the variety of actors involved in the standards strategy and the diverse sources of initiatives for standard setting. Among these actors are government agencies, government research institutes, Chinese companies and industrial associations (as well as players from the international community) and it sometimes appears that there is no simple or consistent identity of interest among them making the harmonization of preferences on standards initiatives quite difficult. For some Chinese companies, for instance, financial success has been found by working within an architecture of standards that has already been established internationally. New government supported initiatives for distinctive Chinese standards may not be welcomed by such firms. Even within govern-

[15] Under the leadership of the Standards Administration of China (SAC), the strategy paper has gone through preliminary drafts (the latest being in September 2004) which have been circulated to domestic and foreign stakeholders for comment. The final draft has not yet been made public.

[16] China's effort to establish WAPI (Wireless Authentication and Privacy Infrastructure) standard in 2004 led to a major dispute with its international partners which led to a remarkable government-industry "stop WAPI" coalition in the U.S. and to the escalation of the issue into a matter of high diplomacy reaching the Vice President's office. Although the Chinese government eventually relaxed its position, and thus avoided even more serious conflict, the WAPI story continues to unfold.

ment, there are signs that different ministries, or parts of ministries, may have rather different views on the desirability of promoting particular standards. Hence, if pursued without finesse, a national standards strategy could increase domestic policy conflict, and could actually retard technological development.[17] A lack of finesse, as seen in the WAPI case, can also induce conflict internationally leading to significant costs and an interruption of technological progress.

—*Foreign Participation*. Another curiosity about the current state of China's efforts to promote a national standards strategy is the role to be played by MNCs. Foreign companies, in general, have not been happy with the access they have been given to Chinese standard setting forums, and continue to lobby for greater participation and transparency from the Chinese. That said, MNCs have been active players in helping to provide technology for Chinese standards development; the role of Siemans in the development of TD CDMA comes readily to mind. More generally, in most of the more prominent cases of Chinese standards initiatives, foreign know-how has been an important component in the development of the Chinese standard. Indeed, in spite of the suggestion of techno-nationalist motivations which are evident in some cases, overall, Chinese standard setting initiatives provide further evidence that technological development is increasingly an international, if not global, exercise, and that a narrow techno-nationalism is likely to be self-defeating. This is a lesson which many—though not all—leaders of the Chinese technology policy community understand quite well.

—*Implementation and Institutional Models*. Another series of interesting questions turn on Chinese strategies for implementing standards. Among these is the extent to which China will embrace market driven approaches to standard setting as opposed to the setting of standards by government, or by formal standards bodies. This question is closely related to the very important issue of whether European approaches to standards, more closely associated with the latter approaches, will have greater influence with the Chinese than U.S. approaches (favoring market forces and action through voluntary associations). Europe has been actively working with China to promote its vision of a standards regime, and although the U.S. has also taken initiatives with China for bilateral cooperation, intending in part to promote the U.S. vision, its efforts may require additional resources.[18] Implementation issues also extend to whether China's regulatory capacity and ability to enforce standards is sufficiently developed. Such questions all suggest that China's standards strategy faces many uncertainties and is not necessarily guaranteed success.

—*The Challenge*. Nevertheless, there is no doubt that China is quite serious about developing a standards strategy and is committed to becoming an important player in standard setting. It brings to this commitment a growing technological sophistication, considerable market size and thus market power for promoting its standards, and a variety of cultural preferences which are also likely to help shape an indigenous standard setting tradition. As the discussion above indicates, however, China is considerably less monolithic in the pursuit of its standards strategy than its initial stance on WAPI might have suggested. Ongoing engagement with China on standards, therefore, is not only possible but will be both necessary and desirable. The transitional nature of China's standards regime suggest that there are still a variety of ways in which the evolution of that regime can be shaped through various forms of cooperation and dialogue. Denying visas to Chinese technical personnel who plan to attend standards meeting in the U.S. is not one of them.

It will be very important for the U.S. Government and the U.S. corporate sector to monitor trends in the Chinese standards scene and deepen their analyses of those trends. This will require, in particular, that we differentiate among cases, that there be understanding of who the actors are in different cases and what their motiva-

[17] Interviews with Chinese familiar with the WAPI case, for instance, reveal that there is considerable dissatisfaction with WAPI, technologically, and in terms of advancing Chinese standards, many feel that it was the wrong case for testing the standards strategy which was promoted in the wrong way.

[18] The U.S. has become more active in addressing the challenges posed by Chinese approaches to standards (seen as one of the most serious market access questions faced by U.S. exporters). In August 2004, the U.S. and Chinese governments sponsored a large workshop in Beijing on standards and conformity assessment (and a follow-on meeting is planned for this year). American standards organizations, working through the American National Standards Institute (ANSI) have now established a presence in Beijing, and ANSI is considering a formal representative office in the Chinese capital. In addition, the Foreign Commercial Service will be posting a standards attaché to the U.S. Embassy in China.

tions might be. It is especially important to understand the underlying organizational interests and politics involved, as well as underlying economics of the cases. The U.S. should be supportive of the development of more market oriented standard setting and internationalist, or techno-globalist, orientations in China, and should strive to make WTO provisions with regard to standards more robust in the Chinese setting. An especially important target of activities may be the formative cultures of China's emerging industrial associations.

Given the fact that China will be playing an increasingly important role in the corporate technology strategies of American corporations, it is important for the public and private sectors in the U.S. to cooperate in engaging China on standards and to develop an informed and deft approach which recognizes China's long-term commitment to becoming influential in technical standard setting and the many problems and uncertainties it faces in pursuing that commitment. There is considerable potential for a misguided strategy, and misguided responses to that strategy, and thus for costly economic conflicts and technological frustrations and dead ends. A degree of wisdom will be required on all sides.

Conclusion

Over much of the past 25 years, China has attempted to enhance its technological capabilities by relying heavily on technology transfers from abroad while slowly reforming and improving its domestic institutions for research and higher education. As entry into the WTO loomed larger in the late 1990s, the Chinese realized that much more attention would have to be given to domestic research and indigenous innovation; following WTO accession, Chinese enterprises would face considerably stronger competition from MNCs; MNCs reluctance to transfer more advanced technology would increase; and China would be forced to give up policy tools used in the past to encourage, if not coerce, MNC technology transfers as a cost of doing business in China. Faced with these contingencies, China began to take the task of building its national innovation system much more seriously and initiated a series of policies to support that effort, including a significant expansion of R&D spending, a series of measures to move the enterprise sector to the center of the NIS, and the promotion of a technical standards strategy.

While many of these initiatives have been successful, a careful look at them also reveals a number of problems—many clearly related to the inherent limitations of a national system of innovation in an age characterized by the global production of knowledge and innovation. We should therefore not become excessively alarmed at the more techno-nationalist themes associated with the building of a Chinese NIS, nor taken in by facile accounts of China as a rising technological superpower. In this connection, it is instructive to recall the many voices in the 1980s warning of a rising East Asian techno-nationalist power and of a coming Japanese technological domination, to ask why so many of these voices were wrong in such important ways, and to reflect on why so many of us seemed to want to believe their message.

Clearly, there are ample indications that Chinese scientific and technological capabilities are improving, and in some cases improving rapidly. China *does* loom large in the emerging world of science based industries, a world in which knowledge production in such fields as information technology, biotechnology, and nanotechnology is both globally distributed and concentrated in local innovation clusters.[19] U.S. companies, U.S. universities, and many agencies of the U.S. Government have already recognized this fact and have incorporated "the China factor" into their institutional plans and objectives. Unfortunately, U.S. public policy has at times reflected a serious misinterpretation of this "new world in the making" and China's role in it. As a result, we may be seeing a worrisome growing divergence between a public policy orientation shaped by those in Congress, in the Administration, and in certain advocacy groups having a deep distrust of China and the increasingly intimate relations with China in science and technology being pursued by U.S. firms, institutions of higher education, and government technical agencies who have identified China's role in this new world as critical for their own futures.

China's efforts to promote scientific and technological development inescapably touch upon the economy-security nexus which is the concern of this Commission. The Commission is to be congratulated for taking this subject seriously and for convening this hearing. As we go forward, we will be forced to rethink our relations with China in science and technology, and the starting point for this must be an accurate assessment of Chinese capabilities and intentions vis-à-vis its science and technology. As the discussion above points out, and as the expert literature on the

[19] For a fuller account, see Richard P. Suttmeier. "Science and Technology: A New World in the Making?" In Ashley Tellis and Michael Wills (eds.). *Strategic Asia 2004–05: Confronting Terrorism in the Pursuit of Power*. Seattle. The National Bureau of Asian Research. 2004.

subject of Chinese technological development makes clear, there are many puzzles and contradictions shaping China's emergence as a country with internationally recognized scientific and technological capabilities, and many inconsistencies in trying to discern its intentions. A major study now underway at the University of Oregon with support from the NSF, (see, http://darkwing.uoregon.edu/~xyao/US__China/index.html) seeks to better understand these puzzles and their implications for the role of science and technology in U.S.-China relations. I invite the Commission to avail itself of this work and to call upon us if we can be of service. It is terribly important that we get the story of China's scientific and technological development right. Assessments of the security implications of this story which overlook its puzzles, contradictions, and inconsistencies, and which reject justifiable nuances, can become highly misleading and detrimental to long-term U.S. interests.

Thank you.

Chairman D'AMATO. Thank you, Dr. Suttmeier.

Dr. Pillsbury.

STATEMENT OF MICHAEL PILLSBURY, SENIOR FELLOW ATLANTIC COUNCIL OF THE UNITED STATES ASSOCIATE FELLOW, INSTITUTE FOR NATIONAL STRATEGIC STUDIES NATIONAL DEFENSE UNIVERSITY, WASHINGTON, DC

Dr. PILLSBURY. Members of the Commission, I have been in and out of the Defense Department for 30 years and so what I say today has got nothing to do with any affiliation I have with the Defense Department or any part of the U.S. Government. I'm just going to give you the results of a research project done for the Commission that really had six topics to examine.

The first one was the statement by Chinese leaders in the past six months or so about their national strategy for innovation in science and technology. I want to contrast what they say with the American approach.

The American approach to science and technology I think is what Secretary Perry said, it was part of the Defense Department's business. Companies benefited from that, but I don't think you can find any statement from any American president that's anything like the Chinese leadership has been saying for the past 25 years, in particular the past year.

The Chinese statements say: The source, the primary source of economic growth and national strength is science-and-technology policy. You cannot find that in any American White House collection of documents. It's not our strategy. We like science and technology. We spend a lot of money on it, but no one anywhere that I know of says in a kind of almost religious matter these are members of the Communist Party who have certain views on religion and what moves history, and they're saying to each other: Chairman Mao, Mao Zedong had it wrong. He did not see science and technology as the primary force of production and national strength; Deng Xiaoping did.

Now the current president of China's best university some would say, Tsinghua, has taken it one step further. He and his prime minister in the past six months to a year have been repeating something new about innovation: Our national strategy is based on innovation here in China. We must not be tail-chasers. We must innovate at home.

Now this is serious. When a Communist Party chairman says to a country of 1.3 billion, "This is our new national strategy," pardon my saying this—it's not like a Member of the House of Representatives making a speech back home during recess, it's very serious.

So section 2 was: What does this mean? Because if this has been China's strategy for 25 years we ought to see something by now, and they ought to be very proud of it. So I did a search of the Chinese press for their claims for their biggest accomplishments in science and technology in the last year. I list 16 of those you. And I would ask you, especially those of you who are like I am, I was a beneficiary of the National Science Foundation Dissertation Grant Program and also the Sputnik shock, of course, caused a new program called the National Defense Education Act, which was responsible for my Ph.D., so I should be very pro science and, in fact, I am. I have been bought by the National Science Foundation you might say. I benefited from the Sputnik shot.

So as I read through these 16 accomplishments I called friends of mine in the scientific community to say, "Is this something impressive or is this just nothing new?" I don't think I have time to read all 16 to you, but I encourage you to go through some of these things.

It is not easy to have cloning technology to produce a live buffalo; the Chinese just did it. It's not easy to have a supercomputer that operates at one teraflop, that is one trillion calculations per second. The fastest one is in Japan at 36. We have one at about 36. They now claim that they can scale up the new one that they've just begun operating in Shanghai to 50, and perhaps higher to 64. Is this something new and startling? My friends in the computer community say, "We never imagined China would do this 20 years ago."

There's something, I won't bore you, but it's called the amino chip nanogram detector for Staphylococcus enterotoxins. The Chinese Academy of Military Medicine has one of these in operation. It is going to improve it even more. It's a great thing, frankly. It helps detect things that should not be allowed into your borders. I'm not saying it's a bad thing, but it's impressive. It's state of the art.

There's something called "pebble-bed reactor technology." It means to have your nuclear fuel inside a graphite ball so there cannot be a meltdown. It can change the safety of nuclear reactor design so that nuclear power becomes feasible once again. We haven't built any, as you know, in America for 35 years. Not one reactor built here for 35 years. The Chinese just announced that they want to build 40 reactors, and the implication is, using this technology, which is being developed in a military area just outside of Tsinghua University.

They're quite proud of this. Other countries are seeking to work with China to obtain access to pebble-bed nuclear reactor technology.

Taiwan just opened up its first tailor design center in Shanghai for circuits, after having said, in fact, to this Commission that it would not do so. And this is one of many design centers being opened up in the Shanghai area.

The Pentium-equivalent chip that China is claiming is going to be patented in China so they will no longer have to pay any fees for a computer chip technology that goes into PCs. They announced this just quite recently. They are modest. They say it's only Pentium III quality, but the key point it's the claim for the patent that it's Chinese-owned intellectual property.

The mini satellite project and the announcement that 100 satellites will be launched by 2020. Packetized optical switching at 10,000 times the current rate, in cooperation with Fujitsu, using nanotechnology. I gave four examples in here of joint projects with Japan in the area of nanotechnology that the Chinese have announced.

By the way, when these announcements are made the Politburo usually shows up, or some of them do. They give a national science and technology award. What's rather amusing to me is the PLA Central Military Commission also shows up. Pictures are taken. It would be like the Secretary of Defense and the President and Vice President Cheney and the leadership of the Congress all getting together to award prizes every year for innovation. Actually it's not a bad idea. There's quite a few things the Chinese do that are not bad ideas for us to copy, including these massive tax breaks for R&D.

Particle accelerator joint research. Okay. New router for the Internet—won't go into this.

I then say to you, Mr. Commissioners and Madam Commissioners, do you want to ask the National Science Foundation, the White House Office on Science and Technology Policy, others who study foreign science, others who study foreign science in our executive branch to give you a new assessment on the rapidity of Chinese progress? Because if you do I suggest 20 indicators that have not been looked at before that might provide a finer-grained analysis of just how dramatically improving the Chinese are, the operation is, especially in the last year or two. So that when you hear someone say, "Oh, the last five years," "Oh, the last ten years," you've got to immediately think to yourself—this gets into my final point about the old paradigm versus the new paradigm on the progress of Chinese science and technology.

The old paradigm is still the dominant paradigm. And I quote to you in my executive summary from the current issue of *The Economist*. *The Economist* starts out, its article on China, talking about 800 million people living in poverty. You have to understand all this, they say, to understand the future of China, and that China's leaders only dream of joining the ranks of the world's leading economies.

The image of China we've had for 30 years under what I call the old paradigm is: They are poor, they are backward. Sometimes it eases into racism: They're not very bright. Yes, they can learn if we show them how and we, nice white boys go over there and teach them something, but they really can't ever innovate on their own. There are about ten points of the old paradigm.

The old paradigm also has a national security angle to it, which is that China is our friend. More than our friend, our quasi-ally, is the term often used. Now when I was an undergraduate 200 yards from here in the '60s, I remember reading speeches by Secretary of State Dean Rusk that China was basically the greatest threat to the world and that we should all go to Vietnam, we undergraduates at Stanford should all go to Vietnam and fight—and he actually was quite explicit—to stop the expansion of Chinese communist power into Southeast Asia. China was considered crazier than the Soviet Union, if not as powerful.

A little bit later in the '70s and '80s we transformed ourselves from that paradigm, China as the greatest enemy, to China as our quasi-ally. And the DOD, frankly, and I'm sorry to say, in many ways I was there, took the lead. The DOD provided China technology of an extremely sensitive nature beginning when Dr. Kissinger offered it in 1973 in a meeting that was only declassified a few months ago. Early warning technology and improvement of their radar and linkages to our satellite-detection system was offered in 1973.

By the time Secretary Perry was Undersecretary we were doing surveys of just exactly how we could help the Chinese military technology base the quickest and the best.

In the '80s one of your Commissioners was involved in this, I believe. In the '80s Ronald Reagan, who we all know is seen as a conservative against communism, Ronald Reagan approved six weapon systems for sale to China. There was a vote on one of them in 1986. Only one senator voted against. Only one Senator voted against the transfer of a program to upgrade the Chinese fighter system, fighter aircraft. It was Jesse Helms. He still believed in the old paradigm, that we shouldn't help Chinese defense technology.

So then in those days: Poor, backward, and a quasi-ally. Now I would submit to you we may be getting into a period where there's another paradigm beginning to take shape. We're hearing about it from Silicon Valley and from the Japanese and from the Indians. But we Americans, generally speaking, especially our China expert community, I would submit, are still stuck in the old paradigm: It's a poor, backward, friendly quasi-ally, and therefore any discussions of improving our own science education programs, improving the NSF budget, all the list you heard about in the first panel, most American China experts would think "What's that got to do with China? They're not a challenge. They're not a reason to be cited for this."

So it's kind of sad that China is going to deny us a Sputnik kind of shock that, according to President Bush's Science Advisory in Colorado, in February of this year, I put his speech in here, he puts up figures of what caused the rise and fall of U.S. science budget funding over a 50-year period, and he makes the point, quoting another person's paper he says, but he agrees with it he says, he makes the point that it's external factors outside the community of scientists that determine budget increases and improvements in our ecosystem of scientific innovation. We need challenges from the outside. We need a tail chaser who is ruthless closing in on us and threatens to surpass us. And according to the old paradigm we certainly don't have that in China.

Thank you.

Chairman D'AMATO. Thank you, Dr. Pillsbury.

Dr. Simon.

STATEMENT OF DENIS FRED SIMON
PROVOST AND VICE PRESIDENT FOR ACADEMIC AFFAIRS
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STATE UNIVERSITY OF NEW YORK, ALBANY, NEW YORK

Dr. SIMON. Good morning. I also want to thank the Commission for organizing this panel and also for focusing on the issue of Chinese science-and-technology development. I believe it's one that has not been given sufficient attention. Today, I'd like to excerpt part of my remarks to you as a way to hopefully generate an interesting discussion about where, indeed, China is headed.

China's emergence as an increasing significant player in the global economic and technology system raises a number of important challenges for the United States. These challenges stem from the fact that the rapid changes occurring in China's international role are part of a broader set of fundamental changes in the structure and operation of the world science-and-technology system, engendered in large part, by the onset of the process of globalization.

Since the last decade of the twentieth century no less than five major continental-size economies have expanded their participation and deepened the nature of their involvement in the international economic and science-and-technology systems: China, India, Russia, Mexico, and Brazil. Add to this mix, the growing technological capabilities of the so-called four Asian tigers plus Japan, and we must recognize that the world science-and-technology order is already in the midst of a paradigm change of immense consequences for our country.

Simply stated, there is no turning back the clock insofar as the evolving landscape of global economic and technology affairs is concerned. As new competing centers of technological excellence emerge, the U.S. will no longer be the sole or even leading rule maker or trendsetter in everything ranging from scientific breakthroughs to the setting of technical standards.

Accordingly, it is incumbent upon the United States—the business, academic, and government communities, to take stock of the features of this new playing field, to alter many of our existing operating assumptions about key success factors, and to prepare ourselves for a world of more intense competition and perhaps greater turbulence in the coming decades.

Just as we have witnessed important changes associated with the globalization of product and capital markets, we are also witnessing critical changes associated with the globalization of technology. Technological advance has been upgraded to a national priority among many countries. New centers of pronounced technological capability have started to appear outside the United States, Europe, and Japan. As the world's leading multinational firms seek to take greater advantage of critical knowledge and skill complementarities that now exist across a range of different economies, the processes of technological exploration and exploitation have become further globalized.

In many instances globalization has led to more rapid movement of technology know-how overseas at an earlier point in their so-called lifecycle. The new core competency for success in this demanding environment of technological globalization is the ability to identify, harness, and manage the forces for transborder innovation and technological advance. The hallmark of competitive advantage in a world of globalization is knowing how to link and leverage knowledge, information, and people expertise across borders and cultures.

At the forefront of the changes associated with globalization stands China, a nation whose political leaders and technical community have placed great faith in the development of science and technology as a tool to enhance their country's modernization and international role. China's growing technological prowess has become an increasingly important catalyst in the evolving reconfiguration of the world's manufacturing and knowledge networks.

Currently the most critical manifestations of China's technological advance lie in the steady quality improvements that already have occurred with regard to the country's human resource base and its physical infrastructure. In short order, the payoffs from ongoing economic reforms and structural change in the science-and-technology system are likely to be more consistently realized as well, thus further drawing China into the mainstream of international science-and-technology competition and cooperation.

I would argue that the key issue for the United States regarding China's technological advance has less to do with how to respond to a potential Chinese technological threat or how to deal with China as a possible competitive adversary, and much more to do with how we engage China as a strategy partner in a world where scientific progress and technological advance are no longer simply within the purview of one nation.

More specifically, the real questions are: First, whether as a country we can truly grasp, in both political and technological terms, and take advantage of the unique opportunities for our country and the world, that derive from the emergence of a more technologically capable China.

And, second, whether we have the political will and the commitment to prepare, educate, and train enough people, senior and junior professionals, in science, engineering, and management, who can interact and work effectively across borders and cultures with their Chinese counterparts. Our strategic goal as a nation vis-à-vis China should be to capture potential technological synergies, take advantage of evolving scientific and technological complementarities, and collaborate successfully to push out the frontiers of science and the boundaries of technology for the mutual benefit of American and Chinese citizens.

China's leadership sees ongoing progress in science and technology as critical to addressing three of the most important policy problems facing their country: China's in the global economy, national security, and the creation of the conditions of a sustainable development model.

It is clear to me that China has entered an important watershed period in terms of the operation and performance of its science-and-technology system. After two decades of structural reform that began under Deng Xiaoping, the Chinese science-and-technology system is positioned for an important takeoff. The question is no longer if this will happen but, rather, when.

The evidence for suggesting that China has reached such an important milestone comes from a broad array of data points across the Chinese science-and-technology system. First and foremost, it's apparent that the inputs contributing to the formulation and implementation of science-and-technology policy in China have become more sophisticated and globally oriented.

China is now focused on creating and perfecting a fully integrated national system of innovation with the goal of bridging together those critical components needed to enhance the overall yield from growing investments by government and industry in research and development. Overall R&D expenditures have now reached 1.3 percent of GDP, reflecting a rapid acceleration in spending on R&D over the last five years.

China is now the third largest R&D spender in the world, trailing only the United States and Japan. And while there are still considerable differences in the magnitude of spending on R&D between China and the U.S., it should be realized that increases in science-and-technology spending have grown faster than the growth of the overall Chinese economy.

Of course, we must be careful not to mistake quantitative growth with qualitative improvements, as large components of the Chinese science-and-technology system still remain inefficient and ineffective users of some of these available funds.

Second, China is engineering the formation of a new technological architecture, one that is helping to redefine the rules, structures, and standards that have been in place over the last several decades. This does not mean that government has disappeared from the science-and-technology landscape. The most compelling example of continued government leadership is embodied in the State Council Document Number 18 which was issued in mid-2000 and recently revised, which continues to provide direction for the growth of the software and semiconductor industries.

Nonetheless, like a gradual but steady volcanic eruption, the old elements of the planned Soviet-style system are now progressively being pushed aside as the core features of a new science-and-technology system emerge.

Third, there has been appreciable improvement in the Chinese university sector. Not only has the system grown in terms of its capacity, only a few years ago only three to four percent of high school graduates could enter university. Today that number has jumped to approximately 17 percent. China now graduates more IT engineers than India, some 350,000, compared to India's 300,000 and about 50-to-60,000 in the United States.

Major investments by universities have been made in new equipment and related resources, and the problems of nepotism and faculty inbreeding are being attacked as the Chinese take on the challenge of creating a number of truly world-class universities.

Finally, and most relevant for purposes of this hearing, China has stepped up its interests in the further internationalization of its science-and-technology system. Most profound are those developments on the commercial side of the equation. China continues to have a voracious appetite for acquiring foreign technology. And, as noted by *Business Week*, unlike Japan there is no "not invented here" syndrome in the PRC.

Estimates today now are that there are well over 600 foreign R&D centers—I recently heard someone say 750—with the number increasing steadily every six months.

We must remember that it was not too far in the past when many foreign firms remained skittish about doing business in

China and were skeptical about the staying power of China's reform program. Today, however, that situation has changed. China is now deeply embedded in the framework of global business and commerce. And, those companies striving to position themselves globally will not be successful unless they have a significant presence in China; not simply in manufacturing and marketing but increasingly, as suggested, in research and development.

Let me make a couple comments about the growth of foreign R&D in China for us to better understand what's actually taking place.

Like many other critical transitions in Chinese economic modernization drive, the growing role of foreign R&D is being driving by a confluence of government and market forces. First, as indicated, the Chinese government has emphasized the importance of strengthening the country's technology base. And, in April 2000 new regulations to formally establish foreign R&D centers in China were issued by MOFCOM, formerly MOFTEC. In 2002, MOFTEC's foreign investment legislation was also modified to change R&D activity from a "permitted" to an "encouraged" form of foreign investment, which made it eligible for all of these different kinds of incentives we've heard about this morning.

Chairman D'AMATO. Please summarize.

Dr. SIMON. Okay. Let me look at the implications for the United States then.

Coming to a better understanding of the prospects for future Chinese scientific-and-technological development is of considerable importance for evaluating and managing the consequences of China's political, economic, and technological evolution in the coming decades.

Globalization, complemented by economic reforms, has changed the playing field for China. The Chinese leadership, once seemingly daunted by the forces of interdependence and globalization, now see enhanced opportunities for China to gain unencumbered access to advance technology and know-how. Thinking about Chinese behavior in terms of tension between the forces of techno-nationalism and techno-globalism actually creates a false and somewhat inaccurate dichotomy for understanding China's current international orientation. These two seemingly contradictory constructs are really part of the same behavior, with techno-nationalism and techno-globalism intertwined in a single synergistic relationship with one another.

The United States Government must take a new look at the tremendous opportunities to be derived from Chinese scientific progress and technological advance, and work to enhance our ability to tap into the steadily growing and improving human resource and technological assets in China, from universities to government think tanks to new technological enterprises. In the final analysis, only by pursuing this path will we help to enhance our own country's innovative potential.

Thank you.

[The statement follows:]

Prepared Statement of Denis Fred Simon
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Overview

I would like to thank the Commission for organizing this special hearing and for taking up the issue of China's technological development. China's emergence as an increasingly significant player in global economic and technology affairs raises a number of important challenges for the United States. These challenges stem from the fact that the rapid changes occurring in China's international role are part of a broader set of fundamental changes in the structure and operation of the world's S&T system—engendered, in large part, by the onset of the process of globalization. Since the last decade of the 20th century, no less than five major continental-size economies have expanded their level of participation and deepened the nature of their involvement in international economic and S&T affairs—China, India, Russia, Mexico, and Brazil. Add to this mix the growing technological capabilities of the so-called "Asian four tigers"—South Korea, Taiwan, Hong Kong, and Singapore, plus Japan, and we must recognize that the world's S&T order is already in the midst of a paradigm change of immense consequences for our country. Simply stated, there is no turning back the clock insofar as the evolving landscape of global economic and technology affairs is concerned; as new competing centers of technological excellence emerge, the U.S. will no longer be the sole or even the leading "rulemaker" or trend-setter in everything ranging from scientific breakthroughs to the setting of technical standards. Accordingly, it is incumbent upon the U.S.—the business, academic and government communities—to take stock of the features of this new playing field, to alter many of our existing operating assumptions about key success factors, and to prepare ourselves for a world of more intense competition and perhaps greater turbulence in the coming decades.

Just as we have witnessed important changes associated with the globalization of product and capital markets, we also are experiencing critical changes associated with the globalization of technology. Generally speaking, there is a more general awareness around the globe today regarding the strategic role of technology in driving both economic progress and international competition. In fact, technological advance has been upgraded to a national priority among many countries. Facilitated by the revolution in communications and transportation, the liberalization of economic and trade policies, and a combination of both increased domestic and foreign investment, new centers of pronounced technological capability have started to appear outside of the U.S., Europe and Japan. As the world's leading multinational firms seek to take greater advantage of critical knowledge and skill complementarities that now exist across a range of different economies, the processes of technological exploration and exploitation have become further globalized. In many instances, globalization has led to the more rapid movement of technology and know-how overseas at an earlier point in their so-called life cycle. The new core competency for success in this demanding environment of technological globalization is the ability to identify, harness and manage the forces for transborder innovation and technological advance. This holds true for universities as well as the commercial world. As Ghoshal and Bartlett have demonstrated in their seminal book *Transnational Management (McGraw Hill)*, the hallmark of competitive advantage in a world of globalization, is knowing how to link and leverage knowledge, information and people expertise across borders and cultures.

According to a business survey published in September 2004 by the *Economist* among 104 senior executives from the world's leading multinational corporations (Scattering the Seeds of Invention: The Globalization of Research and Development), 52% of the firms indicated they had plans to expand their overseas R&D activities over the next three years. The most crucial imperative among multinational firms is to shorten the time it takes to commercialize new innovations. The key to success, in this regard, is fully mining the global talent pool, which involves effectively tapping into "the new centers of scientific and technical excellence that are mushrooming around the world." In fact, it might not be too far fetched to suggest that, somewhat akin to the patent wars of the 1980s and 1990s, the United States is about to find itself in the midst of a global war for talent. Interestingly, in this regard, China was named the *top* destination for future R&D growth among 39% of those interviewed, closely followed by the U.S. (29%) and India (28%).

As indicated above, at the forefront of the changes associated with globalization stands China, a nation whose political leaders and technical community have placed great faith in the development of science and technology as a tool to enhance their country's modernization and international role. China's growing technological prowess has become an increasingly important catalyst in the evolving re-configuration of the world's manufacturing and knowledge networks. Cities such as Dalian, for example, are now being touted as emerging centers of excellence for providing software services for both regional and global markets. Currently, the most critical manifestations of China's technological advance lie in the steady quality improvements that already have occurred with regard to the country's human resource base and its physical infrastructure. In short order, the payoffs from ongoing economic reforms and structural change in the S&T system are likely to be more consistently realized as well, thus further drawing China into the mainstream of international S&T competition and cooperation. I would argue that the key issue for the United States regarding China's technological advance has less to do with how to respond to a potential Chinese technological threat or how to deal with China as a possible competitive adversary, and more to do with how we engage China as a strategic partner in a world where scientific progress and technological advance are no longer simply within the purview of one nation. More specifically, the real questions are *first*, whether, as a country, we can truly grasp—in both political and technological terms—and take advantage of the unique opportunities for our country and the world that derive from the emergence of more technologically capable China; and *second*, whether we have the political will and commitment to prepare, educate and train ample numbers of junior and senior professionals—scientists, engineers, and managers—who can interact and work effectively across borders and cultures with their Chinese counterparts. Our strategic goal as a nation vis-à-vis China should be to capture potential technological synergies, take advantage of evolving scientific and technological complementarities, and collaborate successfully to push out the frontiers of science and the boundaries of technology for the mutual benefit of American and Chinese citizens as well as the rest of humankind.

Stocktaking of Science and Technology in China

To understand China's growing role in global science and technology affairs, it is essential to appreciate a number of the critical changes that have taken place across the Chinese S&T system over the last 5–10 years. The decision of many foreign companies to establish substantial R&D centers in China is closely linked to the recent evidence of progress in a number of key areas.

China's leadership sees ongoing progress in science and technology as critical to addressing three of the most important policy problems facing the country: national security, competitive success in the global economy, and the creation of the conditions for ecologically sustainable development. As someone who has been working professionally on the study of S&T advance in the People's Republic of China (PRC) for about 25 years, it is clear to me that China has entered an important watershed period in terms of the operation and performance of its science and technology system. After undergoing two decades of structural reform that began under the leadership of Deng Xiaoping, the Chinese science and technology system is positioned for an important take-off—the question is no longer if this will happen, but rather when. In many ways, it appears as if 20+ years of preparation for national scientific and technological distinction are beginning to come to fruition, with China poised to become a major international player in science and technology if not, in the long run, a scientific and technological superpower.

The evidence for suggesting that China has reached such an important milestone comes from a broad array of data points across the PRC's S&T system. Let me discuss several of the most recent positive developments, all the time recognizing that China's S&T system is not some sort of unstoppable juggernaut that knows no limits; nor is it an example of a failed experiment in structural reform. China's recent progress cannot be ignored as the following two examples indicate: (a) the development of the Dawning-4000A computer, running at a speed of over 10 trillion operations per second (10 Tflops) and ranked tenth in the world in 2004 on the list of the world's top high performance computers and (b) the launch of Phase II of the Qinshan Nuclear Power Plant (Zhejiang) in May 2004, which marks the operation of the first large-capacity nuclear power station independently developed by Chinese engineers. There are others involving space as well as biotechnology and the human genome. At the same time, it should be realized that there still are numerous structural hurdles and resource constraints that China must overcome before it can begin to approach the comprehensive scientific and technological strength of countries such as the U.S. and Japan.

First and foremost, it is apparent that the inputs contributing to the formulation and implementation of science and technology policy in the PRC have become more sophisticated and globally oriented. China is now focused on creating and perfecting a fully integrated "national system of innovation," with the goal of bridging together those critical components needed to enhance the overall yield from growing investments by government and industry in research and development. Overall expenditures on R&D have now reached 1.3%, reflecting a rapid acceleration in spending on R&D over the last five years. Based on country data from the AAAS for 2003, China is now the third largest R&D spender in the world, trailing only the U.S. and Japan. And, while there are still considerable differences in the magnitude of spending on R&D between China and the U.S., it should be realized that increases in Chinese S&T spending have grown faster than the growth of the overall PRC economy according to statistics provided by China's Ministry of Science and Technology. Of course, we should be careful not to mistake quantitative growth with qualitative improvements as large components of the Chinese S&T system remain inefficient and ineffective users of available funds. Nonetheless, it also is safe to say that current Chinese policymakers and experts recognize that as they devote more resources into the S&T system, they also must attack, with great vigilance and steadfastness, the problems of bureaucratic red tape and organizational inertia that remain in numerous parts of the system.

Second, driven by a combination of economic reform and globalization, China is engineering the formation of a new technological architecture, one that is helping to re-define the rules, structures, and standards that have been in place over the last several decades. This does not mean that government has disappeared from the S&T landscape; through continuing state-sponsored high technology promotion and commercialization programs such as 863, 973, Climbing, Torch and Spark, the central government remains a major force behind China's effort to catch up with the West. The most compelling example of continued government leadership is embodied in State Council Document #18 issued in mid-2000, which continues to provide direction for growth of the software and semiconductor industries. That document was followed by a MOST initiative published in November 2003 called the China Offshore Software Engineering Project (COSEP), which has provided much of the impetus behind the further expansion of outsourcing activities, especially those targeted at the United States and Europe.

Nonetheless, like a gradual but steady volcanic eruption, the old elements of the planned, Soviet-style system are now progressively being pushed aside as the core features of a new science and technology system emerge. A good example of the Chinese willingness to be bold and even provocative is reflected in the Knowledge Innovation Project (KIP), a major reform initiative that has been introduced by the Chinese Academy of Sciences. The KIP project involves a significant restructuring effort inside the CAS organizational framework, leading to the closing down of a number of non-productive research institutes, the merging of others, and the introduction of new commercial incentives to ensure that CAS research activity is more closely linked to the needs of the economy. While we have not yet seen the full impact of the KIP project on R&D activity inside the CAS and there still are an assortment of obstacles to overcome, it is clear that there has been a major shake-up and the changes are anything but modest in terms of moving away from the often rigid modus operandi of the past and establishing new financially-oriented metrics and performance drivers for promoting a more innovative culture.

Related to the changes occurring in the CAS is the growing role of the enterprise as the major source of R&D spending in China. Chinese enterprises accounted for over 60% of the money spent in 2004 on R&D in China, a major change from the situation that existed when the S&T reforms were introduced in 1985. Chinese firms such as Huawei, Legend, Haier, Founder, etc. are now joining foreign-invested firms in helping to define the cutting edge for technological advance in China. Foreign investment has served as an important ingredient in helping to stimulate rather than constrain local technological gains, though the short-term focus of many Chinese companies does inhibit the creation of a real "culture of creativity" inside many PRC enterprises. George Gilboy, Edward Steinfeld and others have argued that we have yet to see firm evidence of true innovative performance coming out of Chinese industry. This is no doubt reflected in a close scrutiny of Chinese data regarding increases in high technology exports. The overall level of these exports indeed may be growing, especially in the IT and telecom fields, but still largely (though not exclusively) on the basis of products generated by foreign invested firms or through the assembly of parts, components and sub-assemblies imported from abroad. Nonetheless, I would argue that there also is discernible evidence of real progress taking place—as a result of new competitive pressures associated with WTO commitments, the continued opening up of the Chinese economy to competitive forces, and the expanded return of larger numbers of PRC nationals from abroad. The bottom line is that we are beginning to see an important convergence of critical success factors that will only enhance innovative performance inside Chinese industry. The path for China's technological future has been spelled out quite well in the following quote in Murtha's discussion of LCD technology in South Korea:

> "Stepping forward into ongoing, knowledge-driven competition begins by taking a step back, recognizing that the point of entry is not a teacher's position, but that of a student. Follower companies can often take advantage of equipment, materials, licenses, process recipes, and consulting services that encompass important elements of the knowledge created by predecessors who have started from nothing. Creating the vital resources needed to succeed in a knowledge-driven industry, however, does not begin with purchasing state-of-the-art technology, but rather with creating a basis in people for learning how to use it. Often this means entering the industry with current generation technology, achieving commercial yields, and running at efficient scale to build up the knowledge foundations necessary to seize a leadership position as the next generation emerges. Substandard returns or losses that come with late entry in current technology amount to tuition, reimbursable through timely entry to the next [technology]." From: Thomas Murtha, et. al., *Managing New Industry Creation: Global Knowledge Formation and Entrepreneurship in High Technology* (Stanford, 2001)

Third, there has been an appreciable improvement in the university sector in China. Not only has the system grown in terms of its capacity to produce larger numbers of university graduates—only a few years ago, only 3–4% of high school graduates could enter university in China—today that number has jumped to approximately 17%. China is now graduating more IT engineers than India; the Chinese churned out about 350,000 IT graduates in 2004 compared to 300,000 in India and 50,000 in the U.S. In addition, there is appreciable evidence from discussions with a broad range of foreign-invested firms in China that the quality and skill levels of graduates in the fields of science and engineering also have risen, though not necessarily evenly across the education system. Major investments have been made in providing new equipment and related resources to upgrade university laboratories and associated facilities. This enhancement of the physical infrastructure has been complemented by the steady improvement in the quality of the faculty. Problems of nepotism and faculty "inbreeding" are being attacked as the Chinese take on the challenge of creating a number of truly world class universities. Here again, these improvements admittedly have not been homogenous throughout the system, with university campuses in the West generally lagging behind those situated along the coast. There also are a large number of graduates that remain unemployed after graduation; estimates are that between 750,000–900,000 will have difficulties finding work this year. Nonetheless, China's universities have shown some remarkable progress that cannot be ignored when looking at the country's human resource endowment, particularly as the demand for higher skilled individuals increases in the years ahead.

Based on data from MOST, China now claims to have the second largest stock of scientists and engineers in the world, with the U.S. still holding the number one position. That number reached approximately 1.3 million in 2004. Of course, on a per capita basis, the Chinese situation still reflects a comparatively weak position, with China being significantly behind Japan, Germany, France and Russia as well as the U.S. The highest quality professionals remain concentrated in Beijing, Shanghai, and Shenzhen, a situation that must be changed if scientific and technological progress is to diffuse to the country's Western regions and lesser developed areas. Experienced research managers and project leaders also remain in short supply, a fact that continues to be one of the key drivers behind recent PRC efforts to court more Chinese who hold positions in industry and academia in the U.S., Europe and Japan to return home to take on leadership roles. There is solid demographic evidence in various scientific and technical fields that China still continues to experience a "talent fault," that is, the after-effects of the damage to the country's talent pool wrought by the Cultural Revolution, with shortages in the numbers of senior, experienced technical and managerial talent still quite apparent.

Finally, and most relevant for purposes of this hearing, China has stepped up its interest in further internationalization of its science and technology system. From the perspective of bilateral science and technology relations, while the Sino-U.S. S&T relationship continues to grow in several areas, it continues to under-achieve in many others. One reason is that the S&T component of our relations with China frequently has been treated as the icing on the cake in the face of other larger U.S. foreign policy concerns; from the Chinese perspective, however, access to U.S. science and technology resources has been the cake itself! The unfortunate demise of the U.S.-China cooperative program in management because of inadequate funding is just one example of a failure on the part of the U.S. to fully appreciate key ways to reap benefit from as well as shape the evolution of the Chinese system. On the other hand, China's S&T relations with the European Union have become especially strategic; the European Union sees the net addition of Chinese scientists and engineers to their own S&T programs as a key asset in its competition with the United States. China sees Europe as an alternative partner to the U.S., with the Europeans seemingly being more willing to place political considerations on the back burner while they focus on the mutual benefits of enhanced S&T collaboration with the PRC. More broadly speaking, Chinese scientists and engineers are becoming important participants in international science and technology affairs and are contributing an increasing share of papers to the world's technical literature, with there being growing evidence that the work of Chinese researchers is being cited in Western journals with increased frequency in fields such as nanotechnology, biotechnology, etc.

Even more profound, however, are developments that have occurred on the commercial side of the equation. China continues to have a voracious appetite for acquiring foreign technology, and as noted by *Business Week*, unlike Japan, there is no "not invented here" syndrome in the PRC. While financial constraints made it necessary for the Chinese to rely heavily on foreign investment during the first twenty years of the open policy, there clearly is now a stronger emphasis on securing access to know-how rather than equipment and process technologies to support manufacturing. The PRC government has introduced legislation over the last several years to make it attractive for foreign firms to bring not only manufacturing and distribution to China, but also to fill out the value chain and engage in R&D activities as well. Estimates are now that there are over 700 foreign R&D centers in China, with the number increasing steadily every six months or so.

We must remember it was not too far in the past when many foreign firms remained skittish about doing business in China and were skeptical about the staying power of China's reform program. Since the early 1980s, Chinese leaders have been quite forthcoming in declaring their intentions regarding the import of foreign technology and equipment to support China's modernization efforts. At that time, China lacked a growing market as well as a normalized business environment to attract many foreign firms, especially when it came to the transfer of high technology. And, to the great frustration and chagrin of Chinese leaders during this period in Sino-U.S. relations, COCOM and U.S. export controls further diminished Chinese access to state-of-the-art know-how, especially in the telecom, computer and microelectronics sectors. Today, however, that situation has changed in a fundamental way. China is now deeply embedded in the framework of global business and commerce. In the 1980s, management gurus such as Peter Drucker argued that American companies had to have an appreciable presence in Japan to be a true global player; today, those companies striving to position themselves globally will not be successful unless they have a significant presence in China, and not simply manufacturing and marketing, but increasingly, as suggested, research and development. Similarly, in the 1980s, Japan specialists such as James Abegglen and others suggested that the Japanese would continue to be the principal economic and technological force in the Pacific Rim for the foreseeable future. Today, however, we can say that a fundamental shift has occurred in the Pacific Rim technological order; Japan's once untouchable position as the premier technological power in the region is steadily, albeit gradually, being challenged by the continued rise of China.

There appears to be an increasing level of coherence as well as serendipity between the imperatives driving Chinese science and technology strategy, international competitive trends, and globalization. The need for new, expanding markets among multinational firms seems to fit nicely with the timing of China's increased market openness along with the growing prosperity and sophistication of Chinese consumers. More specifically, the Chinese value proposition—market access for technology transfer—has become a meaningful attraction for many of the Global Fortune 500. In addition, the ability of multinational firms to tap into China's labor pool and take advantage of the rapidly upward learning curve among many Chinese enterprises fits well with the Chinese desire to sustain high levels of employment and to expand technology-intensive exports. Gaining higher and higher levels of technological mastery has allowed China to assume a more central role in the global supply chain across key industrial sectors, including telecommunications, electronics (consumer and industrial), and information technology. Moreover, the growing desire among multinational companies to capture China's knowledge assets to enhance their local and global competitive position dovetails nicely with the PRC's objective of gaining expanded access to foreign know-how in design, product development, engineering, etc. Many multinationals now see it in their strategic interest to have a substantive R&D presence in the PRC. In essence, China has become the new battleground for the playing out of U.S.-Japan-EU-Korea competition. Winning or losing in China now has global implications in terms of international competition in everything from pharmaceuticals to telecommunications. This means that newer, more advanced technologies are steadily being brought into China as various multinational companies seek to leverage their core technological strengths for competitive advantage in the PRC and abroad.

The rapidly expanding flow of foreign R&D into China has been complemented by a steadily growing, albeit much smaller, flow of Chinese R&D investment abroad. These investments are largely focused on establishing technological listening posts overseas to further facilitate the upgrading of China's technological base. Huawei, the leading Chinese telecommunications equipment manufacturer, has over ten such listening posts across Asia, the U.S. and Europe. Along with helping to support Huawei's global aspirations, these operations also serve as a magnet for recruiting Chinese talent abroad, especially among those who are not yet ready or willing to return to China after living and working in the U.S. for several years. The vibrancy of the Chinese technology networks around the world is one of the most dynamic elements in helping to explain the progress that has been made since the mid-1990s. In fact, Chinese information networks, which increasingly are linked to vibrant capital networks, already have become a steadily potent mechanism for helping to steer China onto a more innovative path. In this regard, the strategic role that Taiwan has played cannot be ignored, especially with respect to the IT sector and recent progress regarding development of the Chinese semiconductor industry.

To more fully encapsulate the impact of globalization on China's technological trajectory, I would like to offer four key hypotheses that we ought to consider as we contemplate how far and how fast the Chinese S&T system may progress in the coming years.

1. Unlike a number of other developing countries that have felt threatened or under attack by the forces of globalization, China seems to have embraced the onset of globalization. Globalization is now viewed as a strategic process for obtaining increasingly unencumbered access to state of the art technologies and know-how.
2. More and newer technologies are flowing into China at an earlier point of time in their life cycle than has occurred in any other developing economy since the end of WWII. The product life cycle, and associated technology life cycles, have been turned on their head in the Chinese case, even as complaints have proliferated and continue to abound regarding the leakiness of the PRC system for protecting and enforcing IPR.
3. The real strategic value of China for the majority of multinational firms lies not in simply gaining access to cheap labor, but rather in accessing China's higher end brainpower, that is, the cadre of heretofore under-utilized or inefficiently utilized scientists and engineers who are now part of a "global" talent pool.
4. More and more multinational firms will not only be setting up R,D&E activities in China, but they will be looking at the PRC as a strategic partner within their overall global innovation system, leading to even greater technological sharing, e.g. Alcatel Shanghai Bell.

I want to stress once again that the picture I am painting is not either of an infallible China or of a Machiavellian China surging forward at the expense of the rest of the world. Rather, what we are seeing in the Chinese case are the results of 25 years of knowledge absorption and learning starting to kick in. Traveling to China 4–5 times a year for the last 20+ years, I continue to be impressed by the inherently more open and sophisticated nature of the discourse that is taking place across Chinese policymaking, business and academic circles. And, I also have been impressed by the growing transparency of the debates regarding science and technology issues. Foreigners, once largely isolated from policy discussions in China, are now asked to render opinions and conduct investigations about the degree to which progress has been made. The recent invitations provided to a broad range of foreign experts to offer their ideas regarding China's 15 Year Comprehensive Long-term Science and Technology Plan is just one such example.

"Grabbing the China Market By Harnessing the Chinese Wisdom"

Foreign R&D in China

In the last part of my presentation, I would like to discuss some of the features of foreign R&D in China as a way for us to better understand where the future might take us in terms of the interrelationship between the U.S. and Chinese S&T systems. In the late 1970s, as part of the so-called "new international economic order," many multinational firms set up R&D centers in developing countries as a way to exhibit their commitment to technology transfer and Third World economic development. In the majority of cases, however, these R&D centers were largely "hollow" operations, with little of substance—research or training—taking place inside except for some local product adaptation. Today, we see somewhat of an opposite picture emerging in the case of China. While clearly not all of the 700+ foreign R&D centers are engaged in state-of-the-art research—basic or applied—and most have eschewed a focus on basic research, there are a growing percentage of foreign companies who are filling out their complete value chain in China by deepening their R&D activities as part of a strategic global re-positioning of their business.

Like many other critical transitions in China's economic modernization drive and its relationship with the outside world, the growing role of foreign R&D in the PRC is being driven by a confluence of government and market forces. First, as indicated earlier, the Chinese government has emphasized the importance of strengthening the country's technology base and upgrading the innovative potential of PRC enterprises. Accordingly, in April 2000, MOFTEC (now MOFCOM), issued Circular Waijingmaozifa #218, which basically formalized the status of foreign R&D centers in China by providing guidance and details on the rules for their establishment. In April 2002, MOFTEC's foreign investment legislation was modified to change R&D activity from a "permitted" to an "encouraged" form of foreign investment. These new policies complement a series of related changes that have taken place with regard to the importation of foreign technology. Moving away from the restrictive regulatory regime of the 1980s and 1990s, in 2002, Beijing radically revised the existing legislation regarding foreign technology imports. In essence, the spirit and intent of these revisions has been to promote smoother and faster movement of technology and know-how into China by shifting the PRC government emphasis toward approval rather than tight control.

Under the new rules for foreign R&D centers, ownership structures can vary from equity joint ventures to wholly-owned enterprises. To qualify for formal R&D status, however, 80% of the staff must hold a college degree and be involved in actual R&D activities. Two types of R&D activities are permitted under the legislation: (1) an R&D center whose main purpose is to engage in the general transfer of know-how to any entity; and (2) an R&D center that is controlled by a parent firm and is involved in research for which it will be reimbursed expenses plus a reasonable profit. In the latter case, the expectation is that the IPR belongs to the parent sponsor. R&D centers, however, cannot engage in so-called "technology trade" that is not the product of their own research and development efforts. These foreign R&D centers are eligible for a range of tax incentives as well as tax relief for equipment imported to support the R&D activities. In addition, the Chinese government has committed itself to easing visa requirements to enable entry and exit to/from China for both locals and foreign nationals employed at the center. Moving beyond the preferences offered by the central government, both Beijing and Shanghai have issued their own regulations to further encourage foreign companies to set up R&D operations in their respective cities; some of these regulations are aimed at attracting expertise from outside China's coastal areas by awarding residency permits, etc.

A second driver behind the growth of foreign R&D centers in China revolves around the issue of technical standards. Since the mid-1990s, Chinese government policy has placed a greater emphasis on acquiring technical know-how to enable local industry to gain a greater percentage of the revenues associated with licensing and technical standards. In January 2005, XU Jianguo, Vice Director of MOST's Development and Planning Department, announced that the Ministry will provide a new injection of funds into R&D for the purpose of establishing 29 international technical standards. The original program, which began in 2002, now involves more than 2,100 scientists and experts working in such fields as environmental protection indicators, trace element examination, textile safety, broadband local area networks, and RFID. Given the steadily expanding size of the Chinese domestic market and the potential weight of Chinese market power on an international level, foreign firms have been anxious to shape or influence China's decisions regarding which standards are being adopted in telecommunications, software, computers, pharmaceuticals, etc. Perhaps no area better illustrates how the competition for standards setting has drawn in foreign R&D investment than mobile telephony. Siemens, Nokia, Ericsson and Motorola have all made substantial investments in building out R&D operations in China in this highly competitive sector. Nokia, for example, used its R&D capabilities as leverage to secure a position in the CDMA handset market in China, while at the same time hoping to secure an advantaged position by working with its Chinese counterparts on further development of CDMA technology. As the requirements and sophistication of Chinese consumers continue to rise in the highly dynamic mobile phone market, local R&D is needed to get new products into the market quickly and reliably, thus helping to set trends and win market share.

Cost-cutting considerations are clearly a third driver for attracting foreign R&D to China. The data seems to vary from city to city and from province to province, but the fact remains that the loaded costs of employing and supporting an engineer in China run about 20–25% of a U.S. counterpart. The issue, however, is not always one of cost-based substitution. In many instances, the movement of R&D to China by foreign firms also reflects a desire to create a critical mass of talent, at affordable rates, that can be utilized to focus on an auxiliary problem or alternative technical solution that otherwise might be ignored and bypassed due to lack of available staff and funds in the U.S. Moreover, the presence of an advanced technical team in China, especially with local language skills and cultural familiarity, gives the foreign firm a better chance to work with local suppliers and vendors to ensure that domestically manufactured parts and components meet required levels of quality and performance. Once local Chinese R&D teams can be integrated culturally and operationally within the global R&D infrastructure of a large multinational firm, they are ready to service global markets as well as the local Chinese marketplace. This is clearly the intention of firms such as Microsoft, IBM and GE—all of whom have steadily grown their research presence in China.

Professional services companies in the human resources field, more commonly known as "headhunters," have found that the demand for their services has substantially increased over the last 2–3 years. In the 1980s and 1990s, the major headhunters, mostly based out of HK and Singapore, spent the bulk of their time finding appropriate expatriates to take top managerial assignments in China. Today, they have expanded their operations to Beijing and Shanghai, and their principal focus is largely on identifying experienced PRC nationals in China and abroad who wish to return home to assume a leadership role in these types of foreign-invested R&D centers and technical organizations. Chinese scientists and engineers, at home and abroad, are drawn to working in foreign R&D organizations because of the nature of the projects, the opportunities for training and travel overseas, better salaries (though not always), and more varied career opportunities. As the staffing needs for these foreign R&D operations have grown, the result has been the creation of an emerging internal brain drain problem, with some of the best and brightest Chinese talent forsaking opportunities with domestic companies and government labs for the seemingly more exciting career path in foreign-invested organizations.

Fortunately or unfortunately, depending on one's perspective, this problem may be short-circuited by the further growth of technological entrepreneurship in China. There is a saying in Chinese, "it is better to be the head of a chicken than the tail of an ox" [ning wei ji tou, bu wei niu wei]. The high turnover rate for junior- and mid-level talent in both foreign-invested and domestic R&D operations reflects their apparent willingness to further "jump into the sea" and embark down an entrepreneurial path that increasingly involves starting their own firms. This is not much different than what happened in Taiwan in the late 1970s and 1980s in Hsinchu Park, when many local engineers left employment with foreign companies such as Motorola and General Instruments to open their own firms—sometimes with indirect government support and even encouragement. One particular difficulty that has already arisen in China from the rapid circulation of such technical talent, however, deals with the security of IPR and adherence to confidentiality agreements contained in employment contracts with their foreign employers. With many foreign firms utilizing trade secrets and not always patents to protect their IPR, it is sometimes hard to prevent critical know-how from being used inappropriately in some of these start-up firms. This also is the case with some returnees from abroad, who have left positions with U.S.-based firms to begin an entrepreneurial journey in China.

There are a range of other drivers that account for the step up in the number of foreign R&D centers being established in China. Some of these factors exist on the "push" side rather than the pull dimension. They include tax and visa policies at home in the U.S., the growing pressures on compensation and benefits packages, and overall problems regarding the availability of well-trained technically-oriented individuals. Most critical, however, remains the imperative of global competition, which continues to be creating more pressures for more sustained innovation, greater customer responsiveness, and more rapid commercialization of new products and services. China's role in this regard promises to be anything but passive. PRC government policies are distinctly based on the notion that the expanding number of foreign R&D centers will serve as a catalyst for sparking new innovative behavior throughout the economy.

Heretofore, it is safe to say that the contributions from foreign R&D activities in China still remain limited, though this has much to do with the fact that the phenomenon is still in its early stages of development. A number of important questions remain, nonetheless. For example, will foreign R&D in China become an integral part of the PRC's national innovation system? Is there a formal capture strategy in place or being conceived by the Chinese government to ensure that the contributions from R&D can be absorbed? And, is China's national innovation system structured and developed to the point that it can maximize the benefits from being steadily embedded in a comprehensive web of global knowledge networks in world science and international engineering? At the present time, the response to these three key questions would seem to be, "stand by, the answer is yet to be fully determined." That said, from both a policy and organizational perspective, there has been growing evidence that the Chinese S&T system is indeed pointed in the right direction as it seeks to optimize the growing presence of foreign R&D activity. While the direction of China's technological progress may not be always linear, aided and abetted by the development of continuously more cohesive relationships with the world's leading technology-based corporations, the pace of progress will likely be more rapid than we might anticipate.

To get more specific, so far, the identifiable contributions from foreign R&D in China seem to lie more in the world of intangible benefits rather than concrete ones. Nonetheless, they still are critically important as a precursor to more rapid Chinese technological advance. They fall into the following areas, many of which in the past have been areas of major weakness for the PRC:

- Training: technical training, cross-functional/cross-cultural teaming, and product and process design methodology, esp. electronic design automation for shortened design cycles;
- Technology transfer: the diffusion of "uncodified" trade secrets rather than specific patented information;
- Standards: best practices, industry standards, performance metrics, and quality requirements;
- Software: programming methodologies, software design architectures, systems integration techniques, and overall testing procedures and quality assurance;
- Management: project management, business management, and management of knowledge workers;
- Networks and information resources: participation in global knowledge networks;
- Spin-offs: new business ventures and entrepreneurial activity; and
- Spillovers: technical assistance to vendors and suppliers.

In the final analysis, however, as Chinese policymakers fully recognize, the R&D activities of foreign firms in China are driven by the strategic agendas of these companies. To gain a deeper, longer term commitment from foreign firms in the R&D area, China will have to improve its overall enforcement of IPR protection. This also is true with respect to China's efforts to develop its software industry, especially if the country hopes to move beyond basic, low-end outsourcing activities. The need for better IPR enforcement is often affirmed by many academic, business and legal observers of the Chinese scene, though with little expectation that much will be done in the short term. Strong IPR enforcement also is necessary for MNCs to be willing to engage in more extensive basic research in China. Securing this type of scientific-oriented research is very much coveted by China's S&T leadership. Venture capital will be hesitant about supporting technological entrepreneurship if there continues to be pervasive apprehension that IP rights cannot be made secure. Based on the experience of other Pacific Rim economies, the key to solving the IPR problem in China actually lies in the degree to which the roots of local technological entrepreneurship take hold. With locally created IP at risk, the appropriate conditions will exist for local government and enterprise stakeholders to make progress in cracking down on those who violate foreign and domestic IP rights.

Implications for the United States

At the beginning of this presentation I raised two critical questions: (1) whether we fully grasp the ramifications of the new globalized technological environment of the 21st century—in which China is becoming a key player; and (2) whether as a nation, we have the will and capabilities to prosper as new rules kick in and new success factors are defined. Coming to a better understanding of the prospects for future Chinese scientific and technological development is of considerable importance for evaluating and managing the consequences of China's political, economic, and social evolution in the coming decades. There are those that would discount the importance of China's emergence in the realm of science and technology simply because they do not see ample evidence of substantial Chinese progress at this time. In this group, are those whose analysis of China's S&T system tends to emphasize the shortcomings of Chinese R&D performance and the continued lags in innovative capability. At the other end of the spectrum are a range of analysts who tend to be alarmists about China's emerging technological capabilities, raising, at times, exaggerated concerns about China's ability to acquire—through legal or illicit means—as well as absorb and assimilate all types of know-how and equipment from abroad. In reality, both perspectives suffer from the same weakness—they fail to capture the complexity and dynamism of the rapid pace of change both inside and outside of China.

Globalization, complemented by economic reforms and structural changes in the S&T system, has changed the playing field for the PRC. The Chinese leadership, once seemingly daunted by the forces of interdependence and globalization, now sees enhanced opportunities for China to gain access to advanced technology and know-how. Thinking about Chinese behavior in terms of a tension between the forces of techno-nationalism and techno-globalism actually creates a false and somewhat inaccurate dichotomy for understanding China's current international orientation; these two seemingly contradictory constructs are really part of the same behavior, with techno-globalism and techno-nationalism intertwined in a single, synergistic relationship with one another. Techno-nationalist imperatives drive Chinese techno-globalist behavior, fostering expanded economic reforms and greater openness—both of which, in turn, facilitate more foreign involvement in the PRC economy through FDI, technology transfer, and the establishment of foreign R&D centers. Techno-globalist actions support Chinese techno-nationalist goals and objectives as broader and deeper engagement with the international science and technology system serves as an enabler for strengthening domestic technological capabilities. While not completely devoid of their old penchant of seeking technological self-reliance, China's current leadership seems to grasp the tremendous utility that comes from embracing (rather than attempting to thwart) the opportunities for cross-border cooperation and collaboration generated by increased globalization.

The United States must take a new look at the tremendous opportunities to be derived from China's scientific progress and technological advance. An enhanced ability by the United States to tap into the steadily growing and improving human resource and technological assets inside of China—from universities to government think tanks to high tech enterprises—will only help to enhance our own country's innovative potential. In spite of some noise in the U.S. media, the good news is that American firms are at the forefront of understanding the meaning of China's new global economic and technological posture, though in concert with the recent NII report by the Council on Competitiveness, they also seem to grasp the dangers ahead if the United States does not expend the resources needed to upgrade our own education system and support critical research activities in both academic and commercial settings. A growing number of American universities as well are re-positioning themselves to take advantage of the opportunities for cross-border research collaboration created by recent S&T progress in the PRC and several other countries. It will not be long before a large percentage of American universities enter the borderless world, with the walls surrounding traditional academic departments coming down and departmental faculty being dispersed around the world instead of being physically co-located in one geographic venue.

As things currently stand, however, there simply does not seem to be enough appreciation in Washington, DC for how we "win" in the changing globalized world of the 21st century. The United States Government needs to invest more in the training of a whole new generation of future leaders who are, at the same time, more cross culturally aware, more managerially adept, and more technologically savvy than their predecessors. To be sure, we must be more expert in our ability to monitor and analyze developments in the Chinese S&T system; we currently lack sufficient numbers of faculty and graduate students who are preparing for careers that would have them delving deeply into the emerging pockets of scientific and technological excellence in places such as China. Moreover, we also must have a cadre of individuals who are adept at seeking out opportunities and working on team-based, collaborative projects with relevant counterparts from around the world whose names may be even more difficult to spell than pronounce. America's technological future is not simply tied to protecting and advancing our own national system of innovation, but rather in creating and developing a global system of innovation, with the U.S. in a leadership role by virtue of our enhanced global awareness and cognition. The rise of China gives us a unique chance to test the efficacy of our global commitment. If we simply envisage China as a foreboding technological threat—potential and real—we are more likely to adopt behaviors towards the PRC that will increase the chances of that becoming a reality. Or, we can view China as an increasingly capable strategic partner that affords us critical opportunities for seizing upon real and potential technology synergies and complementarities. As the Chinese look on, our actions will clearly set the tone. The final choice remains ours to make.

Chairman D'AMATO. Thank you very much, Dr. Simon. Ms. Walsh.

STATEMENT OF KATHLEEN A. WALSH
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Ms. WALSH. Well, thank you very much. I'm pleased to be here, once again, to talk about this very important issue. I commend the Commission for taking it on and having such a cross-section of experts explore this issue. I am particularly pleased to be on such an esteemed panel. I've been reading and exploiting the works of my colleagues here for many years, so.

I'd like to just talk about one issue in particular that I probably know the most about which is the foreign R&D presence in China. There have been some new developments and some interesting dynamics that I think merit the Commission's attention.

As my colleague mentioned, there seems to be a growing number of foreign R&D centers appearing in China. I think, more importantly, the Chinese have seen this themselves as an important issue, warranting their research and analysis. The Ministry of Commerce think tank recently put out a report. I haven't seen it myself. I've only seen excerpts in the Chinese and international press, but it does cite the number of 700 overall foreign R&D centers in China.

To my understanding, based on my past research, this seems to be a very fast pace of R&D investment. Frankly, I question these statistics. I don't know how they were measured and the process, and I know too that the number of 600 was used in June 2004.

So we have to dig deeper into that area to find out what is causing this rate of growth and whether they really are experiencing a rate of growth of 200 new R&D centers a year. If so that would be phenomenal. If not, I think it's still important because there is a lot of activity going on in China and it's concentrated in urban areas that are increasingly becoming clusters around China's east coast areas. So it's a growing trend, clearly, and one that the Chinese themselves find to be important to their own developmental efforts.

Its impact which the Commission is interested in is still unclear in my view, what impact this foreign investment is having on China's own developmental capabilities. The data is, as Dr. Suttmeier mentioned, hard to interpret. And you can interpret it two different ways, the glass is half full, or half empty, and we're in the process still of doing that. But to my mind I think earlier studies on the phenomenon of technology transfer, in particular, about the elevation from production to R&D, tends to show in China and beyond that there is a transfer of technology and learning from these foreign R&D centers. The data is hard to come by, but the phenomenon seems to be playing itself out repeatedly. And we can assume I think at least some of this is happening in China as well.

But more recent data that I think the Commission should definitely take a look at, if they haven't already, is some research done by Gary Jefferson at Brandeis and some of his colleagues. He's working with the Chinese Ministry of the National Bureau of Statistics, and Ministry of Science and Technology to try and interpret the data that they themselves have collected. I think it's very important work.

I look at it and I say it shows that there is not only the technology transfer from the foreign R&D centers, but his research seems to indicate that the Chinese themselves are becoming more innovative, that if you look at Chinese high-tech exports and high-tech manufacturing, that not all of this can be attributed to foreign investment, that the Chinese themselves are becoming more innovative and even more efficient in terms of their R&D productivity when contrasted with international statistics.

So I think this is very important work and it provides some statistical evidence for the phenomenon that we're looking at. It's not clear exactly where this trend is headed. Certainly Dr. Suttmeier's suggestions that this could have some two steps forward, one step back characteristics, I think is a very important consideration as we look at China's potential. But his research, too importantly points out that China is moving ahead technologically very quickly.

According to both the internationally-recognized and comparative S&T statistics, China is moving ahead quickly, continues to do so; and the data suggests perhaps that China could experience a rapid acceleration of capabilities, moving from the developing world to more online or on par with developed countries and the world's most advanced economies.

Looking at the R&D intensity, the R&D spending-per-our-GDP statistic, you can look at it in different ways, but I think that it rings true to me that China could potentially achieve a rapid acceleration in the science-and-technology capabilities, which I think begs the question not of whether China will do this, but as Dr. Simon has said, when and how sustainable China's growth will be. I think that's an important question for the Commission to take a look at, and what this will depend on. Obviously it will depend on continued FDI, but can China achieve this rapid advance and then sustain it and, what are the implications of that—I think this is an area that bears greater attention.

But I think, my view is that China has put in place the infrastructure and the education and the resources that it needs to develop a more innovative system of its own—if Dr. Jefferson's analysis is correct; that the Chinese enterprises themselves are becoming more innovative and that the spillover from foreign R&D centers in China is more indirect or intangible than it is tangible—which rings true with my research—then that says a lot about China's capacity down the road. If they are in fact doing this more themselves than via a direct transfer of know-how from the foreign R&D centers, this is an important indicator.

One other issue I'd like to raise just briefly. I raise it not fully understanding the phenomenon at all but having learned that this is a new dynamic happening in the China market. I raise it as an area of future research, which is, as I mentioned in my testimony, the CJK model, "CJK" standing for or shorthand for China, Japan, and Korea.

In addition to the techno nationalist and techno globalist phenomenon we've discussed, there appears also to be a more techno regional approach to technology development in R&D, akin, of course, to the greater China dynamic that we saw in southern China, Hong Kong, and Taiwan as well in an earlier era; that there may be a broadening today of this regional collaboration. The Chinese, Japanese, and Koreans have signed agreements in the IT sector to collaborate to develop new technologies.

I mention one example that I found in the press, this Linux-based system called Asianux that has been co-developed by companies from these three countries. In conversations in Beijing, both with industry analysts and representatives of each of these countries—although I didn't speak to the Japanese about this—this is a trend that they all are fostering, that is, the complementarity of their technological and economic structures nationally and as well as industrial interests, that they see that this complements each parties' interest in collaborating. And so whether the U.S. will have a role in this in the future I think is a very important question that the Commission may wish to take a look at.

I'll stop there and look forward to the questions. Thank you.

[The statement follows:]

Prepared Statement of Kathleen A. Walsh
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Thank you Commissioners D'Amato and Mulloy and other Members of the Commission. It is my distinct pleasure to speak before you once again, particularly in the company of this very esteemed panel.*

It is particularly fitting that this meeting be held at the heart of U.S. high-tech innovation. That Silicon Valley and other technology centers around the United States remain home to the world's most successful and competitive technology innovators is in America's strategic and economic interest. China's recent science and technology (S&T) advances and growing innovative capacity present a new challenge to U.S. innovation, but not yet one that is overtly threatening nor insurmountable. It is emerging quickly, however, and requires vigilant monitoring and constant analysis. Improving our understanding of China's S&T objectives, capabilities, and future plans will aid U.S. industry, if supported by the Executive and Legislative Branch initiatives, to maintain our competitive edge. So, I commend the Commission on holding this hearing and focusing on this vital issue.

In your invitation, you laid out several questions related to China's S&T efforts and issues related to funding, standard-setting, foreign investment, and foreign corporate R&D in China. Let me take each of these issues in order.

China's Science and Technology Policy: Current Priorities and New Directions [1]

The PRC government continues to play a central role in Chinese science and technology development as well as in promoting high-tech industry innovation. As is PRC government practice, Beijing continues to outline the nation's long-term priorities and plans for S&T development. The latest of these—the 10th Five-Year Plan (FYP) for 2001–2005—is coming to a close. Among the plan's objectives were to double GDP by the year 2010, to increase overall spending on research and development (R&D) to 1.5% of GDP (a goal carried over from the earlier 9th FYP), to prioritize spending on "pillar industries" and key strategic technologies (including information technology and electronics), and to reform China's state-owned enterprise R&D system in order to provide China with a capacity to leap ahead in its economic development. Foreign investment, as discussed later, plays an important role in China's plans and continuing S&T development efforts.

While a full account of the success (or failure) of this latest FYP plan must wait another year, it does appear that China has made strides toward its stated goals. Most measures of China's S&T input and output show continued growth, distancing China further from the developing world and toward levels common in more developed, Western economies. For instance, Beijing's spending on R&D reached 1.3% of

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[1] Much of this discussion is taken from material included in a paper entitled, "China's S&T Strategy: Drivers, Dynamics, and New Directions," prepared for a conference on "*Chinese Military Modernization and East Asian Security: Political, Military, and Defense Industrial Responses*" (Maui, Hawaii, Center for Strategic & International Studies, May 19–20, 2005).

GDP in 2003, putting the stated 2005 goal of 1.5% within reach. Attaining this goal would be an important achievement, placing the PRC on a fast-paced, upward trajectory and closer to the sustained level of R&D spending of about 2–3% that characterizes the world's most developed and technologically advanced economies.[2] In fact, statistical analysis of China's latest S&T output has led some to suggest that China could be in the early stages of an "S&T takeoff," which would have the PRC joining the ranks of the world's top-tier advanced economies within a decade.[3]

Yet, even if this comes to pass, a nagging question for both PRC policymakers and foreign analysts alike is whether China's success will be sustainable and how dependent it will be on continued high levels of foreign investment. There is no clear answer to these questions and much will depend on China's approach to high-tech development and foreign investment in the coming years. There are both worrisome signs ahead and indications of progress that might ease the way for China's high-tech development to be viewed as a win-win scenario by domestic and foreign investors. (It should also be noted here that China's economic failure would risk a troubling lose-lose situation due to the rising level of global economic interdependence, particularly in innovative, IT-based industries).

First a few words on issues of concern. From a U.S. perspective, China's recent efforts to pressure foreign high-tech investors to collaborate with leading Chinese firms in developing advanced technology (e.g., wireless data encryption, computer software, and secure personal computer terminals) are disturbingly reminiscent of pre-WTO Chinese regulations.[4] Other PRC government policies favoring domestic firms and technologies over, or to the exclusion of, foreign brands are also of continuing concern, particularly repeated stories of China's policy on software to be procured for government use.[5] Not only do such policies undermine the confidence of foreign investors in China's long-term market potential, but they risk China's continued high-tech development being viewed abroad as threatening to regional and global interests. Already, there is a rising level of alarm evident in industry and government circles over the rapid pace of international outsourcing and the movement of advanced R&D assets to China and other developing economies; implementing techno-nationalistic, protectionist policies such as these is likely only to reduce the level and type of foreign investment available to the Mainland over time and on which China's long-term S&T plans depend.[6]

Another, related area of concern is China's efforts to develop indigenous-design technology standards. While China's interest in doing so is obvious and represents a goal shared by many states, Beijing's approach to developing home-grown technology standards and their potential application to military technologies poses serious concerns for U.S. economic and security interests. The PRC is pursuing new,

[2] For data on China's S&T progress, see National Bureau of Statistics (NBS) of China, *Chinese Statistical Yearbook 2003*, no. 22 (Beijing: China Statistics Press, 2003); and National Science Board, *Science & Engineering Indicators—2004* (Arlington, VA: National Science Foundation, 2004). For context, see Albert Hu and Gary Jefferson, "Science and Technology in China," Prepared for Conference 2: "China's Economic Transition: Origins, Mechanisms, and Consequences," Preliminary Draft (29 October 2004), accessed online at http://people.brandeis.edu/~jefferso/res.html.

[3] According to Jefferson's analysis: "S&T takeoff is defined here as an abrupt increase in a country's ratio of research and development (R&D) spending to GDP from less than one percent to more than two percent. For these large, high-income economies, this remarkable acceleration in the ratio of R&D spending to GDP occurred on average within the span of a single decade." See Gary H. Jefferson, "R&D and Innovation in China: Has China Begun Its S&T Takeoff?," Prepared for the *Harvard China Review* (August 11, 2004), p. 1.

[4] The first case involving China's Wireless Authentication Privacy Infrastructure (WAPI) data encryption technology is well-known and initially required foreign invested enterprises to collaborate on development with a select set of domestic firms. This case was resolved, at least tentatively, with China's agreement at the 2004 Joint Commission on Commerce & Trade to indefinitely rescind it's policy. Another case recently reported in the media suggests that foreign pc makers will be expected to collaborate in some fashion with China's leading pc company, Lenovo, if interested in competing in China's future pc terminal market. Fiona Chou, "China's WAPI Evokes Foreign Protest," *Telecom Asia* (March 2004); Lenovo Launches China's First Security Chip, *SinoCast China Business Daily News* (April 12, 2005).

[5] See, for instance, Mure Dickie, "Beijing reviews rules on foreign software buying Procurement Policy," *Financial Times* (April 12, 2005). China is also reported to be favoring domestic firms to the detriment of foreign investors in other sectors such as semiconductors. See "China-IC-Policy," *China Business News Online* (April 7, 2005).

[6] See, for instance, articles on outsourcing to China and elsewhere appearing over the past year in *Business Week*, *CIO Magazine*, *Technology Review*, among other venues. Pete Engardio and Bruce Einhorn, "Outsourcing Innovation," *Business Week* (March 21, 2005), pp. 84–94; Christopher Koch, "Innovation Ships Out," *CIO Magazine* (January 15, 2005), online at http://www.cio.com/archive/011505/outsourcing.html; Corie Lok, "Where's My Job?," *Technology Review* (April 2004), pp. 74–75, online at http://www.technologyreview.com/purchase/pdf__dl.asp?79juh=337948&hy6f0=16564.

indigenously developed technology standards in a number of areas, primarily in the information technology sector, in an effort to become more competitive nationally, regionally, and across the globe.[7] Unlike most other markets, however, China's technology standards are often not the result of market competition, industry preference, or consumer choice but of PRCG priorities. Moreover, as reported in the latest report by the American Chamber of Commerce in China, ". . . member companies note a growing influence of standards working groups that either preclude foreign participation or attach certain technology sharing conditions. This is especially common where there is government-funded or encouraged R&D, or in sectors where strong resistance to foreign competition exists (e.g., construction and building materials)."[8]

While it is true that foreign investors not interested in abiding by Chinese standards have the ability to opt out, the reality is that the China market has become such an influential and integral part of the global economy that whatever standard(s) prevail on the Mainland is likely to have global impact as well. There are few companies, including multinationals, willing or able to compete against such a force.[9] Consequently, many foreign investors in the China market are quietly hedging their bets by developing new product lines compatible or interoperable with new or expected PRC standards.

Indigenously designed technology standards are also intended to aid China's military modernization efforts. PRC defense industrial modernization increasingly relies on commercial technology spin-on to defense applications.[10] As with the U.S. military, China is seeking to exploit the ubiquitous nature of dual-use technology in a global economy and the move toward modular production in both commercial and defense industrial development. The emphasis on technology standards developed to Chinese specifications is expected to help reduce China's vulnerability to foreign supply, enhance China's competitiveness, and to limit opportunities for possible hacking, backdoor programming, or sabotage by foreign agents. The process of developing indigenous technology standards could also aid China in overcoming the hurdle of advanced systems integration. Though normally considered an important chokepoint in China's development efforts (particularly on the defense side), systems integration could be less of an obstacle for China than generally presumed given ongoing R&D collaboration at foreign-invested R&D centers in China that often involve systems integration activities with, by, or for PRC partners.[11]

In fact, the number of foreign-invested R&D centers in high-tech industry sectors in China continues to rise, apparently rapidly. The latest statistics emanating from China's own studies of this phenomenon list the total number of foreign high-tech R&D centers in China at 750 (as of the end of 2004). China's statistics have varied widely over the past few years, with the most recent tally suggesting a one-year rate

[7] Richard P. Suttmeier and Yao Xiangkui, "China's Post-WTO Technology Policy: Standards, Software, and the Changing Nature of Techno-Nationalism," *NBR Special Report*, no. 7 (May 2004).

[8] The report also notes that creating new technology standards was highlighted recently as an overall strategy outlined by the Science & Technology and Education Leading Group (which falls under China's civilian State Council) in a draft report published in 2004 entitled "*Study on the Construction of National Technology Standard System*." The AmCham report also notes that the PRCG plays a "key role" by funding most and approving all national standard projects. See American Chamber of Commerce in China, "White Paper on American Business in China" (2004).

[9] Deloitte Touche Tohmatsu, "Changing China: Will China's Technology Standards Reshape Your Industry?" (July 2004), available online at <http://www.deloitte.com/dtt/cda/doc/content/DR_ChangeChina_July2004%281%29.pdf>.

[10] China's spin-on approach has evolved since Deng Xiaoping first announced the strategy of "Combining the Military and Civilian Sectors" (*junmin jiehe*). Today, the emphasis is less on defense conversion than on spin-on activities by civilian and defense industry enterprises for, or in concert with, China's military (the PLA or People's Liberation Army). China's emphasis on "coordinating military and economic development" is noted in Beijing's most recent *Defense White Paper*. See Information Office of the State Council, "China's National Defense in 2004" (December 2004). See also Tai-Ming Cheung, "Harnessing the Dragon: Civil-Military Integration and China's Defence Modernisation," Richard H. Yang, ed., CAPS Papers No. 36 (Taipei: Chinese Council of Advanced Policy Studies, January 2004), particularly pp. 4–5.

[11] On the commercial side, see Kathleen Walsh, *Foreign High-Tech R&D in China: Risks, Rewards, and Implications for U.S.-China Relations* (Washington, DC: Henry L. Stimson Center, 2003); and, for instance, "China, EU, and Galileo," *GPS World* (September 1, 2003). Regarding the defense sector, see Richard D. Fisher, "The Impact of Foreign Weapons and Technology on the Modernization of China's People's Liberation Army," commissioned report for the U.S.-China Economic and Security Review Commission, January 2004; and Eugene Kogan, "Russo-Chinese aerospace cooperation on the up: over 100 joint defence programmes are believed to be in progress; joint development of a commercial transport could be on the way," *Interavia Business & Technology*, no. 669, vol. 58; p. 17 (1 January 2003).

of growth of 200 new R&D centers in the 2003–04 period alone.[12] This would seem extraordinary. While the measures used in determining this and previous totals are unknown (and thus their accuracy uncertain), indicators elsewhere also show the rate of overseas high-tech R&D investments rising at a fast clip. Statistics from the U.S. Bureau of Economic Analysis show that U.S. R&D investments in China have risen exponentially (from $7m in 1994 to over $500m in 2000), achieving the 11th spot overall in 2000 in U.S. overseas R&D investments (up from 30th place just six years prior). Given the rapid acceleration of foreign-invested R&D in China in the years since, it is likely that the Mainland holds an even higher place in overseas U.S. R&D investment today.[13] In addition, a recent survey on the "Globalization of R&D" conducted with 100 senior high-tech executives by the Economist Intelligence Unit found that the majority (39%) favored China as the site for future overseas R&D investments over the next three years; the U.S. trailed at 29% and India at 28%.[14] Thus, foreign R&D investments in China represent an important trend and likely key, contributing factor to China's high-tech development. Beijing supports this trend by continuing to provide attractive investment, tax rebate, and other financial incentives to foreign investors.

Lastly, another interesting trend, though still in an early stage of development, is an emerging "techno-regional" approach to high-tech development. In the IT sector, China, Japan, and South Korea have signed agreements to collaborate on developing new technologies primarily, though not exclusively, for the Asian region.[15] The three "CJK" parties have agreed to co-develop products in at least seven areas of IT technology, including 3G and next-generation mobile communications, next-generation internet (IPv6), digital TV and broadcasting, network and information security, open source software, telecommunications service policies, and the 2008 Beijing Olympics.[16] This model of development was recently applied in developing a new Linux-based computer operating system ("Asianux") developed for the Asia market by China's Red Flag Software Co., Japan's Miracle Linux Corporation, and (since the product's debut) Korea's Haansoft software company.[17] Asianux was developed in cooperation with the U.S. firm Oracle, through joint work reportedly conducted at Oracle's China-based R&D center.[18] While the political issues and challenges surrounding this model of development are significant, this apparent new regional approach to collaborative high-tech R&D could yield interesting and impressive results if these issues can be overcome. This model might also be applied with other neighboring states in Northeast, Southeast, and South Asia, as suggested by recent statements promoting increased Sino-Indian high-tech collaboration.[19] If so, in these relationships, China is likely to continue to serve as the hub for regional high-tech investments, development efforts, and exports, particularly as China focuses on developing the central and western parts of the country, which are hungry for foreign investment akin to that witnessed along China's east coast.

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[12] Excerpts from China's Ministry of Commerce's think tank, the Chinese Academy of Foreign Trade and Economic Cooperation, *2005 Report of Transnational Corporations in China*, cited in "Overseas Investment on the Up," *China Daily* (February 1, 2005).

[13] For information on foreign R&D centers in the ICT sector, see Walsh, *Foreign High-Tech R&D*.

[14] See "China is #1 for R&D Investments," *Economist Intelligence Unit* (October 2004).

[15] Suttmeier and Yao; Martyn Williams, "Major Asian IT Groups to Collaborate on Open Source," *InfoWorld* (November 14, 2003), http://www.infoworld.com/article/03/11/14/HNasianitgroups__1.html.

[16] See Ministry of Public Management, Home Affairs, and Posts and Telecommunications (MPHPT), *Communications News*, vol. 12, no. 22 (February 4, 2002), online at http: // www.soumu.go.jp/joho__tsusin/eng/Releases/NewsLetter/Vol12/Vol12__22/Vol12__22.html; MPHPT, *Communications News*, vol. 13, no. 14 (Oct 2002), online at http://www.soumu.go.jp/joho__tsusin/eng/Releases/NewsLetter/Vol13/Vol13__14/Vol13__14.html#3; and MPHPT, "Results of the Second China-Japan-Korea ICT Ministerial Meeting," *Communications News*, vol. 14, no. 12 (September 26, 2003) online at http://www.soumu.go.jp/joho__tsusin/eng/Releases/NewsLetter/Vol14/Vol14__12/Vol14__12.html#3.

[17] Research conducted in Beijing (May 2004). Kathleen Walsh, "Sino-Korean IT Industry Cooperation and Regional Security Implications" paper commissioned by the Center for Strategic and International Studies (CSIS) International Security Program (June 2004).

[18] "Asianux Gains Strength as Oracle Pledges Support," *ITNetCentral* (26 July 2004) accessed online <http://www.itnetcentral.com/article.asp?id=13764&icontent=17147>. See also joint news release, "Official Signing Redflag Software, Miracle Linux and Haansoft for Co-development of 'Asianux'" (October 6, 2004), accessed online <https://www.miraclelinux.com/english/press/2004/102601.html>.

[19] China is planning to cooperate with Indian software companies to form an industrial alliance, according to the Sino-India Cooperative Office, which was established in December 2004. See "China and India join forces in software," Sina.com (March 10, 2005), online at http://tech.sina.com.cn/it/2005–03–10/0342546148.html.

This leads to your question: Is China successfully integrating R&D and know-how from foreign companies into the development of competitive domestic technology firms? The answer is probably, yes. Anecdotal evidence and ongoing studies of the impact of foreign technology transfer and R&D in China and elsewhere suggest this is the case.[20] A recent U.N. analysis describes the typical process this way:

> . . . while the innovation function of TNCs [transnational corporations] is the slowest to relocate from the home country, particularly to developing countries, it *does* shift to affiliates over time. Given the availability of the high-level skills and infrastructure (including R&D institutions and universities of sufficient quality), affiliates in developing countries do start to conduct R&D. They initially start with simple adaptive tasks, move on to process development, then move to product development and finally to basic ("blue sky") research. Only a few economies have reached this stage, for example Singapore, Brazil, India, the Republic of Korea and Taiwan Province of China (China is catching up fast), and the amounts involved are small relative to TNC R&D in advanced economies, but the trend is clear.[21]

Additionally, recent statistical analysis of foreign and domestic high-tech R&D firms in China finds that China's own enterprises appear to be more innovative, efficient, and profitable than many foreign-invested firms operating on the Mainland.[22] Nevertheless, hard and compelling data on the R&D phenomenon in China are hard to come by and may only become available once a large number of PRC high-tech firms have emerged as competitors in the China market and beyond (which might be interesting from a historical perspective, but would come too little, too late for U.S. industry). The prudent course, therefore, is to assume, based on past experience in other developing countries, that PRC firms will learn from this dynamic, which if anything has been accelerated by recent globalization dynamics, and will become more competitive and innovative more quickly than imagined. This also places the emphasis where it belongs: on what the U.S. approach will be to an increasingly high-tech Chinese economy.

U.S. Policy Response to Rising High-Tech Competition from China

Several studies have been published over the past year or so examining the impact that globalization—and China's economy in particular—are having on the U.S. high-tech industry. Among these is the recently published *Task Force on the Future of American Innovation*, the Council on Competitiveness' *Innovate America*, and the Electronic Industries Alliance's *Policy Playbook on Innovation and Global Competitiveness*.[23] The common denominator among all these efforts is that U.S. technology policy is lacking in its response to the growing challenges posed by China and other developing countries in a global economic environment conducive to increasingly advanced forms of transnational research and development. As the evidence mounts that this trend is growing and likely to be a lasting phenomenon, U.S. policy must keep pace.

Among the suggestions made in these reports and that make sense in the context of the U.S.-China trade relationship are the following:

- **Increase funding for basic or fundamental research,** which remains the key driver of innovation, development, and market competitiveness. U.S. Government funding of basic, non-defense R&D has declined over a number of years as China and other states are increasing their funding levels. Although U.S. funding overall far outpaces China's, basic R&D funding represents an investment in America's future and must remain a priority and be sustained over time if the U.S. economy is to maintain its competitive edge.
- **Work more closely and regularly with industry to analyze this complex challenge and to devise appropriate policy responses.** Industry is on the front lines of this global phenomenon and the best situated to identify new and important challenges to U.S. economic competitiveness. Whatever policy pre-

[20] See, for instance, recent work by economist Gary Jefferson of Brandeis University on R&D in the China market, available online at http://people.brandeis.edu/~jefferso/res.html. Also, see Maximilian von Zedtwitz, "Managing Foreign R&D Laboratories in China," *R&D Management*, vol. 34, no. 4 (September 2004), pp. 439–452.

[21] United Nations Conference on Trade and Development, "Investment and Technology Policies for Competitiveness: Review of Successful Country Experiences," Technology for Development Series, UNCTAD/ITE/IPC/2003/2 (New York, NY: UNCTAD, 2003), p. 12.

[22] Jefferson, "R&D and Innovation in China: Has China Begun Its S&T Takeoff?"

[23] For copies of these reports and supporting materials, see http://www.futureofinnovation.org, http://www.compete.org/pdf/NII__Final__Report.pdf; and http://www.eia.org/docs/innovation__playbook.pdf.

scriptions are decided must also ensure that these measures aid rather than impede U.S. business and investment. Regular meetings of a high-level body comprising leading high-tech industry representatives, U.S. Government officials, and academic experts would benefit each community in keeping track of, and responding to, emerging challenges posed not only by China but by ongoing, fast-moving economic forces having an impact around the globe. The National Academies' Government-Industry-University Research Roundtable (GUIRR) serves this purpose in part. However, such meetings would ideally involve a larger cross-section of experts, be conducted even more frequently, and be free and open to the public.

- **Work more closely with PRC counterparts.** Chinese and American officials as well as analysts are trying to get a better read on overseas R&D investments and other aspects of globalization. While scientific and governmental exchanges occur regularly on a bilateral and multilateral basis in official and informal settings, these could be expanded further, if backed by U.S. Government funding, to improve cooperation on collecting data and discussing data collection techniques in the context of changing global economic dynamics. This is a common problem and could be addressed more effectively through enhanced cooperation and transparency.
- **Finally, the re-constitution of a resource such as the former Office of Technology Assessment** (OTA) would be highly beneficial in gathering the interdisciplinary expertise that is needed to confront the challenges outlined in this hearing. The problem is too large and fast-changing for any single analyst, team, or even institution to monitor, much less analyze while taking into account the United States' myriad economic, political, and security interests. An OTA-style research and analysis unit, particularly located in the Legislative Branch, would be a welcome asset and reserve in effectively confronting the ongoing challenges posed by globalization.

In Beijing, meanwhile, officials have begun to formulate the goals to be set out in the next or 11th Five-Year Plan, which will guide Chinese S&T efforts over the period 2006–2010. This plan will no doubt include further lofty objectives to which China's S&T community will aspire. It is likely that among these goals will be to reach an R&D per GDP spending rate of 2%. Another focus, according to press reports, will be on enhancing domestic development efforts, particularly in China's central and western provinces, in part to alleviate the widening disparity in income between coastal and inland areas. Also, in the next phase of China's technological development, Beijing is seeking to move China from an imitation to an innovative stage of production or, put more colloquially, from "made in China" to "made by China." Beijing's strategy of pursuing "informatization" in civil and military development and the promotion of indigenously developed high-tech standards are designed to further this "made by China" goal.

But perhaps more important than China's stated goals in the upcoming plan will be how PRC officials seek to achieve these objectives. The upcoming FYP may be telling in this regard. If, as recent press reports suggest, the next strategic plan focuses more on establishing guidelines than on outlining a detailed "blueprint" and specific targets for S&T development, it may reflect a new and more successful approach to enhancing China's S&T capabilities.[24] That is, the plan could more resemble long-term development strategies followed in technologically advanced economies than the PRC's own traditional planning documents. If so, this would suggest a new understanding of modern S&T development and innovation policy and could prove more successful than past plans, which have not fared particularly well against the historical record. In this case, we could witness a more S&T-advanced industry on the Mainland than previously expected, perhaps within the next five or so years.

PRC officials have of late also shown greater flexibility in planning and their approach to S&T development, demonstrating a willingness to review funding programs, alter course if necessary, and experiment on an interim basis. China is also becoming more transparent in its S&T statistics and analysis, in other words, willing to admit some failings as well as successes. As a result, efforts to engage PRC experts and officials on what are sometimes sensitive issues are becoming easier and bearing more fruit than in the past. This presents a potential new opportunity for U.S.-China relations.

I thank you for your time and consideration of these remarks. I look forward to any questions you may have.

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[24] Xu Binglan, "Plan Ponders Most Pressing Issues," *China Daily* (6 April 2005), http://www.chinadaily.com.cn/english/doc/2005-04/06/content__431623.htm.

Panel II: Discussion, Questions and Answers

Chairman D'AMATO. Yes. Thank you, Ms. Walsh.

Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thank you very much, Mr. Chairman. Thank you to all of our witnesses who I hope will indulge me on a question that's a little bit off of the R&D but I think has an impact.

Last week our Commission had a hearing on the Chinese government's control of media and access to information, including particularly the Internet. During the Q&A, one of the issues that came up was concerns about the impact of what I would call and other people sometimes call, the "long arm of Chinese censorship on American scholarship about China." Academicians, graduate students here cannot ask certain kinds of research questions. They have to be careful about the topics they pick because if they pick the wrong thing or ask the wrong question they find that they don't have access to China, they don't have access to the information that they need. And, in fact, it seems to be having an impact on a younger generation of scholars who are choosing other topics, which I think has consequences for us in terms of how we understand China as we move forward.

Dr. Pillsbury, you mentioned that no Sputnik moment, which strikes me as quite similar to the Chinese strategy of intelligence gathering, which is a grain of sand here, a grain of sand there, and you keep everything underneath the proverbial radar screen so there's no ah-ha moment. And by the time people have figured out what's going on, they've got what they need and they move on.

Ms. Walsh, you talked a little bit about this. What I'd like some sense of is: How complete and how thorough do you think our understanding is of what is going on in terms of Chinese R&D?

We've heard conflicting things already. Some people believe that they have the capacity to do innovation. Some people believe that they don't have the capacity to do innovation. It gets to what Secretary Rumsfeld has said: We know what we know. We know some of what we don't know, but we don't know what we don't know. I just wondered if you could give us an honest assessment of the body of information, how accurate is it, how thorough? Thanks.

Dr. SUTTMEIER. Well, I'll take a crack at that. You know some of us started in this business a long time ago, and there wasn't much to go on at all. So we kind of pulled together little bits of pieces of information here, there, so forth, and so on. That has changed dramatically.

I think of these days as as some wags have put it, the problem is not getting access to data, it's being able to process all that there is. Now for sure, I think you always have to regard Chinese statistics and other kinds of data with due caution, but there's just an enormous amount there.

With regard to statistical data pertaining to research and innovation, the system is still coming into being. It's not perfect yet. So if we look at, for instance, the standard science-and-technology indicators that China now produces, these are the result of a slow process of 15, 20 years of normalizing Chinese approaches to that with international approaches. But there is quite a lot of data out there.

I made reference in my written testimony to recent work by Albert Hu and Gary Jefferson which uses a new source of data that really wasn't available to foreign researchers until very recently, primarily data that is used by the State Statistical Bureau in its compilations of national statistical reports.

So I would say that in general, while there are still data problems, there is a world of difference from the past. China has become a fairly open place and not only in terms of data but in terms of other kinds of access.

I and others have been invited to serve as consultants to Chinese government organizations on matters of science and technology. This has involved visits to institutes, discussions with high-level leaders, and so forth. Such activities would have been unimaginable in the recent past.

For instance, we have served as commentators on the preparation of China's long-term R&D plan, now in the final stages of preparation. Inviting foreigners into something like this is a sea change; in the past, such plans were guarded, very closely held by the government.

So to me I think that there's an enormous openness with regard to data as long as you kind of understand what the continuing constraints really are.

Ms. WALSH. Could I just add to that? I agree completely with what Dr. Suttmeier said, but I also notice that it's by the invitation of the Chinese to come and cooperate. That says to me two things. One, that I think we should be exploiting this and that there's an opportunity there to push the Chinese for more of this kind of information. They've become more transparent.

I just downloaded their statistical yearbook, all one thousand pages of it, from the Internet, which I thought was phenomenal too, because you used to have to troll through the library to go find these things. So I think this is a real opportunity then that we, the government, the U.S. industry should be pressing China to do more of in order to have a better understanding of their statistics, how they're changing their own statistical-collection methods, and what are the issues that they're interested in. I think it's an opportunity. It would be a plus for us as well as for the Chinese who are obviously interested in these issues.

Dr. SIMON. I think one of the most promising areas is this decision by the National Science Foundation now to open up an office in Beijing. And, in short order, there will be someone I think that's going to take residence or has already taken residence. I think that will help to provide some better insights into what's going on.

What we really need more of is a marrying together of expertise on China with people who have science and engineering backgrounds, and having people basically who understand something about the culture and the social science dimensions of life and organization in China and somebody who understands what it takes to put through a biotech project or someone who understands what it takes organizationally and structurally to successfully manage a nanotech project.

Around the United States, there are an assortment of scientists and engineers who on their own are working on projects, are working on cross-border innovation and collaboration. The problem is that we have never really pulled these things together to come up with a more complete comprehensive picture, so we get anecdotal information. We get a story in the Chinese press, but what does that really mean? How good is that chip? How good is that computer? Has IBM and Sun, et cetera, gone in and looked at the new so-called supercomputer that the Chinese have developed and what is their assessment of it?

We need to be doing more of these kinds of things to really understand how fast the Chinese R&D system is able to put out such kind of new innovations.

Commissioner BARTHOLOMEW. Dr. Pillsbury.

Dr. PILLSBURY. I agree with my three fellow panelists, but I would add a twist to it based on my own experience in DOD. The Chinese are the most open to the United States in areas where they want help from us. They can be remarkably open.

I have been into very sensitive Chinese military factories, one of which they make ICBMs. I was just kind of poking around and I saw they also made air conditioners and other things. I said, there doesn't seem to be even any line, and I got a long explanation about why that is.

A lot of Americans from DOD, some in uniform, have been into very sensitive Chinese military installations, going back 20 years ago—when they wanted our help in that area. However, where I would disagree, I'm afraid, is that any area which would tend to give us a sense of threat from China that they're going to be competitors, there was one Congressman said a couple of months ago, will eat our lunch in science, that's quite difficult to get in. You suddenly discover that that person isn't in town this month or it's not convenient to take you out to see that particular facility.

So I tend to be a little bit cynical that our own—I'm not sure the Commissioners know this yet. We still help China a great deal in science and technology to many other areas of competition and the U.S. Government takes the lead. It's not the private sector. This Commission's concern about currency manipulation led to a Treasury Department mission of many people to go into China last year and help them improve their banking system, in extremely helpful ways to them. They're very grateful. The system of giving loans, the system of how to check credit rates, the system of how our banking system works.

Those who practice this inside the U.S. Treasury and Federal Reserve and the banking examination system all went to China to help them improve what they have been saying for several years, is one of the greatest areas of competitiveness that they face, their banking system.

The Department of the Treasury helped them a lot last summer, and do you know the reason for this mission? Because of Congressional concern and this Commission's concern with currency manipulation, and the Chinese had given the reason why they can't repeg or float is because our banking system is in so much trouble. So what did the U.S. Government do? We'll help you improve your banking system.

Now we did this with their airliner program. I remember visiting the factory in Shanghai in the '80s where there were four FAA GS–15s embedded in the McDonnell Douglas factory helping them get the precision making of the parts correct. And I said, “Excuse me. Why are you doing this? You’re Federal employees from the FAA?”

They said, “You don’t understand. It’s our policy to help the Chinese airline industry get going, airplane manufacturing industry get going. If they don’t manufacture their parts to specifications, they can’t sell these airliners on the international market,” which that makes sense to me.

When the Tiananmen sanctions were put on, the DOD stopped various programs. That one didn’t stop. And China just recently announced selling its first 50 airliners overseas made in that factory. So not only morally does the U.S. Government help China become more competitive but also it’s a matter of national policy.

So I go back to your comment this morning, Commissioner Bartholomew, about the tail-chasing metaphor. The tail-chasing metaphor is not right. It’d be as though we’re reaching back and giving food to the tail-chaser and say, come on and not perceiving the tail-chaser that way at all. So I think we need a better metaphor to capture what is going on.

Chairman D’AMATO. Thank you. I have a quick followup question to that broad inquiry that Carolyn Bartholomew made on the level of understanding what we know. During the Cold War, as I remember, we had a very substantial, robust intelligence community collection process dealing with Soviet science and technology.

My question is, Dr. Pillsbury, within the limits of an open hearing, what is your impression of the depth and quality of U.S. intelligence analysis to collect and monitor foreign science-and-technology developments, particularly with regard to China? Has that capacity atrophied or do we still have a substantial and robust capacity to evaluate Chinese S&T?

There might have been an “NIE” on Chinese S&T in the past, but I don’t remember it. Can you shed any light on that?

Dr. PILLSBURY. Are you addressing this to Dr. Simon as well as me?

Chairman D’AMATO. Dr. Pillsbury.

Dr. PILLSBURY. I would say, in the first place, that our intelligence community suffered massive cuts as part of the end of the Cold War, so everything got cut drastically.

Secondly, the intelligence community as I’ve always understood it needs clients. It wants the President and the Cabinet to demand information and analysis on a topic, so you’d have to ask yourselves just rhetorically how much of a client base has there been for studies of Chinese science and technology? I would submit almost zero. And so if the intelligence community is doing its budgeting job properly, and I have no reason to believe that they’re not, I would expect their capacity to analyze science and technology would be quite low.

Thirdly, I would say there have been a number of academic seminars, Princeton has had some of them, on NIEs done against the Soviet Union and one recently at the Wilson Center on the NIEs against China. I noticed, as you say, Mr. Chairman, the effort on the Soviet Union focused a lot on their science and technology, their R&D, and their new weapon systems.

I notice when the Chinese NIEs were released by the intelligence community a few months ago there’s almost nothing on Chinese science. It's what Dr. Suttmeier referred to—I forgot the exact phrase—but how 20 or 30 years ago there was almost nothing to go on. So those three indicators suggest to me that there's very little, if anything, on Chinese science by the intelligence community, that they believe this is a good thing, that there's simply no client-base concerned about it. It's back to the Sputnik shock, is simply not there and the old paradigm that they're poor and backward and our quasi-allies. So who would want to do an assessment of how a quasi-ally's science and technology is going unless you wanted a national competitiveness strategy.

If you want to build the kind of thing that your Commission recommended last year, that long section in the Report on the National Competitiveness Strategy, you would need to compare American efforts over the next ten years with what China's is likely to do.

And my suggestion in my paper is we simply don't have the—despite the work of Dr. Suttmeier, I don't mean to criticize him, but—and Dr. Simon—we don't really have the kind of knowledge that would lead Members of the House and Senate to say, "Oh, my God, we need a National Chinese Strategy. What a challenge we face from China." We don't have that today. In fact, we have quite the opposite: Everybody stressing that, oh, they're pretty backward still except for a few small exceptions.

Thank you.

Chairman D'AMATO. Thank you.

Ms. Walsh.

Ms. WALSH. Can I just add two cents on that? I think that's correct, but I think a lot of the prejudice perhaps has been that the interest, of course, has been on China's military modernization and defense industrial capabilities, which of course lag the commercial side. But today they're learning from the commercial side. So this is generating new interest today in looking at the commercial sector for lessons learned and what they may mean for China's military modernization. So I think this is starting to happen. But I think that also explains why there's been less interest in China's S&T because on the defense side China has obviously shown much less capacity.

Chairman D'AMATO. Thank you very much.

Dr. Suttmeier, yes.

Dr. SUTTMEIER. Well, just on the point that Dr. Pillsbury made about viewing China as sort of a poor—I didn't mean to myself in this testimony say that there is no progress here. This is going to be a major, major player, no question about that.

But I think what's very important is to begin to get a sense of balance. Consider the issue of comparisons with Japan from an earlier period. I think the issue is not does China compare with Japan, it's more do our perceptions of China in the twenty-first century, how do they compare with our perceptions of Japan in the late '80s and the early '90s, and what were the knowledge bases for the judgments we made then and the judgments we make now.

And I think that in many ways we made lots and lots of misjudgments because we didn't look as carefully as we might have at underlying vulnerabilities. So I think that what I'm trying to argue here is that I think we need to pay attention to both, because otherwise you will get these wild swings over very, very exaggerated claims about China and its potential without looking at any of the weaknesses, or you're going to wind up with the China as the poor, underdeveloped quasi-ally. I mean it's neither, and I think it's important to get that right.

Chairman D'AMATO. Thank you.

Dr. SIMON. Just a quick point. It not only deals with the intelligence community but also the role of science attaches in our embassies and consulates around the world.

A number of years ago, there was an effort through the State Department and through the Foreign Service to basically create a formal career track for the training and positioning of people abroad who really did have science and engineering backgrounds and for them to become Foreign Service officers and therefore to be astute observers of what was going on.

That went through a tremendous amount of effort to get that going, but it never got any traction. The National Academy of Sciences has made recommendations about this, in the sense of putting more of these kinds of people out, out in the field and creating a more professional track. That still hasn't happened. And then the Foreign Service Institute has pulled back on its training of people particularly in those areas.

It is very clear that we need more people who can understand what is nanotechnology all about when they're out in the field. They don't need to have a deep necessarily, totally scientific Ph.D.-level understanding, but we need to have more people out who are professionally trained and aware of what's going on in these fields so that they can report back. And also, on the other side, that there are customers.

It's no good to report on nanotechnology in China in a very sophisticated technology report if there's nobody in the State Department and the intelligence community, et cetera, who's going to read the report.

Chairman D'AMATO. Well, they could report to the Commission.

Dr. SIMON. They could report it to the Commission, that's true. But that's the point——

Chairman D'AMATO. A new client.

Dr. SIMON. No, but we do need to, I mean that problem is part of a larger issue that we need to face up to.

Chairman D'AMATO. Thank you.

Commissioner Mulloy.

Cochair MULLOY. Dr. Simon, I see that you're with the Levin Institute at State University of New York. Is that named after Neil Levin?

Dr. SIMON. Yes, it is.

Cochair MULLOY. I had the great pleasure of working with Neil. And I believe, Blanche and I, when he was on the staff of the Senate Banking Committee.

Dr. SIMON. Oh, okay.

Cochair MULLOY. He was a wonderful young man, and you're fortunate to be working in that institute.

Dr. SIMON. Thank you.

Cochair MULLOY. He was killed on 9/11 in New York, so I just wanted to mention that.

Dr. SIMON. Thank you.

Cochair MULLOY. Dr. Suttmeier, you said, and I want to get this because I think it's an important one, that the scientific community and the corporate community all think it's good to be doing what you're doing in terms of interacting science and technology with China, et cetera, but that the politicians perhaps don't fully appreciate this and you asked us to be a channel or something.

Do you ever think that the politicians are in touch with the people and that they're transmitting signals back to the policymakers that the people aren't benefiting from all this way or have some concerns about it? And maybe the reverse signal should be given to the scientific community and the corporate community that there are some concerns that need to be addressed here?

I worked for the Congress for a number of years, and these people are out there and they're picking up signals and then they try to transmit to the policymakers.

Now Dr. Pillsbury has told us at the highest levels of the Japanese government, they're seized with science and technology——

Dr. PILLSBURY. Chinese government.

Cochair MULLOY. —Chinese government, they're seized with science and technology as the way to move the country forward both standard of living wise and I think national strength wise, which means expanding influence, et cetera.

I'm not sure that we're fully grasping that among our policymakers, understanding that this is a national mission that these folks are engaged in. Then you read this nice testimony by Alan Wong, who is in the business community. He says, "It seems that China is becoming master of the game of attracting foreign investment and technology, creating jobs, rapidly raising standards of living for its people." And God bless them, fine. If I were them, I'd be doing the same. But then we have to say: What is the impact on us? What is the impact on our standard of living?

Mr. Wong goes on to say, "China appears to have given up very little in terms of [market access or] its own resources" or anything else. It may be getting a lot, not giving very much in terms of benefiting us.

Does anybody think that Dr. Pillsbury has put his finger on something quite important that we should focus on and look at this with a little more caution and critical eye? I would ask Dr. Simon and any of the others to comment.

Dr. SIMON. Maybe I'll take a quick crack. First of all, it's not that all of a sudden we've discovered some deep secret among Chinese leaders, that they've had this stated policy. Since the early '80s the Chinese government under Deng Xiaoping and under subsequent leaders have all articulated the same message: Our goal is to close the technological gap between China and the rest of the world, to do it rapidly and to do it utilizing a combination of foreign technology and foreign investment. It's been the stated policy.

We haven't paid much attention to it. I would make the argument that the reason why it didn't have much meaning for us early on is because the Chinese didn't have any leverage in order to make that happen. As we moved from the 1980s to the mid 1990s and beyond, the Chinese market itself became a form of leverage, manifested in the increasing appearance of consumers who had discretionary incomes to buy things, first some basic things like nice clothes and then moving up to cars and computers. They used to talk about the ten or eight most precious gifts that everyone had to have, from a digital watch to a VCR. And today, we talk about cars and computers and houses, multiple houses for some Chinese.

So the fact that we've got these active consumers, 250 to 300 million out there, is a tremendous amount of leverage in the marketplace that wasn't there. So, I think that's the first and most important thing, that the Chinese now have something to leverage out in the market.

Second of all, the next thing that they've got going for them now is what we've all talked about, that is, they've got a steadily improving science-and-technology human resource base. And that human resource base, largely in many cases under utilized or unutilized scientific and technical personnel, they are a very critical asset if you look at the new models of innovation that are occurring.

And we've heard from people this morning that they are working in transnational, multicultural teams. We've heard about virtual teams. That's the world of innovation for the twenty-first century. And China now can play in that game; where before it was just a marginal player, it's now becoming more of a central player.

Cochair MULLOY. Anyone else?

Dr. SUTTMEIER. I would substantially agree with that. I would go back even further. I think that the importance of being competitive in science and technology has been a founding principle of the People's Republic of China. One of the things to remember is how much of an effort was made in the 1950s. We talk about 1.3 percent of GDP now being spent on R&D. In the 1950s the Chinese were spending more like two, two and a half. So there's a lot of background in all of that.

I think that going back to the other part of question, Commissioner, about under estimating the judgment of the political community, perhaps I am. I think what I'm really saying is that I would like to see more leadership from the political community that is smart.

We've heard various points in the course of the discussion this morning about one kind of policy and another kind of policy that we should be doing that we're not doing. I think that's my fundamental bottom line, is that we may not be as far apart on that as possible. But if you're going to do that, if you're going to have an effective national strategy, then I think you focus on, first of all, some of the things that the innovative parts of the community are involved with, their knowledge of this China. Then you don't do the kinds of things that are going to work directly against it.

I think the message that I kept hearing this morning is the extent to which government in some cases really is working against national well being in terms of our own innovative capability, and that's my concern. I think that what I'm really arguing for is attention to this potential divergence and much more of a bipartisan, integrated national strategy to begin to address this kind of thing with China as a reference point.

Chairman D'AMATO. Thank you very much.

This concludes the morning session. We're going to adjourn for lunch. Thank you.

[Whereupon, at 1:21 p.m., the hearing was recessed, to reconvene at 2:15 p.m., this same day.]

AFTERNOON SESSION, 2:15 P.M.

THURSDAY, APRIL 21, 2005

OPENING STATEMENT OF COMMISSIONER PATRICK A. MULLOY HEARING COCHAIR

Cochair MULLOY. I want to join the Chairman and the Vice Chairman in expressing the Commission's appreciation to Stanford University, our former colleague Ambassador Ellsworth, and all the others who have helped in making this event possible out here these next two days, today and tomorrow.

The issues we are discussing are of vital long-term economic and national security interests of the United States. It is important that we discuss them here in Silicon Valley, the nation's hub of technology development and innovation.

I think what Americans need to understand is that the fastest growing sector of our trade deficit with China is in high-technology goods. So policymakers in Washington need to understand what is driving the rapid advance of China's technology sectors. While some observers see this as just the inevitable result of global market forces, there appears to be more to it than that. I don't think it's just market forces. I think there are things going on here.

As the Commission's past work has documented, the Chinese government is following a coordinated and comprehensive strategy coupled with policy incentives to build up its technology capabilities and foster the emergence of globally competitive companies. I don't fault China for having a well-thought, thorough, well-coordinated strategy to build up its technology competitiveness as long as that strategy does not violate its WTO or other international obligations.

I am concerned that our own country has not recognized our current situation and has no strategy to deal with the emerging challenges. That is why we're here, to try and get from the witnesses an understanding of what is really happening out there and what we as a nation should be doing.

This afternoon we continue our discussion with a panel of renowned observers of the U.S.-China high-tech trade and investment relationship. We have Dr. Henry Rowen from here at the Hoover Institution; Mr. Ernie Preeg of the Manufacturers Alliance, a longtime public servant of the United States Government; Mr. Eamonn Fingleton, author of *Unsustainable: How Economic Dogma is Destroying American Prosperity*; and Professor John Zysman of U.C. Berkeley and Co-director of the Berkeley Roundtable on the International Economy. He has authored, among other books, one that we read at least ten years ago, *Manufacturing Matters: The Myth of the Postindustrial Economy*.

I'm delighted to have all of you here today. Let's proceed from left to right, Mr. Rowen, Dr. Zysman, Dr. Preeg, and Mr. Fingleton.

[The statement follows:]

Prepared Statement of Commissioner Patrick A. Mulloy
Hearing Cochair

I would like to join the Chairman and Vice Chairman in expressing the Commission's appreciation to Stanford, our former colleague Ambassador Ellsworth, and all the others that have made this event possible. The issues we are discussing today are vital to the long-term economic interests of the United States, and it is important that we discuss them in Silicon Valley, the nation's hub of technology development and innovation.

The realities of China's rapid economic advancement are well known. What is perhaps less well understood, however, is the broad spectrum of industries, including advanced technology sectors, for which China poses competitive challenges to the U.S. economy. A recent report prepared for the Commission by the Economic Policy Institute concluded that "China's exports to the United States of electronics, computers, and communications equipment, along with other products that use more highly skilled labor and advanced technologies, are growing much faster than its exports of low-value, labor-intensive items such as apparel, shoes, and plastic products." The report further found, remarkably, that the United States is now running a $32 billion trade deficit with China in goods classified by the U.S. Department of Commerce as Advanced Technology Products.

The U.S. technology industry is clearly taking note of these dynamics. In it's 2005 report, entitled *Losing the Competitive Advantage*, the American Electronics Association, whose president, Bill Archey will be testifying later this afternoon, made several key findings: First, "America needs to recognize that future innovation is not predetermined to occur in the United States" and that "even if we were doing everything right, we still face unprecedented competition from abroad." Second, that "China is already the world's manufacturing hub and now is moving up the production line to promote higher end technology firms, creating sobering competition for companies and workers around the world."

Policymakers in Washington need to understand what is driving the rapid advancement of China's technology sectors. While some observers see this as the inevitable result of global market forces, there appears to be more to it than that. As the Commission's past work has documented, the Chinese government is following a coordinated and comprehensive strategy, coupled with policy incentives, to build up its technology capabilities and foster the emergence of globally competitive companies.

As highlighted in the Commission's 2004 Report to Congress, the two key components of China's technology strategy are (i) to encourage foreign investment in areas where domestic capabilities are lacking and (ii) to limit foreign access to markets where domestic industries are gaining economies of scale. One such policy is the requirement that only domestic software or "qualifying foreign software" may be purchased by government entities. The criteria for qualifying foreign software have yet to be defined. The absence of such criteria has inhibited U.S. manufacturers from entering into government business and appears intended to shut foreign firms out of this lucrative market.

A second example is China's development of unique technology standards. By creating such standards, China has attempted to use its market leverage to promote standards that it controls, such as for wireless communication and digital music, rather than internationally recognized standards that are already in wide use. We will hear extensive testimony on this practice during the hearing.

I do not fault China for having a well thought-through, well-coordinated strategy to build up its technology competitiveness. Instead, I am concerned about the U.S. response. Technology competitiveness and innovation is a signature of our economic well-being and we cannot allow our competitiveness to wane. As we recommended in our 2004 Report to Congress, "the U.S. Government must develop a coordinated, comprehensive national policy and strategy designed to meet China's challenge to the maintenance of our scientific and technological leadership," along the lines of the national security strategy that is currently developed to address our global military and political challenges.

This afternoon we continue our discussion with a panel of renowned observers of the U.S.-China high-tech trade and investment relationship: Henry Rowen, from right here at the Hoover Institution, Ernest Preeg of the Manufacturers Alliance, Eamonn Fingleton, author of "*Unsustainable: How Economic Dogma is Destroying American Prosperity*," and Professor John Zysman of UC Berkeley who authored, among other books, "*Manufacturing Matters: The Myth of the Post-Industrial Economy*."

They will be followed by a panel examining the challenges China poses over the long-term to U.S. technology leadership. We are pleased to have with us Bill Archey, President of the American Electronics Association, Rhett Dawson, President and CEO of the Information Technology Industry Council, and John Ciacchella, Vice President at A.T. Kearney. Mr. Ciacchella conducted two studies this past year; one exploring the economic impact of offshore outsourcing on the Bay Area, and another (due out soon) consisting of interviews with 300 high-tech leaders assessing their competitiveness in today's market.

Thank you all for being here today, I look forward to this afternoon's panels and tomorrow's session.

PANEL III: DYNAMICS IN THE U.S.-CHINA HIGH-TECH RELATIONSHIP

STATEMENT OF HENRY S. ROWEN PROFESSOR EMERITUS, GRADUATE SCHOOL OF BUSINESS SENIOR FELLOW, THE HOOVER INSTITUTE EMERITUS DIRECTOR, THE ASIA PACIFIC RESEARCH CENTER STANFORD UNIVERSITY, STANFORD, CALIFORNIA

Mr. ROWEN. Thank you, Chairman. It's a privilege to be invited to appear before this group. I attended some of this morning's session and so I will not dwell on topics that I know you've already discussed today. I'll say a little bit about a few of them.

The four topics I want to touch on very briefly, the place that's been called China's Silicon Valley—a lot of places get called as Silicon Valley—this place in Beijing is one of them. In China it's actually in competition with Shanghai. Shanghai's more silicon, but that's a detail.

The importance of international linkages, which has come up, certainly a lot this morning. The concept of value added and some indicators of the rise of Chinese science.

Now Zhongguancun. There are a lot of letters there. "ZGC" for short. It has the largest concentration of high-tech companies. 12,000 is the nominal number. There are not 12,000 real companies. At most there are maybe 8,000, and some of the 8,000 are questionable, if you really properly identify what's a company.

About 400,000 workers. Total revenues in year 2002 of $29 billion which is rather less than the Intel Corporation, so just to put it in scale. But it's grown enormously.

In 1998 there were only 527 companies, by the count there, with 10,000 workers. So in a quite short period of time it's just grown enormously. This region, by the way if you know Beijing which I imagine you do, is the west side of Beijing. It's a big area. It's where the major universities are located, the research institutes, and now all these companies.

It's an officially designated science park, but the place began to take off before it was called a science park, designated a science park, and it took off for an obvious reason: The government ministries are in Beijing with the research institutes there. As soon as the economy began to be liberalized, it was just natural for people to start setting up companies there. And some of the leading companies, in fact, came out of the Academy of Sciences, Legend, Lenovo, Founder, and others, out of universities as well. And they stayed where they were.

And for telecommunications companies, in particular, as is in this country, it pays to be near the seat of power, political power. That's why you see in the beltway so many telecommunications companies. It's the same thing in Beijing, be where the action is and where the money is.

So the environment that was there, especially before the creation of this science park idea, had pluses and minuses. And the pluses were significant: Well-educated, talented people. These research institutes. Governments applied finance. You can say that's a negative, maybe a positive, but under the circumstances it was a positive because otherwise there was no way of getting money.

The negatives were very substantial: Inadequate legal system—still is. Weak financial institutions—still true. Micromanagement by government bureaucrats—maybe there's less of that now, I'm not sure. And isolation from world markets—well, that has certainly changed. Less isolation.

By the way, Mr. Wortzel, this morning—is he here? He quoted from my paper this estimate of 40,000 products coming out of the research institutes to the market. That's not my estimate. That's an estimate of the Zhongguancun Park Administration. I have no idea what those 40,000 products are.

Well, helping greatly with some of these difficulties was the arrival of foreign firms into ZGC. China gets most of its technology from overseas and multinational companies are the main source. So in 2002 in ZGC they accounted for 43 percent of total revenues and 78 percent of exports, a very huge proportion. But what's being acquired, what these companies are bringing in is not just technology. It's a package and it's the package that matters. And the package includes management skills, products, obviously the product inputs, talent, and ideas. All of the above comes with the money. The capital is the least important part of it, and technology is certainly an important part of it, but it's the other stuff as well.

As I'm sure this Commission knows and undoubtedly has discussed China's poor protection of intellectual property causes these foreign companies to try and restrain the transfer of advance technologies to China because they have the feeling it will be lost. But a lot flows, a lot of less advanced technology certainly flow.

Another kind of capital that's flowing is human capital, of which there's a great deal of it flowing. And in ZGC by 2002, 4900 returnees had started 1800 companies. During 2001 and 2002, it was about two per working days, two new companies per working day by the returnees, which is kind of impressive.

Now I don't know the fate of these companies but, judging from the Silicon Valley experience, it would not be surprising if a lot of them failed, but maybe a lot of them succeeded, too.

University business links. These have been very important there. Unlike anything seen in the U.S. or really any other place in the world, the university linkages with business.

For various reasons universities founded and they own many companies. The estimate for Tsinghua University and Beijing University is each about 200 companies. And you might ask why did this happen. Well, historically it made a great deal of sense for this to happen. But in the view of the university leaders now in these places, those relationships are problematical and they need to find out a way to disentangle this ownership of companies. I imagine that this will be changed in the years ahead so that have more of a separation of the universities from these companies.

The big obstacle for China's high-tech future, and others have mentioned this, particularly Professor Suttmeier this morning, the future is bright, there's no question about that, but the challenges are very substantial. And it's essentially on the building of institutions: Institutions of law; finance; management skills; and learning how to create technology. Viewing it from the perspective on research, which has been on information technologies, we don't see anything very impressive coming out of China so far. It's quite unimpressive. But that doesn't mean it's not going to be, but so far.

Foreign links has been mentioned. All I will say is it's enormously important. I'm struck by one fact. I think it's a fact: 81 percent of the members of China's Academy of Sciences have studied abroad.

Cochair MULLOY. Eighty-one?

Mr. ROWEN. Eighty-one percent, mainly in the United States. That's extraordinary. It's like 81 percent of the U.S. Academy of Sciences, say a hundred years ago, having studied in Germany. I mean I'm sure that many did, but probably not 81 percent.

Value added. Most of the numbers that you see and I see and that everybody see quoted widely are almost everywhere, the statistics, press, everywhere, are gross numbers, revenues, total revenues, total sales, et cetera. Well, they're relevant, but they can be very misleading.

In the first quarter of 2005 exports were reported at $156 billion. That's a huge number. But what does it mean? What's missing in such reporting is how much of that value was created inside of China. The best estimate that I know of was an estimate, it's actually for the year 1995, which is some time ago. It's very hard to do this, but Chen, Cheng, Fung and Lau did a paper several years ago using Chinese data, it took a lot of work, and estimated that the value added within China for a category of electronics and telecommunications, which is pretty close to high-tech, was 20 percent. So you export a hundred yuan of goods, China had to import from somewhere, source from the United States, maybe not from the United States, from somewhere, 80 just to be able to do that.

It's not a wild distortion to think, at least in the high-tech world especially, as a big processing zone, not a place that's really originating all that much. Gives it a little bit different perspective on some of this stuff.

Progress in science, I'll just summarize very briefly. It's very significant in certain areas, very substantial. There are indicators of this, the rate that is measured by papers, international referee journals going up. Citations still pretty low, citations in these articles and journals still pretty low, but growing. So the trend is really very substantial.

I like to look at it from two angles: From the science end it's really impressive progress. If you view it from the other end, to the commercial R&D end, not so impressive so far. And in between is kind of a big gap or a big challenge in between, which is the institutional set of obstacles I had mentioned before. This is the legal system, the financial system, and management skills, all of the above that make it a challenge, which will be overcome. But how quickly it will be overcome is very hard to determine.

Thank you.

[The statement follows:]

Prepared Statement of Henry S. Rowen
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Some Key Factors in China's Remarkable Rise in the Technologies of Information

I will touch on four topics today: One is the leading center of high tech companies in China, Zhongguancun Science Park. Second is the importance of international linkages in China's high tech rise. Third is the importance of domestic value-added in understanding the economic significance of China's export numbers. Fourth, is some indicators of the rise of science.

Zhongguancun Science Park (ZGC For Short)

This park, located northwest of the center of Beijing, has the largest concentration of high tech companies in China. It had 12,000 of them in 2002 with over 400,000 workers and revenues of $29 billion. Sixty-four percent were in the information technology (IT) industry with the rest in advanced manufacturing, bio-medical, materials, and energy sectors. An understanding of its history and present status helps us to understand how China has made giant strides in high technology industries.

Its high tech strategy has been to train many technologists, to help scientists and engineers in research institutes and universities form companies, to make state-owned one more market-focused, and to encourage foreign firms to bring technologies via direct investments. Taiwanese companies and foreign MNCs are responsible for a large proportion of China's IT exports. Large investments in telecommunications have been a core part of the strategy. The ZGC cluster in Beijing has made a remarkable transition from a set of government research institutes, state companies, and universities in a non-market system to a more dynamic, market-driven place with many new companies.

Shortly after China's reform movement started, in 1980, a researcher, Chen Chunxian, left the nuclear laboratory of the Academy of Sciences to set up the first privately funded research and technology institute in Beijing. He was followed by other entrepreneurial scientists and technicians. According to Adam Segal (in *Digital Dragon; High Technology Enterprises in China*), from 1950 to 1978 the Chinese Academy of Sciences "which owned all the technology . . . in all that time did not sell one product. Since the reforms, 40,000 products have been passed to companies and have been put on the market."

By the end of 1987, the Academy had spun out several dozen high-tech enterprises, including the computer companies Legend (now called the Lenovo Group) and China Daheng Information Technology. Most were PC-related. By the end of 1987, hundreds of enterprises were crowded along a ten-kilometer long street called Zhongguancun Electronics Street.

During this period, Tsinghua University and Peking University also established their own high-tech enterprises. There were two main motives: one was to supplement low salaries and enable them to keep the best people; the other was to move technology from laboratories to the market. University-funded enterprises have played an important role in Zhongguancun's development.

In 1988, the Beijing Experimental Zone for Development of High and New Technological Industries was set up with the power to try new rules and institutions on a small scale before moving them nationwide. It became known as the Zhongguancun Science Park. It was small, with only 10,000 workers in 1989, but about to take off. Waves of start-ups in ZGC coincided with, and depended on, the rapid growth of China's IT industry. The domestic market was greatly aided by large government investments in telecommunications while paralleling this was China's rapidly growing participation in the global IT market. Essential to this strategy has been an openness to foreign goods and direct investments.

At the beginning the region had important assets and daunting liabilities. The main assets were many scientific and academic institutions, a well-educated and talented group of scientists, and a willingness to experiment, and supportive governments, both at the national level and locally. The liabilities, also substantial, included poorly defined laws, including those for intellectual property rights, an array of state-owned companies, bureaucrats micro-managing state-owned enterprises, weak managerial skills, isolation from world markets, and an underdeveloped financial system, especially for risk capital.

Essential to the successes that followed were networks of relations that connected families, the new entrepreneurs, the institutes from which they had come, universities, local governments, and national ministries. The institutes supported their spun-off entrepreneurs in several ways, including financially; local officials for the most part worked to reduce regulations, arranged for finance usually in the form of loans, and did not interfere excessively in the inner workings of enterprises; universities set up enterprises and maintained close ties to their graduates; and national ministries kept research money flowing to institutes and universities.

From 1988 to 2002, the number of its companies grew from 527 to over 12,000 (of which perhaps 4,000 are not really viable) with total employment going from 10,000 to 420,000. In 2002, fifty-five of these companies were listed on an exchange and thirty-three had sales of over U.S. $12 million per year. ZGC firms have 40 percent of the market for software applications and 50 percent of the PC hardware market. It has the No. 1 Chinese portal, Sina.com, and the top online game firm in China, ourgame.com. It is the leading place in biotechnology, new medicines and new materials, but these industries are still small.

At the small end of company sizes, 4,300 had sales of less than $120,000. This is far from an equilibrium situation. For example, 82 percent of the 4,300 small companies lost money in 2002. The number of firms in ZGC is likely soon to shrink.

Today, China gets most of its technology from overseas with multinational companies as the main source. In ZGC, they account for 43 percent of the Park's total revenues and 78 percent of its exports. Actually, what is being transferred is not only technology in a narrow sense but also design techniques, know-how and managerial skills, including knowledge about how to solve problems and how technologies are related to each other. Investments made by multinationals are a kind of package that combines money, products, technology, talent, managerial skill and ideas. Many are establishing research centers; for example, Intel, Microsoft and Novozymes (a Danish enzyme company), have set up such centers there. China's poor protection of intellectual property discourages the transfer of advanced technologies but it has not prevented a large and sustained flow of direct investment by foreign firms.

Another major source of "capital" is the human kind embodied in returnees from overseas. It is remarkable that the total of 4,900 such people (3,500 since 1999) had started 1,800 companies in ZGC by 2002. In two years they had started two companies each working day on the average.

ZGC has both advantages from being in the capital city and disadvantages. On the advantages, there is a large flow of money from government ministries both directly for procurement and indirectly through support of institutes and universities and it benefits from the idea incorporated in the Beijing Experimental Technology Zone, "What is not forbidden by the law is not against the law." Two examples: one is that a venture capital limited partnership can be established; the other is that the scope of a business need not be clearly defined. On the disadvantages, from the vantage point of Silicon Valley—or Shanghai or Shenzhen—there are benefits in being far from the Emperor, whether he is seen as being in Washington or Beijing.

On ZGCs human resources, about half the workforce has at least bachelors degrees. There are over 30 online job service web sites and 42 percent of workers find jobs through them. The job market is a classical free market one: employment at will by both the employee and the employer; those who don't measure up are dismissed, an especially effective measure in the early development stage when other enterprises had lifetime employment. Worker mobility is high; two-thirds of employees working for less than three years have changed jobs. (A rate this high may be dysfunctional.)

The ZGC system has changed. Tax advantages were reduced in 1993 and the Academy of Sciences ended its support for many successful firms in order to support new ones. Competition has been encouraged among domestic firms and has intensified with the arrival of foreign ones. Corporate forms were adopted with ownership being expressed though stock issuance, appointment of general managers and boards of directors.

Close university links to business are also under pressure to change. Universities and research institutes within ZGC run their own ventures, often holding 100 percent of their equity. Problems inherent in these connections have become evident. Legal unclarity in ownership makes it impossible to share it with other investors, a barrier to raising capital. Efforts are underway to clear up enterprise ownership, to enable university-founded enterprises to operate independently, and to set rules so that teaching, research and operation of university-founded enterprises can be mutually beneficial and not in conflict. This requires a separation of the teaching and research missions of universities from commercial activities that may be socially useful but that can detract from their core missions.

China's financial system, especially for risk capital, remains underdeveloped. Despite the fact that the Beijing Municipal People's Congress enacted the first local law allowing limited partnership venture capital firms, this organizational form has yet to be adopted and a mergers and acquisition market has yet to emerge. High-tech companies are listed in Hong Kong or, ideally, on NASDAQ. (A recently established NASDAQ-like second board at the Shenzhen exchange might provide a domestic market listing for young firms in a few years.) In 2002, 21 ZGC start-ups received RMB 830 million (U.S. $100 million) of venture investments. Foreign investors are still dominant; 12 local institutions supplied 29 percent and 7 foreign ones supplied 71 percent.

In little over 20 years ZGC has come a long way. Its future depends on that of China, which faces challenges in building institutions, including those of law, finance and those for the creation of technology. Given its record, it will overcome them.

It is hard to miss the high proportion of scientific and technical papers published in the leading scientific and technical journals that have Chinese authors, many of them at American universities. Increasing numbers are returning home. This was a major source of talent for Taiwan in the 1980s and 1990s and now there is a growing flow back to China. They return not only with scientific and technical skills but also know-how on organizing and conducting research projects and building companies. It is remarkable that the total of 4,900 such returnees (3,500 since 1999) had started 1,800 companies in ZGC by 2002 and that by 2003, 4,300 returnees to Hsinchu had created 119 companies. Foreign nationalities constituted over one-fourth of Singapore's professional IT manpower in 1995–97 and is likely to have increased since then.

Whether among Silicon Valley, Hsinchu, ZGC, or Bangalore, linkages have been critical. Some of these places have become hubs, such as Silicon Valley, linked through flows of goods, people, capital and technology into a global network.

International Linkages

The story of ZGC reveals many important foreign connections: People, direct investment, technology, markets. Martin Kenney and Kyonghee Han (in "The Venture Capital Industries in Five Asian Nations") describe three types of people links between Silicon Valley and Asia. The first was the human linkage provided by Asian students who stayed in the United States and worked in Valley firms and elsewhere in the U.S. such as Bell Labs. They soon began launching their own start-ups while they kept close relationships with friends and families in Asia. Second was Asian students and seasoned managers who returned to their various nations, either joining the Asian operations of Silicon Valley firms or setting up companies that contracted with Silicon Valley ones. The third link was Asians trained at home who then joined the overseas operations of Silicon Valley firms. Each link was a conduit for information transfer and learning. The repeated interactions that occurred on many levels created awareness of what was occurring in Silicon Valley, not only in terms of the technical and managerial skills but also of its entrepreneurial character.

According to Marguerite Gong Hancock, Jen-Chang Chou and Ming Gu, a new and prominent international network example is the Semiconductor Manufacturing International Corporation (SMIC), a silicon foundry whose headquarters are in Shanghai. It has three fabs in Shanghai, one in Tianjin, and three being built in Beijing. Ninety percent of its output is exported. Almost all of its early management team were veterans of the semiconductor industry and had spent most of their professional careers in leading semiconductor companies worldwide before they joined SMIC. Chief Operating Officer Marco Mora, for example, had more than 18 years of management experience at STMicroelectronics N.V., Texas Instrument Italia S.p.A, Micron Technology Italia S.p.A and WSMC (a Taiwanese foundry). Of its 4,400 workers, 500 came from Taiwan, 300 from the U.S. and 200 from other places outside of China. Significantly, all but one of its initial management team started out in Shanghai.

Its funding was also global: from H&Q Asia Pacific, Walden International, New Enterprise Associates, Oak Investment Partners, Vertex, Goldman Sachs, and four Chinese state banks.

In short, it is hard to imagine anything like the present global IT industry without these many kinds of connections. In the present post-bubble era, it is common, almost a rule enforced by venture capitalists, that Silicon Valley start-ups establish a part of their operations from the outset in some place in Asia. Costs are lower and able people can be recruited.

Putting China's Export Numbers in Perspective

The common practice of reporting gross revenues from exports can lead to a misinterpretation of their economic significance. Almost always missing in such reporting is the value created domestically associated with these exports. This is often modest. Thus, according to Wong Poh Kam, in Singapore, 25 percent of the value of its exports of disk drives in the mid-1990s was added domestically and, according to Chen, Cheng, Fung and Lau, China's domestic value added to its electronics and telecommunications exports to the U.S. in 1996 was about 20 percent. These numbers imply that for every dollar of exports, goods costing 75 cents or 80 cents had to be imported. So, if China exported, say, $50 billion of high-tech products to the United States, it had to import around $40 billion of goods (although not necessarily from the U.S.) for that to be possible.

Doubtless, the value being added domestically in China to its high-tech exports is growing but it is growing from a modest level.

Some Indicators of Progress in Science

There is a growing belief in scientific and technical circles worldwide that Asia, and especially China, will become not only a place for making things but also—perhaps soon—will become a creator of technology. They have able, well-trained people, have or are developing needed institutions, and are connected to the world of ideas.

One indicator is the large and growing numbers of well-educated scientists and engineers. According to Diana Hicks, the number of Ph.D.'s granted in China from 1986–1999 increased by about 50 times (from 100–200 to over 7,000). Others are increased spending on research and development; the growth in scientific publications and in their quality measured by citations. Still another is the setting up by high-tech foreign firms of R&D centers in China—about 200 in number. Today, these centers seem to be doing more "D" than "R" but that mix will surely shift towards doing more research.

China has great ambitions in science and technology and given its accomplishments they are likely to be realized—although the timing is uncertain. Between 1995 and 2000, its spending on R&D more than doubled. It was still only one percent of GDP but it was growing at ten percent a year and the government says it wants to increase that share.[1] According to Kathleen Walsh, by the year 2000 China ranked eighth in the world in scientific papers contributed by Chinese authors (three percent of the world total) compared with it being 15th in the world five years earlier. This is not to assert that China's capacities are up to those of the industrialized countries. This will not likely happen soon but it is on the move.

The rise of China in innovativeness will have mixed impacts on others. The generation of new ideas can benefit everyone. It also gives their creator an advantage—as Silicon Valley has demonstrated. What should not be in doubt is that the U.S. and everyone else will face a large challenge coping with the rise of an innovative China.

Cochair MULLOY. Thank you, Dr. Rowen.

Let me just tell the panelists: Your full statements will be included in full in the record of the hearing. If you could limit yourself to seven to eight minutes, and then we'll open it up to Commissioners asking questions. Thank you.

Dr. Zysman.

STATEMENT OF JOHN ZYSMAN, CO-DIRECTOR BERKELEY ROUNDTABLE ON THE INTERNATIONAL ECONOMY PROFESSOR, UNIVERSITY OF CALIFORNIA, BERKELEY, CALIFORNIA

Dr. ZYSMAN. Thank you very much. Many of you may know the degree to which the international economy was really formed around the U.S.-China trade struggles. I emphasize that because I wasn't exactly known as soft on, shall we say, foreign economic challenges. And I want to set some of what I'm going to say here today in that regard.

One of the great moments for me was having one of the friends from BRIE take me into his office and point out that I had been moved off of the Japan enemy's list, which they actually had with a big target. And many of my friends had been moved to the sidelines.

[1] Kathleen Walsh, "Foreign High-Tech R&D in China: Risks, Rewards and Implications for U.S.-China Relations, the Henry L. Stimson Center, 2003.

BRIE has also worked some on U.S.-China relations on the issue of China's entry to the WTO. But when speaking with Members of the Commission and speaking with the staff, when I was invited to speak here I asked myself: What could I, who's not really a great expert on China, add to the conversations that friends like George Scalise, John Gage and the industrial side, Barry Naughton on the academic side, wouldn't say otherwise.

There were really three things that I wanted to say that I thought were worth taking your time.

The first, I usually like these to come up as a whole, so let me just simply say: Let me list the three points I'd like to make very quickly—is that China's not the first great new economic power to enter the world scene. We could go back a century and remark on Germany, even the United States. Japan is obviously something we've dealt with.

We're not going to stop China's entry. We may shape the character of China's entry, but we're not going to stop it. And the great question is the nature and character of our own adaptation, our own adjustment, our own successful response to the character of the economic and security challenges that that poses.

The second point that I want to make is that the key issue is the nature of our adaptation and our adjustment. The third is that the core of that is going to be an emphasis on innovation, not simply technical innovation, but in fact innovation in business models, innovations in fundamental business strategies.

Now having said that let me run through these slides fairly quickly, and I'll put, as you've asked the core points in the record. The first, as I say, is that China's not the latest story. Really the term "globalization," if you actually count it really emerges with Japan. We had a bilateral world. Bilderberg was the center of the universe until the Trilateral Commission emerged with the emergence of Asia as a real challenge. And Japan was really the first instance of that Asian challenge. In a certain sense globalization is a sequence of national stories, told on a larger stage.

When I emphasize that China is not the only story I suspect that Motorola would pick a different national story as its big threat. It might choose Finland. It might choose the character and strategy that the Finnish adopted that led them from being on the periphery of the Soviet empire to a core player in the communications era.

As I say, the core issue that matters for the United States is the nature of our adjustment. Now obviously we need to enforce appropriate rules and negotiate the best possible international agreements. Nothing that I'm saying suggests other than that nor that I don't take that very seriously, but I do. But I think as in the Japan era, much of what was, in fact, lost sight of was the character of the American adaptation that was required.

In the Japan story we had a story of closed markets, radical domestic expansion, and then production innovation and managerial innovation. It was a very straightforward story. In some ways Jim Martin, who spoke to you this morning, the great—it was Korea's expansion that complicated that story as it became a player in the semiconductor industry that in some ways made the story more complicated.

China's, as Barry Naughton and others have told us, is a story of FDI as an instrument of development; of manufacturing; of outsourcing; of the effort to try and capture R&D and higher valued-added activities; of local networks built out, around and underneath FDI. It's a struggle for standards, and IP is a strategic game. As my friend Stu Feldman at IBM suggested, that what we really are looking at is a game of three-dimensional Go played on what most people understand is a two-dimensional chess board, but the game that is being played is much more complicated and much more serious than we conventionally understand.

It's not going to be the last story. This Commission will reconvene in a few years about India, I'm sure, and which the story is one about service outsourcing, a less concerted national strategy perhaps, but managerial innovation and outsourcing service.

Now as an instance, because I want to use the Indian story as an instance of what I mean by adaptation here. Part of the problem that we face is that when we face challenges, we respond with old lessons and old tools.

If you look at the outsourcing story, which is different than the offshoring story since you can offshore without outsourcing and you can outsource without offshoring, the question becomes: Why does a company like Wipro suddenly show up in my backyard as an outsourcer in this area? And the answer is that certainly part of the story was about low cost labor being able to be outsourced to India.

Another part of the story was that they clearly learned managerial lessons about how to organize outsourcing that permitted them to come back into this area with a new managerial innovation and begin to organize outsourcing onshore. The question we have to keep track of is what are the real challenges and how is business going to respond.

Since time is limited I will put in the record my arguments about what the character of the nature of the business challenge really is, which is finding the spot of differentiated assets that prevent you from being caught in a commodity, that much is blurring. Commodities become products become commodities. Internal functions such as R&D become products. Services become products. And product companies like IBM become service companies. It's not very stable.

And, in fact, there's an endless search for new positions, and the real search is for new business models and an experimentation to allow that to happen.

Now in the last minute of overtime that I'll permit myself is the question is what ought we to do? Now I would emphasize that obviously we have to pursue the best possible international arrangements. We have to defend international appropriate global rules of intellectual property and the like. But others will emphasize that.

Domestic adjustment and adaptation is for me the key. Innovation in the end is going to be the key to that adaptation. I look at the fact that in China we see massive network build-outs in communications networks. And we ask the question as Korea builds out significant networks in high-speed telecommunications networks, Internet networks, if the leading edges of usage are outside the United States, will our companies be able to follow?

So the question becomes: What do we do? Government policy has to be aimed at sustaining the U.S. as a driving source of innovation, as a source of R&D to assure that we maintain ourselves as a technology pump, that we remain on the leading edge of infrastructure and technology exploitation and education, education, education.

Corporate strategy has begun to be imaginative, identifying the shifting markets and understanding the innovation in business models, not just technology to understand what the new opportunities are in this set of challenges. And then I've put up a few things that I think might be useful to the Commission that I'll be glad to submit later that might be helpful in thinking through some of the choices that are before us.

Thank you.

Cochair MULLOY. Thank you very much. Dr. Preeg.

STATEMENT OF ERNEST H. PREEG
SENIOR FELLOW IN TRADE AND PRODUCTIVITY
MANUFACTURERS ALLIANCE/MAPI, ARLINGTON, VIRGINIA

Dr. PREEG. Thank you. I'm also delighted to be here today and talk about what is a highly dynamic U.S.-China relationship in the high-technology industry. I'm just completing a heavy study on the subject, it will be out in June with the title: "*The Emerging Chinese Advance Technology Superstate*."

And the principal conclusion is that China, indeed, is an emerging super state in this context and this poses a serious challenge to the longstanding U.S. leadership in technology innovation and related production exports. And if the gap continues to narrow, as it is now, there will be major implications for U.S. commercial, national security, and geopolitical and other foreign policy relationship, could be a very fundamentally changed international order.

My written statement does summarize both my analytic and policy conclusions. So I will just use my time here to tick off what I consider the essential ingredients to achieve such advance technology super state status, and a few issues that need to be watched in terms of China getting from here to full status with the U.S. and Europe being the other established broad super states in this area.

I see six essential ingredients for super state status, and I see China meeting all of them. Much of this has been talked about already. First there has to be a very large internal market for these new products to be marketed first at home. China with 1.3 billion people, nine-percent growth clearly has the market. And more and more investment is directed toward the domestic as well as export market.

Second, we talked a lot about R&D, a major commitment to R&D resources. This really started in 1995. There were key decisions of the Chinese government that really put this up as the top priority. From 1995 to 2002 their R&D grew 22 percent a year versus six percent for us. They're passing Japan by this year to be the second largest R&D commitment. I should also say it's much more heavily directed toward manufacturing industry where the new technologies are being developed, whereas our public R&D certainly is much more heavily in the health sector compared with NSF, for example.

The third ingredient is, again, we've talked about education: A tripling of their college program and graduates since '95, from one to three million graduates. They are now somewhat higher than U.S. graduates.

There's a tendency to look at doctorates in science and engineering. This year roughly doctorates in engineering will be about 9,000 there versus 5,000 in the U.S. The educational system is much more heavily oriented towards science, math, engineering.

The fourth ingredient is investment in infrastructure. And here again their resource commitment in terms of savings, environments is really quite extraordinary. And certainly for the advance technology sector, when it comes to transportation, communications, electric power, and other supporting infrastructure they have been keeping up and it's quite impressive.

The fifth and sixth ingredients are linked. One is to have a very fiercely competitive, if you will, private sector or relationship among these companies who have to keep moving ahead quickly. And, second, you have to have a very open trade and investment policy. These are linked, and China has both of them. Certainly everything we read about the advance-technology sector between multinational companies and China companies coming on-stream and rather rapidly is intense competition. And this really creates the incentives to move ahead in these areas.

In fact, the whole process of these last ten years, take the last four or five, has been driven very much, as we know, by foreign direct investment. Very export oriented. The foreign direct investment up to '95 was quite low because labor-intensive industry, textiles and such, doesn't need much foreign direct investment, but it's gone up from five billion in '91 to 38 billion FDI in '95 to 62 billion last year. Again, mostly, 70 percent in the manufacturing sector and very export oriented. The percentage of total of Chinese exports by foreign companies last year was 57 percent. I think that's without precedent. And it would be much higher if you limit it to the advance-technology sectors, because that's where the FDI is so concentrated.

And this is related to the extraordinary trade performance: 35 percent growth in exports in '03 and '04. It'll probably be at least that much this year. In fact, I'm predicting that their global trade surplus will go up from 40 billion last year to maybe a hundred billion this year, just taking off. Partly apparel and textiles, but it's also semiconductor, steel, and the information technology sectors. So very trade oriented. And this is where the trade, the high-tech trade is the bottom line in international Chinese in these areas. And here the Chinese trade structures change dramatically in the last three or four years. Over half of Chinese exports are now in the so-called high-tech sectors, as defined by the OECD.

Apparel, textiles, and footwear, they're down to 18 percent. It'll be a little bump this year, but it's just going down. So they're a high-tech exporter, for the most part.

When it comes to U.S. trade, we have this trade category: Advance-technology products. These are the ones that have the most deeply embedded, the highest content of R&D and engineering input. It's about 30 percent of our manufacturing sector. Globally our advance-technology industry in this ATP trade has gone from a surplus of 20 billion in '98 to a deficit last year of 37 billion. And the shift has been almost all China. We were in trade balance in '98. Last year the deficit with China was 37 billion, accounted for the entire global.

That's the overall picture of the ingredients. Let me just tick off four of the things we should keep watching to get to the if you will status. One, will there be Chinese companies coming on to achieve multinational status in terms of competitiveness. Ex companies are coming on fairly quickly in almost every advance-technology sector. They want to establish a brand name, quality, a reputation, and a big R&D capability.

A second point to look at was raised earlier: The export platform relationship where they import components and then export. This is almost entirely an East Asian relationship with Taiwan, South Korea, and Japan. I think it's changing rapidly. I think on average in the information technology, telecommunications sector probably now, but we don't have good data, probably over half of the content on average is Chinese. And it goes up because there's more and more going to Chinese sourcing and trying to upgrade. But it's an important relationship and we certainly need more information.

Thirdly, there is a need for structural reforms: The banking, financial sector shifting from industry to other sectors. But, again, if you say how, this can have adverse impacts on disruption, but probably not relatively as much so for the advance-technology sector. This—this sector's financed not by the big Chinese banks. It's overseas' financing by the foreign companies and even the Chinese companies. They're not having to turn to the internal banking sector.

So I think although there are big problems and challenges here, it's unlikely to really slow down the advance-technology momentum.

Finally, there is the process of political change. I believe it's almost inevitable there will be some form of democratization, without saying how or what pace. It can be disruptive, it need not be. Certainly South Korea, Taiwan have went through it without disruption from authoritarian, but it could be disruptive. The question is how will this impact on the advance-technology sector. Again I can't predict that, but it's unlikely that they would really do things that would undermine the sector, but this is certainly something that needs the scrutiny.

That's it. And on the policy response, as I say, the conclusions are listed in my written statement, and we might want to get into those during the question period.

Thank you.

[The statement follows:]

Prepared Statement of Ernest H. Preeg
Senior Fellow in Trade and Productivity
Manufacturers Alliance/MAPI, Arlington, Virginia

The Emerging Chinese Advanced Technology Superstate

China is an emerging advanced technology superstate, which poses a serious challenge to longstanding U.S. leadership in technology innovation and related production and exports. A further relative advance in Chinese advanced technology performance will have important impact on U.S. commercial, national security, and foreign policy interests.

An advanced technology superstate is defined in terms of economic, technological and financial power, leading to political power in international affairs and to becoming a military super power as well. The essential ingredients for superstate status are a very large internal market, correspondingly large public expenditures for research and development (R&D), education, and infrastructure, a highly competitive private sector, and an open trade and investment policy. China meets all of these conditions, although further market-oriented reforms are needed, especially in the financial services sector.

These are the central conclusions of my study, *The Emerging Chinese Advanced Technology Superstate*, scheduled for publication in June. More specific conclusions, grouped in terms of the analytic assessment and the recommended U.S. policy response, are as follows:

Analytic Assessment

(1) Deng Xiaoping's "Four Modernizations," put forward in 1978, have led to 25 years of 9 percent annual GDP growth in China, and a fivefold increase in per capital income. This rapid growth, however, has been in two distinct stages. The first stage, from 1980 to 1995, centered on export-led growth in low technology, labor-intensive industries, while only during the past 10 years has advanced technology industry development become the top priority.

(2) The two principal "resource" indicators of advanced technology development are R&D expenditures and science and engineering graduates. Chinese R&D expenditures grew by 22 percent per year from 1995 to 2002, compared with 6 percent in the United States. Projected to 2005, Chinese expenditures will be higher than those of Japan, more than 60 percent of the EU level, and about 40 percent of the U.S. level. Chinese R&D is more heavily concentrated in manufacturing than is U.S. R&D, with 60 percent of the Chinese R&D performed by enterprises, 28 percent by government research institutions, and 10 percent by universities.

(3) Chinese science and doctoral degrees increased by 14 percent per year from 1995 to 2001, compared with minus 1 percent in the United States. Projected to 2005, annual Chinese doctoral degrees will be half that of the U.S. level. Chinese doctoral degrees in engineering grew 18 percent per year from 1995 to 2001, compared with minus 2 percent in the United States. Projected to 2005, Chinese engineering doctorates will be 70 percent higher than the U.S. level.

(4) Two performance indicators are patent applications and technical article authorship. Chinese patent applications increased annually by large double-digit percentages from 1995 to 1999, as did technical article authorship from 1995 to 2001, but from very low base levels. More up-to-date figures would be revealing, and the National Science Foundation is urged to provide more current figures.

(5) Foreign direct investment (FDI) in China was relatively low during the first stage of labor-intensive industrial growth, less than $5 billion per year through 1991. FDI then increased sharply, related to wide-ranging incentives for advanced technology investors, to $38 billion in 1995 and $62 billion in 2004. Seventy percent of FDI is in manufacturing, with heavy concentration in export-oriented companies and advanced technology sectors. In 2004, 57 percent of total Chinese exports were by foreign investors.

(6) Taiwan is the largest foreign investor in China, accounting for up to half of total FDI, but there are no precise figures because most of it comes indirectly through Hong Kong and other sources. The United States was the second largest foreign investor through 2002, but in 2003 and 2004, South Korea and Japan pulled ahead of the United States. In 2004, South Korea invested $6.2 billion, Japan $5.5 billion, and the United States $3.9 billion.

(7) Taiwanese investment is concentrated heavily in the information technology sector, including the semiconductor sector. China plans to build up to 18 semiconductor plants by 2005, and there are now about 400 chip-design companies in China, about one-third of which are foreign.

(8) American investment in China is broader in industry scope, although with 70 percent in manufacturing. China provides tax incentives and exerts coercion on American companies to do R&D and upgrade the technology level of production in China, and many companies are doing so. There is also a trend to work with Chinese suppliers and thus increase value added within China. Ingersoll-Rand employs 20 engineers to train Chinese suppliers to meet quality standards. Cisco CEO John Chambers predicted that "China will be the IT (information technology) center of the world."

(9) Chinese exports grew 35 percent in both 2003 and 2004, and will probably come close to that again in 2005. China passed Japan in 2004 to become the third largest exporter after the United States and Germany, with most of German exports

within the EU, and on current course China will be the number one exporter within three years.

(10) Chinese high and medium high technology exports are growing the fastest and their share of total manufactured exports increased from 33 percent in 1995 to an estimated 52 percent in 2004, while low and medium low technology exports were down from 67 percent to 48 percent. In 2004, less than 20 percent of Chinese exports were in textiles, apparel, and footwear.

(11) The U.S. merchandise trade deficit with China increased from $57 billion in 1998 to $162 billion in 2004. For advanced technology products (ATP), which have the highest R&D and engineering content, the United States was in rough trade balance with China in 1998, but had a deficit of $36 billion in 2004. The ATP deficit was $39 billion in the information technology and communications sector, offset by small surpluses in semiconductors and commercial jet aircraft.

(12) The "export platform" issue involves Chinese exports of advanced technology products with large import content of high technology components. There are no precise figures for the extent of this relationship, and the import content varies widely by plant and industry subsector. The overall degree of export platforming is probably relatively small and declining steadily as the share of Chinese value added increases. The very large majority of export platforming is by Taiwanese, South Korean, and Japanese companies, and very little is by American companies.

(13) The net assessment is that China, indeed, is an emerging advanced technology superstate, in terms of its domestic market size, the resource commitment to R&D, engineering, and infrastructure, the rapidly growing and highly competitive investment sector, and the spectacular export performance.

(14) One indicator for final arrival as an advanced technology superstate will be the emergence of internationally competitive Chinese firms, with brand recognition, quality product reputation, and a leading edge R&D program. A number of large Chinese firms in several sectors are approaching this stage of multinational competitiveness.

(15) China nevertheless will have to make important structural adjustments to maintain its high rate of growth in advanced technology development. Financial sector reform is most important, and significant steps are underway. A sectoral shift from export led to domestically generated growth needs to be made, which should include a greater resource commitment within China to health care, infrastructure, and environmental improvements.

(16) Political change in China is difficult to predict, but disruptive change that would undermine advanced technology industry is highly unlikely. A process of democratization within China, whatever the pace and modalities, is almost inevitable as China progresses toward being an affluent, more highly educated, information-based society, with a rapidly growing middle class and a highly productive private sector.

(17) One geopolitical consequence of the Chinese rise to advanced technology superstate status is that it is becoming the economic hegemon in East Asia. China is or will soon become the principal trading partner of all other East Asians, including Japan and South Korea. China is the largest recipient of FDI by far, and an outward flow of Chinese FDI to Southeast Asia is gathering momentum. Once the yuan becomes a convertible, market-based currency, Shanghai, Beijing, and Hong Kong will soon become the financial centers of Asia. As a result, China will have the dominant economic influence within the region, with corresponding growing policy leverage.

(18) One geostrategic consequence of the Chinese rise to advanced technology superstate status is that Chinese internally generated military modernization is moving ahead much faster. A fundamental restructuring of Chinese defense industry in 1997–1999 shifted control of defense enterprises from the military to the civilian government, and integrated their operations with commercial advanced technology enterprises, including competitive bidding for defense contracts. In effect, China shifted from the discredited Soviet model toward the U.S. model for weapons development and production.

(19) The result has been a more rapid rate of military system modernization, particularly for the navy and defense electronic systems. During the 1990s, the U.S. Department of Defense (DOD) consistently assessed the Chinese military capability as being at least 20 years behind the United States. The 2004 DOD annual assessment was that China will have uneven success in its goal of catching up with the industrialized nations within 5 to 10 years, and the 2005 assessment will likely indicate an even faster narrowing of the gap.

The U.S. Policy Response

(1) China is the most important U.S. bilateral relationship. A new relationship, resulting from China's emergence as an advanced technology superstate, centers on a deepening economic engagement of wide-ranging mutual benefit, together, up to this point, with a far less engaged set of mutual national security interests. The most important medium to longer term U.S. interest in play is to maintain U.S. leadership in advanced technology industries, which is importantly related to relative military force capabilities.

(2) The political relationship is troubled, but likely to move in a positive direction over time through democratization within China, largely as a result of the deepening economic engagement, which can be helped through targeted U.S. diplomacy. Deepening ethnic and cultural ties between the two countries, including through study and travel, will also help. Confrontation over Taiwan should be avoided as a mutual interest, but this can become more difficult as Chinese military modernization proceeds at a faster pace.

(3) The recommendations here focus on the economic relationship, beginning with the most important immediate problem, Chinese currency manipulation. The Chinese yuan is estimated to be at least 40 percent lower than a market-based exchange rate, as a result of massive purchases of foreign currencies, over the past four years, by the Chinese central bank. Others, particularly Japan, South Korea, and Taiwan, have followed suit, which has had a substantial overall adverse impact on U.S. trade, particularly the manufacturing sector, including advanced technology industries. The U.S. trade deficit is in the order of $150 billion larger as a result of such currency manipulation, which is in violation of IMF and WTO obligations. The United States should act vigorously against all four East Asians to cease the practice, initially through direct consultation, but making clear that the United States is prepared to pursue IMF and WTO dispute settlement procedures if necessary.

(4) Once China moves to a convertible, market-based exchange rate, which is its stated objective, the international financial system will soon take on a new structure oriented around three key currencies, the dollar, the euro, and the Chinese yuan. The IMF system will also change fundamentally, with few if any large IMF loans, the policy focus on how floating rates are managed, and possible initiatives for currency unions. The most challenging financial relationships will be within Asia and across the Pacific with the dollar. The United States and China will thus take on principal leadership responsibilities and need to structure their bilateral financial collaboration more effectively.

(5) The U.S.-China trade and investment policy relationship has bilateral, multilateral and regional dimensions. The bilateral dimension centers on implementation of Chinese WTO accession commitments and involves negotiations on a wide range of issues. Protection of intellectual property rights (IPRs) is the biggest problem area, with serious adverse impact on U.S. advanced technology industries. Other issues of particular interest to U.S. advanced technology industries which need to be addressed include investment policy, standards and technical regulations, taxation, subsidies, telecommunications services, and biotechnology regulations.

(6) The multilateral dimension currently involves the WTO Doha round, which is bogged down largely over the issue of nonreciprocity for developing countries. The United States and China could go a long way to breaking the impasse through a jointly supported formula for tariff reductions in the nonagricultural (almost all manufacturing) sector, in which China would make a fully reciprocal offer in view of its strong export competitiveness in manufactures.

(7) The regional dimension of trade policy is now focused most importantly on East Asia, in view of the China/ASEAN free trade agreement (FTA), with Japan and South Korea following in the wake. Such an East Asian preferential trading bloc would have further substantial adverse impact on the U.S. trade deficit in view of the high tariffs throughout East Asia, and would also have a negative geopolitical consequence as a high visibility Asian grouping in an adversarial position vis-à-vis the United States.

(8) The only practical way the United States can head off an East Asian preferential trading bloc, which excludes the United States, is through initiatives to create an Asia-Pacific free trade agreement, as agreed at summit level in Bogor in 1994. The centerpiece of such an agreement would be U.S.-China free trade, which although not feasible at this time, should be addressed through the formation of a high level U.S.-China study group to examine the economic costs and benefits of free trade between the United States and China within the Asia-Pacific context.

(9) In parallel, the United States should undertake or complete FTA negotiations across the Pacific with Thailand (negotiations under way), South Korea (official talks under way), and Taiwan (informal talks under way). This "three spoke" initia-

tive, in addition to existing U.S. FTAs with Singapore and Australia, would definitively move the United States into the trans-Pacific free trade relationship, and would be incorporated as part of a proposed formal APEC review of progress toward the Bogor objective. Such trans-Pacific FTA initiatives, moreover, could well lead to a multilateral free trade agreement for the nonagricultural sector.

(10) A U.S. domestic economic policy response to the Chinese challenge to U.S. leadership in advanced technology industry is essential. In broadest terms, the U.S. manufacturing sector is the engine for technology-driven economic growth and needs to be more competitive internationally. The $552 billion trade deficit in manufactures in 2004 was one-third the size of U.S. production, which greatly reduces the domestic revenue and employment base for continued innovation. The trade deficit needs to be greatly reduced or eliminated, which involves two principal domestic policy areas.

(11) The first macro-policy area is the need to increase domestic savings so as not to have to borrow abroad to finance investment which, in turn, drives up the trade deficit. Greater incentives for private and business savings, and the reduction or elimination of the Federal budget deficit, are the policy vehicles.

(12) The second remedial policy area involves various specific policies that place cost or other disadvantages on U.S. manufacturing industries compared to major trading partners, and to China in particular. Specific proposals and conclusions are offered for tax policy, education, R&D, tort reform, health care, regulatory policies, and the Sarbanes-Oxley law.

(13) The current U.S. domestic policy response to the Chinese advanced technology challenge is disturbing and points to an increasingly difficult road ahead for American companies. To remedy this, there is a need for better public communication about the relationship between the advanced technology engine for growth phenomenon and U.S. international as well as domestic interests. What is lacking most of all is a sense of national purpose in responding to a rapidly changing world, driven most importantly by the development and application of wide-ranging new technologies on a global scale.

(14) The final conclusions extrapolate the Chinese advanced technology experience over the past 10 years into a broader historical perspective ahead. Prevailing paradigms about the post-Cold War world are found inadequate. A revised and updated new order of international relationships will center on political, economic, and military power relationships increasingly dominated by three advanced technology superstates—the United States, the EU, and China—each a regional advanced technology hegemon within the North America/Caribbean, European, and East Asian regions, respectively. The three regions together include 52 percent of global population, 79 percent of GDP, and 85 percent of merchandise exports. India may rise to advanced technology superstate status within 10–20 years, as the South Asian advanced technology hegemon. Relationships among the three advanced technology hegemons are not yet well defined, however, and other regions of the world will face important adjustments as well.

Cochair MULLOY. Dr. Preeg, thank you very much.

I want to give a special thanks to Mr. Fingleton for getting here. He flew from London to New York yesterday and got up and took a 6:15 flight out of New York to be here with us today. So, Eamonn, thank you so much. We really appreciate it.

How do you feel?

STATEMENT OF EAMONN FINGLETON, ECONOMIC AUTHOR
UNSUSTAINABLE: HOW ECONOMIC DOGMA IS DESTROYING AMERICAN PROSPERITY
TOKYO, JAPAN

Mr. FINGLETON. Thank you for that introduction. I think my head is at twelve o'clock at this stage, 12:00 midnight.

I'd like to address a fundamental misunderstanding in the United States about the rise of China. Most Americans seem to think that other countries must give way, must sacrifice their industrial workforce and their manufacturing base to accommodate China's rise.

I think this is an America-specific point of view. Few other nations take this view. And this should be clear from the fact that although China runs a huge surplus with the United States, it actually runs a deficit, a large deficit with the rest of the world.

Certainly in East Asia other East Asian nations do not take the view that they have to sacrifice their manufacturing bases because China is suddenly rising. I've lived in Japan for 20 years and I think that the Japanese example is particularly relevant.

Wages in Japan are very high and Japanese imports from China are growing very rapidly. Yet on balance it's very clear that Japan has benefited from China's rise.

Let's go through some of the facts of the situation.

Japan's imports from China have risen 263 percent in the last ten years. Chinese goods now account for nearly 21 percent of Japan's total imports. Now how big is that number? Well, by comparison Chinese goods represent a mere 13 percent of America's total imports.

Outsourcing has clearly been a big factor in the rise in Japan's overall imports in recent years. Japanese companies outsourcing from China. Thus if any nation should be hollowed out by China's rise it should be Japan, particularly as Japanese wages are actually higher than American wages. They're about 20 to 30 percent higher than American wages.

Yet now look at Japan's trade position overall. Japan's trade position has not been weakened by the rise of China, quite the reverse. Japan's current account surplus last year was $181 billion, $181 billion. That surplus was three times the surplus earned in 1989, which was the last year of the financial boom in Tokyo. It was also the peak year of American awareness of the Japanese juggernaut. So Japan in the time of China's rise has increased its current account surplus three times.

How has it done this? What is Japan doing that the United States is not doing in relation to its policy with China?

Unlike the United States, Japan manages its trade. It manages its trade with all nations, but particularly these days with China. It manages the trade relationship in two very important ways. One, it avoids the hollowing out of the Japanese industrial sector, and two, it avoids the transfer of key technologies to China. There are many policies that support these objectives. A key one is Japanese labor policy.

As we know, Japan has an unusual labor system known generally as the lifetime employment system. That's a misnomer. "Permanent employment" is a better way of describing it, but the basic point of the system is that layoffs are not allowed for healthy, large corporations. There are some exceptions, and they get publicity in the American media so that people get the impression that the system is breaking down. It's not breaking down.

Basically in Japan for major corporations payroll in domestic operations is a fixed cost. That completely transforms the way that management in Japan views their responsibilities. The basic responsibility of a Japanese CEO is not to please the stock market. It is to ensure the long-term viability of the jobs in the Japanese operations of that corporation.

It falls almost automatically that top management in corporate Japan will align themselves with the objective of the nation's overall economy. Japanese companies do not shift work overseas until they find better work for their people at home. When I say "better work," I mean more capital-intensive work, more know-how intensive work, much more capital-intensive work, typically much more know-how intensive work.

So when a company like Toshiba, for instance, finds that it wants to outsource assembly of television sets to China, it already has much more interesting, much greater value-added work for its people at home to do. Typically such work is making components, very often maybe ten times more capital intensive with an enormous amount more know-how involved in the production process.

The labor policy in Japan also supports the Japanese government's policy objective of avoiding the transfer abroad of key technologies. From a Japanese corporate perspective there is absolutely no point in shifting high technology processes abroad. You want to keep those processes for your home workforce to maintain their productivity edge and to maintain their competitiveness in world markets.

All this adds up to a pattern that is very different from the American pattern of trade with China. Japanese corporations import a lot of assembled goods from China. That's as in the American case. But they export a vast number of key components, thus Japan has a broadly balanced trade relationship with China. In this sense, a classic example of the division of labor. Japan has shifted abroad low quality work and has redirected its own workforce into much more high quality work, thus for a relatively small increment of the total costs it has received a big increase in unit volumes. And much more could be added, but I see I'm pretty much out of time.

If it were of interest, I'd be happy to discuss why Americans have not understood this point in the past. It seems to me that it's a question of how the media approach the subject of——

Cochair MULLOY. Why don't you take another minute or so and finish.

Mr. FINGLETON. Yes. Well, it seems to me that the American media have completely misunderstood the East Asian economic phenomenon. And you see that in so many ways. The media described Japan as having collapsed in the 1990s. There was no collapse in Japan in the 1990s. That's obvious in the trade figures of Japan.

People who don't go to Japan very often don't realize it, but consumers in Japan are among the wealthiest consumers in the world. They increased their living standards very dramatically in the 1990s. In every way that you look at an economy like Japan, if you look at what is actually happening as opposed to what people are saying, you find that Japan has done well. So, as I say, this is a question for the media. It's also probably a question for academics that study Japan.

[The statement follows:]

Prepared Statement of Eamonn Fingleton, Economic Author
Unsustainable: How Economic Dogma is Destroying American Prosperity
Tokyo, Japan

For more than a decade now we have been told that it is inevitable that high-wage nations like the United States will be hollowed out by a rising China. This is dangerous nonsense that has already done untold damage to the United States.

Although China has every right to aspire to become rich, other nations should not be expected in response to have to weaken their industries, let alone impoverish their manufacturing workforces. If this point is not understood in the United States, it is well understood elsewhere, not least among China's richest trading partners in East Asia. In varying degrees, South Korea, Taiwan, Singapore and Japan have cooperated with China's desire for export-led growth yet they have done so without compromising their own fundamental economic interests.

The experience in Japan, where I have lived for nearly twenty years, is particularly instructive. It is a little known fact that wages in Japan are actually higher than in the United States—about 20 to 30 percent higher measured at recent market exchange rates. Yet even as Japan has rapidly increased its imports from China, it has shown no evidence of being hollowed out. Quite the reverse. Japan's industrial strength has, on balance, actually been considerably enhanced by trade with China in recent years. Certainly Japan's trade surpluses have continued to burgeon. Japan's current account surplus last year, at $181 billion, was not only the largest of any nation in world history but it was more than three times Japan's current account surplus in 1989, the last year of the Tokyo financial boom.

It is interesting to note that China supplied full 20.7 percent of all Japan's imports in 2004, compared to a mere 13.4 percent of America's. Measured in yen, Japan's imports from China increased by 263 percent in the ten years to 2004.

Just as in the case of the United States, outsourcing from China has played a major role in the rise in Japan's imports in recent years. There the similarity ends. Unlike the United States, Japan believes in managing its trade. Although Japanese officials recognize, of course, that consumers can benefit considerably from trade, they also recognize that people need jobs and incomes before they can consume. Thus where imports would pose a significant threat to jobs, the Japanese government generally acts to minimize the damage. It does so typically by issuing guidance to key players in, for instance, the Japanese distribution system to minimize their purchases of the relevant imports.

Where outsourcing is concerned, a second key concern for Japanese policymakers is to keep tight control of the nation's key production technologies, thereby maximizing Japan's productivity edge. It is taken for granted in Japan that production technologies are as much the nation's property as they are the property of the corporations that developed them. Thus individual corporations are not permitted unilaterally to transfer advanced technologies to foreign operations. The sense that the technologies are national property is enhanced by the fact that they are typically developed jointly by Japanese corporations in industry-wide research cartels. It is assumed by all concerned that the latest technologies will be applied in the first instance in factories at home, thereby giving Japanese workers a vital edge in global competition. Any decision to move the technologies abroad will be the result of a government-guided industry consensus. Thus although corporate Japan has transferred significant production technologies to China in recent years, it has never given away the crown jewels.

Much of the control of Japanese trade stems automatically from the nation's distinctive labor regulation. A basic principle is that employers should avoid making layoffs. This principle is applied flexibly—in the Japanese way, bureaucrats are entrusted with extraordinary case-by-case discretionary powers. Thus exceptions to the no-layoff policy are permitted, particularly in the case of small firms and corporations in near-terminal financial difficulties. But for large, solvent corporations, layoffs are generally not permitted.

In practice therefore the operating assumption in corporate Japan is that payroll is a fixed cost. This profoundly alters how Japanese top managements see their responsibilities. Thus whereas in corporate America, profits come way above jobs in a CEO's priorities, in corporate Japan the ranking is exactly reversed. It is useful to see the world as the chief executive of a major Japanese corporation sees it. Whereas his American counterparts are much concerned with pandering to the whims of securities analysts and micromanaging quarterly earnings flows, a Japanese CEO is necessarily focused on long-term production planning. His principal concern is to create new and ever more productive work for his Japanese colleagues at every level in the organization. Not the least of his concerns will be to ensure the viability of the jobs of the thousands of young workers recruited this year, workers who can be expected to be still on the payroll thirty years hence. Towards this end he will want to make sure that the corporation spends heavily on research and development and that this spending is directed principally towards developing new production technologies intended to give his workers a productivity edge in world competition for decades to come.

All this means that a Japanese CEO's attitude to outsourcing will almost automatically be closely aligned with the Japanese national interest. Because he cannot easily shed labor at home, he will move production activities abroad only after he has already lined up new and better work for his domestic workers. By new and better work is meant work that is either more capital intensive or more know-how-intensive or both.

By way of example, a Japanese television manufacturer might move assembly operations to China only after it had first determined to redeploy its domestic assembly workers making sophisticated components such as liquid crystal displays. The significance of this shift is apparent when you realize that the manufacture of components is often ten or even twenty times more capital intensive than assembling television sets. It also often involves an enormous amount of secret production know-how that can give Japanese workers an enormous edge in global competition. In the case of liquid crystal displays, the importance of production know-how can be readily demonstrated. A liquid crystal display consists of perhaps as many as a million separate dots each controlled by a separate transistor. If the display is to be a saleable product all the dots and transistors must work perfectly. If there is any deviation from perfect conditions in the factory, there will be a significant number of dysfunctional transistors and the resulting displays will have to be scrapped. By dint of learning by doing over thirty years or more, Japanese LCD manufacturers have so honed their production technologies that they can secure a yield of perfect products of as much as 90 percent in a typical production batch. By contrast any new entrant into the field—say a Chinese company or an American one—would probably be lucky to get a yield of as much as 10 percent. In other words, Japanese workers by dint of their employers' superior production know-how can readily outproduce workers abroad by a factor of nine to one. For Japanese CEOs, the availability of cheap Chinese assembly labor has on balance been a major plus because it has made possible a highly efficient division of labor. Released from labor-intensive assembly functions, workers at home increasingly concentrate on making sophisticated components.

Thus the rise of outsourcing in China has enabled Japanese corporations, (1) to increase greatly their total unit output, (2) to redeploy their home workers in ever more productive work, (3) to cut unit costs and unit prices, thereby expanding ever further the global market for their products. All this helps explain the fact that though Japan has now been ostensibly eclipsed by China in exports to the United States, the Japanese are not complaining. In reality much of the most sophisticated value added in China's exports originates in Japan.

Below is an article, which will be published in May in The American Prospect.

Rediscovering Asia's Real Powerhouse
By Eamonn Fingleton

For those who claim an above average knowledge of the global economy, here's a question: which East Asian economic powerhouse recently announced the largest current account surplus in world history?

The answer is, of course, Japan. Not that readers of the American press would have noticed. Given the press's obsession with China, little about East Asia's other economic powerhouse makes it into print these days. Yet in most of the ways that matter to current American economic policy, Japan is far more important than China.

To be sure China is growing very fast. But all misinformed American commentary to the contrary, China remains a long way from displacing Japan as Asia's largest economy. Still less is China any sort of benchmark against which a high-wage economy like the United States should be measuring itself.

Japan by contrast is avowedly such a benchmark. A fact utterly lost on the American media is that Japanese industrial wages are now among the world's highest. They are not only far higher than in China—about four to fifteen times higher depending on the region of China—but they are actually 20 to 30 percent higher than in the United States. Yet Japan's export industries have not only survived but also thrived.

The largely untold story of Japan's extraordinary manufacturing successes of recent years should inspire a radical reappraisal of fundamental American economic assumptions. Certainly Japan's trade performance stands as a stunning rebuke to those who hold that high-wage nations can no longer compete in manufacturing. Their argument has fostered an utterly unwarranted sense of inevitability about America's manufacturing implosion. Just how much damage has already been done can be gauged from the fact that, at more than 5.6 percent of GDP, America's current account deficit last year was proportionately the second worst of any major economy in history. It was exceeded only by Italy's 7.7 percent deficit in 1924—

hardly a happy precedent given that Mussolini seized dictatorial powers in January 1925.

Let's get Japan's true economic standing into perspective:

1. Translated at market exchange rates Japan's gross domestic product last year came to $5.1 trillion—three times China's $1.7 trillion.
2. Japan's current account surplus last year, at $181 billion, was more than two and a half times China's. Even more impressively it was more than three times what Japan earned in 1989, the last year of the Tokyo financial boom. (Full disclosure: Japanese officials are now worried that, thanks to higher oil prices among other things, the surplus could dip as low as $145 billion in 2005. But Americans need shed no tears. This would be a nice contrast moreover with the last time oil prices last seriously cramped Japan's mercantilist style: in 1980, after all, Japan incurred a ***deficit*** of more than $10 billion.)
3. Despite the fact that the United States now buys about one-third more from China than from Japan, the Japanese are hardly complaining. On the contrary, Japan makes most of the high-tech components and materials in China's exports. Japan's know-how-intensive and capital-intensive factories are using China (as well as dozens of other nations) as an export pipeline to the United States. Judged by where the added value is really created, Japan is still a far larger source of U.S. imports than China.

How can all this be reconciled with the press's account of a perennially ailing Japan? It can't, of course. Japan is no basket case and never has been. Strange as it may seem, for many years Japanese leaders have—for very Japanese reasons—been assiduously exaggerating Japan's weaknesses and understating its strengths.

Perhaps the biggest surprise is how rich Japanese consumers have now become. Their affluence is immediately obvious in how they dress. Already considered the world capital of fashion by such style mavens as Suzy Menkes and Amy M. Spindler, Tokyo was recently pronounced "the coolest city on the planet" by the editors of GQ magazine.

As UCLA management professor Sanford Jacoby points out, Japan's prosperity is also abundantly apparent on the roads, which are full of late-model cars, and in its electronics stores, which are perennially packed with free-spending males. Indeed the Japanese are so rich that many of the most advanced new products—everything from the latest game machines to the most spectacular new flat-panel television screens—are launched in Japan months or even years before they hit the United States.

"Japan is a very affluent country with an income distribution much less unequal than in the States," says Jacoby, author of a new book on Japanese corporate governance. "Those in the bottom two-thirds of the income distribution enjoy a higher quality of life than their U.S. counterparts. As for the upper one-third, they too benefit from Japan's high level of public services as well as the security that comes from a stable, cohesive society."

Even in the late 1990s, when commentators abroad were daily performing the last rites for the Japanese economy, the palpable prosperity on the ground in Japan stunned visiting Americans. A typical recollection is that of Nathanial (stet) Gronewold, a Minneapolis University graduate who studied economics in Hiroshima in 1997 and 1998. He says: "My time in Hiroshima went down in the record books as two of the worst years for Japan's economy. But the affluence I witnessed in and around Hiroshima was a stark contrast to the scores of empty storefronts and offices in downtown Minneapolis, which was supposed to be booming at that time."

Although Japan's real estate crash early in the 1990s has received plenty of attention, the veritable boom in construction that Gronewold witnessed in Hiroshima was no isolated phenomenon. As measured by the architectural website *skyscrapers.com*, 80 skyscrapers were built in Tokyo in the 1990s, versus just 49 in the 1980s (skyscrapers being defined as buildings rising at least 35 meters). In Osaka the total was 56 versus 18; in Yokohama, 19 versus none. By comparison London's total was 33 versus 28. Meanwhile New York actually registered a decline: a mere 103 skyscrapers built in the 1990s versus 257 in the 1980s.

Here are a few other examples of how well Japanese consumers have been doing:

- **Car navigation systems.** With 3 million systems sold annually, Japan is by far the largest market for these invaluable gadgets. (They use satellite technology to pinpoint a car's position, suggest routes, provide alerts on traffic jams, and generally take much of the second-guessing out of getting from A to B.)
- **The Internet.** As reported by London-based Total Telecom magazine, Japanese Internet connections are now not only the fastest in the world but the cheapest.

Investing more heavily in optical fiber networks than almost any other nation, Japan now leads the world in so-called FTTH (fiber to the home).

- **Mobile phones.** Japan has come from nowhere in the early 1990s to establish a lead of 25 percent over the United States in the rate of mobile phone ownership. Japanese mobile phone networks now lead the world in service quality. Thus camera-equipped phones took off in Japan as far back as 1999. Ditto for "I-mode" service—the ability to access the Internet via mobile phone. Already by 2003, according to the Virginia-based consulting firm TMG, 29.5 percent of the Japanese population enjoyed I-mode service. Such access was still almost unknown in the United States.
- **Health care.** Boasting one of the world's better universal health care systems, Japan has cut its infant mortality by more than one-quarter since 1990 to just 3.28 per 1,000 live births. Less than half the American rate and a mere one-seventh of China's, this constitutes a world record low. And, despite the fact that the Japanese have been eating more and more unhealthy Western food, they are living longer than ever. Female life expectancy at birth is now 84.5 years, an increase of 2.7 years since 1990. The Japanese now live four years longer than Americans, and eleven years longer than the Chinese.

If Japanese consumers have made remarkable progress in recent years, the advances in Japanese industry have been stunning. Thanks to consistently heavy investment, Japan has made huge strides in industrial productivity. Thus, as Fortune recently reported, Toyota Motor seems set to pass General Motors within the next two years to become the world's largest automaker. By contrast in Japan's "juggernaut" era of the late 1980s Toyota was still being out-produced more than two to one by General Motors and more than 50 percent by Ford.

Japanese workers these days typically work with ten to twenty times the capital of their Chinese counterparts. For the most part therefore the Japanese and the Chinese are positioned at opposite ends of the manufacturing spectrum—a spectrum moreover that has never been wider. The Japanese worker's huge productivity advantage is well illustrated by the fact that, on latest CIA figures, Japan is home to 57 percent of all the world's industrial robots.

Underlying all this has been a national strategy to out-invest all foreign competition. The result is that, utterly overlooked by the American press, Japan has established monopolistic leadership in more and more areas of advanced manufacturing, particularly in producers' goods such as materials, components, and machine tools. Almost invisible to the consumer, such monopolies constitute "chokepoints" which give Japan control over ever-larger swathes of the global industrial landscape.

One such chokepoint is Japan's little noticed but geopolitically important lock on advanced lens-cutting. Leadership in lenses helps explain why Japanese companies dominate the world market in everything from television studio equipment to endoscopes. Lens technology even gives Japan a crucial inside track in semiconductors. The point is that advanced lens-cutting is the single most important technology in creating so-called steppers, the photolithographic machines that print minute electrical circuits on silicon chips. Japan's champion lens-cutters, Nikon and Canon, make more than two-thirds of the world's steppers.

Japan also monopolizes such important semiconductor production equipment as photomasks, as well as key materials such as silicon, gallium arsenide, and epoxy cresol novolac resin (ever purer versions of which are needed for each new generation of computer chips).

Elsewhere in the electronics industry Japan's hidden chokepoints include charge coupled devices (essential in everything from home video cameras to guided missiles), high-tech batteries (vital in many portable devices, not least military equipment), and laser diodes (the enabling technology in, for instance, the ever growing CD/DVD family of gadgets). In miniaturized disk drive motors, Kyoto-based Nidec has 90 percent of the world market. Its highly precise, almost silent, motors are the enabling technology in the Apple iPod.

In mobile phones, the Japanese are quietly dominant. Although Western brandnames like Motorola and Nokia appear to lead the industry, today's sleek mobile phones would not exist without Japan. Japanese electronics makers embarked on a massive government-led effort in the 1970s and 1980s to miniaturize the various components. A survey by Deutsche Bank found that as of 2000 of 36 suppliers of the nine key components in mobile phones, 29 were Japanese. Japan also owns most of the world's optical fiber production capacity.

Even in the pharmaceutical industry, where the Japanese are generally regarded as also-rans, Ajinomoto supplies 60 percent of all amino acids. It also makes 70 percent of all threonine, a vital ingredient in animal feeds, as well as 40 percent of all aspartame.

Perhaps the single most surprising area of Japanese industrial success has been aerospace. After decades of quietly capturing key chokepoints in avionics, carbon fiber, and titanium, Japan has now passed a fast declining United States in all but name. One indicator is that, as officially acknowledged by Boeing, Japanese contractors will build 35 percent of the new super-advanced Boeing 787, a big jump on their 21 percent share of the Boeing 777. In the view of independent experts, the 787 will be more a Japanese plane than an American one.

Although it is impossible in a few paragraphs to do full justice to Japan's progress in recent years, it should be clear by now that the "lost decade" story was a hoax. In truth the Western media have been blindsided by a 180-degree reversal in Japan's public relations program. Whereas in the 1980s Japan had aggressively emphasized its strengths (some real, others imaginary), it switched in the 1990s to a highly counterintuitive "bad news" strategy.

The up-beat propaganda of the 1980s had been intended primarily as a defense in dumping suits. Hence, for instance, a bogus claim, much aired in the American media in the 1980s, that Japanese car-makers were supposed to be more than ten times more productive than their American peers.

Japan's propaganda needs changed abruptly once major American corporations laid off their factory workforces and switched to outsourcing. As companies like Hewlett-Packard and Motorola stopped competing with the Japanese and started buying from them, a new era of U.S.-Japan corporate partnership emerged in which the dumping suits disappeared. Meanwhile America's trade deficits with Japan widened rapidly, prompting Washington to view Tokyo more and more as a power rival. In the new circumstances, Japan's old super-economy image was not so much an irrelevance as a liability.

Washington's mood softened remarkably, however, after the Tokyo stock market crashed in 1990. Assuming quite wrongly that the crash signified fundamental problems in Japan, Washington began expressing gentlemanly concern for the "fallen giant."

Never slow to spot an opening, Japanese leaders soon found other sob stories to tell. In an early gambit, officials reversed Japan's vagrancy policy. In the 1980s they had carefully kept Japanese cities miraculously free of vagrants, thus fostering a myth that Japan was immune to the pathologies of lesser societies. In reality, as James Fallows documented, down-and-outs had existed all along in Japan. Up to the early 1990s they had been kept hidden in special remote ghettos such as the Sanya district of Tokyo. The new "bad news" strategy called for a radical change: now down-and-outs were given carte blanche to camp out in Tokyo's glitziest neighborhoods, such as the park opposite the toney Imperial Hotel.

Another official gambit was to adopt highly conservative national accounting assumptions, which drastically choked back Japan's apparent growth rate. Hence the fact that, though both Japanese living standards and exports have palpably boomed in the last fifteen years, annual GDP growth is officially stated to have averaged only about 1 percent.

Meanwhile officials began beating their breasts about an apparently disastrous deterioration in public finance. One "footnote" has been omitted: Japan's official foreign exchange reserves rocketed from $85.1 billion in 1989 to $840.6 billion at last count. In effect the Japanese government has been borrowing to prop up not the Japanese economy but the American one.

Some of the sob stories had a basis in truth, but nonetheless greatly exaggerated the real trauma. Take the banking crisis. This present writer was virtually alone among Tokyo-based observers in the 1980s in predicting the banks' problems. These duly emerged in the early 1990s but, pace all misinformed alarmism in the American press, Japan never came close to a domino-style banking collapse.

Far from countering the alarmism, many prominent corporate chieftains compounded the jitters. In 1998, for instance, the president of Toyota Motor made world headlines when he suggested that a collapsing Japan could take the world financial system with it. This remark seemed on its face inexplicable. Certainly no one climbs to the top of a major corporation anywhere, least of all in Japan, by shouting "Fire!" in a crowded theater. Of course, if all the dramatis personae in the Japanese establishment knew that the fire was merely part of a kabuki act, that would be different. . . .

What is clear is that nothing in Toyota's own business experiences remotely justified the remark. In fact Toyota's profits in 1998 represented a healthy 56 percent advance compared to 1989, a performance that put Ford and General Motors in the shade. The home market in Japan moreover had remained profitable as household car ownership increased by 2.2 million in the 1990s. The cars moreover had become much larger and more luxuriously fitted, with the svelte Toyota Lexus, for instance, replacing the dowdy old Toyota Century as the executive limousine of choice.

If Japanese leaders put on a convincing impression of economic decline in the 1990s, it has to be admitted that Western commentators made a gullible audience. Many press correspondents wailed about corporate Japan's low profits. And sure enough profits are low in Japan. What the correspondents have not understood is that in the Japanese system—whose workings are consistently misunderstood by foreigners—profits are a secondary consideration. That may seem surprising but the fact is that even in the "juggernaut" years of the late 1980s Japanese corporations were notoriously unprofitable.

In general the further people were from Japan the more extreme their statement of the "basket story." Take New York-based Karen Elliott House, who in 1992 compared the Japanese economy all too gleefully to children's toys called Shrinkies, which were advertised to "shrink right before your eyes." In a similar outburst of misplaced schadenfreude, Paul Krugman recycled unchecked a myth that Tokyo had been reduced to building "bridges to nowhere" and "roads with no traffic" to stimulate the economy. Japan has no bridges to nowhere; and it is hard to build unnecessary roads in a nation with one of the highest ratios of cars to road space in the world.

For sheer absurdity few observers came close to Michael E. Porter. In a book entitled "Can Japan Compete?," Harvard's competitiveness oracle persuaded himself that Japan had ceased to innovate by the mid-1980s. Thereafter its export drive had allegedly become increasingly dependent on industries so laughably low-tech they would embarrass an Afghanistan or a Peru. Among these were yeast, flaked cereal, and, most memorably, "raw bovine and equine hides"! For some reason Porter's list overlooked all the hundreds of high-tech products that were then—he was writing in 1999—driving not only Japan's export boom but the world technology revolution.

To be fair to Porter et al it has to be added that key members of the Tokyo foreign community had an agenda to mislead visiting Americans. It has always been so. As far back as the 1970s, Tokyo-based consultants were already describing the then utterly closed Japanese market as one of the world's most open. In the 1990s key analysts pitched in to support Japan's new "bad news" strategy. This may seem surprising but several of the key analysts in Tokyo have consistently shied away from invitations to debate their doom-and-gloom take on post-bubble Japan.

If there is a moral in Japan's hidden strengths it is this: it is past time Washington began to address the implosion of advanced American manufacturing. Any full consideration of the flaws in current policy is beyond the scope of this article but Washington could at least as a first step take a jack-hammer to Japan's closed markets.

In a chivalrous wish not to kick a man when he is down, American trade negotiators removed all pressure for Tokyo to open Japanese markets nearly a decade ago. Thus even Japan's rice market is still tightly closed—and this despite the fact that the American press announced in banner headlines in 1993 that the market had supposedly been opened. (Database note: many of these reports seem to have been airbrushed from the permanent record.)

For American trade policy, the most outrageous failure has been the Japanese car market. Detroit's share in Japan last year was less than 0.2 percent. Of course, Japan's trade lobbyists allege that Detroit does not make cars configured for Japan's drive-on-the-left roads. Actually this is blatant propaganda. The Detroit companies have never had any trouble serving Britain, the world's other major drive-on-the-left market. In any case, many Japanese car buyers prefer the steering wheel on the "wrong" side: in a country where imports tend to be egregiously expensive, this is a status symbol.

The ultimate smoking gun here is the plight of the Korean car industry. Its products have made inroads all over the world—everywhere except Japan. While Japan has opened up in a token way to Korean electronics exports (Samsung in particular has become highly visible in Japan), Korean car-makers are still completely excluded. Thus their sales in Japan last year came to just 2,930 units—less than 0.04 percent of Toyota's output.

If the Japanese car market is really so closed, why hasn't Detroit pressed harder for access? Up to the mid-1990s Detroit did try but since then it has given up. The reason is clear: Japan holds the whip hand. The Japanese corporate establishment is noted for the alacrity with which it retaliates against American corporations who make trouble for its trade policy. Detroit used to be relatively immune from such pressure. Not any more. The American car companies are now heavily dependent on Japan for key materials like special steels, precision components like air conditioning compressors, and, most of all, for such vital machine tools as painting robots and body presses. In a word they are a prime victim of Japan's chokepoint strategy. If they were to make more than a token effort to fight Japanese mercantilism now, they would face certain retaliation.

All this prompts a question: if America's largest manufacturing industry can't stand up to Japan anymore, which nation is really the basket case?

Panel III: Discussion, Questions and Answers

Cochair MULLOY. Thank you, Mr. Fingleton.

We'll open it up for questions. All of these trends and the movement of R&D and the large trade deficits and that sort of thing, this isn't the inevitable part of technology and market forces and other things, this all is taking place within a public policy framework that officials of the United States and other countries put in place: The WTO and before that the GATT.

In other words, if we didn't have an average tariff and lock it in the WTO, and before China became a member of the WTO, they didn't get as much investment. Once they get the market locked open through being a member of the WTO and locking our tariffs in, then the investment could flow because people could move and feel pretty sure they can send their goods back to this market with a very low tariff.

I think this isn't just historically inevitable. These are forces and a framework that's been put in place.

Secondly, when you were talking about the components going into China trying to assemble them, only 20 percent value added, it's interesting that that whole East Asian block, though, when we talk about currency manipulation, it's not just China. Japan's in there, Korea's in there, Taiwan is in there. They're all massively intervening in currency markets to help manage this transfer of wealth from the United States across the Pacific Ocean. That's my impression. And the third thing.

When we talk about a national competitiveness strategy, Dr. Zysman, I don't think we're just saying China is the reason for this. I think we've thrown ourselves into a globalized economy with 3.2 billion new people coming onboard with China, India, and Eastern Europe and others that we didn't have 15 years. This has made an enormous difference. The fact that we have a legal framework that may have been put in place without fully understanding what we were doing, has driven some of these changes that we're now witnessing. But I'd like to open that up for any comments.

Mr. ROWEN. Let me pick up on one point. You mentioned R&D. Research involves ideas and ideas do not go through customs. Ideas move. And if there is talent, which heretofore has been untapped, but now it's generating, it's growing, it's accessible. You can't stop ideas, in some sense. You can try, but it's hard.

So one of the things that's happening is that a lot of companies have discovered that there are people with talent whose wages are lot lower than they are in the United States or in Europe or in Japan, who can be accessed. That's only one aspect of it because there's quite a lot of other parts of to it, too. But that aspect is very important. You mentioned R&D, and that's what it's about.

So in that sense it's inevitable. It is truly inevitable that if there emerges, as there has, a place with talented people and with telecommunications costs having plummeted, for example, ideas really can move. Those people are now part of the global system. It is a globalization phenomenon. And that is not in itself a result of any change in policy.

Cochair MULLOY. I agree with you on that. Let me just add one more thing. I think at the time that the policies were put into place, technologies were changing quite rapidly. The rise of the Internet, particularly in the services industry area, is an enormous development.

Of course with public policy, you could change that. You could just put a tax on transactions for the Internet. So it's not like it's all inevitable. If you didn't want it to happen there would be ways that you could do it. I'm just pointing that out.

I think we fully didn't understand what we were doing when we get into some of these arrangements.

Yes, Dr. Preeg.

Dr. PREEG. Well, you were groping toward a policy framework or explanation, but you also we talked about the manufacturing sector where it comes together. Manufacturing is ten times more engaged in trade and that's where the innovation takes place. Two-thirds of commercial R&D in the U.S. is in the manufacturing sector, over 90 percent of new patents come out of the sector. And here we've got a $600 billion trade deficit in manufactures, of 1.5 trillion value added. So 40 percent of the trade deficit; we'd have a 40 percent larger manufacturing sector or resource base for R&D and everything else if our trade were in balance in this sector. And I think that's an orientation that makes the imbalance that is talked about by finance ministers much more qualitative in terms of it's hitting directly into the advance-technology, the innovation of technologies when the brunt is all here. And that's why there's such a difference with East Asia where they're all leaning the other way.

The policy response is certainly is the currency issue. There are some trade issues. But we also have to have a domestic policy agenda. That's why I would agree with all the comments this morning, that we really have to have a concept and we have to have a broad strategy and commitment as a nation to this issue, which we don't have now and certainly the Chinese do.

Cochair MULLOY. Commissioner Reinsch.

Commissioner REINSCH. Thank you. I have two questions.

Mr. Fingleton, I was looking at your written statement while you were talking, and you had a very intriguing beginning. And then I kind of got lost, and maybe you can clarify.

You began by saying in your written statement we've been told that it's inevitable that high-wage nations like the U.S. will be hollowed out by rising China, and then you suggest that this is nonsense and then proceeded to talk about Japan, which was very, very interesting. I was fascinated by your description of what's going on in Japan, but can I draw you back to China for a couple minutes and ask you to tell us, A, why it's nonsense and presumably, since I think Dr. Preeg essentially said the opposite and that we are being hollowed out, maybe you can tell us why he's wrong.

Mr. FINGLETON. Well, there's no question that the United States is being hollowed out, but what I'm challenging is the idea that this is inevitable. Other countries don't regard China's rise as necessarily leading to their hollowing out. They have policies to take care of that, to balance out.

Commissioner REINSCH. And what policies would you recommend that we adopt to achieve the same result?

Mr. FINGLETON. Well, clearly America has a problem in the sense that it cannot emulate the practices in East Asia where the official position is that all these countries are in favor of free trade, yet the unofficial reality is that they're all highly mercantilist. The United States is not in the business of double standards, so it seems to me that the appropriate response is outright protection. It's not a word that many people think favorably about these days, but what's the alternative? Your economy is being completely gutted. A very drastic response is necessary.

I don't know whether people fully understand how weak the United States economy now is. The current account deficit last year was, what, 5.5 or 5.6 percent of GDP?

Cochair MULLOY. Seven hundred billion.

Mr. FINGLETON. Five point seven percent of GDP. That's the second worst current account deficit in percentage terms of any nation, any major nation in the history of recorded trade.

Dr. PREEG. Seven percent this year.

Mr. FINGLETON. The only nation that ever had a worse deficit than that was Italy in 1924. And in 1925 Mussolini seized dictatorial powers.

Commissioner REINSCH. Well, maybe we could pursue this for a minute with some of the other panelist. Dr. Zysman, do you agree with Mr. Fingleton's prescription? Your testimony, I thought, was, as some this morning was, very helpfully focused on what the United States ought to do with respect to its own competitiveness. Mr. Fingleton suggested a slightly different route. Do you think he's right?

Dr. ZYSMAN. Well, I'm going to answer to the first question of what should we do and why.

Commissioner REINSCH. You don't have to be tactful. That's all right.

Dr. ZYSMAN. The first issue is the trade deficit as such doesn't necessarily have its underpinnings in industrial or technological competitiveness as such. Any good economist, and I'm actually not an economist by formal training, would argue that it lies in domestic savings and expenditure structures, and I think we have to acknowledge that. If there is a problem, and I actually think there is in the long-term, it doesn't translate into an argument about trade flows in that way.

The second issue is, is how does one respond to the hollowing out, if you will, of the American industry. Having written a book some time ago arguing precisely that those issues mattered, our prescription at the time was not that we use protection, it was rather that we aggressively develop the capacity of American firms and industry to compete. One could choose sectors such as the automobile industry where clearly in response to the Japanese there's been great progress made and at the same time not enough. And one has to ask the question of why companies such as General Motors and Ford are not effectively competing in auto sectors and what are the character of the choices that they are making.

Cynics like myself who grew up in Nebraska would say maybe the reason is they design cars in Detroit rather than Los Angeles. And to some extent there are issues: Such as what the basic strategies here, what are the manufacturing issues here.

The other questions that I would emphasize is what can we do in terms of developing the R&D and innovative capacity in this country, and that's where I would put the emphasize. We're not going to change—whether or not Eamonn Fingleton is right, and I don't agree with the position as such, we're not going to reverse 50 years of American trade policy. That's not going to happen. Therefore, the question is what do we do. And I think the question is we have to make sure that in leading-edge technology areas, such as telecommunications, our networks are leading edge so that our equipment producers have the targets to aim at that leading-edge users are really emerging in the United States, that we educate the population for a digital era as rapidly as the Chinese are trying to do.

If we don't do those kinds of things it won't matter what we do with trade policy, because we'll lose.

Commissioner REINSCH. Ernie, you want to have the last word on this point?

Dr. PREEG. A quick word, but just noting that there's no single simple policy response. In my paper I list a comprehensive set of 14 things that we should be doing, but I certainly think the two most important ones is the currency manipulation issue is huge. If it really is at least 40 percent under valued China and 20 percent or more in the other East Asians, this is a major cost difference.

For automobiles 20 percent on the yen, Japanese yen, that's $3,000 a car. That's the whole difference between General Motors making a loss and Toyota making a profit. So that's one big area and it's finally being engaged, I feel, now in recent months after several years. And this has to be dealt with.

The other is the domestic issue that's been—we need not only a higher savings rate so we don't have to borrow abroad, but there are a number of other measures, domestic policy measures that we should take from R&D expenditures to taxes to Sarbanes-Oxley, whatever, that are really putting U.S. companies at a disadvantage vis-à-vis China and others.

Commissioner REINSCH. Thank you.

Cochair MULLOY. Yes. Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thank you, Mr. Chairman. Thank you to our panelists. I have questions for Dr. Zysman and Mr. Rowen.

Dr. Zysman, the chart that you had up comparing Japan, China, and India, I was interested because the first two characterizations of Japan were closed market and rapid—was it rapid domestic growth? And I was interested, of course, that you didn't include as the first two characteristics on the Chinese description because closed markets are still an issue, WTO-compliance problems, phytosanitary standards, all sorts of things American products aren't getting.

So I'm trying to understand your analytical framework of comparing and contrasting.

Dr. ZYSMAN. You're right. And as I looked at the slides I wish I had redone them. But let me make the point that I would make, which is what the Japanese did was use closed domestic markets and not banning foreign direct investment, as a mechanism of basically being able to extract technology abroad and develop it in rapidly growing markets at home. The Chinese obviously are using foreign direct investment and attempting to see how much technology can get transferred internally from local relationships with multinational corporations.

There was a particular dynamic in the Japanese days, particularly evident here in Silicon Valley in the semiconductor wars in which you couldn't invest, you couldn't sell, markets would expand in particular products, and the first sales of American companies would go up. And the first Japanese product that would enter, sales would drop to zero or close to zero. So it was a different dynamic, and I should have characterized it as a different dynamic in that regard.

Commissioner BARTHOLOMEW. And some of what we're trying to do, at least I am, is understand the Japanese model, the Chinese model, how predictive. As you say, we have a tendency to fight our next battle based on the last war and whether that is always good or accurate or not.

I think one of the characteristics we're seeing is how rapidly things are changing.

Dr. ZYSMAN. That's right.

Commissioner BARTHOLOMEW. That it's picking up speed and tempo and size as we go along. And are our old models of changing within this society, within our economy going to work fast enough in order to make the changes that are necessary?

Dr. ZYSMAN. I agree with that.

Commissioner BARTHOLOMEW. Yes. Mr. Rowen, I was interested when you said you can't stop the movement of ideas, which I think we'd all really like to believe. But of course the Chinese government seems to be predicating what it's doing on the idea that you can't stop the movement—well, that they can control the movement of ideas.

As we've been hearing about science and tech, it's quite clear that they want the science and tech ideas, but again last week we heard about the chokeholds they have on Internet service providers and the other kinds of ideas that they are blocking. I wondered if you could talk a little bit about economic reform leading to political reform, what you think about that, and how long China can continue to grow its economy based on the model that they're using of only allowing certain kinds of information in, but blocking political change.

Mr. ROWEN. That context was ideas affecting science and technology and commerce.

Commissioner BARTHOLOMEW. Okay.

Mr. ROWEN. That was the context. And it is remarkable, as was observed this morning by, I think it was, Suttmeier, how open they are in terms of the kinds of information. I mean Chinese statistics, people call—you can call some of our own, they are really worth looking at. I mean a lot of that material is very valuable, and that did not used to be the case. They are putting up vast quantities of useful information for their own purposes, and of course anybody can get that stuff.

So in the context of commerce and science, science has to be international. If you try and make it national science, forget it.

You're going to lose. It has to be international to count, to be fruitful. So that's really very clear.

On the more political side that's not really the subject of this particular area, my belief is that they're fighting a losing battle, but that's just a belief of mine. I'm trying to control information, generally speaking, this other kind of information. But for the science and commerce kind, they are really quite wide open.

Commissioner BARTHOLOMEW. Thanks. Anyone else? Mr. Fingleton?

Mr. FINGLETON. Yes, I'd like to address this question, the flow of ideas. I think that you have to make a distinction between different types of ideas. In general, in competitiveness we're talking about production technologies. Production technologies can be kept secret for a very long time. I know that in the Japanese case, for instance, they are very, very protective of their production technologies. They license their technologies to the Koreans and to the Taiwanese sometimes, but many of the technologies they keep entirely to themselves.

When, for instance, they have overseas operations using these technologies the technologies will be embedded in the machines—in the settings and so on and are not obvious to the local workers, so that if a machine breaks down the local workforce will not be able to repair the machine. They'll send somebody out from Japan to repair that machine, one of their own highly trained engineers who will be completely discreet and will make sure that no technology is transferred. So there are many, many areas where Japan has world monopolies in typically key components, key materials, in the jargon, "choke points." Japan has been able to maintain these choke points for many years without the production technology leaking abroad.

Cochair MULLOY. Commissioner Dreyer.

Commissioner DREYER. Thank you.

As I listen to people talk about this huge expansion and the number of engineers China is turning out, my concern is that it's best not to interpret these statistics without knowing the context behind them. I think the context behind them has been misinterpreted here.

The reason for the large increase in the production of Chinese engineers and, in fact, the Chinese educational system as a whole, is not increased demand from industry. It stems from the large increase in the unemployment rate. The Chinese educational system began a rapid expansion about 1999 with the object of keeping numbers of young people off the job market, since there were few jobs for them, and concern that unemployed young people would increase the potential for social unrest.

As we found out in our own country when we had a rapid increase in the educational system at the time of the Vietnam War—because many young people wanted the draft exemptions that attending college game them, this results in a dilution of the quality of education. The consensus in China is that these new graduates are not well trained. Another interesting factoid is that not many of these additional college graduates are finding jobs. This is even true of the students who've returned from overseas.

There is a wonderful pun on this, which if you don't know Chinese characters is hard to appreciate the humor of, but basically it depends on a homonym in which the characters for returned students are pronounced the same as those for sea turtles, which has a good connotation. But now they call themselves by another homonym, which translates as seaweed. The idea is that they have been washed up on shore and no one wants them.

What I am wondering is if you see this as a temporary thing. Are these kids going to beef up their skills? Is the expansion of the system going to mean that some day these engineers are wanted?

We saw this, in fact, with the Soviet Union. We were scared for years by scare-mongerers who said, "Oh, my God, look at how many more engineers they are training than we are; we have to train more engineers." After the Soviet Union disintegrated many of them went to Israel to try to find jobs, and the Israeli authorities considered them unqualified. So perhaps we're scaring ourselves too much or perhaps you think the industry is going to expand and absorb them all anyway?

Mr. ROWEN. A comment on that. One indicator of employment, the demand for various skills is the wage rates. My impression is that for engineers and certainly electrical engineers, computer scientists, that's one small category to be sure out of a much larger set, it's going up rapidly. Rising rapidly. That suggests there isn't a lot of unemployment, so much so that companies are moving activities or starting up activities increasingly in other parts of China than the east coast, going to Chengdu, going inland, to get access to people because they're getting too expensive in Shanghai. That does not suggest unemployment.

Now I don't know about civil engineers, frankly. Maybe there are a lot of unemployed civil engineers, I just don't know. But I'd be kind of surprised. By the way, this is a noble thing. I'll bet the Chinese national income statistics have a category, which I haven't looked at I must confess, at wage rates for various categories. Some day you ought to look at those wage rates. I'll bet one would find in looking at them they're going up for various categories. If that's true then it is not about an unemployment problem.

Commissioner DREYER. My source is Beijing Review, which rarely gives out unwanted bad news, and also the Chinese economist He Qinglian.

Mr. ROWEN. Well, okay. Somebody ought to look at the numbers and see what's happening to the wage rates.

Dr. ZYSMAN. I think there are a couple of issues here. Let me deal with the secondary comments I have and then come to the core. The secondary comments are that some of the issues such as the inappropriately trained Soviet engineers can itself be somewhat misleading.

I looked at one point at Hungarian engineers, who were great experts at dealing with variable flows of electricity because they were better than anyone in the world because the system, the electrical system didn't work very well. And so they weren't capable of building product that could accommodate that, they would fail. Suddenly they had stable electrical systems and a lot of those skills were irrelevant.

One could say some of the same things about those trained in military technology areas in Southern California and the difficulty of their adapting to a commercial era. At the moment if you look at St. Petersburg it's the mathematicians who are now sources of outsourcing, of heavy outsourcing of software activity and the like. So there were Soviet skills, they weren't necessarily the engineers that people expected them to be.

The comment I'd make, and I don't know the statistics in China, but I do know the broader panorama, which is we should not discount the efforts that others are making to educate their populations in high-technology skills in very significant ways. That is, whatever is true of that set of statistics today, the Indians will make up for it tomorrow, and the Chinese in improving their own education system, the day after. So that the fundamental problem of an enormous abundance of skilled, technically-trained labor that we will confront in different ways will be there over time. And the question is how to assure that the best come through the United States, that we're the technology pump.

I would agree with Henry, we can't hold on to the technology. We can only make sure that it passes through here and is developed in innovative ways.

If you look at the Berkeley—I don't know Stanford as well—Computer Science and Electrical Engineering Department the current chairman is Indian, the chairman before him was Indian, the chairman before him was also head of the DARPA Computer Science Division, came from Bangalore. The dean of engineering is from New Zealand. The leader in semiconductor design activity worldwide is Alberto Sangiovanni-Vencentelli, which suggests he might be Italian, and so on. It's that flow-through, that technology pump that is absolutely critical. We have to keep it vibrant. We have to run away from the competition, not move back to it.

Commissioner DREYER. Oh, without question. So I take it you would agree then with the idea that the economy will eventually absorb these people even though they may not be able to find jobs this year?

Dr. ZYSMAN. I have no idea how well they're trained, but if they're not properly trained, the next generation will be.

Commissioner DREYER. Thank you.

Dr. Preeg.

Dr. PREEG. This is a very important question and, as usual, it's very hard to get hard facts. But my reading is somewhat different, and I make three points.

One, I would doubt very much that the increase in college graduates of one million to three million every year over the last ten years, which was related to those decisions in '95 and '96 to put science and technology at the top, that this was to somehow offset the tens of millions of workers coming off the farms or the SOEs being—people put out of work. So it's a very slow-moving and, I would think, very expensive way of dealing with these huge numbers of people that were unskilled and unemployed.

Commissioner DREYER. Excuse me.

Dr. PREEG. Yes.

Commissioner DREYER. That isn't what I said.

Dr. PREEG. Oh, okay.

Commissioner DREYER. This is a large number of people who turn, let's say, 18 or 19——

Dr. PREEG. Yes.

Commissioner DREYER. —and they're not coming off the farms. They're coming out of urban high schools.

Dr. PREEG. Anyhow, that was not my reading of the buildup in the late 1990s.

The second page is that I've seen in the recent press, I think it was in *The Economist* magazine, a long piece recently, that there is upward wage pressures, particularly in professional and skill labor jobs. There are some real problems of companies being able to hire enough people. And there's a lot of competition of multinationals competing and taking away workers, trying to retain your workers without. So there appears to be some upward movement of incomes, at least in recent months.

The third point is that though the engineers, and there's been a lot written about this, the most detailed I've had is from the Taiwan relationship, which is so close. Incidentally, the U.S.-Taiwan Business Council puts out a lot of good material on this. All the experience in a lot of case histories is that these engineers, Chinese engineers, they have all the basic technical training and skills, but they're not business related. That they have to be trained to do that.

That's why the Taiwanese, they come in, and very mixed about what this means for the future of Taiwan, and they set up in China. And they hire these engineers who have the basic training and then they need a few years of working in a competitive private sector company to really put it together and make them a much more valuable asset. So I think there is this building process, but I haven't seen anything where they're basically not competent in their engineering skill. So I would be more on the side that there may be some transitional ups and downs, but that they're building a pretty solid basis of engineers and technically-skilled people.

Commissioner DREYER. Thank you.

Mr. Fingleton.

Mr. FINGLETON. I don't have knowledge of the detailed facts here, but surely if there is an oversupply of labor it's simply a short-term phenomenon. If this labor is valuable labor it's not going to go unused for long.

Commissioner DREYER. Thank you.

Cochair MULLOY. Thank you.

Chairman D'Amato.

Chairman D'AMATO. Thank you, Commissioner Mulloy.

I wanted to pursue a couple of things. One, Mr. Rowen, in terms of the transfer and free flow of ideas, this question of flow of ideas, we had a hearing, and we're required to look into the Internet, by statute, by Congress, so we're looking into it.

We had a hearing two weeks ago and a very comprehensive report was released by a group from Harvard, Cambridge, and Toronto working together. And their conclusion was very disturbing, that the Chinese had been, in fact, more successful than anyone had expected in terms of manipulating the Internet at various points, both the backbones and other nodes, and along with other techniques including thousands and thousands of people dedicated to intimidating Internet users if they get out of hand, closing of Internet cafes by the tens of thousands on big sweeps.

I think that Dr. Perry was correct this morning in saying that the control of ideas through these techniques by the Chinese government has had an effect, negative effect on their development. When we passed the Chinese Most Favored Nation Treatment back in, what was it, 2000, which was the creation of this Commission, the Administration argued at that time that this creation of a market economy in China would ultimately bring democratization and political reform. That argument was used consistently throughout the debate, particularly by the Administration.

So the question is to what extent has that actually occurred, and our conclusion is it hasn't occurred at all. It hasn't occurred at all. In terms of if the Congress had at that time been told that, yes, they're going to be able to create a super state, economic super state and still be able to control the flow of ideas politically, and there will be no political reform and it will be a continued, highly brutal communist dictatorship, that vote might have turned out differently.

Now the jury may still be out. It's only five days down the pike, but the transfer of all these technologies by people like Cisco and Nortel have assisted the Chinese in being able to use sophisticated techniques to control the Internet.

We'd like to send you the results of that hearing. I think that would be something we would be interested in getting a reaction on. Although there are some entrepreneurs in Silicon Valley who are able to penetrate the Internet through various techniques, it still seems to be very much on the margin and is not available. And the user has to be quite sophisticated to be able to plug into it, so the average Chinese is not going to be able to use these techniques to get the *New York Times* or the Washington Post. So that I think is something that we found very disturbing. We were wishing that it would not be that way, but the worry is that it will continue that way.

So we will face a continually strengthening China that continues to control the ideas in its society and the ideas that may not be friendly to the United States, will be hostile to the United States, using nationalism to control thought in China.

Anyway, just a comment I wanted to make on that.

I don't think it's much of a mystery what we have done in the past when we have faced a competitive challenge. What we did in the post-Sputnik era was very simple: We marshaled a vision and leadership and money at the Federal level to hot house technologies and to rebuild our educational system and so on.

It seems to me, maybe I'm missing something, but first the recognition of the problem and then the result of that recognition bringing leadership from the national level. Where else is it going to come from but the Federal Government in terms of producing more money for education, for technology development, and the vision to go with it.

Does that make sense to you? I mean the fact is we don't have the recognition of a problem. We have a leading editorial in the *New York Times* today that basically says there isn't really a problem in manipulated currency, it's all being made up by Congress, and that this is protectionism raising its ugly head that we would even talk about doing something with regard to punishing China for manipulating its currency. Right here in the *New York Times*, it doesn't exist as a problem. When you don't have a problem, you don't have a solution.

This is a very interesting article. Everyone should read this editorial about leadership in terms of fixing the currency problem.

Anyway, that's just my thought. Do you have any questions?

Mr. FINGLETON. If you can give me ten seconds on that. It seems to me that if there were a truly free market on the dollar, the dollar would drop by 50 percent against most of the East Asian currencies overnight.

Cochair MULLOY. That's your judgment, Mr. Fingleton?

Mr. FINGLETON. Yes. But put it like this, what level does the dollar have to fall to for the United States to balance its trade now? It doesn't have the manufacturing capacity to increase exports, even if the dollar were down to 50 yen. It doesn't have the capacity to take advantage of a cheap dollar anymore.

Chairman D'AMATO. Well, the realignment of the currency, however, would have some effect, some say 15, 20, 25 percent, on the level of the deficit. So every little bit helps, and 20 percent is certainly an important percentage.

Mr. FINGLETON. I agree, totally agree that the dollar is overvalued and that part of the solution is to reduce the dollar's value against all the East Asian currencies, but it's a matter of a very long time. In the short-term, a devaluation of the dollar would increase the trade deficit. In the long-term, yes, it would be beneficial, but it would be quite long-term, five, ten years ahead.

Chairman D'AMATO. Yes.

Dr. PREEG. Just a couple of points. There is the J-curve effect, that you would have a very short-term increase in trade deficit, but there are also time lags. It will take not ten but maybe one to three years to play out, to a very substantial improvement in the trade deficit position, as happened in the late '80s. But there also has to be corresponding steps within the U.S. economy to shift resources, so it's not simple and it does take time, but that is the basic solution.

One other point, just to respond to you, it's not just in the *New York Times*, the *Wall Street Journal* off on the right is just as bad on the currency-manipulation issue. But the saving grace here is these elite papers in New York City are kind of away from the countryside. It's the Congress that has to go back to their constituents each weekend and who hear about it. Certainly on both sides of the aisle in the Congress there is very strong feeling about the currency-manipulation issue, and that's driving the White House a little more than the *New York Times* is today.

Chairman D'AMATO. Yes. That's right where the action is. The Congress is reacting and, of course, the Congress will overreact, as it does, only because the Administration hasn't acted on these issues. So you get these overreactions. That's expectable. But without that you don't have any action.

Dr. PREEG. Just like financial markets, usually over react, too.

Chairman D'AMATO. Yes.

Dr. ZYSMAN. If I could just suggest, it would seem to me that obviously part of the question is to ask how much of the currency problem is straightforward manipulation, but even—let's assume that it is. I think this question of what the consequences of different levels of devaluation of the dollar would be at this point really needs to be looked at, because I don't think it's a solution. And that's a serious problem.

I know you don't think it is, but I think in fact that it's not going to solve the problem in and of itself.

Chairman D'AMATO. That I don't think what is——

Dr. ZYSMAN. That a devaluation of the dollar will, in fact, as you said, it would make some contribution to it——

Chairman D'AMATO. Yes.

Dr. ZYSMAN. —but it wouldn't solve the problem.

Chairman D'AMATO. Right.

Dr. ZYSMAN. And I think we shouldn't convince ourselves that that would, in fact, solve the problem—make it go away.

Chairman D'AMATO. I agree with that, but if you have multiple problems and you solve none of them——

Dr. ZYSMAN. Absolutely.

Chairman D'AMATO. —you've got to start working on these things incrementally. Pretty soon you're getting into the domain of solving the overall issue.

Dr. ZYSMAN. That's right. As long as we don't think we've solved it by dealing with that one somewhat, in a certain sense, let's just blame the currency problem.

Chairman D'AMATO. Let me just say, I don't think that we're solving it by changing—we would not want to cause the currency you want to float, because the banking system is too fragile. But they can repeg it. Everybody agrees that a repegging of 25 or 30 percent could be done by the Chinese without affecting their banking system.

So the problem is that if we're going to have an international system bound by rules and market action, or are we going to have one that's being manipulated continuously.

Cochair MULLOY. I'd like to finish up by noting that I agree with you, John that the currency is not a silver bullet, but it is one bullet. And it needs to be done. This Commission strongly recommended that and we have for over a year and a half been telling the Congress this is an important issue.

I'm delighted that during the debate on these issues our reports are being cited by Congressional Members, and that's why it's so important for us now to move on to the broader vision. I think Congress needs and the nation needs to think about a more comprehensive look at what is going on here, and that's why we're in the business of trying to help them. And you have helped us very much and I want to thank all of you for being here this afternoon.

If you have anything else that you feel we should know about, feel free to contact us because we're going to now wrestle with this and try and distill some recommendations to the Congress.

Thank you very much.

Commissioner REINSCH. On those comments, I can just note for the record the Commission was not unanimous in that recommendation.

Chairman D'AMATO. It was almost unanimous.

Cochair MULLOY. No, last year, on the Exchange Rate Report to the Congress, our Annual Report, that was a unanimous report, that we said China was manipulating its currency, and not just China but other countries in Asia like Japan, Taiwan, and Korea.

The one that we sent up most recently more or less endorsing Senator Schumer's bill was not a unanimous recommendation, correct.

Thank you very much. We'll take a five-minute break and then we'll have our last panel of the afternoon.

[Recess.]

PANEL IV: CHALLENGES TO U.S. HIGH-TECH LEADERSHIP

Cochair MULLOY. We're going to start our final panel of the afternoon, in which we're examining the challenge that China poses to the long-term U.S. technological leadership, upon which depends our standard of living and our national security.

We are pleased to have with us an old and dear friend, Bill Archey, who has served the great Republic for many years in the public sector, but is now the President of the American Electronics Association. Thank you for being here, Bill.

Mr. Rick Dawson, the President and CEO of the Information Technology Industry Council. And Mr. John Ciacchella, Vice President at A.T. Kearney. He has conducted two studies this past year, one exploring the economic impact of offshore outsourcing on the Bay Area and another which is, I understand, due out soon, consisting of interviews with 300 high-tech leaders, looking at assessing their view of their competitiveness in today's world market.

So I want to thank each of you for being here. We're looking forward to your testimony. Any statement that you give us we'll put in the record of the hearing and transmitted to the Congress. If you could limit your opening statement to seven or eight minutes, and then open it up for discussion, questions and answers. Thank you.

Mr. Archey.

STATEMENT OF WILLIAM T. ARCHEY
PRESIDENT AND CHIEF EXECUTIVE OFFICER
AMERICAN ELECTRONICS ASSOCIATION (AeA)
ADVANCING THE BUSINESS OF TECHNOLOGY, WASHINGTON, DC

Mr. ARCHEY. Thank you very much, Mr. Mulloy. A pleasure to be here.

First of all, I'd like to note just in February this year AeA released a report whose title probably says it all: "*Losing the Competitive Advantage? The Challenge for Science and Technology in the United States*." I'd like to submit a copy of this report for the record, if that's all right with you.

Cochair MULLOY. It will be included in the record.

Mr. ARCHEY. Thank you.

I would also to note that the report is receiving a great deal of attention. I would like to believe it was because of its wonderful content, but it's thanks to Tom Friedman for publishing his book. And we have discovered, as I discovered of Monday this week, I briefed three United States Senators at their request because their staff told them they didn't have to read Friedman's book, all they had to do was read ours and it was a little shorter. So I thank Mr.

Friedman because next week I'm briefing ten Members of the Congress about competitiveness.

And the thrust of our report is pretty straightforward. It is not that the United States is per se in decline but, rather, that our competitive edge is slipping. We are also—would argue that by almost every metric the United States is still the leader in most technologies in most economic areas, but the lead is clearly eroding and, most importantly, other countries the catching up.

I think that one of the things that we talked about is, is that even if the United States were doing everything right, the competitiveness equation on the world stage has changed fundamentally. And we would still have a significant competitiveness challenge even if we weren't doing everything right. Our problem is, is that we don't believe we're doing everything right, and I'll talk a little bit about that.

We basically hit on just five variables. The first is, is that economic reforms around the world are rapidly transforming economies. As all of you on this panel realize, for a number of years the United States has been seeking to persuade other countries to adopt market economic principles and practices. The good news is they did. The bad news is they did. And, as you know, if you look back to 1985 and if you county China as just being in the incipient and choate stages of its own economic development to a different system, 60 percent of the world lived under some sort of a command-and-control economic system. That's now down to about 15 percent or less, that are living under a command-and-control system.

I look at, for example, India, when I was there in 1985 when I was with the government and an American company could not own a controlling ownership, all kinds of restrictions on foreign investment, et cetera. Now it hasn't changed completely, but it's changed dramatically from that period of time.

The second thing that we talk about, which is something that I don't think gets enough attention, is—and some of this also was referenced in a CIA report that came out last month that basically noted that you do not have to be the innovator of a technology to essentially be a leader in using it and in developing your own economic and technological system.

Indeed the point they make is that the diffusion of technology now is so rapid that your ability to use it is almost as important as being the innovator of it. And I think that's an important point in terms of the way the world is going.

The third issue that we note is that if we're going to be competing in this world, in what I would call a brave new world of competition, we had better do something about the issue you all have been talking about which is the whole issue of science and technology education in the United States. We say it in the report that we got to stop this stuff of, "Boy, math and science is terrible and it's awful, and what are you having for lunch." We've got to get to the point of acknowledging it's a disaster. And I think there's a lot of things that we could talk about, about that.

By the way, Chairman Dryer made a mention of something about the fact of four to six times more engineers in China. I just got back from China on Friday night. We met with the plant director or the country manager of three American companies. And we put in our report some question about what the competence was of Chinese engineers, at least raising the question. I asked that of all three. The answer that all three gave is you're talking about three or four years ago, not today.

Chinese engineers are world class and they also made the point that the biggest problem they have now is keeping them, because the amount of competition for engineers in China is enormous for Chinese engineers. They said their biggest problem is the poaching by American companies of each other of engineers.

This point about the increase in salaries, they were talking about how much that's gone up in just the last two or three years. But in terms of competence and technical skills, their argument is these are really first notch. So I just make that as a matter of reference.

The fourth point that we're making is that if we're not going to have our own engineers from the United States, the answer is not to keep high-skill talent from other countries from coming into this country. I would argue that the United States has been the beneficiary of the greatest influx of minds, of great minds, over the last 50 years. What we are doing now is basically saying, "Well, you're maybe not welcome."

I'd like to just give two anecdotes not in my papered statement.

In China last week the chairman of the board of one of the companies, a member company of ours, was talking about the problem about immigration and visas. They have a fairly large facility in Court. They like to bring back their Chinese managers to their home office that's based in Portland, Oregon. They could not get a single visa for one of their workers over the last two years, so they now have a training facility in Toronto, Canada, which the chairman of the board said that makes no sense at all, because the Toronto facility now is almost as big as their home office. But they're doing all the training in Toronto because they can't get the visas to come to the United States.

The second one has to do with the problem of graduate schools in terms of the decline. You may have seen it. NSF has noted this. We're looking at a 35-percent decline of Chinese graduate students applying to graduate schools of engineering in the United States.

Gerry Van Eeckhout is one of the former founders of ACT Teleconferencing. It's a national firm. He now teaches, after he retired, a course at the Fudan University in Shanghai for eight weeks a year. And I just saw him in Denver three weeks ago, in fact, talking about competitiveness. And he made note of the fact he just got back from his class. He had 22 students. These are seniors in college. He asked how many were going to graduate school. He said 19 of the 22 were going to go graduate school.

And he said, "Well, how many are going to a U.S. school." Not one. And he asked, "Why not." He said, "We can't get the visa."

And, interestingly, the university or the country most benefiting from it was, Australia. About seven were going to graduate school in Australia. And, interestingly, two were going to Eastern Bloc countries, where they noted that the masters in engineering program was being taught in English at an Eastern European school.

So what we don't fully understand and appreciate and I don't think the country understands is how much the immigration situation has changed dramatically. And I have a personal view about this because I happen to think that all of the foreign nationals who came to the United States, went to school here, worked here and may have gone back to their home country, I think they went back to their home country with an awfully positive view about this country. And I think we're losing that now. And I think we're going to continue to lose it.

The fifth issue that we deal with in all of this has to do with the Federal funding that you talked about and in detail about R&D. My prepared statement makes mention of it. But I want to end my comments by saying something to the Chairman who made mention of something.

We say in this paper that there's a lot of things we got to do, but that's not the pressing problem. The pressing problem is to acknowledge we got a problem. That has not happened.

I would submit to you that official Washington's view is: What competitiveness problem? There isn't any.

First of all, it's America's birthright to be number one. And if that doesn't work God has ordained that we're going to be number one. And my argument about that is until we, in fact, deal with the issue that the rest of the world is catching up, that this competitiveness issue is not the statement of a handful of elites, that it's a real problem, I don't think we're going to get to any of these solutions that were talked about in the previously panel or maybe some panels this morning when I wasn't here. We have got out raise a consciousness.

Next November, we've got three or four major partners in it, we're going to do a program in Washington entitled "Sputnik 2005." And it's to take a look at the whole potpourri or panoply of issues, not just education, but to look at all of them; and to also talk about what have other countries done and where are they. Maybe they can raise a consciousness. Well see. Thank you very much.

[The statement follows:]

Prepared Statement of William T. Archey
President and Chief Executive Officer
American Electronics Association (AeA)
Advancing the Business of Technology, Washington, DC

Mr. Chairman and distinguished Members of the Commission, thank you for having me here today to talk with you about the topic of U.S. competitiveness. This is a very timely discussion as I just returned from a weeklong trip in China. This was my 22nd trip to China. My first trip was in 1981 to Beijing. I refer to that period as the "BT" period. Before Traffic. At that time, a trip across town took 10–15 minutes. Today, it takes an hour or more. The traffic today is emblematic of what is happening in China, and especially Beijing.

In February of this year, AeA released a report whose title says it all: "Losing the Competitive Advantage? The Challenge for Science and Technology in the United States." I am submitting a copy of this report to the Commission for the record.

The thrust of our report is that the United States is slipping. Yes, we are still the leader in nearly every way that one can measure, but that lead is eroding as other countries are catching up.

Let me be clear, it isn't that the United States is in decline. It's that others are advancing quickly from behind, putting all their economic resources into moving their countries forward. The problem is that even if the United States were doing everything right, the world still poses an unprecedented competitive challenge. Unfortunately, we aren't doing everything right, and this compounds the challenges that we face.

Our report on competitiveness identified five themes, which the United States needs to address to prevent an impending slide in U.S. global competitiveness.

First, the economic reforms around the world are rapidly transforming economies, making them dramatically more competitive.

The United States has long urged the world to adopt free market principles. Well, the world listened. Major economic reforms have taken place in Russia, Eastern Europe, China, and India, to name a few. Indeed, if you look back just 20 years to 1985, over 60 percent of the world lived under command and control economic systems.

While many Americans are just now beginning to recognize how competitive the world has become, this change didn't happen overnight. Just as the U.S. didn't achieve its current leadership overnight. It takes years of investment in your innovation infrastructure. You need to invest in research and development, particularly basic research. You need to invest in your people, especially in science and technology education. You need to adopt a system that encourages investment, welcomes change, and promotes risk-taking and rewards it.

Which brings us to our **second** theme, that other countries are adopting and utilizing technology to enhance their economic growth and competitiveness. And as a recent CIA report states, "the greatest benefits of globalization [will] accrue to countries and groups that can access and adopt new technologies."

Already many countries are using technology to leapfrog from behind. Technology allows countries to bypass traditional development paths and use the latest technology to bring themselves forward. The implications are far reaching for U.S. competitiveness; the stagnant economy of yesterday could be the competitive rival of tomorrow. There is no better example of leapfrogging than the development of China's wireless telecommunications infrastructure.

Other countries realize that the U.S. experience of the 1980s and 1990s is the model to be followed. Namely that the growth of the high-tech sector leads to wealth and job creation. But for that to happen, there is a need to build a high-tech infrastructure.

To this end, many countries are making great strides. China now graduates four times the number of engineers as the United States. Japan graduates twice as many, and South Korea with ⅙ the population, graduates the same number of engineers as we do.

The changes in China have led to massive injections of investment into the Chinese economy, and where investment goes, trade follows. In 2002, China surpassed the United States as the prime destination for foreign direct investment in the world. In 2004, China surpassed the United States as Japan's largest trading partner. In the same year, China was the largest U.S. trading partner for technology products, surpassing the combined 25 countries of the European Union.

China is not alone. Many countries are increasingly climbing the technology ladder. As with China, they are no longer satisfied simply to manufacture technology products. They are also striving to become creators and designers of the next generation of breakthrough technology products and services.

This is my **third** point. If U.S. workers are to compete in a world economy that is increasingly knowledge based and driven by technology, the American education system must improve.

A highly skilled workforce is the lifeblood of any successful company, industry, or national economy. Regrettably, the American K–12 system is failing to provide the math and science skills necessary for kids to compete in the 21st century workforce. Which in turn means that the U.S. higher education system cannot produce enough scientists and engineers to support the growth of the U.S. high-tech industry that is so crucial to our economic prosperity.

We should be appalled and embarrassed that our 12th graders score at the bottom on international math and science tests. Far too often, our students shy away from engineering and tech programs because these are seen as careers for geeks and nerds. Interestingly in China, 39 percent of its college students are majoring in engineering while only five percent do so in the United States.

This leads me to my **fourth** point. If we cannot produce enough domestic scientists and engineers, keeping out high-skilled foreign talent is not the answer.

For decades, if not centuries, America has been the beneficiary of an influx of many of the most talented minds on this planet. Foreign-born individuals represent one of every five scientists and engineers in the United States. That is over 1 million workers. These workers are job creators. They contribute a tremendous amount of knowledge, talent, and innovation to the U.S. economy. People might be surprised to learn that almost half of the Nobel Prizes awarded to researchers in the United States between 1901 and 1991 were won by foreign-born individuals or their children.

Unfortunately, immigration policy post 9/11 has deterred foreign nationals from coming to the United States to study or work at the very time that this talent has tremendous opportunities elsewhere. We literally cannot afford to lose their intellectual abilities. Indeed, last year we saw a 35 percent decline in Chinese applications to U.S. graduate schools of engineering.

Finally, the U.S. Federal funding that spawned so many technology breakthroughs in the 20th century is faltering. Few people realize that Federal funding helped create the Internet, MRI scanners, the mouse, and GPS system—to name a very select few.

So what has been happening to R&D funding? Well, federally funded research has declined as a portion of the economy, and the priorities have shifted away from technology. In 1981, half of all Federal R&D went to technology; by 2003 this dropped to one-third.

In November 2004, the U.S. Congress even cut the budget of the National Science Foundation by $105 million, the first cut in 16 years.

Government investment plays an indispensable role in building the foundation of a knowledge-based economy by investing in ventures, concepts, and ideas often years before a commercially viable product or service is available. When government provides the foundation, U.S. businesses convert these innovations into new products, services, and sometimes, new industries. Why would we want to break this cycle?

Mr. Chairman, the United States is not preordained to lead the world in economic or technological advancement. We achieved this lead by the sweat of our brow and 60 years of investments in our infrastructure. We understood that innovation—taken in its broadest sense as the open acceptance of change and new ideas—is what fuels our economy.

Yes, we are still in the lead, but I hope that everyone understands that it is a precarious one. While we are taking this lead for granted, others are rapidly moving up from behind.

The world is a changed environment. It is intensely more competitive, and we are going to have to work harder to stay out front. Unless this realization hits home, our lead will continue to narrow, and at some point, we will be staring at someone else's back.

Mr. Chairman and Members of the Commission, thank you for having me here today.

Cochair MULLOY. Mr. Archey, thank you very much for that statement. It was very clear and very forceful, and we appreciate it.

Mr. Ciacchella, please.

Commissioner DREYER. Do you pronounce it c–h?

Mr. CIACCHELLA. Yes, it's like in c–h, Ciacchella.

Cochair MULLOY. Thank you.

STATEMENT OF JOHN CIACCHELLA
VICE PRESIDENT, A.T. KEARNEY, SANTA CLARA, CALIFORNIA

Mr. CIACCHELLA. Thank you, Mr. Mulloy. I appreciate the opportunity to be here.

I actually brought a small, short presentation. There were two studies was I submitted to the panel before that I think will add some slight context to what Archey presented, but in two different contexts. One is from a U.S. high-tech executive perspective and the other is from a Silicon Valley regional perspective. So I'd like to share those with the panel, and we'll just walk through here.

The two studies, one was focused on high-tech and telecom competitiveness. We surveyed 300 U.S. executives. This was done at the end of December and the beginning of January. The findings have gotten some pretty wide review. And really if you look about the overall finding there, U.S. tech companies, there is a lot of change happening on a global level. The feeling is that U.S. companies need to improve their competitive positioning, that they're not doing enough, and I'll go into a little bit more in detail on that.

The second study was really looking at what I would call a very strategic region, which is the Bay Area, Northern California, and the impact of offshoring in jobs here. And here what we did is we took a look at really what are the capabilities that this region is competing on and how are those capabilities stacking up on a global level. Which capabilities are competitive in and which capabilities are we losing ground in. And that was based on a number of interviews, plus a lot of analysis of job postings and trying to understand where are jobs headed.

Just to summarize some of the key results from the competitiveness studies of the U.S. executives, three major trends came out as driving this competitive intensity. One is, and as Archey mentioned, we have two mega markets that have come online: China and India. What's interesting about these is they are both interesting markets, but they're also generating their own global competitive players.

The second thing is there's been a pretty significant shift in where technology's going. If you look at the major driver of technology over the past 20 years, it's really been around the enterprise infrastructure. Last year was the first year that integrated circuits going into consumer applications exceeded those going into enterprise or defense applications. So technology is going into the consumer market.

The consumer market is a very global market, plus you got a very big global economy that's forming, a free market economy that's forming.

The other thing is it is a technology business, so you're seeing a lot of proliferation of new technology. There are a lot of technologies that have very recently crossed the chasm, so to speak, that are being deployed very rapidly and very broadly. Everything from digital media, wireless type of capability, broadband capability, so technology is also proliferating on an infrastructure level as well.

I think it's important to note those because there's some policy things that we may talk about in terms of technology.

We asked the question: How prepared are U.S. high-tech companies. Most executives, a vast majority, 90 percent said, yes, they feel this competitive intensity. Things are more intense. The competitive playing field is getting harder. Only 15 percent rate themselves as being very prepared to deal with this; 70 percent actually rated themselves as fair to good; and less than 40 percent have any formal process at the company level to really start to look at competitiveness on a global level.

A lot of high-tech companies tend to be organized by products or market segments, so they're working very diligently in these product segments, but there's a lot of bigger changes that are starting to happen that are changing market boundaries and changing traditional production boundaries.

You have companies like Apple today, a big music company, so you're getting a lot of these changes. Those are hard to pick up when you're working at a product sort of level.

U.S. companies aren't standing still, but there were some key actions that seemed to be missing, from our point of view, when we looked at this. Company-level strategies for China and India were very few and far in between. We found a lot of product level strategies, but really treating these as new markets that they needed to go into with the full power of their companies.

Innovation was happening around product extensions, but in terms of making the bigger bets and really driving some of the newer types of innovation, companies that have been coming out of a recession are still in a little bit of a bunker mentality in terms of placing bigger bets and trying to make some bigger plays. But this is a time with these exploding new markets where that might be actually what needs to be done.

And then there was just some comments about improving their consumer processes.

If you think about it from a policy perspective, that's were the comments and some of the things that I summarized out of the study. One is to balance a playing field between the U.S. and other mega markets. U.S. companies have the same access to the labor pools that are over there, so they have the access to the low cost labor pools. But the access to the markets, those consumer markets, that doesn't seem to be a level playing field.

Also some of the things regarding intellectual property protection, compliance type of issues, those are things that are unequal right now. So the challenge they have is, yes, we can access the talent, put our manufacturing there, but in terms of going into those markets and competing head to head with the companies that are over there, we're playing under a different set of rules than they're playing under. We need to get that rule base balanced out.

There's been a lot of discussion already about the foreign workers, especially the high-talent foreign workers. It's especially important because high-tech companies are global companies. If you look at most of them, they have people who are working in multiple regions who are flying back and forth between here and China and India on a monthly basis, in some cases. We've interrupted that flow, is essentially what's happened. And that's a flow that's been very positive for U.S. companies as well as, you'll see later, U.S. regions.

And then I think the point in terms of funding for science and technology and research, a key theme that came out, it wasn't so much amount, but being steady about it. Having a steady policy around technology and science type of research, especially in critical technologies. The ability to be able to plan and to understand that the U.S. Government is actually working on these things and it's not going to go through some sort of whipsaw procedures.

I'm shifting gears here in terms of the Bay Area job study. In terms of offshoring. Offshoring is really not an issue. It's an issue in the sense that it impacts people, but this is a practice that's been done especially in the Bay Area for a long time, so it's a well-established practice.

The Bay Area is very well positioned in critical technologies: Bio, info, and nano—the three O's. Archey mentioned that the U.S. in terms of its position on technologies is still pretty good, but the sense of erosion is what's in there.

When we looked at capabilities there were three that stood out of the five that we said the Bay Area was competitive in. Three that were pretty new—I mean entrepreneurship and research and advance technologies, this area is pretty well known for that. But three that stood out that were a little bit newer and that are shining a little brighter and that other regions see this region actually driving is cross-disciplinary research, so this is bio and information technology. So this is where you're taking chemical processes and electronic processes and bringing these together.

Cross-disciplinary research is something that is actually very unique to this region. It's something that's harder to do in other places, so that was something that came out.

The last one that I wanted to talk about is global integrated management. These are managers and engineering project type of managers who can actually manage projects that are actually going beyond company boundaries or beyond country boundaries and working those. We have a unique skill set in terms of managing very diverse, spread businesses.

In terms of weaknesses: Mass production, back office operations. Those have been pretty well known at least in this area. It doesn't mean that the U.S. can't compete in some of those in some other regions, but the high cost here prevent some of those.

But what's interesting is product and process enhancement, and there's been a lot of discussion about engineering. Engineering that's associated with testing software, engineering that's used to cost-down products for—as they mature out. Those engineering skill sets are easily duplicated. That's a lot of what you're starting to see being offshored from this area, that type of engineering.

The net is there is a feeling that there will be job creation in the region. Keep in mind the region's job growth is half of that of the U.S. So even the Bay Area has this reputation of being this job growth engine. Actually, if you look over the last 20 years, it's been about half the U.S. job growth rate. But what is interesting is there's a lot more churn here, so you're getting quite a bit of churn that's happening.

In terms of policy implications, the key notes here are really investing in the capabilities that the region, and I would transpose this to the U.S., is what capabilities are we betting on? Because we can't bet on supporting all the capabilities that we have, so where are we going to invest? And then promoting policies that fit those capabilities.

There was also quite a bit of commentary around government being more innovative in terms of supporting a transitioning workforce. If you want to think about this, cycles are picking up. In fact, it's interesting, if you look at the enterprise business market versus a consumer business market, the enterprise business market has a cycle or a cadence of about two to three years in terms of changing products and infrastructure. Where a consumer market is 12 to 18 months.

The world is speeding up and jobs are changing much quicker. Everybody's going through jobs, but our ability to take health benefits and those kinds of things move them around with us is something that's very difficult to do. There's a need for innovation in restructuring some of the support processes that are underneath.

So those are just a couple of prepared remarks. I know you have the reports. I just wanted to give you a quick summary.

[The statement follows:]

Prepared Statement of John Ciacchella
Vice President, A.T. Kearney, Santa Clara, California

A.T. Kearney has recently conducted two studies on competitiveness that have intriguing policy implications when it comes to maintaining U.S. leadership in high technology. In this testimony I will review each study and its results, and then examine their policy implications.

Tech Industry Competitiveness

A.T. Kearney's "Crunch Time: The Competitiveness Audit" finds an industry of rebounding opportunity but also increasing competitive intensity. The study was conducted in late 2004 and early 2005 in cooperation with the CMO Council and the BPM Forum, and it is based on a survey of 300 U.S. technology and telecommunications executives.

The study finds three major trends impacting technology markets:

- **New Mega Markets—China and India.** In coming years, information technology spend growth from the Asia-Pacific region, for example, will be double that of the United States and Europe. Consumer spending growth for China, India, and Russia will also be double the domestic rates. These represent new mega-markets in which high-tech firms can sell their products.
- **Shift From Defense and Enterprise to Consumer.** The consumer has become the main driver of the tech market, as illustrated by the eclipse of semiconductors going into consumer applications over those going into business or defense purposes.
- **New Technologies.** Emerging technologies such as wireless and VoIP (voice over internet protocol) are fast becoming mainstream. The most significant five-year growth forecasts are for digital TVs, MP3 players, digital hotspots, and RFID.

Meanwhile, competition is increasing as companies become larger, more global, and more efficient than ever before. Whether it's new players from China, Korea or India, or larger players resulting from domestic consolidation, the result is companies with a combination of greater size and increased agility.

Where is this competition coming from? Respondents vote the United States as the number one geographic source, with China and India trailing close behind. When asked about factors influencing competitiveness, the top three responses are emerging technologies, industry consolidation, and new entrants into the market.

So how prepared are U.S. high-tech companies? While 90 percent of our survey respondents expect competitive intensity to increase, just 15 percent rate their own company's preparedness as "very good." (Most gave themselves a "good" or "fair" grade.) Less than 40 percent have a formal function or process to assess competitiveness. Most drive their competitive planning and action within product and market groups—not at the company level.

Why is this a problem? The mega-shifts discussed above are challenging traditional market and product boundaries. Leaders use innovative business models to exploit the intersection of new markets and new technologies; for example, Apple with music, eBay with auctions and Yahoo and Google with advertising. Among established players, EMC is moving from storage to "content management," while IBM continues to migrate from hardware to software to outsourced services. In short, companies that want to position themselves to play globally and change markets with new technology must break out of their product business silos.

In summary, the study shows that the U.S. technology industry is not standing still; it is taking key actions. However, given the significant market changes underway, companies may need to do more. The study identifies six dimensions to improving competitive positioning. The three most important, according to technology executives, are:

- Strengthening their companies' strategic position in the marketing place, e.g., developing company-level strategies for emerging markets such as China
- Enhancing product and service innovation, e.g., innovating not just through incremental improvements around core products, but in a few big bets on potential new technologies
- Improving customer intimacy and experience, e.g., engaging customers and channels to improve customer processes and systems, strengthen account management, and shift sales focus from products to solutions.

Other key dimensions are managing operational complexity; managing organization, culture, and leadership; and optimizing governance and capital deployment.

Competitiveness of a Strategic U.S. Business Region

"The Future of Bay Area Jobs: The Impact of Offshoring and Other Key Trends," undertaken in 2004 in partnership with three area nonprofits (Joint Venture: Silicon Valley Network, the Bay Area Economic Forum, and the Stanford Project on Regions of Innovation and Entrepreneurship), began as a rigorous examination of the much-discussed effects of global offshoring on the domestic jobs base. It soon found, however, that while the offshoring trend has actually been around for decades, other factors also drive changes in the job market.

Based on 120 interviews, analysis of 9,000 online jobs listings, extensive review of secondary source materials, and in-depth examination of the semiconductor and software industries, the study's analytical framework focused on four key components: trends, regional capabilities, the regional business environment, and the regional job market.

Our study found that the Bay Area is overall well-positioned in three critical technologies: information technology, biotechnology, and nanotechnology.

Analyzing the region's capabilities—perhaps the most important component in companies' choices to locate and invest in a region—the study found that the Bay Area is highly competitive in five key areas:

- Entrepreneurship/new business creation
- Research in advanced technologies
- Cross-disciplinary research
- Concept and market development
- Global integrated management

The Bay Area is less competitive in three areas: mass production, back-office operations, and product and process enhancement. Remember, however, that this study focused only on the Bay Area (where the cost of living is quite high), and other domestic regions may be competitive in these capabilities. It's not that such operations are necessarily headed for China, or anywhere offshore—a call center in Nevada or a distribution center in Dallas, for example, will still have advantages over offshore locations. Further study of various pockets or regions within the country would help identify their competitive capabilities.

But to return to the Bay Area, we found that its unique strengths should produce net job *creation* for the foreseeable future. The region should continue to incubate and grow new businesses; small and new businesses will keep most of their jobs local until their business processes and products mature.

In addition to job creation, there will be job destruction. With the regional economy's focus on innovation and strong link to economic cycles, an individual may find that after the creation and scale-up of a business, her job might move to another region of the country or world—and she'll probably want to stay in the Bay Area and start with a new business centered around a new technology. But again, despite (and in part because of) the stress on any one individual, the macro jobs picture will be strong.

Policy Implications

From our competitiveness study, the primary policy implication of interest to this Commission concerns balancing the playing field for trade between the United States and China. China is a potentially huge market for U.S. products—but who will have access to it? Currently, Chinese firms have far greater access to U.S. markets than vice-versa. Part of the problem is maturity of infrastructure (retail, logistics, etc.). But part of it is market entry issues, including intellectual property protections. U.S. firms need government help to assure that they can grow globally just as Chinese firms do.

Again, I'm speaking of markets to sell products. As the offshoring phenomenon shows, we do already have access to low-cost labor in China. But that labor is unregulated—which brings up another issue of balancing the playing field. We must ensure that Chinese firms are held to the same standard of compliance as American firms when it comes to the environment, labor, and accounting. U.S. policies on these issues reflect our society's concern for the long-term sustainability of financial markets and the health and welfare of both workers and the world we all live in. We must call on the Chinese government to match our support for these ideals.

We have also hampered our own competitiveness by limiting H–1B visas, the tool through which high-potential, highly talented foreign individuals can come to this country for work or school. The program suffered from some abuse in the late 1990s, and was justifiably examined in the aftermath of 9/11, but we should now reinvigorate the inflow of skilled immigrants who can power our economy. Many of these talented people end up staying permanently in the country where they study or work—and if we don't bring them in, then Canada, the United Kingdom, and other countries will.

The Bay Area jobs study generated recommendations for individuals, businesses, and all levels of government, but let me focus now on the government end. Primarily, the lesson is that we should invest in promoting the region's competitive capabilities, including mechanisms such as:

- R&D tax credits
- Funding for science in next-generation technologies, including bio, nano, and energy
- Increased grants for higher education that supports our competitive capabilities.

Note that it is far more effective to use taxes and policies to *maintain* our leadership position in areas where we are already strong than to try to shore up areas where we are less competitive.

The volatile nature of the Bay Area economy, our study found, has many benefits to business, although it frequently takes a toll on individual workers. As companies mature and move certain functions offshore, they can do so without calculating the total burden on their transitioning employees. That burden has traditionally fallen on the government (in addition to the employee himself). We should thus encourage businesses to "share the load" of job transitions.

But since that volatile job market is nevertheless a robust one—good for national competitiveness—we as a society can also pursue innovative approaches for transitioning employees. A big concern for individuals considering leaving their jobs is maintaining their health insurance, so better portability of health accounts might allow them to take more chances in business creation. Likewise, leaving an established company for a startup generally requires new skills to apply to the new technologies that the emerging company is centered on. The 401(k) is a wonderful innovation that basically creates a portable retirement account; workers are calling for a similar approach to their continuing reeducation and retraining needs.

Finally, policy should address the needs of the supporting business environment, such as housing and transportation. Current policies are in place to do so; however, has government demanded the same type of productivity and efficiencies from its suppliers and departments that businesses have gained from their suppliers and internal departments?

Conclusion

China's high-tech development contributes to the intense competitive environment for U.S. high-tech firms—but at the same time it promises huge markets for those who succeed. With a level playing field in trade, and policies that invest in our competitive capabilities, the Federal Government can permit well-prepared U.S. companies to thrive in the challenging but promising years to come.

I thank you for the opportunity to share our perspectives on these important issues.

Cochair MULLOY. Thank you, Mr. Ciacchella.

Mr. CIACCHELLA. Thank you.

Cochair MULLOY. Mr. Dawson.

STATEMENT OF RHETT DAWSON
PRESIDENT AND CHIEF EXECUTIVE OFFICER
INFORMATION TECHNOLOGY INDUSTRY COUNCIL (ITI)
WASHINGTON, DC

Mr. DAWSON. As the last speaker on the last panel on a very long day——

Cochair MULLOY. Of today.

Mr. DAWSON. —of today, and I compliment all of you for your interest and participation. And I checked up there, and your chairs are no more comfortable than the chairs out here, so good for you for staying engaged. I'll try to step through my little piece here quickly, but thank you for inviting me.

I am going to take a case study, which is probably familiar to most of you, called WAPI, that has to do with the Chinese standard with the Wireless Local Area Network, that we went through a year ago, and use that as a case study to try to draw some broader understandings. More specifically, to try to come up with some prescriptions both for what industry can do and for what government can do in other cases, as they surely will arise in the future.

First of all, just a word about standards. Standards, as you know, can create markets and they also can close markets. We are in the standards business up to our eyeballs and have been for a long time. The WAPI case was not as unusual as it appears to be. It has happened before. We have dealt with similar cases outside of China. But this one was unusual and unique because it pulled together a lot of different of the threads that I'll describe to you. It started in May of 2003 when China issued a compulsory standard that would have gone into effect the following June. It was an incompatible standard but purposely so with every other international standard.

In order to comply with the proposed regulation U.S. technology companies or any technology companies would have had to collaborate with their Chinese competitors and, effectively, turn over their technology to co-produce the products for that specific Chinese market for that standard.

In the process, of course, they would have had to choose being sharing their valuable intellectual property with the Chinese competitor or abandon the Chinese market. These regulations, if they had gone into effect, would have excluded China from the world market for wireless local area network products or WiFi products, as they're called, and it would have essentially split the world into two WiFi camps.

One of the things that defines the IT production and services world is we like to have one standard around the world rather than having a proliferation of standards.

Moreover, the Chinese in their regulation would have only provided this mandatory technical standard to selected domestic producers in China of wireless equipment and then designated those companies as the obligatory partners of any foreign manufacturer seeking to do business or bringing those products into China.

Fortunately, the highest level of the Administration were engaged and the Congress, too, and the Chinese agreed to indefinitely suspend implementation of this mandatory standard and revise the standard based upon the comments from both foreign and domestic firms. They promised further to participate in the international standards body.

This was an important result for the U.S. industry. And beyond just the simple product and market losses it would have been a terrible precedent that would have allowed China to discriminate against foreign firms through the standards process and it would have been an example to other countries.

Moreover, we did all of this without going through the delays associated with the WTO dispute settlement procedures, which sometimes can drag on for years. So we are really pleased and impressed with what the Administration did in working together to coordinate with industry and allowing us to move forward.

Let me just kind of skip to the end and tell you what four different prescriptions I have for government and four that I have for industry.

First of all, we need to give policymakers in our government the tools to be able to understand and then turn around and explain, countries particularly in emerging markets about the importance of technologies and standards, and why it's in their interest to adopt and deploy internationally recognized market-driven standards.

Secondly, we have to give our government the ability to advocate and promote global market-led voluntary standards that support innovation and interoperability as opposed to government-mandated standards.

Third, we have to press for market access so consumers, industry, and economies around the world can benefit from what we think are beneficial highly innovative technological advancements.

Fourth, when China or any other signatory does not comply or play by the rules, we ought to be prepared to take the case to the WTO.

Those are the four prescriptions for government.

Now for industry I think we have to continue to promote the value of these voluntary standards that are both compatible or interoperable.

Secondly, we have to work to gain an appreciation and a better understanding of intellectual property rights, how governments work on standards, particularly in China. And there I commend to you Pete Suttmeier's prepared testimony, which was an extraordinary well-prepared piece of explication of the problems. We also have to understand the implications of our investments in China, as we heard about over lunch.

Third, we have to increase the effectiveness of Chinese participation and leadership in a broad range of internationally-recognized standards, organizations.

Finally, we have to engage in a private-sector dialogue, industry-to-industry dialogue within China on the value of global standards.

That concludes my statement.

[The statement follows:]

Prepared Statement of Rhett Dawson
President and Chief Executive Officer
Information Technology Industry Council (ITI), Washington, DC

China, Standards and the U.S. High-Tech Industry

My name is Rhett Dawson and I am President and CEO of the Information Technology Industry Council, a trade association of 31 top high-tech companies. I have been asked here today to provide testimony on China's use of standards and the impact this may have on the competitiveness of the U.S. high-tech industry, as our association has been working on technology standards for almost ninety years.

To jump into that often complex set of issues let me illustrate that with a recent experience we had, one that I believe highlights many challenges the industry is facing, not only in China, but around the globe. The illustration I will use is the Chinese Wireless Land Area Network (WLAN) standard proposed last year as a mandatory one for selling these types of wireless products in China. It is better known by its acronym "WAPI."

In May of 2003, China issued compulsory "WAPI" security standards that would have gone into effect on June 1, 2004 and were incompatible with the international standards upon which most WLAN products are based. In order to comply with the proposed regulations, U.S. technology companies would have had to collaborate with their Chinese competitors to co-produce products for the Chinese market—and in the process potentially risk sharing their valuable intellectual property with their Chinese competitors—or abandon the Chinese market and its opportunities.

These regulations would have excluded China from the world market for WLAN products as products made anywhere else in the world would not have functioned there, essentially splitting the world market for these products. Moreover, China only provided this mandatory technical standard to several of its domestic producers of wireless equipment, and designated these companies as the obligatory production partners of any foreign manufacturers seeking to market these products in China. ITI worked very closely with our industry colleagues around the world and also brought together the various groups in the U.S. to closely collaborate to maintain a strong industry voice on this issue. ITI worked hard to keep our government informed and to make sure this issue was on the Adminstration's agenda. Facing pressure from the highest levels of the Bush Administration and the Congress China agreed to indefinitely suspend implementation of this mandatory standard, revise the standard based on comments from foreign and domestic firms, and participate in international standards bodies.

This was an important result for U.S. industry. IT is a leading U.S. export to China, accounting for 26% of all U.S. exports to China in 2002. This amounts to several billion dollars per year of U.S. tech exports to China. Many of these and as yet to be designed U.S.-made products and components would have been affected by this standard, jeopardizing high-end U.S. jobs. The fast growing wireless market in China (forecast to grow by 25% per year) remained open to U.S. competition, and we avoided a terrible precedent that would have allowed China, and, potentially other countries who might wish to follow a similar path, to discriminate against foreign firms through the standards process.

Furthermore, results were achieved immediately, without the delays associated with the drawn out legal process of the WTO dispute settlement procedures. The well-executed cooperation and coordination at a variety of levels within and among U.S. Government agencies was highly impressive and crucial in the success on this issue. This type of continued coordination will be necessary going forward as we will see similar issues from China and must be prepared, as industry and government, to address them.

This example goes far in highlighting concerns that all sectors, but particularly the U.S. high-technology sector are currently facing in China. The precedent that may have been set in the above example, by a government—a signatory to the WTO agreement—mandating a technology and forced domestic production would have had significant implications, resulting in incompatible technologies across the globe.

It is a well publicized fact that the Chinese government wants to develop a robust domestic high-technology industry. This is not unique to China, as many governments around the world including our own want to see healthy and competitive domestic industries. However, the challenge for China is balancing her efforts to promote a domestic industry with upholding its commitments and obligations to their trading partners, as agreed to in their accession to the World Trade Organization and through bi-lateral and regional agreements.

The principles and policies that ITI and the U.S. and global IT industry are advocating for in China are consistent with China's aims, and in fact, will ultimately provide for a more competitive and innovative high-tech industry around the world and in China.

Interoperable standards are key to the success of the global ICT industry and to the benefit of users of technology. A unique technology standard in one economy, especially one as large and influential as China, isn't a good solution for consumers, industry or governments.

Requiring global companies which have invented, innovated, and developed the ideas for the technology to transfer that same technology to hand selected Chinese companies as a price of doing business amounts to a disinvestment to the benefit of a competitor.

And if left unchecked, this technological protectionism has the strong potential to create dissension that would stifle innovation, prevent interoperability, and stunt the growth of the global information and communications technology infrastructure.

Some of the lessons we have learned from this experience are:

- We need to engage on an ongoing basis at the policy level directly with our government and other governments, particularly in emerging markets, about how technology and standards can help grow their economies and why it is in their interest to adopt and deploy internationally recognized, market-driven standards.
- We need to redouble our already considerable efforts promoting global, market-led, voluntary standards that support innovation and interoperability.
- We need to encourage market access so that consumers, industry, and economies around the world can benefit from innovative technological advancements.

- We must convince governments that forced technology transfer may look like a "short cut" to industrial modernization, but in a global market such short cuts are counter productive in the long run.

Some of the actions U.S. industry is taking or is planning to take to advance these objectives are:

- Aggressively promote the value of global, market-led, voluntary standards that are compatible and interoperable
- Encourage greater appreciation for IPR and investments in R&D in China
- Encourage more private and public sector capacity building efforts focused on Chinese participation in the international standards process
- Increase effective Chinese participation in a broad range of internationally recognized standards development activity
- Build strategic alliances with Chinese industry and other (non-PRC) industry groups
- Continue efforts to educate key decisionmakers in Chinese and U.S. Government on standards issues

Thank you for this opportunity.

Panel IV: Discussion, Questions and Answers

Cochair MULLOY. Thank you, Mr. Dawson. We were actually talking about something that you said in your testimony and we were clarifying our own thinking on it.

Mr. DAWSON. That's good to know, as opposed to when are we getting out of here.

Chairman D'AMATO. Figure out your testimony.

Cochair MULLOY. No, absolutely.

Chairman D'Amato.

Chairman D'AMATO. Thank you, Commissioner Mulloy.

Mr. Archey, I was just taken with your perspective in your testimony, and the fact that you are briefing Members of Congress. We think you should brief all the Members of Congress and get around to see everybody on that, because I think you're absolutely right.

Dr. Pillsbury talked about the old paradigm and the new paradigm. And it's increasingly occurring to me that the old paradigm does have a hangover effect and is dominating much thinking and writing here. And if you don't have a sense that there is a problem your investigation is not going to get to aggressive solutions.

Let me ask you: Have you looked at the Tax Code with the kind of recommendations that might be useful to revise the Tax Code to entice companies to stay in the United States or bring their earnings back from abroad?

It seems to me there are a lot of pieces in the Tax Code that actually encourage companies to go abroad, the earnings-overseas provision, for example. Have you looked at that? Because it seems to me there's some pay dirt in looking at how the Tax Code can be revised to encourage firms to invest in America.

Mr. ARCHEY. Mr. Chairman, we have a tax committee that's been within AeA for almost 30 years. It's got anybody the 95 companies. That is, in fact, what they're looking at right now. And probably will be another month or two before we're going to have any final recommendations coming out of it. So I don't want to really speculate as to where it's going to come, but it's being thoroughly looked at.

The second item, I just want to make a comment that I should have made in my opening statement, because I'm kind of fascinating by it.

I've been in Washington 31 years. In the 1990s, in an era of globalization, where globalization got lots of attention, I find it ironic and a great paradox that, in my judgment, the Congress of the United States became more insular in that last ten-year period than they were ten years earlier. And at a point in time when we're talking about the world as the marketplace, all those kinds of things.

So the fact that we're having a difficulty with members acknowledging what's going on in the rest of the world I guess shouldn't be surprising. I can remember in the '80s and '90s when you'd hear all these people talk, "Oh, this is a protectionist Congress." I used to laugh at that because it wasn't at all, but I will say this: If this is not a protectionist Congress it's pretty damn close to a neo-isolationist Congress. I'm just amazed at it because it's happening at a point in time when the rest of the world is now so much more prominent in terms of who we are and how we act and all that, and yet I think we have become more introspective and more insular, and I think that's the big problem.

Chairman D'AMATO. I think part of the problem is Members are afraid to travel because the politics of assassination in this culture has gone through the roof. You go overseas and you're an opponent in an election cycle, you're going to get smeared. That's a big part of this problem.

Cochair MULLOY. Chairman, thank you.

Vice Chairman Robinson.

Vice Chairman ROBINSON. Thank you.

Mr. Dawson, notwithstanding the case study you mentioned, as we prepared for this hearing—and I want to commend the Commission staff for a superb briefing book that was made available to us along with background papers—one thing that really struck me is that the Chinese seem to live for creating standards-related obstacles and, frankly, unfair barriers.

Wherever they can find a standard or a different way to go to protect their industries or give advantage to their domestic companies, they'll move in that direction. I wish I had on the tip of my tongue four or five different industry sector examples, but I think most of you know which they are. And even in the capital markets arena, you have a Chinese investment bank that has to be the partner for Goldman Sachs and Morgan Stanley and virtually everyone else, for large equity offerings on the New York Stock Exchange.

I'm interested in your take on whether the Chinese are breaking the code slowly but surely, that this kind of barrier-building is not conducive to the kind of broader trade relationships that they want to enjoy with ourselves and others in the world. Also, that there is an increased resolve to do something about it and to mobilize our respective governments intervene aggressively and see what can be done.

But I can tell you my take on it. I don't think the Chinese get it and that they can't resist the temptation to manipulate standards.Do you have a more optimistic view on that?

Mr. DAWSON. I should have clarified my view that the experience at WAPI did not make me a Pollyanna. As a matter of fact, it made us much more vigilant and put us on our guard. Secondly, made us come up with a work plan that was going to go try to work with the Chinese to show them why it's better to work another way. That plan is still in development. It's going to be deployed this summer in China.

But let me say two other things, one of which is you and I both talk about "they" when we're talking about China. Well, Pete Suttmeier's confirmed my view, actually, which is that there is a lot of "they" out there. There are the standards wonks that want to try to put a trap against any foreigner that might get in their way.

Then there is a government official, like Madam Wu who came to deal with us in the JCCT, and found our arguments more compelling on balance; and went back and told standard organizations the directions they should take. So the "they" is a little bit more complex and it needs to be discriminated and it needs to be articulated fairly well.

So I guess we're not quitting. We're going to go redouble our efforts to try to show them the error of their ways. I guess if I didn't believe I was going to be effective in doing all that, I wouldn't keep trying.

Cochair MULLOY. Thank you.

Commissioner Reinsch.

Commissioner REINSCH. Thank you.

On the standards issue, I appreciated the last point you made. We've had at the National Foreign Trade Council a standards expert, if you will, working with us for the last year and a half, who has produced three really thoughtful papers on this subject. The use of technical standards as a barrier to trade is a serious and growing problem.

As a practical matter, the largest sinner, if you will, is the EU, not the Chinese. And they're actually in the process of trying to persuade everybody else to be as bad as they are. That's not by any means to excuse the Chinese but to suggest that it's a pervasive and also a growing problem. Let the record show Mr. Archey is nodding his head yes. And it's something that I think our trade negotiators really need to go after. There are WTO issues here in the technical-barriers-to-trade part of the agreement that can be mobilized.

It's nice that there's the occasional happy ending, but your point that one shouldn't be Pollyannish about that is very well taken. I think this is going to be a far more serious problem in the future even than it's been in the past.

I do have a question for Mr. Archey. As always, I appreciate your tactful way of presenting your views. We benefit from it enormously. And I was very happy with your comments about students and visas and travel because, as you know, I've been giving that speech for a long time. I think the damage that we're doing to our economy long-term is enormous.

I did want to ask you: And probably I know the answer given what you went on to say about the current Congress, but have you raised that issue with Members of Congress, the visa, business travel, immigration issues at all? And, if so, is there any ray of hope that you can share with us there? Because that's really a larger part of the problem.

Mr. ARCHEY. We have, in fact quite a bit in the last month. I'd also have to acknowledge that it gets caught up with the overall immigration issue and it gets intermingled with it.

Commissioner REINSCH. Yes.

Mr. ARCHEY. I find it sometimes very difficult in meeting with a Member to make that distinction between amnesty and all of those other kinds of issues about workers coming across from Mexico. But I would argue that right now, Mr. Reinsch, I would argue that I have never seen a Congress that the immigration attitude seems to be just: Don't let them in. And that makes it fairly simple and straightforward and then easy to implement. I'm not being facetious. I think that really is the attitude.

I just want to make one other point that you made about the standards issue. We wrote a paper about a year ago, and I think Mr. Dawson's group is doing a very good job on those standards stuff, but I would just reinforce your point. We made a point about a year ago that the big nontariff barrier of the new century is going to be standards.

And, in fact, we said that the European Union is the absolute leader in terms of that and we're seeing it in the environmental area left, right, and center. I think we're going to see it in about four or five more areas coming. I think the Europeans are feeling a lot of insecurity about their competitiveness. And standards are a great way to have a WTO-acceptable way of maybe lessening the competition.

Commissioner REINSCH. I couldn't agree more.

Mr. Dawson, you had a comment.

Mr. DAWSON. To your point about standards, we need to distinguish between the European Union as a government and the European industry or distinguish between the Japanese IT or CE industry and the Japanese government. Earlier this month I met with my Japanese and European counterparts on the TBT approach in Geneva we were all on the same page, so there wasn't an argument among industry about what needed to be done in the IT and CE space on the nontariff barriers to trade. So I think we have to elevate it and make it clear to our governments that here's what industries at least in the IT space wants to do.

Commissioner REINSCH. Do you have a Chinese counterpart?

Mr. DAWSON. I do and I have not met him or her.

Commissioner REINSCH. Well, I guess my advice would be that perhaps you should.

Mr. DAWSON. I intend to.

Commissioner REINSCH. I'm sure you do.

One of the things we've noticed is that industry in the other locations has been pretty much on the same page, although, as you well know and I'm sure Mr. Archey knows from past lobbying efforts, the American industry has been a lot more aggressive and I think effective taking on its government on an issue like this, than European companies, for example, have been taking on their government. And Japan is a whole different story.

If there were a Chinese industry that was capable of mobilizing and approaching its government to explain how some of these things affect them, I think that would be worthwhile to develop, so I'd encourage you to do that.

Thank you, Mr. Chairman.

Cochair MULLOY. Yes. Thank you, Commissioner Reinsch.

Commissioner Dreyer.

Commissioner DREYER. Mr. Archey, now that we have you briefing all of Congress, I would suggest that you include some college presidents and educators in your briefing. They, too, are unwilling to confront the fact that we are losing the technological edge. They provide a lot of statistics about how SAT scores have gone up. But there are caveats to that which they don't mention, which you and I can talk about separately some other time.

The last thing on people's minds at universities—I am a professor in my other life—is genuinely increasing the quality of students.

Mr. ARCHEY. I don't think I disagree, but I would say the heartening thing is that two university groups, which probably won't announce for a couple of weeks, are going to be a partner in our Sputnik 2005 seminar. And one of the groups I can talk about, which is the group that's doing the Workforce in the Twenty-First Century group, and I think that there are some others.

I also would argue—here we are on the Stanford University campus—that four-year universities have a great tendency to not want to change. I would argue that some of the greatest changes in terms of dealing with technological jobs have been in the community colleges in the United States because they're not hung up about the fact that they're actually cooperating with business. And they're rather quick to be able to move on some things, so.

I don't disagree, but I was heartened by the fact that we were solicited by a couple of groups who had read that report and said, "Are you actually going to do that seminar?"

And we said, "Well, what do you think?" And so we're going to partner with them.

Commissioner DREYER. If you don't mind, we'd like to keep up with you on what you feel the progress has been, because this is potentially just very important. Of course, it's also possible for universities to pervert exactly what you're doing while telling you that they're complying. So I'd be very interested in your assessment after, say, five years.

Mr. Dawson, you made a very interesting comment. You said that we've got to press for better access. I'm wondering how, in practical terms one does that. Does one reason with Madam Wu Yi or somebody like that or point out the advantages for China? How do you leverage this?

Mr. DAWSON. Well, you push every button on the elevator. You push the button that takes you to Geneva, you push the button that let's you talk about these conversations at the JCCT, and you keep that agenda going. You make sure that industry stays on the doormat of the government so they know that when you bang on the door you really care. And you make sure that USTR knows that IPR matters, and you don't stop. You become a pest and you push and keep pushing. And if you have any ideas about buttons on that elevator that ought to be pushed, I'll push them, because we're very interested.

Commissioner DREYER. Thank you.

Cochair MULLOY. I have a suggestion for another. You want to work with other countries—entities like the EU if they'll be helpful in carrying out that agenda, then you ought to work with them pretty closely.

Mr. DAWSON. Oh, we do.

Cochair MULLOY. Yes.

Commissioner Wortzel.

Commissioner WORTZEL. Thank you.

I appreciate all of you being out here. Your presentations were lively and right to the point. I have a question for Mr. Ciacchella.

You've got a very interesting highlighted paragraph in here in the presentation that says that there's a shift from defense and enterprise to the consumer, that the consumer is now, for the most part, the main driver of the high-tech market as opposed to defense; and that semiconductors are going into consumer applications versus business or defense purposes. I want to draw you out on that a little bit, if I could, because it strikes me that defense at one time clearly drove new research and cutting-edge research, which later found its way into the civil market.

China's high-technology strategy used your model: Find things that will work well in the consumer market, bring it in through import substitution, and then figure out how to use it in the defense sector.

I guess now my concern is whether or not there are specific technology areas, either here in the United States or in China, sectors where defense remains the driver. If we had to say, okay, "Don't worry about competitiveness, the United States will compete," that's part of your message, let technology go and float where it will. It will sort out the marketplace, and innovation will sort it out. But are there specific technology areas where defense is the driver because they are so unique to defense and then they then begin to affect the security of the United States?

Mr. CIACCHELLA. There are a couple of things there, so let me comment. The first is I brought up the switch to consumer markets only because if you put it in context and you go back to the late 1970s and 1980s, and if you think of high tech before the 1980s and into the 1970s, some of the companies that were around that were high tech didn't make it through that transition from defense to enterprise. Because I think when applications going into enterprise exceeded those going into defense was about in the mid-'70s when that shift happened. That created a whole another group of companies and competitors, and there were a lot of other companies that they didn't make the transition.

So if you look at history as any indication, we've gone through an interesting trigger point now where if you go, if you project that forward to the next 20 years, there will be the similar shifts in companies. New companies are going to take over, where the companies who were wrapped up in the infrastructure areas are going to have a tough time.

You see this quite a bit in the telecom industry, for instance, the Lucents of the world and some of those. It's tough. You're going to continue to see a lot of that. And this is a trend that's probably going to go out for 20 years.

So I bring that up because that is a trigger point that actually happened. And we have historical precedent to see that, okay, at that time that changed and churned a lot of the industry.

Now if you start to look at it for, okay, let's look at it from a defense perspective, for instance, and what does that mean. Well, if there are suppliers or if there are companies today that are providing critical path technologies to U.S. defense, U.S. security, they happen to be subsidizing a lot of into the enterprise market. They're struggling to make the shift into the consumer market. The U.S. Government, U.S. defense agencies are going to have to find ways to either shift to suppliers who are going to make that transition or are going to have to find ways to help subsidize some of these companies who are doing that.

So not knowing the specifics, if I'm looking long-term at my suppliers, so if I'm in the procurement function, for instance, who are the suppliers who are susceptible to the shift that are going on, and who are these suppliers that are giving me critical path technologies right now and are they vulnerable? I would start to put them on my radar screen, is what I would start to do.

Commissioner WORTZEL. Thank you.

Cochair MULLOY. Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thank you, Mr. Chairman.

And thank you to our witnesses. It's a long day, but we've actually had longer.

Mr. Ciacchella, I'm interested in what you're saying with this distinction. I want to take us full circle back to where Secretary Perry started us this morning. One of the issues he talked about was the distinction between the technological base, investing in the technology base versus what the companies are doing, which is product development. He drew a very clear distinction, and that's what I hear you're saying, that companies are moving away from what Secretary Perry called the seed corn on which the product development is based and moving directly into product development.

I'm curious about where the role of the U.S. Government is and where it should be. I mean he seemed to clearly come down on the side of the government needs to be making sure that there is a strong basic research component that has traditionally come out of the defense and military sectors. And then almost in ways the private companies will take it from there and do what they're going to do and do the innovation. Is that some of what you're seeing or what you're advocating?

Mr. CIACCHELLA. It's something that we're seeing and advocating. If you look at some of the—out of the U.S. high-tech study that we did, from a policy recommendation there was this theme about steady investment in science, steady investment in critical sciences and in emerging science areas. So biotechnology, for instance. Next generation energy. So it's the underlying sciences in some of those things that came out as the—U.S. companies are not going to be investing in the basic research. But, again, if you look historically, if you look at the foundation for the Internet, for instance, that was a DARPA-funded thing that became—and what's the Internet today and the web and everything else that was built around that.

In a similar fashion the funding that was need for the human genome and the project is spawning this sort of thing. So it's finding those, as you mentioned, what are these kernels, because most U.S. companies have shifted their R&D focus. You're absolutely right. It's into product development. In fact, this shift to consumer markets is going to require them to be much more adept at understanding what are really much more fragmented markets now.

So R&D and development from being a technology development activity is going to become more to being almost an analytical type of approach. You're going to have to understand multiple customers, multiple segments, and multiple geographies. That's a lot of investment. That's a lot of trying to understand what are the needs and how can we plug in technologies that already exist. What can I pull off the shelf.

If you go—who's going to be developing the sciences that are going to support those? A lot of U.S. technology companies are starting to—they're looking to find it, not develop it anymore. That's a different model.

Commissioner BARTHOLOMEW. And I guess that's my question, which is if they are focusing on consumer development at the same time that the government is reducing its investment in basic research, surely even somebody who's thinking ahead in a business knows that their product development is dependent on basic research, where do they think the research is going to be coming from?

Mr. CIACCHELLA. Well, that's a good question. And I can tell you what some of them are saying, is they'll go get it wherever they can. So if they're not getting it here they'll get it overseas. Or if they can't get it here and if they can't get it overseas but their competitor can, then we're going to be losing the ability to develop an industry around that technology.

Commissioner BARTHOLOMEW. Thank you.

Cochair MULLOY. Thank you.

I have a couple of comments and then a question. The issue of the Congress being more protectionist or isolationist—I can offer a couple thoughts, because I did work up there a long time.

Going back to NAFTA, the Congress was told: This will help get exports to Mexico and it will help stop illegal immigration. It did neither.

Congress was told: Support the WTO and it'll help the U.S. trade position in the world. Our average tariff MFN rate is probably 2.5 percent. We locked in an average tariff with India, probably 15 percent or so. So there are terrible inequities built into this system.

I remember this clearly because I was in the Commerce Department in the Clinton Administration when they were trying to sell PNTR to the Congress, and they were doing list state by state of all the exports we were going to get to China, when they were selling that to the House. I remember the Wall Street Journal the day after the House voted to approve PNTR for China: Morgan Stanley Investment Bank has said ha-ha-ha. This wasn't about exporting to China. This was about the multinationals investing in China.

And then they look at a $700 billion current account deficit and they see no end in sight. We're heading toward a trillion, they begin to say: Why would we listen to these folks anymore. There's a lot of doubt because they're hearing from their people: My God, okay, the blue-collar guys, your jobs are going to go. But we're going to move up. And now we hear the people who are supposedly moving up, the white-collar guys, saying, "Our jobs are going out to India now."

So there's a lot of concern in the Congress and no one has completely helped them understand what is happening here. I think that's what really needs to be done. And it has to be that somebody feels like this is the national interest and, boy, if we don't do this we're really going to be in trouble.

Now I'm hearing more and more students don't want to go into fields that are a part of the internationally-competitive part of the economy because they say, "If I go into chemical engineering, or something, somebody can outsource that job to India, and I'm not going to go into that. I'm going to go into lawyering or investment banking or media or something like that," so that's a problem for us.

I remember we had a guy named Ron Hira come out in Seattle. I read his testimony, and he said these H–B1 visas and other things, all we were doing was bringing in people, training them, and then they would go back, and it made it easier to outsource jobs here. That's what this H–B1 program was about. So now the Congress is getting that in their head, so they're reluctant to go down that road as well.

So I think we have to speak the truth to Congress and tell them what is going on and help them understand. We cannot, even if it's for the sake of a short-term goal, go up and there and oversell something without explaining what really is going to, or you're going to get this kind of reaction.

Now I know that we've all said we need to put more money into R&D. So this is the question I have: If the Congress were to follow this recommendation, is there any chance that we would put all this money into R&D, help our companies, and then that they would then transfer the R&D abroad as part of their competitiveness? How would we deal with that issue? How would you reassure the Congress in that area?

Mr. ARCHEY. Just the last question or the other three?

Cochair MULLOY. Anything you want to comment on.

Mr. ARCHEY. Okay. First I want to comment about this point about kids don't want to go into programs that are internationally competitive because they're worried about the jobs. I would argue that it's much more than that.

I think if we're going to increase young kids going into math and science we've got to do a fundamental change in the attitude and in the aura about those jobs, because in the 1990s the high-tech industry increased its employment by 50 percent. Engineering graduates dropped by six percent in the same period of time. Every study in the last ten years has indicated for a kid in high school who thinks about a career in high-tech, their view is that that's for geeks and nerds and basic dorks. And it's a interesting thing. It's really got a very pejorative connotation about it.

I used to say all the time in the days when *L.A. Law* was on that we needed a new situation program called "L.A. Geek" where we basically talk about how exciting a career in high tech is.

We've got a report coming out Tuesday on high-tech jobs in all 50 states and the national data. In 2004 the average salary for a high-tech worker was 84 percent higher than the rest of the private sector, so it's not the issue of how much money are you making. It's an issue of the aura and the status that is associated with it that I think is the problem.

I think on the last one, in terms of would they transfer the technology if this were defense sponsored or government sponsored.

Cochair MULLOY. Government sponsored.

Mr. ARCHEY. I doubt they would, but I wouldn't make it categorical that they wouldn't. But I don't think so. We talking about globalization, we talk about global companies. We talk about all that. We've always talked about, oh, the world citizen and all that. Hell, I think nationalism right now all over the world is more intense than it's ever been. And that's after this incredible period of globalization.

I think that American CEOs and American executives are acutely aware of the fact that they're American companies. They may have plants everywhere else in the world, but they also know from whence they came, and that matters a lot. And they also tend to be awfully good citizens.

Cochair MULLOY. Thank you.

Mr. Ciacchella.

Mr. CIACCHELLA. On the workforce topic I just wanted to comment briefly and just substantiate what Archey said. We actually did a study for Joint Venture Silicon Valley about three, four years ago, and looked at K through 12, so high school was really the area that we focused on and interviewed quite a bit. The bottom line was tech was not cool. And this was done actually at the peak of the Internet revolution.

And, as Archey mentioned, the jobs paid well. At the time it was a very respected kind of a profession. But the issue was it's competing with MTV. It's competing with entertainment and other kinds of video games and other types of media out there and impression. So there is an aura. It's an education sort of thing.

There are some programs, I don't know if Stan Myer's on any of your panels, he's at the Semiconductor Equipment and Materials Institute. There, for instance, they have this technology day where they're taking kids through fabs and showing them what it's really like to work with technology, because it can be actually pretty cool.

But the real question is how do you make technology, how do you make science cool again, because the kids of today don't see it as a cool thing. And it's more of a marketing issue than I think that any kind of—there's something fundamentally wrong with the types of jobs that are out there. So I tend to put that that's a marketing problem. And we've got to figure out how do we better market science and technology jobs to kids, because it's competing against a lot of other occupations. We've got to do a much better job of doing marketing. Fashion, I mean you name it.

Commissioner DREYER. CSI.

Mr. CIACCHELLA. CSI, exactly.

Cochair MULLOY. Yes.

Mr. CIACCHELLA. On the topic of R&D investment by U.S. Government, and will that leave the country, through time that will happen. I mean that happens with all technologies as they mature out. But with the executives that I work with, there is a strong propensity to use and to develop technologies, the next generation technologies here. U.S. companies, their primary research centers for a lot of their next generation technologies are here, if you look at the evolution of a product and you look at the evolution of technology, it starts in a place and it migrates out.

So I think it's not an either-or situation, it's an evolutionary process. Technology that we develop here that we fund here will stay here in the beginning, and the beginning's an important period of time because that's when a lot of the innovation and that's when a lot of the margins and the profits from innovation come. Later you're playing a very low-margin game. As technology proliferates and goes overseas, then it's an okay thing. I think what's important is to look at that beginning stage of when technology happens.

Mr. DAWSON. To your first point about telling the truth about trade. We are up on the Hill every day of the week every week because we're facing a vote on Central America free trade, Dominican Republic, and the truth about high tech in that agreement is it's a one-way street. We have no tariffs. Several of those Central American countries do, so it's a free ride for the high-tech industry.

I don't represent the sugar industry. I don't represent the textile industry. I represent the high-tech industry. And for us, in truth, it is a good deal.

Cochair MULLOY. Um-hum.

Mr. DAWSON. Now I don't know how I talk about sugar and . . .

Cochair MULLOY. We ought to go back and have Mr. Wizard on television. I don't know if you remember him, he used to do those science shows when I was kid and we all watched him learn how to do it.

One last thought, if there are any ideas on how Congress could tie the money you put into R&D, at least that there's some benefit maintained here, think about how to do that.

Mr. Archey.

Mr. ARCHEY. Well, all they got to do in the Congressional Research Service and everybody else on the Hill is we've got it, so just take a look at how many preeminent technologies over the last 25 years in the world of technology came as a direct result of the sponsorship by the Federal Government of the R&D. It is the most unbelievable list. Many of you are familiar with it.

I contend that that's where if you're going to start talking about increasing R&D budgets, just give them the list. By the way, these things came out of DARPA, these came out of NSF, these came out of NASA, et cetera, et cetera. I mean it's in the story.

You've got to remember one thing, too, on this. Until about the early '90s there was a really intensive ideological debate over the role of the United States Government in funding R&D. And eventually it became this marvelous new term, "precompetitive research," which made it okay for the government to invest in it. And that debate has pretty much ended, but that was really intense back in those days. And there were all kinds of folks who were the government shouldn't be involved at all.

But look at something like fiberoptic technology, the original work that was done on the basic materials aspect of it, which nobody was expecting was going to turn out to be a fiberoptic line, was done by the Federal Government.

Cochair MULLOY. Thank you.

Chairman D'Amato has a final question and maybe observation.

Chairman D'AMATO. I want to thank you all for coming and staying and thank the audience for coming and staying. Mr. Dawson, this question about government procurements standards. Have we lost that battle with the Chinese government?

Mr. DAWSON. No, it's on the table. In fact, it's on the JCCT agenda. We are pushing hard. It doesn't mean we're going to be successful. It doesn't mean we're going to get all the pieces, particularly software that we're seeking, but we are certainly pushing to try to get that undertaking signed up and we're not giving up.

Chairman D'AMATO. Good. Good luck on that.

Thank you very much.

Cochair MULLOY. Thank you, all.

[Whereupon, at 5:00 p.m., the hearing was adjourned.]

CHINA'S HIGH TECHNOLOGY DEVELOPMENT

FRIDAY, APRIL 22, 2005

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION,
Washington, D.C.

The Commission met in Stauffer Auditorium, Hoover Institute, at Stanford University, Stanford, California at 9:10 a.m., Chairman C. Richard D'Amato, Vice Chairman Roger W. Robinson, Jr., and Commissioner Patrick A. Mulloy (Hearing Cochair), presiding.

OPENING REMARKS OF COMMISSIONER PATRICK A. MULLOY HEARING COCHAIR

Cochair MULLOY. Good morning. Today we're going to continue with our hearing in which we're trying to assess China's high-technology development and its implications for the United States.

In our first panel this morning we will hear testimony on what China's technological growth means for U.S. companies and what trends we can expect from China in industries such as the semiconductor industry.

On our first panel we have: Mr. John Gage, who's the Chief Researcher and Director of the Science Office of the Sun Microsystems Corporation; Mr. Mark FitzGerald, who is the Managing Director of Equity Research for Banc of America Securities, is also on his way. I think he's gotten lost somewhere on campus, but he will be here shortly.

Mr. Gage, feel free to start your testimony.

PANEL V: CHINA'S GLOBAL TECHNOLOGY COMPETITIVENESS II

STATEMENT OF JOHN GAGE CHIEF RESEARCHER AND DIRECTOR OF THE SCIENCE OFFICE SUN MICROSYSTEMS, INC., SANTA CLARA, CALIFORNIA

Mr. GAGE. Thank you very much. It's a great pleasure to be here. I put this up on the screen just as a warm-up because I thought it would be interesting for us to recognize as we examine technology and its spread.

This shows our laboratory in Beijing and where Tsinghua is. What I'm doing here is showing you an application. Google actually owns this. They bought this company and the companies named Keyhole, for those of you that have a Defense background.

The company began with a number of Sun people and Silicon Graphics people that used to build command and control, and then realized that since PCs are pretty powerful, in '98, '99, they could do with the PC what you could do with a Sun or a Silicon Graphics machine, and they started a company. Twenty people acquire satellite data and they tried to make money of it for a while, and they haven't made much money. Then Google bought them six months ago. Google feels rich these days, because they are. And they said: We'll let you kids ride with this until we have 30-centimeter data for the entire surface of the Earth.

Now 30-centimeter data is interesting data. I've used this in Beijing in other places to say to people, the Chinese: It's really quite a narrow strait here. Why don't we look.

Then you fly over to the other side and there's a Chinese air force base there. And the Chinese response to this is usually: You can't do this.

And you say: Oh, no, watch me. So you come down on the Chinese air force base and you look across the strait. And you say: That's where Sandy Berger put the boat. See, right over there. And here's the margin of error that you might have had, had you managed to have a slightly crocked takeoff with a missile. So it's an interesting storytelling mechanism. I won't launch into why we're going to look at Antarctica, but I put that up just as an indication that I could as easily been sitting in Beijing watching this. It's access to the data across the network and it would allow an examination at 30 centimeters of where your lawn furniture's arranged in the backyard or where your car is parked.

As the data becomes accessible from webcams, or I was in Seoul two weeks ago and held in my hand the old, the five-megapixel cell phone. And they said that's the old one. The new one's seven megapixels. So a seven-megapixel image from, let's say, one of the 350 million cell phones deployed in China at this moment would allow me to have tail numbers off of those planes parked on the Chinese—and it would just be data thrown up on the data. Lots of data's being thrown up on the data.

So I just thought I'd show this to let you get a feeling for the universality of access to information. I'll turn this off now.

This is what I wanted to talk about. You posed a variety of questions yesterday. Some went to the state of technology in China. Some went to the deployment of research done in the United States to entities in China that might use that information for defense purposes. Commissioner Wortzel asked: "Well, what if this stuff that's just for defense things, what are they doing there. What are the barriers being put up, what's the standards gambit going to be in China? What's the frontier of all this. Where does the U.S. R&D go?"

How do we know that when we bring the best and brightest from China to the United States, modular visa requirements, that it's advancing our national interest. How do we really at the bottom get a grip on the impact on the balance in national security by looking at what's going on in China.

Let's try this one first. This was two weeks ago. The Association for Computing Machinery has an annual contest for who's the best programmer. And there are the world champions, Shanghai Jiaotong.

Shanghai Jiaotong's team, you see part of one of the team members there, the problem set's there. The problem set, there are ten problems dealing primarily with things like how do you efficiently locate cellular telephone towers and so forth. The list of overall winners this year is here.

Now for an idea of where is the technology capability distributed, this is a pretty good list. Here they are. This is the compute crowd. Now this is not precision machinery. This is not aeronautics. But, notice, we start out with Shanghai and Moscow and St. Petersburg, Waterloo—perennial comer—Poland, and then there's Fudan, and then there's Beida, and Hong Kong, Tsinghua, Yonsei—well, that's actually in Korea. Keep on going down through the winners here, there is CalTech lumped together. So in the top 30, MIT top 30.

I was at Berkeley last week for the chancellors' investiture. Richard Newton, the dean of engineering, who says Berkeley is the number one engineering school in the world, as the surveys all have showed now, I said, "Yes, but the last time Berkeley won this competition was seven years ago. Where are you guys?"

So the competition for the world's smartest people is now being won by, if I've got a really hotshot computer science faculty at Jiaotong, which apparently I do, I'll go to Jiaotong. I might go to Moscow. It's a little grim and cold. I might go to St. Petersburg. It's colder. I might go to Waterloo, it's cold. Why don't I go to places like this or this or this or this, places where I'm able to get a world class education and I'm received warmly in an entity that is building a gigantic engineering enterprise throughout all of China.

So the questions that you have posed about where is the talent and how good it is—I'll leave the itsy-bitsy drone thing—well, actually maybe I'll show that. When anybody can see how to make this sort of thing, which is just some power, some solar panels on top of a little propeller with big cameras underneath, that thing there will make the Earth viewer app. I showed you a few moments ago considerably sharper.

So this is all relatively simple technology to do. I guarantee you people are making these things in China. And there's a lot of effort that's gone into that.

So I thought I'd show you the talk I gave two weeks ago. We have a twelfth annual conference where we bring a thousand Chinese universities to Beijing with the Ministry of Education and we talk to them about the advances in the world's fastest machines, what we're doing. And this guy, Professor Wu, who directs CERNET, which now reaches almost 2,000 Chinese universities with bandwidths at a minimum of two megabits, but at a maximum gigabit, he's built over 12 years the largest Internet in the world. He's building the new one, CERNET2, that's at Internet 2 positions. And from their position there is a new protocol or there's—actually ten years of development of this—that's the next step for all of us doing Internet protocols. It's called IP Version 6.

One of the components of it is when you send a packet around in IPV6, it has a source address and a destination address that are known. We've run out of addresses at I Internet Version 4. So you give somebody an address and behind it are hidden thousands of addresses that are given. So when you browse the net you don't know where the stuff is coming from. Well, now in IPV6. The Chinese government loves this.

We're going to know where the package is coming from and we're going to know where they're going. But it will also mean that the development of new applications in a world where for security you do want to know where source and destination IP authenticated, this changes finance because it makes the entire Internet much more secure.

So who's going to be the first place that's got access to a completely IPV6 large-scale network? China. It's built; 200 universities are on it right now. And this is at gigabit to ten-gigabit speeds. These guys are moving.

Now the minister in charge of all universities, Minister Wu, Wu QiDi, has a problem. She's got to bring higher ed. everywhere. And so I put this up on the screen. It's our ad. You know, hello, all of China. Sun is embedded in doing the sorts of things you want to do, but the statement of national purpose, about investment in the Chinese student body and finding the smartest people is her primary concern.

If you've ever visited any of the golden high schools, that's are the high schools in Beijing where the hotshot kids go, poor, backward Stanford. The high schools have better facilities than Stanford does. Not in machinery. They can't make chips, and so forth. But, boy, the money has poured in to providing an environment for very smart, hard-working kids to do very serious work.

So in answer to your questions yesterday about where is everybody in China, they're moving right along. And the IBM challenge—IBM makes, from our point of view their machine is down 60 percent of the time, so we don't think much of it—but at the moment the fastest computer in the world is a pile of little relatively slow processors all jammed into a room that's a parallel machine. And so for all Chinese kids, they'll get access to a direct real-time competition called "IBM Eserver Blue Gene." They will use the IBM power—that's the name of a chip—power based parallel supercomputer—the Opteron chips are faster—which is used to solve some of the most difficult problems in physics, engineering, biology, geology, and university. And so this is for compete. Get on the supercomputer, one of the most powerful parallel—you can be anywhere.

You can be in Chengdu, you can be places to get access, get your protocols, make them run—as long as the IBM machine is up, so the notion that there is some kind of a container in which we keep technology isn't the right metaphor. And at the base, to get your instincts right, you've got to tune your metaphors, because you find over and over when you're trying to make a quick decision you don't think a lot about it. You base it on some metaphor that you believe captures the essence of the situation, but if you got the wrong one you don't think clearly, and certainly not under pressure.

So from our point of view as a technology company, we're an open company. Actually I should have shown you this, but I'll do it right now. Let's look at the Ministry of Science and Technology in China and the standard—woops—software corporation. We made a deal last year with the Ministry of Science and Technology and with the Ministry of Information, MII, and we said to them—there they are—"We're going to give you the source code for the stuff that replaces Microsoft on the desktop." You have a heavy-duty problem. Ninety percent of government offices are running stolen Microsoft software. Probably the case in the city government of Washington, D.C. And you have a way to take open source Linux and all the stack above it that does the desktop stuff and put it out throughout all of China.

Ninety percent of small and medium enterprises use stolen Microsoft software because it costs $5. Cost zero is better. And it allows everyone in China to add value.

So we made that arrangement. And now several million desktops at the moment are running this stuff. It's created a new place for employment for the smart kids coming out of Jiaotong because they're going to go do innovative work, very Chinese-based work on the sorts of environments to read and write on people's desktops.

So our view of this is you've got to be there and participate. We have a research lab of about 300 people in Beijing. We have offices in about ten cities around China. Yesterday I sent mail to our Vice President of Human Resources saying the panel had some questions about how many bodies there are hither and yon in—how much of our workforce comes from China.

So the response is, and I should probably pass this by the lawyers but it's nonetheless real-time communicate here: "Unfortunately the way companies are required to collect university data only has themselves identify as people as Asian. So it's very difficult to estimate numbers country by country. Theoretically the U.S. Government should know from L1 and H–1B visas, but haven't seen any data."

Now that goes to the point of: Where is Washington in the Valley? Somebody ought to be coming around to us and saying we are looking at all this stuff, the Commission has asked us to be able to get clear numbers about who is where and what are they up to. And here's our numbers. So to have our Chief Human Resources Vice President not have had any communication with anybody running the L1 and H–1—now maybe it's just a phone call away, but it's clear there's no proactive mechanism for people to be building the date that the Commission needs to be able to give probing analysis of where we are.

So I could give you offhand the guy that's in charge of building Sun—all of Sun's hardware except for the supercomputer—which is we're building the world's fastest machine for DARPA. He's not in charge of that—is David Yen, born in Taiwan, spent many years in mainland Taiwan. Has no Taiwanese accent, but he does use Taiwanese slang when he speaks in Beijing, which is irritating to the PRC people, but he's in charge of all of our hardware.

Li Gong that runs the lab in Beijing created the security models for Java. Why is that important? Because almost two billion devices run Li Gong software as a security model in every cell phone from Motorola or Nokia or Samsung or anybody else. It's all in there.

So then I said, "Well, Bill Archey just said the quality of Chinese engineers, what do you think?"

"Yes, we agree on quality of people. Beijing is one of the six cites we, Sun, have targeted for growth. We've had an Austin lab, a Burlington lab, a Prague lab, St. Petersburg, and Bangalore. And right next to Tsinghua"—oh, Beveridge has an odd spelling of "Tsinghua," but anyway, the phonetic spelling—"and so we're putting a lot of"—woops—"we're putting a lot of money into this." This is a response about do we have to do crypto.

So now what—"We're recruiting every person we can."

So what's our problem?

"Our multiple problems I think are affecting competitiveness. Visa restrictions are awful. They open up each year in October. The 85,000-person quota is filled in a month. The Labor Department predicts by 2010, five years away, there will be a shortage of ten million workers in the U.S. It affects us disproportionately. In addition, the new government restricted-persons list limits the kinds of jobs we can give to Chinese nationals both here and in China. Don't get me started on stock option expensing. Because of the restricted-persons issue, we have not yet seen Canada as a reasonable alternative"—that would mean do we go train people in Canada. We can train people anywhere we want in the world.

"Is that"—well, no, Crawford doesn't think so. He says, "I'd at the moment rather move more engineering to China." This is just to take advantage of quality and the depth of expertise and, in fact, the advances people are making in China that we aren't at the moment making in the U.S.

So then Crawford waxes global, "I fear between our legislators, our regulators, our lawyers, and our accountants we're seeing the beginning of the end of American competitiveness, absent internal upheaval, which is"—"upheaval, which is possible, the Chinese are on their way with India, Brazil, and Russia to be massive economic forces. We need to engage more, not less."

So that's essentially the sentiment that I think is shared in the Valley by everybody. And Intel, H–P, Motorola, all of us as we build our labs in a variety of places in China are attempting to make some—take advantage of that pool of expertise and knowledge. And since we're global companies, as you saw this morning in the *New York Times*, the estimate that General Motors and Ford, hammered as they are, are going to suddenly be facing cars made completely in China at a quality asserted by the Hyundai guys as good as anything made in Korea, which is pretty good, we're going to watch a major assault in all frontiers, technological frontiers.

Now on the current state of affairs in the economy. The observation of the New York Times' story this morning went one level deeper. The assault is not simply by making a cheap car. Making a car is not so much the metal, it's the database. It's figuring out what should be where at what point and how do you arrange the logistics chain so that you're efficient.

When people talk about how, oh, the cheap labor in China is really the problem we have, and you'll hear these textile people say these things, the garment people, they're flat wrong. If you go to look at a plant in China you will look at for a garment-manufacturing operation, a kilometer-and-a-half building completely computerized with the world's most modern fabric and textile machinery run by a couple of people. They're very good at the logistics supply chain work, you have to be if you're going to start making something to compete globally, as they say, an automobile manufacturer, because you've got to integrate hundreds even thousands of components in your logistics chain.

So it's that other dimension of manufacturing capability. John Zysman wrote a book once called *Manufacturing Matters*, and it does because you learn how by doing. And every time you build a new plant you're ten to 20 percent more efficient because of the stupid things you did on the first one, you get better on the next one. And if you capture that knowledge by doing it, then you're on the road out making very serious inroads industrially.

So I think I should stop with that, just as an overview of how we see the role of what we do globally and, in particular, with respect to China.

Cochair MULLOY. Mr. Gage, thank you very much for that presentation. I see you must have stayed up late last night getting it ready, but we appreciate the effort you put into it.

Mr. GAGE. In spite of the generous wine from the Commission.

Cochair MULLOY. Mr. FitzGerald, I'm sorry we started prior to your getting here. I understood you got lost on campus. I did the same thing yesterday trying to find my way here, so we welcome you. I see that you must have spent some time in Montreal. I spent two years there. I'm glad we have a chance to talk.

STATEMENT OF MARK FITZGERALD
MANAGING DIRECTOR AND
SENIOR RESEARCH ANALYST IN THE TECHNOLOGY GROUP
BANC OF AMERICA SECURITIES LLC
SAN FRANCISCO, CALIFORNIA

Mr. FITZGERALD. Yes. I don't speak French very well, though.

Cochair MULLOY. Mr. FitzGerald, when I introduced the panel I noted that you were the Managing Director of Equity Research for Banc of America Securities.

Mr. FITZGERALD. Thank you. While they get the presentation up, I think the message that I'd like to leave with the panel is that the outlook in the semiconductor industry in terms of competitiveness in China is not nearly as dire as in some other aspects of it. I think there's very good news here, particularly for the U.S. because if you look at the semiconductor industry and some of the segmentations in it, the U.S. clearly leads and dominates in these areas. It's going to be multiple years and billions and billions of dollars that China or, for that matter, any new entrant to the semiconductor industry is going to have to basically invest to even begin to rival some of the leadership.

The problem is that the capital intensity of the semiconductor industry and the know-how that's required is so high and so deep that no one simply walks into this business and is a supplier of semiconductors overnight. Simply put, you want to think about the semiconductor industry not as a monolithic industry but as subcomponents. Each one of these subcomponents has major technology, intellectual property associated with that.

What I want to give you just is a brief overview of where that intellectual property resides today and how difficult it is to duplicate it. Basically the way we think about it, there's three segments. There's the semiconductor-equipment manufacturing industry. This is the very bottom of the food chain. Then there's the semiconductor-chip production. This is the chip companies that have these large, expensive semiconductor plants that they build. And then there's what we call the design or the intellectual property in terms of the designing of chips.

If you look at these different segments, the U.S. clearly has a major leadership position in several of these. Two of them are really very difficult to attack at this point for any global competition, because we are so far down in the road in terms of developing the technology at this point.

The capital equipment part of the business is already consolidated to the point that there are just two global leaders in this part of the business: It's basically us with about 40-percent market share and Japan. There are a few pockets outside of those two regions in terms of some technology, but it's in places like Europe. And someone like Israel actually emerges here as a factor.

For someone like China to come in and duplicate the infrastructure, the know-how in this segment, I think is almost impossible at this stage of the industry's development. We've even seen as other Asian countries have tried to pile into this semiconductor industry, Korea, Taiwan, Malaysia, it's been impossible for them to duplicate the technology and the infrastructure that the U.S. and Japanese companies have basically put in place at this point.

Then if you looked at the semiconductor-production side of the business, the U.S. has much smaller market share here. This is where a lot of the movement is happening in terms of Asia emerging. But, again, I think in this area it's very fast coming down from our vantage point to about eight to ten companies globally who are going to dominate this business. And within that there is a handful of U.S. companies, a handful of Japanese companies, and a couple companies in Taiwan and Korea.

Again this is where China is trying to enter the marketplace at this point, but again the technology hurdles are incredibly high. It's going to be multiple years to see whether any of these companies can really emerge in China as a factor in terms of actual chip production. There's a lot of money being spent in China, but I can go through Asia in the last ten years and show you billions of dollars that was spent on semiconductor-production technology in places like Korea and Malaysia, Thailand, that have just not ever produced anything and are basically shells of operations at this point.

I think what you really need to appreciate, that leading-edge technology is really coming down to eight to ten companies globally. And you get companies like Intel, Samsung, Texas Instruments, who are really dominant in this area. There are clearly a handful of Japanese companies and there are companies in Taiwan, Taiwan Semiconductor I think emerges as a major player here.

If you're going to look at vulnerability, though, and where I think China has the biggest opportunity, it's really in the design part of the area. This is where the capital hurdles and the hurdles in terms of having established technology are a lot lower. There are clearly many start-ups in this area that are happening, but ultimately these design companies are going to have to rely on the rest of the food chain for their technology, so you want to look at this as where they're trying to enter is really going to engage them with the rest of the global semiconductor industry.

Moving on, this is simply the way that a semiconductor factory is laid out. What we basically have here is multiple steps in terms of how we make semiconductors. It starts at the beginning there and then runs through this process. What I've highlighted is the individual equipment that each one of these accounts for a step in the semiconductor industry.

What I wanted to show you, not so much getting hung up on the technology here, but if you take each one of these steps and then move to the next slide, which is a bit of an eye chart here, and look at the companies that dominate those steps. You will go through and see it's a U.S. company or it's a Japanese company.

Again, this is where I think it's going to be almost impossible for anybody to make an entrance into the global stage at this point because the customer base for these equipment companies is very rapidly shrinking, to about eight to ten companies at this point.

If you look at the people who buy the semiconductor equipment—so this is one step up—this is the capital spending that we've seen in the last five years. You can see there is a huge shift to Asia at this point. But what we're seeing very rapidly happen is that the spending on semiconductor factories at this point, this is spending by companies like Samsung and Intel, Taiwan Semiconductor, is very rapidly getting concentrated in about the top ten companies at this point.

What we're talking about now is to build a new semiconductor plant, a two and a half to $3 billion investment. That's getting to be a big problem even for countries that are pursuing industrial policy. And those $2 to $3 billion investments have to generate, on average, a year about $5 to $6 billion to justify, commercially justify those semiconductor plants.

Well, if you do the math here, the total semiconductor business today, a $250 billion business, it's not going to take too many of these semiconductor plants to basically justify the total global production. That's why we're seeing very rapidly this industry shrinking to a handful of companies. The next set of technologies is so difficult that if you haven't had the learning curve of the last 20 years, it's incredibly difficult to enter the business.

I cover one of the leading Chinese semiconductor companies, a company called SMIC. It's had an incredibly difficult entrance into the semiconductor industry at this point. It came public a little over a year ago. Its reception on Wall Street and on the global markets has been somewhat of a disaster at this point. When you really look at the strategy of the company, it's really difficult to see how this company's going to emerge and really compete with a company like Samsung or Intel at this point.

Bottom line: If you're going to be a player in the semiconductor-production industry, you have to have a commercially driven strategy. And that's something that Asia has learned in a big, big way in the last ten years here, which is basically you can get all sorts of government funding. You can get government grants and free land, but ultimately if you are a semiconductor company and you do not have a commercially driven strategy, then you don't have a long-term viable model and it's just going to be a sinkhole for cash at this point.

Again, when I look at the actual semiconductor-production technology I think China has an incredibly difficult challenge ahead of them. I don't want to say that it's impossible, but this is just a very steep hill to climb for China at this point.

Compounding the problem is that the industry is clearly starting to show aging—which we're starting to see the semiconductor industry, the growth rate start slowing. It was a lot easier to enter the industry in the 1990s when we had the super high growth rates. It's going to be that much more difficult to penetrate a slower-growth environment.

Where I think the Chinese industry has the biggest opportunity ahead of it is basically in penetrating the application or the design side of the business. This is where you can get a lot of smart engineers. And, as Mr. Gates pointed out, China is clearly graduating a large number of engineers at this point. Where the capital intensity is low, you can do a start-up company, get a couple engineers together and design chips going forward. The success of that model, though, is really predicated on the applications that they're focused on.

What I think is the big challenge and the biggest opportunity for China is to become a leader in leading applications. That gives the semiconductor-design companies in that region of the world an opportunity to enter.

So if I had to point out a weak link in terms of the strategy that China's pursuing, it's basically focusing on the lower end of the semiconductor food chain. If they really want to be successful, I think really focusing on the intellectual property or the design part of the industry and really developing applications, I think, will be the real key for China.

I would point out today: The U.S. still leads in a major way here in terms of the design area. So it's still a major strength, but it's probably the area that is most vulnerable in terms of global competition at this point.

[The statement follows:]

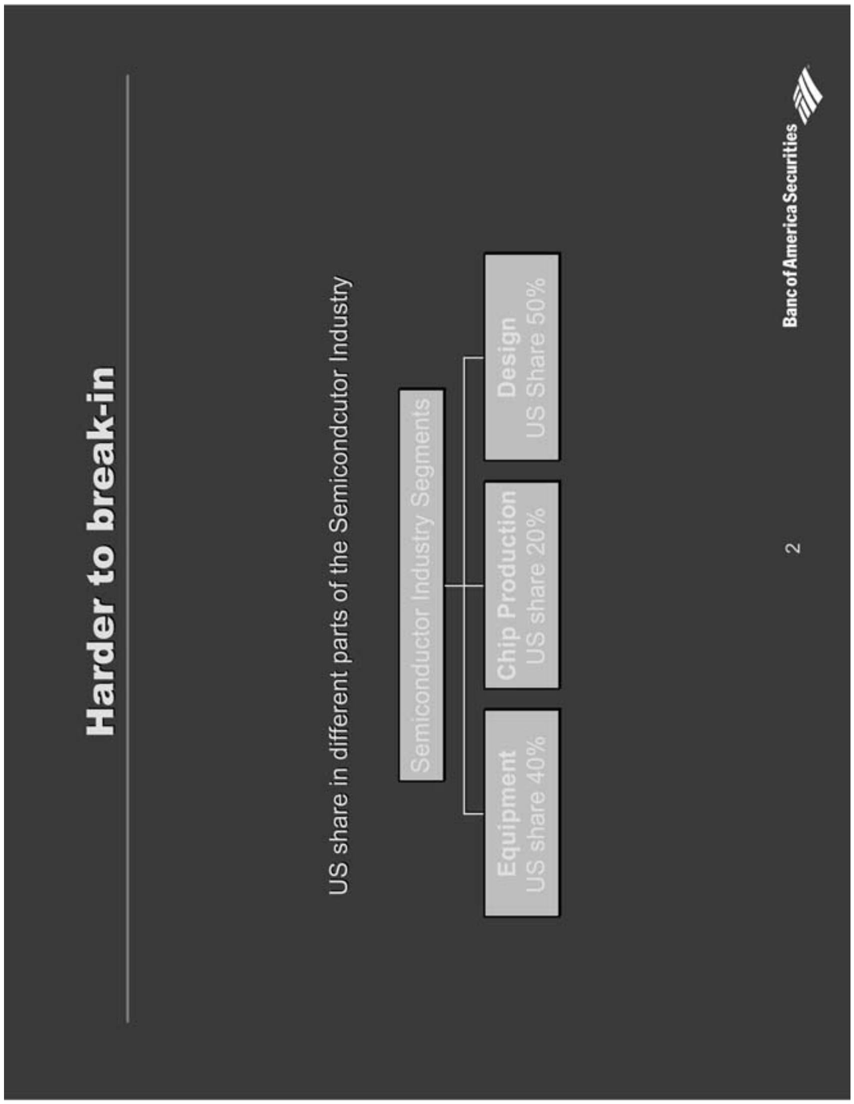
Is China Too Late To The Semiconductor Race?

China's Global Technology Competitiveness II

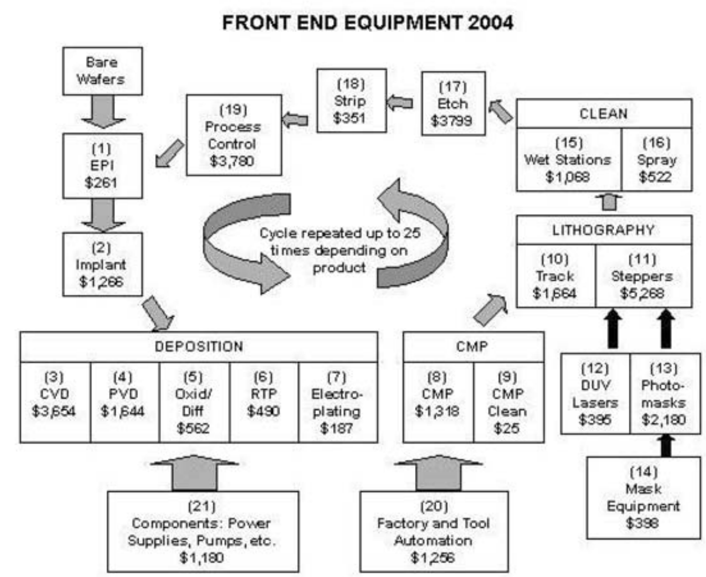
Mark FitzGerald

Managing Director,
Senior Research Analyst
Before the The U.S.- China Economic and Security Review Commission on
" China's High –Technology Development"

April 22, 2005


Harder to break-in
US share in different parts of the Semicondcutor Industry
Semiconductor Industry Segments
Equipment
US share 40%
Chip Production
US share 20%
Design
US Share 50%
2
Banc of America Securities

How semiconductor chips are made



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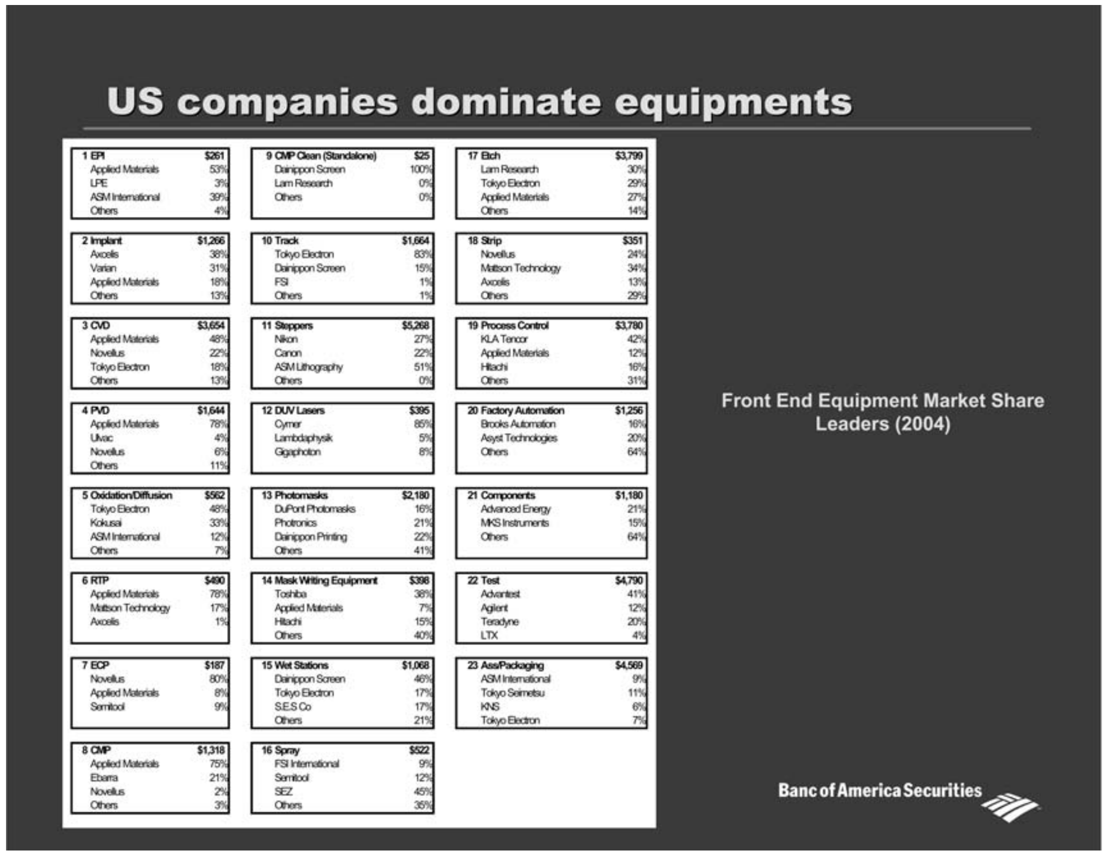
US companies dominate equipments
1 EPI $261
Applied Materials 53%
LPE 3%
ASM International 39%
Others 4%
2 Implant $1,266
Axcelis 38%
Varian 31%
Applied Materials 18%
Others 13%
3 CVD $3,654
Applied Materials 48%
Novellus 22%
Tokyo Electron 18%
Others 13%
4 PVD $1,644
Applied Materials 78%
Ulvac 4%
Novellus 6%
Others 11%
5 Oxidation/Diffusion $562
Tokyo Electron 48%
Kokusai 33%
ASM International 12%
Others 7%
6 RTP $490
Applied Materials 78%
Mattson Technology 17%
Axcelis 1%
7 ECP $187
Novellus 80%
Applied Materials 8%
Semitool 9%
8 CMP $1,318
Applied Materials 75%
Ebarra 21%
Novellus 2%
Others 3%
9 CMP Clean (Standalone) $25
Dainippon Screen 100%
Lam Research 0%
Others 0%
10 Track $1,664
Tokyo Electron 83%
Dainippon Screen 15%
FSI 1%
Others 1%
11 Steppers $5,268
Nikon 27%
Canon 22%
ASM Lithography 51%
Others 0%
12 DUV Lasers $395
Cymer 85%
Lambdaphysik 5%
Gigaphoton 8%
13 Photomasks $2,180
DuPont Photomasks 16%
Photronics 21%
Dainippon Printing 22%
Others 41%
14 Mask Writing Equipment $398
Toshiba 38%
Applied Materials 7%
Hitachi 15%
Others 40%
15 Wet Stations $1,068
Dainippon Screen 46%
Tokyo Electron 17%
S.E.S Co 17%
Others 21%
16 Spray $522
FSI International 9%
Semitool 12%
SEZ 45%
Others 35%
17 Etch $3,799
Lam Research 30%
Tokyo Electron 29%
Applied Materials 27%
Others 14%
18 Strip $351
Novellus 24%
Mattson Technology 34%
Axcelis 13%
Others 29%
19 Process Control $3,780
KLA Tencor 42%
Applied Materials 12%
Hitachi 16%
Others 31%
20 Factory Automation $1,256
Brooks Automation 16%
Asyst Technologies 20%
Others 64%
21 Components $1,180
Advanced Energy 21%
MKS Instruments 15%
Others 64%
22 Test $4,790
Advantest 41%
Agilent 12%
Teradyne 20%
LTX 4%
23 Ass/Packaging $4,569
ASM International 9%
Tokyo Seimetsu 11%
KNS 6%
Tokyo Electron 7%
Front End Equipment Market Share Leaders (2004)
Banc of America Securities

Asia dominates in chip mfg.

TOP 25 SEMICONDUCTOR CAP-EX SPENDERS ($M)

	2005	2004	2003	2002	2001	2000
Samsung	5,810	5,310	3,308	1,825	2,880	4,130
Intel	5,600	3,843	3,700	4,700	7,300	6,700
UMC	600	2,560	600	1,400	1,800	2,800
TSMC	1,700	2,400	1,250	1,580	2,200	4,500
STMicroelectronics	1,300	2,000	1,221	996	1,700	3,300
SMIC	1,000	1,950	492	897	0	0
Sony	1,400	1,774	1,370	760	1,439	2,316
AMD	1,100	1,500	586	705	703	805
NEC	1,000	1,438	826	494	929	1,820
Micron	1,433	1,433	1,048	781	1,253	1,300
Hynix	2,030	1,740	744	435	480	1,600
Toshiba	1,400	1,920	1,036	504	650	1,382
Texas Instruments	1,100	1,300	800	802	1,790	2,800
Renesas	900	1,286	782	685	0	0
Matsushita	1,100	1,238	614	512	744	1,148
Nanya Tech	1,000	1,140	600	300	300	780
Infineon	1,050	1,050	1,025	654	1,687	2,181
Winbond	600	120	131	104	175	453
Grace Semiconductor	800	800	500	600	100	0
Chartered	700	700	221	420	550	911
IBM	600	600	800	1,000	2,100	1,900
PowerChip	600	870	300	268	163	313
Anam	550	550	200	200	280	370
Elpida	1,000	495	389	317	0	0
Mosel	450	450	250	400	200	400
TOTAL	**34,823**	**38,467**	**22,793**	**21,339**	**29,423**	**41,909**
Yr-Yr Change	-9%	69%	7%	-27%	-30%	

5

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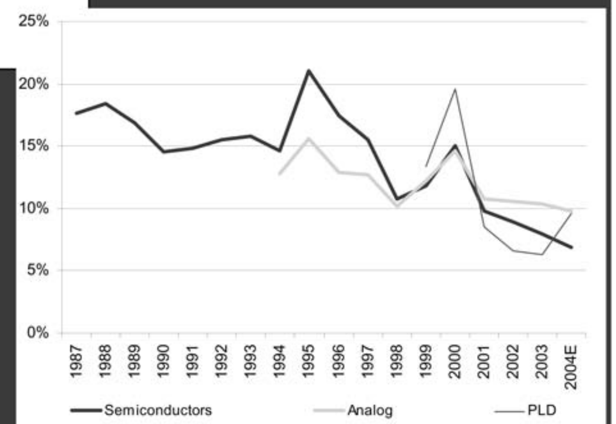
Slowing Industry Growth
Higher Hurdles for new entrants

The Times, They Are A' Changing…"Semi-Growth" is Slowing

Peak - Peak		Semi Revenue CAGR	US GDP CAGR
1959 - 2000	(41 Yrs.)	17%	3%
1974 - 2000	(26 Yrs.)	15%	3%
1984 - 2000	(16 Yrs.)	14%	3%
1995 - 2000	(5 Yrs.)	7%	4%
2000 - 2005E	*(5 Yrs.)*	*4%**	2%

* Estimates are based upon 25% growth expectations



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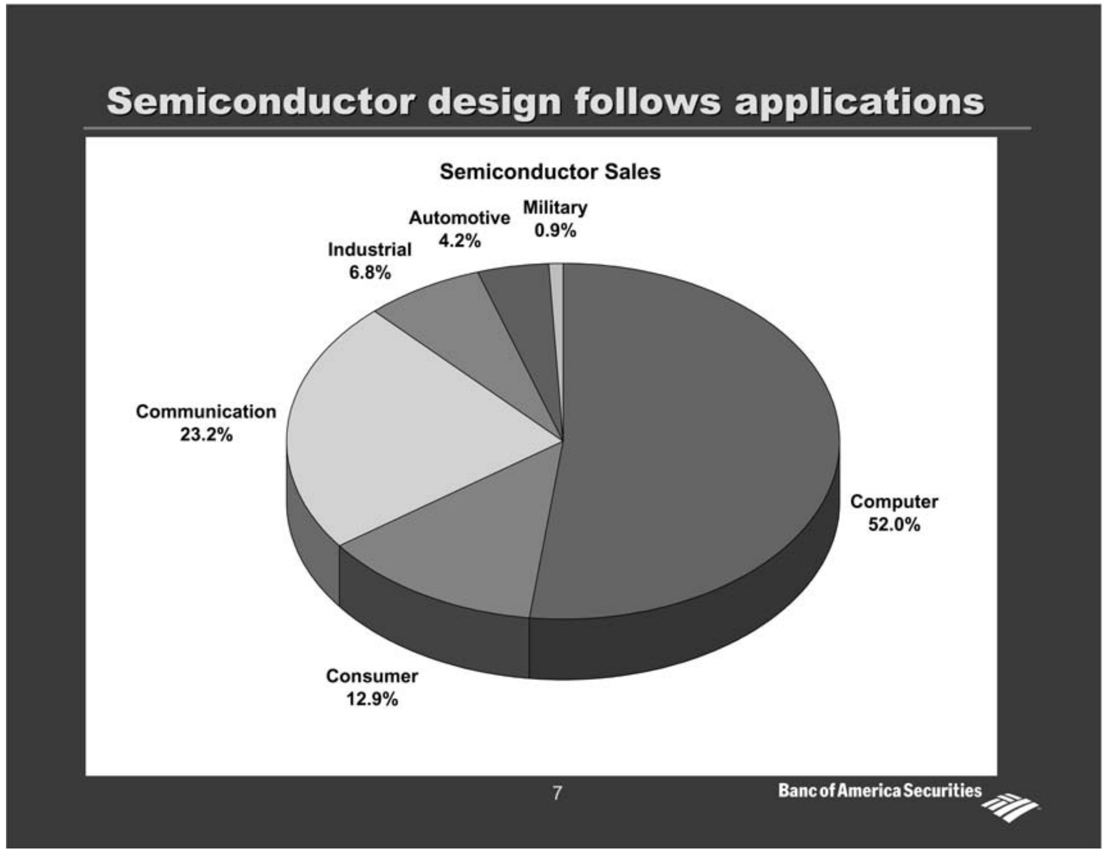
Semiconductor design follows applications
Semiconductor Sales
Military
0.9%
Automotive
4.2%
Industrial
6.8%
Communication
23.2%
Consumer
12.9%
Computer
52.0%
7
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Volatility		Ratings		
		Buy	Neutral	Sell
Low	0-30%	10%+	9%-(6)%	(7)% or worse
Medium	31-40%	15%+	14%-(10)%	(11)% or worse
High	41-70%	25%+	24%-(15)%	(16)% or worse
Extreme	71%+	50%+	49%-(25)%	(26)% or worse

Source on volatility: Bloomberg.

Rating Distribution
Global Coverage

Coverage Universe	Companies	Percent	Investment Banking Clients	Companies	Percent*
Buy	258	41	Buy	124	48
Hold	325	52	Hold	139	43
Sell	39	6	Sell	13	33

Technology Sector

Coverage Universe	Companies	Percent	Investment Banking Clients	Companies	Percent*
Buy	24	27	Buy	4	17
Hold	56	63	Hold	8	14
Sell	9	10	Sell	1	11

* Percentage of companies in each rating group that are investment banking clients.
As of 09/02/2003.

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Panel V: Discussion, Questions and Answers

Cochair MULLOY. Thank you very much, Mr. FitzGerald.

We're going to have rounds of questions. Now each Commissioner will have an opportunity to ask questions of up to five minutes. Commissioner Wortzel.

Commissioner WORTZEL. Thank you both very much for the illuminating presentations.

I am fascinated with just how advanced you've characterized the Chinese as being in this area of technology, yet the obstacles they face. And I'm perplexed by what I see as big gaps in other areas, which you may not be able to explain, but you may be able to tell me whether these gaps can be filled through the application of programming skills, because they may be—Jiaotong may be number one in the world in programming, but—one of the top jet engine manufacturing companies in the world, Rolls-Royce Spey, went into China in 1978 with the idea of producing viable either military or commercial jet engines for the People's Liberation Army.

They worked very quietly in semi-secret in Xian from 1978 to 1984. The first jet engines they were able to produce that worked came off that assembly line in 2004. And they almost adequately power the J10 aircraft that is a clone of our F16.

If you visited the Northern Industries Corporation or Group plant south of Beijing near the Marco Polo Bridge, where on parallel lines they produce armored personnel carriers and Valdo buses, to this day the Chinese industrial sector cannot make a diesel turbine engine or a gas turbine engine or a diesel turbine tank engine. Can't make it.

Now I don't understand how that's possible, that you could be so advanced in one, this has perplexed me, why you have these wonderful on missiles, wonderful on telecommunications, wonderful in radar, world-class computer programming, and in 1978 to 2004 is, what, 30 years, you can't make an engine for an aircraft. Thank God they don't make really good engines for aircraft. Tank engines don't bother me as much.

But can the world-class capabilities you've described quickly begin to close that gap what are the great deficiencies in the Chinese military industrial sector?

Mr. GAGE. That's a great question. I'm certain I'm not qualified to answer this question. But as you watch a change in fundamental design—Daimler with this announcement about what they're doing. Daimler's stated for the last six years, what they make is a network on wheels.

So you take the wiring harness out. All the complexity that you'd have in any car that you buy out here in the parking lot and replace it with a fiber optic link tying all the components in a car together and make everything a component on the network, given the automobile's design cycles, people take not 30 years but they take ten years to get that kind of a change. But the fly-by wire or drive-by-wire vehicles, parts and component count drops significantly.

So what we do, just the piece of the puzzle that the information technology guys put together, is changing fundamental design of all of these vehicles and planes, which means time to market becomes much shorter, design cycle's faster. And a kid who started school five years ago, say, at one of these great high schools who's now finishing in graduate school at Tsinghua is learning about the control mechanism that could turn into an industry shift quite rapidly as you design new—I think of the cars in Malaysia, some of the other attempts.

When Lotus moved, joined the manufacturing plant in Kuala Lumpur to help teach people how to make smarter designs, all of a sudden there was some shift in Proton's manufacturing efficiency. So I think that translates immediately into these domains.

On the battlefield in Iraq the devices that speak one to another use networking. It's unfortunate with the fight we have with the music people, it's all peer-to-peer communication so that a Howitzer is able to talk to a radar is able to talk a forward observer, all in a conversation that no human being's involved in. That's the stuff we do and that's the stuff, which is generic technology that everybody learns how to do.

So the U.S. dominates in space-based surveillance devices. It costs a lot to get them up there. But, as you see, when you're able to combine them with this remarkable change in imaging technology that's in your cell phone, you're suddenly building a different mosaic of information that can be the transformative force we've all—network-centric warfare is the mantra, even since the failure in Desert Storm of Navy to speak with Army. Now that we've united in a battlefield management system based completely on networking, those that know about networks are a let up, wherever they may be.

Chairman D'AMATO. Commissioner Dreyer.

Commissioner DREYER. Thank you both for some really fascinating testimony. My question relates to something Mr. Gage started out his presentation with, these tantalizing photographs of areas with military applications in the Taiwan Strait.

I also noticed that one of your top-scoring universities was Chung Shan, which is in Kaohsiung, in the southern part of Taiwan. I am wondering if you could expand a little on the relative military applications, for Taiwan versus China, in a scenario in the Taiwan Strait.

Mr. GAGE. Move into fiction. Well, the fundamental technical change that's occurring is the creation of sensor networks. We've all talked about sensor fusion. You can go to Berkeley at the moment. Berkeley makes about a cubic millimeter sensor with a radio built in. Smart dust would be—so the ability to make something that has not a loud signal, it peeps a little bit, but if you have a lot of them and they're scattered around on the surface—on the ground, one talks to the next, talks to the next. You make a dynamic mesh, and suddenly you have a sensor network, which can be quite broadly deployed. And all these peer-to-peer discussions start going on.

Did somebody step on you? Did a tank roll over you? Is it hot where you are? So this dream, in essence, for an intelligent, all-sensor fusion environment is coming very rapidly. If you think about 350 million cell phones in China, they're all in some sense capable of communicating each with the other. You can download something to all of them and make them play a symphony in unison right now.

So we're entering some world where the boundary between what's a piece of civilian technology, a handheld seven-megapixel camera, and what's a military piece of technology, don't you wish you had a seven-megapixel mobile camera. We're watching the story of how the consumer-level stuff surpasses the capabilities of things we currently deploy to our armed forces.

Your son knows better than—look at the generation. Ask the 20-year-olds who are very good at doing things, they say, "Oh, my God, the 15-year-olds." You ask the 15-year-olds and they say the real hotshot are the eight- or nine-year-olds that just are deeply into this.

So we're watching generations arrive that have a very different feel for technology and a different expectation of how to do things. And I suppose that's a military application for that.

Commissioner DREYER. Since it's highly unlikely that Taiwan would attack China, could we imagine Taiwan deploying a ring of these sensors to let it know when a missile is headed this way?

Mr. GAGE. They sure ought to be doing that, yes, if you can make the stuff. My view on this is: Anything we can dream up somebody's doing. And the issues about how do radios work, we're in some sense in an isolated world in the United States.

When you think that 85 percent of Koreans have broadband, when you think that six million in Japan have ten megabits to their home back and forth for 20 bucks a month, we're in a backwater in the United States at this moment. The feeling you have about what's possible, if you're in Korea and you're walking down the street with your cell phone, which is receiving direct, full-bore video to the screen of the cell phone from satellite and from, in about a week, the terrestrial network, you have a very different sense about what's possible; than here where you can barely make—in fact at this moment I'll bet none of your cell phones work in this room because we're sitting in a blackout area with very inefficient cellular telephone providers.

The thought you'd be able to get full-bore video to your cell phone in this room is out of our perception. It's happening at this moment in Korea and it's happening for 60 percent of the population in Korea. Ninety percent have cell phones, some number like that.

So maybe if we talked about how you make the universities receive more money for advance research, well, absolutely. But this other component about jabbing the American technology community to provide the environment inside the United States that stirs the imagination of the kids, that's another component. We did say *L.A. Law* should have an "L.A. Geek," well, there something to this.

Finally, if I'm drifting off the subject so much, the disturbing thing is we are not focusing, as many people have said, on teaching science and mathematics in the elementary schools.

And, just as a citation, the smartest person in this domain is a man named Alan Kay, who dreamed up Small Talk here in Palo Alto 25 years ago, a computer language that would let a ten-year-old do programming things that would beat the kids at Jiaotong today. And Alan has said why would we worry about how well the kids are doing on tests when the teachers that teach the stuff don't understand math or science themselves and, therefore, we're stuck.

Commissioner DREYER. Mr. FitzGerald, did you want to add anything to that?

Mr. FITZGERALD. No, I can't add anything to that.

Commissioner DREYER. Thank you both.

Cochair MULLOY. Chairman D'Amato.

Chairman D'AMATO. Thank you, Commissioner Mulloy.

Mr. Gage, you had on your screen there earlier the word "legislators." Those are the people we work for. In fact, they're the only people we work for. We report to the Congress.

You also mentioned you thought it would be important for Washington, I think you said something about engaging the Silicon Valley in a more in-depth way. We're interested in how we can do that, to develop a program for us to become more competitive. Obviously we have problems with our Tax Code. We have funding shortfalls, let's say, in some new programs that need to be funded. We have regulatory problems.

The question I have is: Have you thought about how would you, if you had the opportunity, structure a dialogue and recommend how we would become more competitive in these various areas? How would you do that? What is the first thing you would do to turn this competitive situation around?

Mr. GAGE. Focusing on legislators or just in general the executive branch——

Chairman D'AMATO. In general. There may be things that legislators can do and things that they cannot do, but there's a range of funding opportunities and changes in the Tax Code, for example. We think there are some things that have to be done there and maybe some regulatory questions. How does one engage Silicon Valley with the national legislature to try and make us more competitive?

Mr. GAGE. Now that's a great question. The standard way to engage Silicon Valley is to talk—Silicon Valley has very simple, repeated demands, which most businesses would say the same thing: Don't regulate us, don't tax us, leave us alone. We're doing just fine, thank you. So you get that standard response. Every CEO you would put in front of the panel would say exactly the same thing. The answer is: We need tax credit. The answer is, don't talk to us.

Well, that's not clearly the answer, because I think a separate conversation, and the forum for it could be the Competitiveness Council or a variety of places. Just take my own company, Sun. Named after the Stanford University Network, though all the software came from Berkeley. The Defense Advanced Research Projects Agency in the past put money into very advanced research, which had a high chance of failing.

The Defense Advanced Research Projects Agency today has cut off almost every advanced computer science research project in the universities because they view themselves as delivering operational capability to the battlefield nine months from date start of grant. This is the stupidest thing we could possibly be doing.

So you could get the chief technical officers or the chief scientists or the chief engineers, not the business crowd to say what we really need is a flow of the world's smartest people, and that has to start by doing the sort of things you heard yesterday, about we have to start the seed corn, because without that we simply have nothing four or five years down the road.

So four or five years down the road for us there's a shift from the kinds of computing we do now to new kinds of computing. We're building the world's fastest supercomputer because one guy's invented a new way to bond chip to chip without wires in between so we can go a couple of thousand times faster, get rid of the heat.

There is to be a change for optical and for quantum. That's coming. So where do we have the optical and quantum research going on? We need to make sure that that's funded now, and it's not funded on one of these "write me a lot of reports every year about how far you've gone." DARPA's glory was in giving people three or five years worth of relatively burden-free funding so you could think about things.

So if we had to make recommendations to legislators it would be, on the one hand, stop requiring that one of the most advanced researchers someplace submit a monthly report about how well they're doing, because that's just time taken away from thinking. This is not a good idea. And stop picking on some research area that may have a stupid name to present how we're wasting Federal money. The amount of money we're spending on these things is so small that it really doesn't make any—it's nice to grandstand, but it harms the research environment overall. There's a longer talk about beefing up the armed service research capabilities, which we definitely need to do.

As Negroponte takes his charge to try to do some integration of the agencies, I believe there will be an integration of research agendas. It would be a nice place to start, where people are able to say, "These are things we really need," and have the voice come from Geospatial as well as from NRO as well as from—everybody has a way to express what should be done.

I think in those domains, as we go through the oversight of the intelligence budgets, which is a necessary step to take, there needs to be pressure on the legislative side that the research agendas for the most advanced and most demanding applications turn into funding for those places where that kind of work takes place. We're sitting in one of them, but also be sure it takes place all across the country in all sorts of institutions that then allow us to draw upon the smartest people around the world. That's another component of national security.

Chairman D'AMATO. Thank you very much.

Do you have anything to add to that, Mr. FitzGerald?

Mr. FITZGERALD. I would just emphasize that inasmuch as we lead in several of these technologies, feeding this semiconductor industry with the best and the brightest is absolutely critical. Clearly a lot of this talent, given that we're not graduating the number of engineers we need to, is coming from overseas. The easier you can in terms of greasing that process of bringing people into the country, I think the better off we'd be.

Chairman D'AMATO. So while we're ahead in the semiconductor industry, let's stay ahead.

Mr. FITZGERALD. Exactly.

Chairman D'AMATO. I think part of the problem is I'm not sure that there's a national consensus that we do have a competitiveness problem. One would assume that if we could establish that consensus, then the various funding flows to various technologies would be easier to marshal. Thank you very much.

Cochair MULLOY. Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thank you, Mr. Chairman, and thanks to our witnesses. It's a particular pleasure to hear from Mr. Gage, who I described to somebody last night as having iconic status here in the Silicon Valley. I had the pleasure and the luxury of peppering him with questions for three hours last night, so I won't drag him through that again.

But I am interested in this concept of free flow of information, which is what it's all about. It's almost as though there are two levels of information. There is the free flow of the scientific information upon which of this technology is based and the technology carries information. So it is the free flow of the content of the information that's being carried. And of course the electronic frontier. All of these issues in some ways I think of as an anti-authoritarian move.

So what I have trouble reconciling, as you mention CERNET and—is it—IPV6?—with the Chinese taking technological leadership on these kinds of initiatives? How do we reconcile the fact that the Internet is about the free flow of information with the technological leadership that is coming from a government that has demonstrated that it is not interested in the free flow of all kinds of information but only certain kinds of information?

Mr. GAGE. Professor Wu, whose name I put on the screen, 12 years ago had to keep his head down because the Minister of Telecommunications, also Wu, would have handed it to him if he realized exactly what was going on with the universities creating a fiber network throughout China without the permission of the Minister of Telecommunications by contracting with the Minister of Railroads, who didn't like the Minister of Telecommunications, and the PLA that did the slave labor to put the fiber along the railway tracks, and suddenly there's a fibernet all over China linking a thousand universities, and state council—everyone's divided. What's good, what's bad, everybody just let this happen. Suddenly the network's up and rolling.

There is a bit of exaggeration, how we're the only place doing this, the most advanced, because this is something we can do quite quickly or are, in fact, doing in a lot of places. But in a way it's a statement of the sense of inevitability that's in the hearts and minds of the kids who are studying late at night that, "We've been so backward we can't even make a jet engine and now we're at the forefront of things. And, oh, boy, this is an opportunity for China to assume its natural place of leadership in the world."

So there are many different—just as IP blocking and, I was in Shanghai. We had an 8,000-engineer conference in Shanghai a couple of months ago. It was at the moment of the Tiananmen Square anniversary, actually it was June, so the BBC announcer was blacked out. They'd watch BBC until they said, "And today in commemoration of," and the screen would go black all over China. You could get the *New York Times*, but you couldn't get the story about Tiananmen Square because it would block on content, so you can block on the source of where it's coming or even down inside the packets on what's in the packets, but there are a lot of packets. So it's a problem for anybody that wanted to try to really block things from blocking.

So there's a tension. There's a constant tension. Will the conservatism of China—and Orville Schell phrases it: Will the Internet change China or will China change the Internet. And it's a little bit of both.

Then think on the other side, Samsung, a $68 billion company with—we buy so much stuff from them because—some memory and all these things. It's one of the world's greatest semiconductor companies. Samsung has a lot of dealings with the Chinese government because if moved to the West means they want to start putting in fabs and things in the West, so relationships that have nothing to do with what the U.S. is thinking it's up to are shifting the technical ground underneath us.

So a component of the Commission's work could be to examine the relationships between Korea and even in Japan, in spite of demonstration, every one of the biggies, Toshiba, NEC, everybody's going out to do business in China. That's a significant technology transfer that's—Asia backbone doesn't concern us. The dream of Asia is to stop having the packets come to San Francisco to get rerouted so when you send mail from Shanghai to Beijing—it used to go through San Francisco, it doesn't anymore. So these global relationships are really powerful.

Because people really want to get the information around, the kids learning things that you wouldn't believe they know. But the bloggers are active in China, millions of them. And we're an open systems, share-the-code company, and it's always been taken to my astonishment as some kind of a political statement in China. So ten years ago I'd talk about open systems, and they all viewed this as a challenge to the existing regime. So this is a mantra. People do believe they should have access to everything. I suppose in a way when the Chengdu Ph.D. student finds he can't get a visa to get to the U.S., he writes off the U.S. because he doesn't need it anymore. He's got enough openness to be able to build something important in China.

Commissioner BARTHOLOMEW. Thank you.

Cochair MULLOY. Mr. Gage, you must have read your papers today because you talked about the articles in the *Times* and the *Journal* about China's auto industry. I paid attention to those, too. We did a hearing on that area in Ohio in September, 2004, and got a picture of what is coming at us there.

I don't know whether you saw this other article in the *New York Times* about Mr. Portman who has been nominated to be head of USTR, and that he's really getting a going-over. He's promising to take a tougher line on China.

But the problem is we have to be careful of what kind of line we take and why and understand more comprehensively what we do. Mr. Anthony Rock, who from the State Department is going to testify on the next panel, tells us: "China has used the lure of its enormous emerging consumer market to induce firms wanting to get into the Chinese market to sign investment agreements that systematically include some form of technology transfer."

Secondly, he says, “Chinese investment policies encourage foreign investment in high-tech industries in particular with a system of preferential tariff and tax rebates designed to create incentives for high-tech industries, as contrasted with lower-tech industries.”

From what you know, is that correct? If both of you could comment on that. And if that’s the case and we wanted to, how would we counter that as a nation? What should we be doing to deal with that situation?

Mr. FITZGERALD. There are clearly incentives being given by China to attract technology companies, but I’ll tell you there’s one major hurdle that they face at this point that I don’t see any immediate resolution to, and that’s the protection of intellectual property. If you look at the global companies at this point, you have companies like Intel putting some manufacturing in China at this point. But it’s the lagging technologies, it’s the older technologies, it’s the non-critical technologies.

People are so concerned about the protection of their assets at this point, because China does not have a good legal system at this point to protect them, that they are induced by the opportunity of the size of the marketplace. But none of the kind of family jewels is being placed in China at this point because of the lack of protection. I suspect that’s an issue whether you’re sitting running Samsung today or running Sony or Toshiba, you’re all looking at the opportunity there and being encouraged to invest. But it’s not the leading-edge technologies that are going in at this point. So I don’t see until that issue is resolved that China’s going to really be able to attract the best and the brightest in terms of the leading-edge technologies.

Cochair MULLOY. Mr. Gage?

Mr. GAGE. Yes. I’d say Tony Rock really knows what he’s talking about. I look at the agreements we have been entering. When we started in China, the oil crowd showed up with a contract typed on a 40-year-old typewriter where the “o” was so sharp it made holes in the paper. And it was one of these: We are going to be friends and everything will work out, and we’re going—and that was it, about three paragraphs.

And we said, “Have you any clue about American lawyers? By the time we come back to you with a contract that says, ‘In case of hurricane, the deal’s off’ or, ‘If you cheat and steal,’ you’re going to be so offended by our legal contracts you’re not even going to talk to us again.”

Well, 15, 20 years later things are considerably different. But the Chinese style in general is a very sharp business. I shouldn’t say “sharp,” a very standard business deal. “Hello, big phone companies, we’ll allow three of you to now serve Beijing. First all put your bids in. Oh, so the three get your prices way down. Oh, now that it’s you three, we expect to see a 50-percent reduction again if we’re going to keep doing business.”

So it’s just, the lure, as Tony Rock says of a giant consumer market brings lots of people in. From our point of view, take an example like Huawei. Huawei makes machines that rival Cisco. It’s not too hard to make these machines. Andy Bechtolsheim, our Sun employee number one, built a machine ten times faster than anything

Cisco did, and then Cisco bought, and he went over to Cisco for a few years, just making a chip.

So Huawei has entered and is competing throughout Asia and is beating Cisco in country after country after country with lower prices. Northeastern University has some software from a professor and they started making MRIs and scanners. They beat Siemens and GE by, let's say they're at 30 percent of their price and the costs are almost nothing for these machines comparatively, so they make an enormous amount even beating American manufacturers. So there is a direct pull for companies that will begin to go global. Huawei is going global.

In fact, in the United States the new smart washing machines and new smart laundry stuff, dryers and things, made in China, easy to put circuitry in that fixes the thing when the filter's not been cleaned, reports home, in advance of a lot of the white goods manufacturers around the world.

So we're watching, just as he says, industry by industry, depending on how much advanced technology you need. Now semiconductor guys need an enormous amount of advanced technology, but white goods people don't and can hit a market. Router-and-switcher people don't. They can hit an immediate market with things that everybody knows. So it gets down to your commercial negotiating capability to stay in the game.

From our point of view, since we sell to all these guys, China Telecom, and we run all the cellular operations in China, our goal is to just be in the game, stay there, participate deeply in the 2008 Olympics, be part of the country. We ran Athens, we'll run Beijing. It won't be our face you'll see, it will be Lenovo, but we are being pulled into China to bring all of our expertise to bear on this emerging large market.

Cochair MULLOY. I want to thank you both.

Are there any other Commissioners who have any followup questions? No.

Thank you very much for your testimony here today. If you have anything that you want to submit for the record, we'll be happy to package that in what we send up to the Congress.

We're going to take a five-minute break and then we're going to have the panel with the State Department and the National Science Foundation.

[Recess.]

PANEL VI: CHINA'S SCIENCE AND TECHNOLOGY TRAJECTORY

Cochair MULLOY. From the second panel this morning we will hear from representatives from the Department of State and the National Science Foundation. Anthony Rock is the Principal Deputy Assistant Secretary of State in the Bureau of Oceans and International Environmental and Scientific Affairs. Dr. Larry Weber is Acting Deputy Director of the Office of International Science and Engineering for the National Science Foundation. We appreciate very much both of you for being here and we look forward to your testimony.

Mr. Rock, we'll start with you and then go to Dr. Weber.

STATEMENT OF ANTHONY F. ROCK
PRINCIPAL DEPUTY ASSISTANT SECRETARY OF STATE
BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS, WASHINGTON, DC

Mr. ROCK. Thank you, Mr. Chairman, and Members of the Commission. First of all, let me just start by saying I am frankly in awe of the speakers that have preceded me. This has been an excellent session overall.

I wanted to also report to you that it's cold and rainy this morning in Washington, D.C., so I'm delighted to be here on behalf of the Department of State and in particular the Bureau of Oceans and International Environmental and Scientific Affairs to talk to you specifically about the U.S.-China Science and Technology Report that we recently submitted to Congress.

The U.S.-China Science and Technology Cooperation Report is a comprehensive review of U.S. Government civil science and technology activities during the period of 2002 and 2003, under the U.S.-China Science and Technology Agreement of 1979. I understand that the Commission worked closely with Congress in developing the reporting requirement, of course, for this. And, by the way, I have submitted the full text of my comments for the record, with your permission.

Cochair MULLOY. It will be included in the record.

Mr. ROCK. Thank you very much.

The State Department of course coordinated the contents of this Report with numerous Federal agencies. The Report now, by the way, can be found on our website: *http://www.state.gov/g/oes/rls/or/44681.htm*.

Mr. Chairman, broadly speaking, the Administration takes a view that advancing a candid, constructive, and cooperative relationship with China is the key to achieving our long-term national security goals. As the President noted in the 2002 National Security Strategy, "[t]he United States' relationship with China is an important part of our strategy to promote a stable, peaceful, and prosperous Asia-Pacific region."

So through governmental contacts, through scientific contacts, through academic contacts with a large number of Chinese officials and, frankly, everyday citizens, we do exert an influence over their views, their path toward the development of a market-based system and the policies that they take broadly with respect to the United States.

Science-and-technology cooperation is a key component of any nation's economic and social development. China like the United States has long endorsed this view. And they are on the move, as we have heard over the course of the past few days, and will continue to be so whatever occurs, whether or not there is a U.S.-China government-to-government science-and-technology agreement.

However, since China and the United States signed this bilateral agreement on January 31st of 1979, I think we've used this cooperation for a diverse and I believe mutually beneficial commerce of ideas, if you will. And it's been accomplished through scientific cooperation. It's been accomplished through education. It's been accomplished through dialogue across a wide spectrum of human knowledge.

I want to emphasize that the U.S. agencies engaged in this activity carefully consider the critical importance of our national security, our intellectual property protection, our economic security as they weigh the costs and benefits of the kind of cooperation that they will undertake with China.

The principal objective of the agreement is to provide broad opportunities for mutually beneficial cooperation. And U.S. agencies are engaged with their Chinese counterparts, essentially in seven major fields that we've discussed in the report itself. And those seven fields are: Agriculture, energy, space, health, environment, earth sciences, and engineering.

The nature of the agreement provides for exchanges of people, scientists, scholars, specialists, and students. It also provides for the exchange of data and information and training.

Just a quick word, if I may, about the agreement itself. The agreement is what we call an umbrella or a broad agreement that provides a general framework and conditions for cooperation. It cannot anticipate all of the subjects for cooperation that may arise over the years. So the U.S. technical agencies and their Chinese counterparts develop subsidiary, subject-specific agreements as part of the overall process. These are in the form of protocols or memoranda of understanding. And some of these protocols are specific with regard to the science-and-technology activities. Others are broader with regard to science and they themselves have subsections or subagreements for specific projects.

So, all in all, we have 26 protocols and 60 annexes to the agreement across those seven fields of science-and-technology cooperation.

So what are the benefits that we are achieving from these protocols and these annexes of this overall agreement? I'd just like to give a few examples of some of these benefits, and I would be happy to provide more details as we come back in the Q&A portion of the discussion today.

There's no question that access to a larger cadre of low-cost and well-trained and well-equipped researchers has helped our U.S. scientists to go more rapidly and more efficiently toward their scientific basic research goals.

I'd just like to give one example of that, the access to a significant high-energy physics research facility in Beijing, built at Chinese expense, with technical cooperation from the United States has really helped ultimately for us to look at some very important elements related to particle physics, jointly, cooperatively, and advancing theoretical research in the high-energy physics area.

The fact that we are working with China on clean coal and clean-burning fossil fuel technologies has opened huge potential markets for clean-energy technologies and equipment in which the U.S. is a world leader. And these collaborative projects set the stage for Chinese support for U.S. energy businesses more broadly.

I think it's critical that China works directly with the National Institute for Standards and Technology to help promote U.S. measurements and U.S. standards related to products and manufacturing. This is a major step towards supporting international trade and ultimately helping to increase U.S. exports.

Joint research with China on mineral resources including oil and gas helps both nations not only with alternatives to Middle East oil, of course, but helps to create additional potential markets for U.S. oil industry equipment suppliers as well as joint-venture opportunities for U.S. oil companies. These are activities that are well underway.

When we look at the nuclear power industry in China we have an opportunity to understand the state of the technology better and we have the opportunity to open potential markets for advanced U.S. power technology as well.

China has invested heavily in remote sensing and in mapping research, and a large number of Chinese scientists are now leaders in the field. The U.S. Geological Survey is working with these Chinese experts and leveraging that expertise to provide some very valuable global data that helps us monitor transboundary environmental phenomena and deal, in particular, with issues related to climate.

I was particularly struck by the work that's done in the health arena. One example, 250,000 women in China were studied, demonstrating conclusively that folic acid supplementation during early pregnancy can help to prevent neural tube defects. It's an incredible study underway with HHS support.

Mr. Chairman, as a Foreign Service Officer who grew up on the East Coast, I was particularly struck by some information that I learned from the U.S. Department of Agriculture, that most of the grass growing on U.S. rangelands throughout the United States is actually derived from Chinese varieties of grasslands that were acquired by the Department of Agriculture as part of these programs.

Commissioner DREYER. When?

Mr. ROCK. I'll have to go back and look at the document to get the exact date.

Similarly, in the agricultural area, issues such as the DNA sequencing of cotton and rice genomes increased rapidly the DNA sequencing data. It helped us take an active approach to crop breeding in the United States as a result.

There is cooperation in the area of marine resources emphasizing large-scale fisheries, emphasizing aquaculture production and practices that have been very energetic in China as well. And, as I mentioned earlier, the data exchange with regard to climate has helped us look at improved predictive models for climate change and improve our climate science capabilities.

I think it's clear from the discussions we've heard so far that China is rapidly becoming a science-and-technology center throughout Asia. And there are some areas of the S&T base that are going to merit continued U.S. attention, areas such as information technology, software development, and the changes and developments in micro and nanotechnologies.

Through basic research cooperation, such as what we are seeing in the government-to-government programs, we spur our own innovation and we monitor theirs, quite frankly. The win-win scenario of science-and-technology cooperation is not unique of course to this agreement or to this relationship. It's part of a much larger trend in the way we are looking at science globally.

We've heard a lot about the activities of the multinational corporations, the fact that they are seeking to tap into emerging markets and low-cost, highly-skilled labor in the developing world and that this itself is leading to the internationalization of research and development worldwide.

In China and in other countries it's the rise of the Internet, it's the mobility of humans, and it's the mobility of financial capital that is resulting in this global dispersion of these well-educated scientists. With the free exchange of science information worldwide, the future of our technology leadership will depend not on our hoarding our capabilities but on managing our partnerships and diffusing the technology in a more appropriate fashion.

I would simply like to say that I believe that under the Science-and-Technology Agreement China has made enormous economic strides, but those are economic strides with respect to agricultural production, energy efficiency, reducing pollution, improving public health, and helping to develop their mining minerals and other industries. Even in those areas, in fossil energy technology, for example, when we look at their energy growth we also look at their climate-change impacts.

We've talked about the real developments, the real causes of developments, the market-based reforms, the large supply of domestic research, and the foreign capital investment from multinational corporations, these are the drivers.

[The statement follows:]

Prepared Statement of Anthony F. Rock
Principal Deputy Assistant Secretary of State
Bureau of Oceans and International Environmental and Scientific Affairs, Washington, DC

Introduction

Mr. Chairman and Members of the Commission, I appreciate the opportunity to appear before you today on behalf of the Bureau of Oceans and International Environmental and Scientific Affairs of the U.S. State Department to discuss the U.S.-China Science and Technology Report, the contents of which we coordinated with numerous Federal agencies and recently submitted to Congress. This report satisfies the requirements of a provision of law that calls for a comprehensive review of activities under the U.S.-China Science and Technology Agreement of 1979. I understand that the Commission worked closely with the Congress in developing the reporting requirement.

The Administration believes that advancing common interests in peace and prosperity with China is key to achieving our long-term national security goals. As noted in the President's 2002 National Security Strategy, "[t]he United States' relationship with China is an important part of our strategy to promote a stable, peaceful, and prosperous Asia-Pacific region. We welcome the emergence of a strong, peaceful, and prosperous China." One of the requirements of this report is an "assessment of how the Agreement has influenced the foreign and domestic policies of the People's Republic of China and the policy of the People's Republic of China toward scientific and technological cooperation with the United States." Through government, scientific, and academic contacts with a large number of Chinese officials and citizens, we are exerting a critical influence over their views, their path of development to a market-based system, and policies toward the United States.

Turning to science and technology cooperation, a key component of any nation's economic and social development is the effort to advance scientifically and technically. China has long endorsed the view that there can be no true economic or social growth without such advancement. Since January 31, 1979, China and the United States, under the S&T Agreement, have carried out a diverse and mutually beneficial commerce of ideas through scientific cooperation, education, and dialogue across the entire spectrum of human knowledge. Although there are areas where we likely will compete, as there are areas where we must protect both information vital to our national security and the intellectual property of our citizens, the benefits of our scientific and technological cooperation with China far outweigh the costs of this relationship. Achieving a candid, constructive, and cooperative relationship with China is the task set before our diplomatic and scientific communities by the President. In response, the goal of the Federal agencies now engaged in the efforts highlighted in the report is not only to tap into and help shape China's growing scientific and technological resources, or to help China handle pressing problems like environmental damage or HIV/AIDS, but to influence China's development into a country with whom we can share common interests that align our nations together against poverty, international crime and terrorism, and other global threats to human welfare, health, and dignity.

The Science and Technology Agreement

The principal objective of the Agreement is to provide broad opportunities for cooperation in scientific and technological fields of mutual interest, thereby promoting the progress of science and technology for the benefit of both countries and of mankind. Cooperation under the Agreement includes activities in the fields of agriculture, energy, space, health, environment, earth sciences, and engineering. The Agreement provides for exchanges of scientists, scholars, specialists and students, and of scientific, scholarly, and technological information and documentation. It also provides for joint planning and implementation programs, courses, conferences, seminars and projects, joint research, development and testing, and the exchange of research results and experience between cooperating U.S. and Chinese entities. Facilitation of scientist-to-scientist collaboration under this agreement has been a key to the success of the bilateral S&T relationship.

The S&T Agreement itself is a broad "umbrella" agreement that provides for some of the more general conditions for cooperation, but which cannot anticipate all of the subjects for cooperation that may arise over the years. The U.S. technical agencies and their Chinese ministry counterparts therefore develop subsidiary, subject-specific agreements for their cooperation that are "Protocols" or "Memoranda of Understanding." Some of these protocols refer to single specific joint S&T activities, while other protocols cover a broader subject area and may contain a set of related sub-agreements (project annexes) to further define cooperation in specific areas. The number of protocols has grown over the years, and there are now more than 26 active protocols and over 60 annexes.

Benefits of the Agreement to Both Countries

Science and technology cooperation with China has benefited the United States in many areas. The following are examples:

- Access to an increasingly large cadre of low-cost, well-trained and well equipped researchers with whom U.S. scientists can do cooperative research to meet U.S. scientific goals.
- Access to a significant high energy physics research facility built at Chinese expense, with much technical assistance from the U.S., and collaboration in its scientific program has resulted in many important measurements of elementary particle properties.
- Obtaining current information on the evolution of the Chinese nuclear power industry and the state of its technology. Cooperation in the nuclear power industry opens potential markets for advanced U.S. nuclear power technology.
- Adoption of clean coal and clean burning fossil fuel technologies in China opens a huge potential market for clean energy technologies and equipment in which U.S. industry is a world leader. Collaborative projects have set the stage for Chinese support of U.S. energy businesses.
- Chinese exchanges with the National Institute of Standards and Technology (NIST) help promote the use of U.S. measurements and standards in China. The development of a measurement infrastructure is necessary to support international trade and help increase U.S. exports.
- Joint research into Chinese mineral resources, including oil and gas, has given the U.S. an advantage in a number of areas. Increases in China's oil and gas potential provide both nations with alternatives to Middle East oil. U.S. cooperation in discovering and developing China's fossil energy reserves also creates large potential markets for U.S. oil industry equipment suppliers, as well as joint venture opportunities for U.S. oil companies.
- China has invested heavily in remote sensing and mapping research and a large number of Chinese scientists are international leaders in the field. USGS-China cooperation leverages Chinese expertise to provide global data valuable in monitoring transboundary environmental phenomena.

- A multi-year U.S.-China study of almost 250,000 women in China demonstrated conclusively that folic acid supplementation during early pregnancy can prevent Neural Tube Defects such as spina bifida and anecephaly.
- Cooperation brought substantial benefits to U.S. agriculture. Much of the grass growing on U.S. rangelands is derived from Chinese varieties acquired by USDA.
- In projects of mutual interest, like DNA sequencing of the cotton and rice genomes, cooperation provides access to the DNA sequencing data in a shorter timeframe and at much less expense than if the U.S. were working alone.
- Cooperation in marine resources benefits the U.S. scientific and commercial sectors by providing access to large-scale fisheries and aquaculture production practices used in China.
- Cooperation has brought mutual benefits to both the U.S. and China with new data on climate to develop improved, predictive models for use in understanding how climate may change.

Some areas where China has gained include:

- Collaboration (mostly) with the U.S. has facilitated China's becoming a participant in the worldwide high energy physics research enterprise.
- The overall public health of China's population has been improved through collaboration in the fields of medicine and public health. The U.S. Government funded Global Aids Program and Comprehensive International Program of Research on AIDS is but one example of this cooperation.
- Safety of China's growing nuclear power industry has been enhanced by cooperation with the U.S. Nuclear Regulatory Commission and the Department of Energy.
- Chinese agricultural production has increased as a result of collaborative programs with USDA. New crops, new varieties, and improved irrigation and farming techniques were introduced through S&T collaboration.
- China's efforts to clean up industrial pollution and prevent further environmental degradation have been aided by cooperation with NOAA and EPA.
- Access to U.S. labs has helped Chinese scientists address disease, genetic and biotechnology issues and develop environmentally-friendly fish farming techniques.
- China has become more efficient in the use of energy. Alternative energy technologies have been introduced.
- The development of China's mining and petroleum industries has been facilitated by joint projects in mineral research, geology and deep-ocean drilling.
- China's efforts to investigate fusion as a potential energy source for the future, including participation in the negotiations to construct a major international fusion facility called ITER, have been aided through technical collaborations with Department of Energy sponsored laboratories and universities.

Assessment of the Influence of the Agreement

The U.S.-China S&T Agreement has provided China with some benefits that have helped close some of its scientific and technological development gaps. At the same time, the Agreement has helped moderate the bilateral relationship, given the U.S. access to the Chinese market and labor pool, and supplied the U.S. with significant amounts of high-tech research talent and labor. As a result, both countries have benefited from the Agreement, though in different ways. The report's analysis of various aspects of the Agreement's implementation has not identified any signs of significant diversion of high-tech information that would be of use to China's military and defense industries.

The S&T Agreement has facilitated a deep and ongoing dialogue between the U.S. and Chinese science communities. This dialogue occurs between U.S. technical agencies and their Chinese ministry counterparts at the policy level, but is probably most intensive at the level of individual scientist-to-scientist communication, either face-to-face at conferences, meetings, and in the laboratory, or through the Internet. Such communication would undoubtedly occur regardless of the presence of a diplomatic agreement, but the cooperative activities undertaken as a result of agency memoranda of understanding (MOU's), signed under the Agreement and its protocols, provide a structural basis for individual scientists to develop partnerships with colleagues living in other countries with similar research interests.

The Administration also believes that U.S.-China S&T cooperation has played a consistent stabilizing role in U.S.-China relations. While the overall U.S.-China relationship may swing up or down as a result of political and economic developments, changes in leadership and other factors, the U.S.-China S&T relationship has remained a largely stable pillar of the bilateral relationship, allowing a continuance of cooperative activities in science and technology at levels determined more by scientific accomplishment, interest and available budget than by geopolitical interest.

In addition to promoting good will, trust, and openness, U.S.-China science and technology cooperation has contributed to PRC domestic policy reforms by providing the PRC government with information that helps guide the ongoing reform process. For example, in the area of remote sensing, cooperation between USGS and the Chinese Academy of Sciences has involved joint research and exchanges in the rectification, enhancement, classification, and interpretation of remote sensing images. As an example, using this information, the Chinese leadership concluded that China was losing cultivated land to development at a rate faster than previously thought. In response to this information, Chinese leaders ordered a one-year freeze on all agricultural land conversions not specifically authorized by the State Council and imposed strict new measures to intensify land management initiatives to protect China's cultivated land. In another example, remote sensing information revealed that local governments, intending to maximize their disaster relief assistance, exaggerated the amount of land affected by the 1998 Yangtze flood by ten times. Both of these examples illustrate how U.S.-China cooperation in remote sensing can provide information that helps redress local government misreporting and corruption.

China is a rapidly developing science and technology center in Asia. Several areas in China's S&T base warrant close U.S. attention, including information technology, software development, and the budding biotechnology and nanotechnology sectors. As China progresses toward catching up with Western industrialized nations, continued U.S.-China research cooperation allows the U.S. to monitor China's technological advancements. But U.S.-China cooperation can also help leverage U.S. research investments in key high-tech areas by using the contributions of Chinese scientists to attain U.S. research goals. China's developing science and technology capabilities suggest that future U.S.-China cooperative activities could yield even more benefits to the U.S. than ever before.

This win-win scenario of science and technology cooperation is not unique to the U.S.-China relationship, but is part of a much wider trend in the way science is advancing globally. Multinational corporations, seeking to tap into emerging markets and low-cost, highly skilled labor in developing countries, have led the internationalization of research and development worldwide. In China and other countries, the rise of the Internet and the increasing mobility of humans and financial capital have led to the global dispersion of well-educated engineers, scientists and researchers, laying the foundation for international research cooperation opportunities in both the private and public sectors.

Now, more than ever, government-funded science has become a unified global effort. For the past two decades, the most challenging science and engineering problems have been tackled by international teams of researchers with common interests and complementary expertise. In an increasingly global world of open information and collaboration, scientific cooperation is not a zero-sum enterprise. Generally, scientists only cooperate if they share complementary resources that can be leveraged to achieve mutually beneficial goals. Today's team-centered, global approach to science and technology provides tremendous potential for advances and discoveries in international "big science" cooperative projects. Bearing these trends in mind, tomorrow's technological leaders will not be the countries that restrict the sharing of knowledge and technology, but those which can effectively use international scientific resources to create innovative new solutions through cooperation.

An example of this global cooperation is the proposed ITER project whose mission is to demonstrate the scientific and technological feasibility of fusion as an energy source. Six Parties, including China and the U.S., are currently involved in negotiations for the construction, operation, and decommissioning of ITER. If these negotiations are successful and the project proceeds, all of the Parties will have excellent opportunities to work together on ITER construction and to share the benefits of such collaboration as well as the subsequent research results gained during operation.

Four specific areas in science and technology development are of particular interest to the United States: information technology, software development, biotechnology, and nanotechnology. China's information technology sector (IT) now forms the core of China's S&T enterprise. China's IT market is one of the fastest growing markets worldwide and is now the second largest in the Asia-Pacific region, behind Japan. The Chinese market for IT products and services was $22 billion in 2002, and is expected to exceed $40.2 billion by 2006. Chinese companies are matching most if not all of the current trend lines for advanced telecommunications systems and are providing the full range of telecommunications equipment.

China could also become a significant player in software development. As of 1993, China already had more software professionals than any other country aside from the United States. China's Ministry of Information predicts that software and systems integration product sales from China's 2,200+ software companies should climb 30% in 2004 to reach U.S. $25 billion. With computer and communications hardware becoming increasingly complex, software developers worldwide are encountering severe problems devising reliable systems. According to experts, U.S.-China cooperation efforts to resolve some of these fundamental difficulties could be highly productive for both parties.

China is making a significant effort in biotechnology, especially in the area of genetic engineering. The Chinese government has promoted biotechnology since the 1980s through ambitious multiple research programs. Current Chinese research areas include agricultural biotechnology, genomic sequencing, biochips, leveraging leads produced by traditional Chinese medicine, bioinformatics, stem cell research, biomanufacturing, and toxicology testing. Biotech research, which was traditionally concentrated in universities and state research facilities, has also spun-off startup companies comprising a booming Chinese biotech market. China's biotech market is currently about $3 billion, and is forecasted to grow at 13.5% annually to reach $9 billion in 2010.

While China is globally competitive in genome sequencing, agricultural biotechnology, and gene therapy, its biotech industry as a whole struggles to commercialize new products and produces relatively few exports. Experts predict that it will take at least a decade for China to develop a world-class biotech industry. Major barriers to commercialization include a weak venture capital industry, poor patent protections, and difficulties in adopting Chinese products to fit stringent regulations in major world markets.

China is starting to become a global player in nanotechnology, which Chinese leaders view as one of the nation's most important scientific fields for future research and development. While still a nascent industry, China is investing heavily in nanotechnology, with the central government budgeting approximately $240 million and local governments contributing $240–360 million from 2001–2005. China already ranks third in the world, behind the United States and Japan, in the number of nanotechnology patent application cases. Its 2,400 patents represent 12% of the world's total. China is also seeking to establish a national nanotech infrastructure and has established the China Nanotechnology Center facility in Beijing, a center dedicated to nanotechnology research and development. China's current research in nanometric materials and their applications, tunnel microscope analysis and monatomic control, has approached internationally advanced levels, but domestic studies in nanometric electronics and nanometric biomedicine still lag behind the developed countries.

Advances in Chinese S&T capabilities in key research areas can provide important opportunities for the U.S. S&T enterprise. Using the expertise, initiative and money of foreign partners like China can help the U.S. retain its competitive advantage and technological superiority. The free exchange of scientific information and the growing S&T capabilities of developing countries will mean that the key to future U.S. science and technology leadership will not depend upon hoarding high-tech secrets from other countries. Instead, it will depend upon creating with foreign partners a distributed information network from which spring global innovation and discovery.

China is rapidly developing and becoming a major user of fossil energy resources. The S&T Agreement has provided key data and training to Chinese scientists to understand how China's energy growth may impact climate in the future.

Assessment of Impact of S&T Activities on China's Industrial Base and Economic Capabilities

Over the period in which the S&T Agreement has been in force, China has made enormous economic strides. Certainly cooperative activities under the agreement have provided some economic benefit to China including helping to develop China's minerals, mining and petroleum industries, increasing agricultural production, enhancing energy efficiency, reducing pollution and improving public health. Economic benefits to the U.S. derived from this cooperation and highlighted in an earlier section, have also been considerable.

The extent to which cooperative S&T activities conducted under the Agreement may have contributed to China's economic growth is difficult to assess. China's dramatic economic transformation has been the result of macroeconomic decisions by the PRC that allowed market forces and capital to operate in China, and stimulated massive foreign and domestic capital investment. Advances in China's science and technology capacity have also played a critical role in driving China's economic growth. High-technology exports from China and Hong Kong exceeded $100 billion a year and 19% of China's total exports are now high-technology products. Although the high-tech industry has been the leading edge of China's economic growth, the driving force behind China's scientific and technological advances has not been technology transfer from the U.S.-China bilateral S&T activities, but rather:

- Market-based reforms of China's science and technology infrastructure
- The large supply of domestic S&T research talent
- Foreign capital investment from multinational companies
- Technology transfer from foreign companies
- Chinese government investment in strategic high-tech technologies

A 1985 Chinese Communist Party Central Committee report on "The Reform of the S&T Management System" provided guidance for restructuring the Chinese S&T system. The restructuring reformed funding allocations and cut state budgets for research institutes and universities; it also encouraged them to launch their own commercial ventures. These initial reforms opened the door for many more institutional reforms that were modeled on the S&T policies of advanced nations, resulting in improved coordination between government bureaus, universities, research institutes, and companies. Following these structural reforms, China embarked on multiple long-term S&T research and development plans. These programs set national S&T targets, encouraged cooperation between research and production units, and significantly increased funding for the development of key technologies critical to economic development and national security.

Foreign direct investment has been another significant factor in China's scientific and technological advancement. In exchange for access to China's growing market, foreign companies, many from the U.S., have poured capital, technologies and know-how into China's commercial sector. From 1994–2001 the cumulative investments of U.S. multinational corporations in China more than quadrupled, from $2.6 billion to $10.5 billion, growing at an average annual rate of 20.1%, adjusting for inflation.

Multinational companies are encouraged to invest in R&D activities in China by attractive tax-based incentives. Many Chinese research institutes and companies now form joint ventures with multinational companies to achieve specific research or technology development objectives.

Another important factor in China's technology transformation is the availability of a large pool of cheap, technologically sophisticated workers. The lure of well-educated engineers, researchers and scientists has drawn many foreign companies to invest in research and development activities in China. What sets China apart from advanced nations is its ability to produce such large numbers of scientists, engineers, and researchers. Furthermore, while China has long suffered from a "brain drain" to the U.S., an increasing though limited number of China's top students are choosing to return to China after receiving graduate degrees abroad. The Chinese government attracts talented, foreign-educated Chinese students by offering them higher salaries, generous housing packages and even putting entire research teams at their disposal.

Supported by the government's emphasis on technology commercialization, market-based reforms, strategic research programs and a highly-skilled S&T labor force, high-tech nongovernmental enterprises have flourished in the Chinese economy. While S&T Agreement-related joint activities may have provided some ancillary economic benefits to China, the trendlines of its economic transformation would have been largely in place regardless of whether an S&T Agreement with the U.S. had been in place during this period. Against the overall context of market-driven economic growth in China, the role of government-to-government cooperation appears to have had, at best, a minor and ancillary role in contributing to the build-up of China's economic, industrial and military capabilities. It is clear that China's remarkable economic development occurred largely independent of cooperative agreements with other governments. The U.S. S&T Agreement is only one of many that China has with advanced industrialized nations.

Another factor in the rapid rise of Chinese S&T abilities is the PRC's continuing effort to acquire technologies from the West. The Chinese have employed a variety of methods to accomplish this objective including attracting foreign investment, particularly in R&D areas; sending large numbers of students abroad to study scientific and technological disciplines; industrial partnerships; joint ventures and offset deals; placing significant numbers of Chinese scientists, technicians, and engineers in key private sector firms abroad; scientific and military cooperation with countries where advanced technologies are developed; and covert means. Another valuable source is information mined from open S&T journals and websites.

China's Investment Strategy

The rapidly growing U.S. business investment in China is vital to the development of bilateral commercial ties, and reflects the eagerness of U.S. firms to position themselves in China. A Department of Commerce study highlights China's policies concerning investment by overseas firms, American companies in particular. According to this report, China has used the lure of its enormous emerging consumer market to induce firms wanting to get into the Chinese market to sign investment agreements that systematically include some form of technology transfer. Chinese investment policies encourage foreign investment in high-technology industries in particular, with a system of preferential tariff and tax rebates designed to create incentives for high-tech industries as contrasted with lower-tech industries. Among the industrial sectors in which China is seeking investment are information technology, aerospace and electronics, including telecommunications. Some IT multinational companies have even agreed to transfer core technologies, such as source code, in order to gain market position. Although under the World Trade Organization (WTO) obligations, China is not allowed to require technology transfer as a condition of doing business, state-owned enterprises and local government bodies in particular are still widely believed to continue the practice.

An increasing source of technology transfer from U.S. private sector companies is the increasing use of offset deals which include the creation of a laboratory, center or institute intended for joint research and development in key industries such as IT, telecommunications, electronics, chemicals, and automobile manufacturing. There are estimated to be more that 400 research and development branches of multinational corporations in China, including companies like Motorola, IBM, and GM. U.S. companies attempting to gain a foothold in the Chinese market are often reluctant to complain about the difficulties of doing business in China, the Commerce study reports. However widespread complaints have been received from U.S. firms investing in China about de-facto coercion by Chinese officials to transfer technology as the price of admission to the Chinese market. This Chinese investment strategy, designed to extract technology from American firms as a condition for entering the market, in State's estimation has been the principal source of technology transfer from the United States to China. The minor transfers of technology that may have taken place within the context of S&T cooperation carried out under the Agreement, are in State's estimation, inconsequential in comparison.

Conclusion

Examination of the S&T relationship between the U.S. and China under the 1979 S&T Agreement, shows that cooperation undertaken in the context of this Agreement has been of significant value to both countries. The cooperation undertaken by the USG agencies is, as intended, in the benign civilian domain. Although it is impossible to rule out unintended benefits to the military sphere, such side effects are almost impossible to document or substantiate and any benefits to China's military would have been small compared to the overall benefits of cooperation. As a vehicle for acquiring technology useful in the military or industrial area, the Agreement is of miniscule importance in the overall perspective of China's abilities and means to gather scientific and technological information. The U.S.-China Agreement is useful, mutually beneficial, promotes stability in the bilateral relationship, and should be maintained. S&T cooperation under the Agreement brings significant benefits to both countries and should be continued.

Cochair MULLOY. Thank you, Mr. Rock.

Mr. ROCK. Thank you.

Cochair MULLOY. We'll have some questions for you.

Mr. ROCK. Please.

Cochair MULLOY. Dr. Weber.

STATEMENT OF LARRY H. WEBER
ACTING DEPUTY DIRECTOR
OFFICE OF INTERNATIONAL SCIENCE AND ENGINEERING
NATIONAL SCIENCE FOUNDATION (NSF), WASHINGTON, DC

Dr. WEBER. Distinguished Members of the Commission, thank you very much for the invitation. I certainly second Mr. Rock's observation about the quality of the witnesses yesterday and this morning. It's been delightful to be here.

Let me start with a brief overview of the National Science Foundation and the mission that we fulfill to provide some context.

Then I'll speak briefly to two sets of indicators relevant to today's discussion: R&D and education.

For more than 50 years the National Science Foundation has been a strong steward of America's science-and-engineering enterprise. NSF's five and a half billion-dollar annual budget represents only four percent of the total Federal budget for research and development. The agency supports half of the nonmedical basic research conducted at U.S. academic institutions. Support is given through a competitive, peer-reviewed grants process.

In the Federal R&D structure the National Science Foundation is unique. We don't have a mission-oriented research objective, such as health, agriculture, or space. Instead we keep all fields of science and engineering focused on the furthest frontier, recognize and nurture emerging fields and prepare coming generations with scientific talent.

The agency is also congressionally mandated to collect and interpret data on key scientific-and-engineering indicators, and provides a biennial report to Congress entitled "Science-and-Engineering Indicators."

Let's look at some key indicators relevant to today's discussion. Overall trends provide the best story.

By 2001 China accounted for nine percent of the world's high-tech exports. This reflects a threefold production increase by high-tech industries in China between 1996 and 2001.

Because the size and openness of the U.S. market provides incentives for foreign inventors to apply here for patent protection, trends in the number of U.S. patents issued to foreigners can indicate changes in patterns of inventiveness. Although a much higher number, the number of patents granted to U.S. inventors grew only 42 percent from 1996 to 2002. Over that same time period patents granted to Chinese inventors increased fourfold.

Funding invested by U.S. parent companies in R&D in their majority-owned affiliates in China is another key indicator. In 1994 R&D expenditures at the 172 U.S.-majority-owned affiliates in China totaled only $7 million. By 2000 the number of affiliates had increased to 454, and R&D expenditures reached $506 million. This made China the eleventh largest host of U.S. R&D expenditures overseas.

Gross expenditures for R&D are an indicator of overall capacity of a country for technological innovation. In 1996 China's R&D investment totaled $20 billion in purchasing power parity. That was only ten percent of the U.S.'s investment at the time. By 2002 China's investment reached $72 billion, representing 26 percent of U.S. expenditures and positioning China as the third largest investor in R&D, after the United States and Japan.

The ratio of R&D to gross domestic product measures the share of the economy devoted to innovative activity and technological change. The U.S.'s R&D-to-GDP ratio has fluctuated between 2.4 and 2.7 for many years. China's R&D-to-GDP ratio more than doubled from 1996 to 2002, when it reached 1.3.

What makes this rapid rise in R&D-to-GDP ratio more impressive is that it occurred against the backdrop of a rapidly expanding economy with an average GDP growth of almost ten percent per year. The Chinese government has stated a goal of increasing R&D

expenditures to 1.5 percent of GDP this year and seems well positioned to do just that.

On the education side, the human dimension of innovation, including education and workforce, offers another set of key indicators.

Higher education policy in China has resulted in a dramatic shift from an elite-based education system to a mass-oriented education system. For example, only ten percent of Chinese 18- to 22-year-olds were enrolled in tertiary education as recently as 1999. The Chinese government then set a goal to increase that ratio to 15 percent by the year 2010. The goal was nearly reached in just three years, with enrollments of 14.7 percent by 2002.

From 1991 to 2001 China almost tripled its number of workers with associate degrees or higher, adding nearly 30 million college-educated workers to their labor pool. During the same period the U.S. increased its number of workers with associate degrees or higher by only one-third.

The number of Chinese students getting bachelor's degrees in science and engineering also increased dramatically, climbing 20 percent in five years, to over 337,000 in 2001. Comparable data show only a four-percent increase in the United States.

Even greater growth has occurred for science-and-engineering doctoral degrees in China, nearly doubling to over 8,000 from 1996 to 2001. During the same period the number of U.S. science-and-engineering doctoral degrees remained essentially flat at between 25,000 and 27,000, of which approximately 40 percent were to non-U.S. citizens. China is now the largest producer of science-and-engineering doctoral degrees in the Asia region.

It's noteworthy also that while science and engineering account for only about one-third of all bachelor's degrees in the United States, these fields account for nearly 60 percent of bachelor's degrees in China.

The Ministry of Science and Technology reports that as of 2003, five million students were enrolled in science-and-engineering programs at Chinese universities. Data on China's science-and-engineering degrees over the next five years will be interesting, indeed.

In summary, data on China's science and technology show a trajectory of rapid expansion in commercial output, in research-and-development investments, and in higher education. While the data only cover years up to 2001 or 2002, all trajectories are strongly positive.

NSF will release a comprehensive report on Asia science and technology this summer that we hope will provide useful context for the Commission's policymaking efforts.

There are also important considerations regarding the role of foreign-born individuals in the United States, and much of that was discussed yesterday. I do want to note one point. At 33,000, individuals born in China accounted for nine percent of the doctoral degree holders employed in science-and-engineering occupation positions in the United States in the year 2000.

Lastly, I'd like to refer to the question of visas, which has been discussed to some extent, and note that there has been considerable discussion on this topic. I would respectfully refer the Commission to an October 2004 Foreign Relations Committee hearing on the topic and a March 17th House Subcommittee hearing on Twenty-First Century Competitiveness and Select Education.

Just two weeks ago on April 4th NSF participated in a congressional roundtable on the impact of U.S. visa policy on the U.S. research-and-scientific community. I will leave a copy of NSF's testimony with you. Thank you very much.

[The statement follows:]

Prepared Statement of Larry H. Weber
Acting Deputy Director, Office of International Science and Engineering
National Science Foundation (NSF), Washington, DC

Chairman D'Amato, Commissioner Mulloy, Members of the Commission, and distinguished guests, I appreciate the opportunity to appear before you today on behalf of the National Science Foundation (NSF) concerning China's science and technology trajectory.

First, I'd like to set the broad context for my presentation with a brief overview of the NSF and the mission we fulfill. Then, I'll speak briefly to two sets of indicators relevant to today's discussion—R&D and education.

For more than fifty years, the NSF has been a strong steward of America's science and engineering enterprise. NSF's $5.5 billion annual budget represents roughly 4 percent of the total Federal budget for R&D. It's an important 4 percent, supporting half of the non-medical basic research conducted at U.S. academic institutions.

In the Federal R&D structure, NSF is a unique agency. We do not have a mission-oriented-research-objective such as energy, health, agriculture, or space. Instead, we advance learning and discovery in all disciplines of science and engineering and foster connections among them. It is NSF's job to keep all fields of science and engineering focused on the furthest frontier, to recognize and nurture emerging fields, and to prepare coming generations with scientific talent.

NSF supports the best and brightest people, ideas, and tools in the nation through a peer-reviewed granting process. At present, NSF receives more than 40,000 proposals per year. NSF's merit review system is widely imitated around the world, and numerous governments, including China, have created their own science foundations based on the NSF model.

In addition to NSF's day job of guiding science and engineering to the latest frontier, the agency is Congressionally mandated to provide a central clearinghouse for the collection, interpretation, and analysis of data on scientific and engineering resources, and provides a biennial report to Congress titled, "Science and Engineering Indicators."

Hence, I'm here today to highlight some important data indicators to support your policy discussion.

It is important to note that not all of China's data are fully internationally comparable. Because there are often questions about individual data points, it is most useful to look at overall trends.

While China's science and technology enterprise lagged significantly behind other countries in the early 1990s, the last decade has seen phenomenal growth in a number of key indicators. The Chinese government has instituted strategic policy initiatives intended to "revitalize the nation through science and education." These policies have been articulated through a number of formal channels, including the 1995 National Conference on Science and Technology and the tenth five-year (2001–2005) S&T plan. China's Ministry of Science and Technology reports that the policies have boosted China's overall high-tech development, R&D capacity, socio-economic development, and national security.

A few statistics will highlight the rapid growth of China's science and technology enterprise, including industrial advances and R&D investments, and education infrastructure and the workforce.

By 2001, China accounted for 9% of the world's high-tech exports. This is a reflection of the three-fold increase in production by high-tech industries in China between 1996 and 2001. It is notable that in-house production, characterized as "value added," also grew at the same rate as total production (Appendix Table 1).

Because the size and openness of the U.S. market provides incentives for foreign inventors to apply here for patent protection, trends in the number of U.S. patents issued to foreigners can indicate changes in patterns of inventiveness. The number of patents granted to U.S. inventors grew from 61,104 in 1996 to 86,973 in 2002, an increase of 42%. Over the same period, patents granted to Chinese inventors increased four-fold from 134 to 522. Because the review process leading up to the official granting of a U.S. patent takes approximately 2 years on average, trends in the number of U.S. patent applications provide a more up-to-date, albeit less certain, indicator. For the period 1996 to 2001, the number of U.S. patents applied for by Chinese inventors increased by three and one-half times.

Another indicator is the amount of funds U.S. parent companies invest in R&D in their majority-owned affiliates in China. In 1994, R&D expenditures at the 172 U.S. majority-owned affiliates in China totaled only $7 million. By 2000, the number of affiliates had increased to 454, and R&D expenditures reached $506 million, representing 2.6% of total overseas R&D by U.S. companies, and making China the eleventh largest host of U.S. R&D expenditures overseas. Moreover, U.S. affiliates in China invest relatively more in R&D compared with U.S. affiliates in other countries, as measured by the ratio of their R&D spending to their value-added gross product. In 2000, this ratio was 9.2% for U.S. affiliates in China, compared with 3.3% for the aggregate of U.S. affiliates in all host countries.

Gross expenditures for R&D (GERD) are an indicator of overall capacity for technological innovation. In 1996, China's R&D investment totaled $20 billion in Purchasing Power Parity dollars—only 10% of the U.S.'s investment. By 2002, China's investment reached $72 billion, representing 26% of U.S. expenditures and positioning China as the third largest investor in R&D, after the United States and Japan.

The ratio of Gross Expenditures for R&D (GERD) to Gross Domestic Product (GDP) is a measure of the share of the economy devoted to innovative activity and technological change. The U.S.'s GERD to GDP ratio has fluctuated between 2.4 and 2.7 for many years. China's GERD to GDP ratio more than doubled from 0.6 in 1996 to 1.29 in 2002. What makes this rapid rise in the GERD to GDP ratio more impressive is that it occurred against the backdrop of a very rapidly expanding economy, with an average GDP growth of almost 10% per annum. The Chinese government has a stated goal of increasing R&D expenditures to 1.5% of GDP by 2005, and seems well positioned to do just that.

The human dimension of innovation, including knowledge creation, education, and workforce, offers another set of key indicators. Several prominent trends regarding education in the U.S. and China have emerged.

Higher education policy in China has resulted in a shift from an elite-based education system to a mass-oriented education system. During the 10-year period ending in 2001, China almost tripled its number of workers with associate degrees or higher, adding nearly 30 million college-educated workers to the labor pool. During the same period, the U.S. increased its number of workers with associate degrees or higher by only one-third. The trend suggests that China's number of college-educated workers will soon surpass that of the United States.

With 10% of their 18–22 year olds enrolled in tertiary education in 1999, the Chinese government set a goal to increase that ratio to 15% by the year 2010. The goal was nearly reached in just 3 years, with enrollments of 14.7% in 2002.

The number of Chinese students getting bachelor's degrees in science and engineering increased from 281,245 in 1996 to 337,352 in 2001, a 20% increase. Comparable data show a 4% increase for the United States, with 398,622 science and engineering bachelor's degrees in the year 2000. There has been even greater growth for doctoral degrees in science and engineering in China, nearly doubling from 1996 to reach 8,153 in 2001. During the same 5-year period, the number of science and engineering doctoral degrees in the United States remained essentially flat at 25–27,000, of which approximately 40% went to non-U.S. citizens. As a point of comparison, at over 8,000, China is now the largest producer of science and engineering doctoral degrees in the Asian region.

It is noteworthy that, while science and engineering account for about one-third of all bachelor's degrees in the United States, these fields account for nearly 60% of bachelor's degrees in China. The Ministry of Science and Technology reports that, as of 2003, there were 5 million students enrolled in science and engineering programs at Chinese universities. Data on China's science and engineering degrees over the next 5 years should be interesting indeed!

An indirect indicator of the development of a trained science and engineering labor pool is the number of individuals born in a country who are employed in science and engineering occupations within the United States. The number of individuals with college degrees who were born in China and employed in science and engineering occupations in the United States rose from 31,000 in 1990 to 124,000 in the year 2000, constituting an increase from 1.2 to 3.1% of all tertiary-degreed individuals working in S&E occupations in the United States. During the same period, the number of doctoral degree holders employed in U.S. science and engineering occupations who were born in China increased from 5,500 to 33,000, representing an increase from 2.6 to 8.7% of the total number of doctoral degree holders working in U.S. science and engineering occupations (Appendix Table 3).

In summary, I hope this snapshot of data provides useful context for your policy-making efforts. China faces many challenges in developing its science and technology enterprise, including social, political, organizational and bureaucratic constraints. However, data show significant growth in China's high-tech industries, and in their investments in R&D and education. Given their enormous reserve of human capital, and the increasingly global nature of science and technology in the 21st century, China appears poised for continued rapid growth in the future.

The National Science Foundation looks forward to tracking future trends and to continued participation in such timely discussions. Thank you again for the opportunity to appear before the Commission.

Appendix Table 1.

China's S&T Trajectory
R&D Indicators

	United States			China				
	1996	2001	2002	1994	1996	2000	2001	2002
World High-Tech Exports (%)	20	17			7		9	
High-Tech Industries Production (billions of 1997 U.S. $)	597	941			93		266	
Value-Added Production (billions of 1997 U.S. $)	258	412			24		70	
Value Added/Production (%)	43	44			26		26	
U.S. Patents Granted to Inventors of U.S. and Chinese Origin	61,104		86,973		134			522
U.S. Patent Applications from Inventors of U.S. and Chinese Origin	106,892	177,511			364		1252	
R&D Expenditures of U.S. Majority-Owned Affiliates in China (millions of current U.S. $)				7		506		
Value Added/Gross Product of U.S. Majority-Owned Affiliates in China (millions of current U.S. $)				678		5,516		
Ratio of R&D to Value Added to Gross Product for U.S. Majority-Owned Affiliates in China (%)				1.0		9.2		
Number of U.S. Majority-Owned Affiliates in China				172		454		
Gross Expenditures on R&D (billions of U.S. $ in current PPP)	198		277		20			72
GERD/GDP (%)	2.6		2.7		0.6			1.3

Appendix Table 2.

China's S&T Trajectory: Education Indicators

	United States					China		
	1991	1995	1996	2000	2001	1991	1996	2001
Tertiary-educated Workers (thousands)	45,403				59,185	16,121		45,709
S&E Bachelor's Degrees		384,674		398,622			281,245	337,352
S&E Doctoral Degrees			27,243		25,509		4,428	8,153

Source: Science and Engineering Indicators 2004, National Science Board; and other

Appendix Table 3.

China's S&T Trajectory:
Workers in U.S. S&E Occupations

	Born in United States		Born in China	
	1990	2000	1990	2000
	(thousands)		(thousands)	
Bachelor's or Higher Degree	2,185	3,068 (77%)	31	124 (3.1%)
Doctoral Degree	159	240 (62%)	5.5	33 (8.7%)

Source: Science and Engineering Indicators 2004, National Science Board

Panel VI: Discussion, Questions and Answers

Cochair MULLOY. Dr. Weber, thank you very much.

Thank you both for some really good testimony and very helping, good information in there.

Commissioner Wortzel.

Commissioner WORTZEL. Thank you very much.

I'm very interested in this agreement, Doctor, for a couple of reasons. You're probably aware that in, I think it was, 1984 or 1985, under a very similar series of agreements the U.S. Geological Survey had linked to the Russian Soviet Academy of Sciences a set of computers that were really designed to do bathymetric and—metrology generally is the science of measurements, metrological studies. It seemed like a very innocent agreement that advanced science. And it turned out after a fairly extensive counterintelligence investigation that what had actually happened was the bathymetric data and geodetic data that would have permitted Soviet submarines to choose the best firing points to target American missile silos or bunkers or underground facilities.

The salinity and geodetic data that would have allowed them to adjust the launch of that missile correct, to hit more accurately, was being automatically transferred to the Soviet armed forces.

The effort to shut it down was strongly opposed by your Bureau, I would add. It's a very reassuring report, but you acknowledge in your own annual report that at least in the area of nuclear physics there may have been some losses. The Cox Commission Report outlines some losses that may have improved China's nuclear capability.

I would imagine that if we looked into it, the same sort of bathymetric and geophysical data that was of concern with the Soviet Union in 1984 is now being transferred to the Chinese Academy of Sciences and could be used for this new nuclear submarine program.

So I'm not as sanguine about all the activities that go on in there. Most of them I think are great activities and I would really support, but when you get into mapping and metrology and geodetics and when you get into nuclear physics, I think it requires more control.

So question one would be: Could you describe to us the counter intelligence or security controls that accompany these agreements and how do we know that these scientists aren't mishandling data or losing large spools of classified data?

Second, you say in your testimony that the report's analysis has not identified any significant diversion of high-tech information that would be of use to China's—could you characterize for us the insignificant stuff that went over there? Who has that standard of what's significant and what's insignificant?

So I'm skeptical. I support a lot of this. Are there 12 or 18 protocols?

Mr. ROCK. There are 26 protocols.

Commissioner WORTZEL. Twenty-six protocols. Well, of those I have expressed serious reservation about two, based on real serious problems. So I'd like to explore that and ask you to discuss those. Thank you.

Mr. ROCK. Thank you very much, Commissioner. And, first of all, I think I should simply state and I know you're all aware of this, that what we are discussing today was the unclassified version of the document. And I know that you all have also had an opportunity to take a look at the classified version of that as well.

Let me just first, if I may, talk about the overall monitoring and approval process for these agreements, because it sort of operates at four levels, if you will. The most macro level is the Joint Commission itself, the high-level commission that is chaired by the President's Science Advisor and by the Chinese Minister of Science and Technology. It's through that mechanism and a supporting Executive Secretariat process that we have regular meetings and we discuss the overall areas of cooperation, the projections for the future of where we would like to see that cooperation take place.

And there are a range of interagency meetings that precede those JCM discussions. And in those interagency meetings we have the participation of all key agencies, including the Department of Defense and the intelligence community as part of that dialogue.

There are then subsequent interagency working group meetings that occur after the JCM dialogue, so that we can get a sense about whether the areas that we are proposing are areas that we can, in fact, follow through on.

That gets us to stage two in the evaluation. And if an agency says that they believe that they can follow through in an area of cooperation, they start something called the Circular 175 process, which is the process by which they design a proposed agreement that they intend to negotiate. Again that agreement goes through the entire interagency evaluation process and, in fact, it's my bureau that has the responsibility of ensuring that each component, both within the State Department, which includes our nonproliferation bureaus and our intelligence bureaus and our regional bureaus alike, and the interagency community, again including DOD and the intelligence community, all participate in reviewing the draft agreement that's the subject of negotiation.

The third level is a bit of a postfactum but it is indeed the biennial report itself. We do circle back as a result of the efforts that you and the Commission have identified for us. We do circle back and see whether or not there has been progress toward the goals or whether there has been something that might suggest diversion.

The fourth level is a little bit more diverse, but let me just say that individual agencies monitor their own programs. And this is true across all sectors. And I would point out, for example, that Health and Human Services has posts in Beijing right now. The Department of Energy will be putting in posts; the National Science Foundation will be putting representatives in Beijing. We of course have an Environment, Science and Technology Section within the Embassy in Beijing itself.

The Department of Commerce reviews the U.S. agency activity on a regular basis. I would note NOAA, NIST, and NSF in particular that got recent reviews in these areas.

All travel is reviewed across all of the agencies' activities. All grants are reviewed. All of our NIH grants are reviewed. All of the visa applications for S&T personnel obviously are reviewed throughout the course of this process.

So it is a fairly comprehensive evaluation I think at each stage of the game.

What are we losing? What might be diverted? This export-control review is not a competitiveness review. It is not a review that examines whether or not the corporation that decides to assist in an R&D facility in China is doing the right thing or the wrong thing. It looks specifically at the Federal agencies and at their activities.

If you look at something like nuclear safety, for example, it's in our shared interests to ensure that we don't have another Chernobyl. And so we look at plant aging. We look at security of materials. We look at all of these elements.

Do we learn more about the materials? Do they learn more about the materials as a result of that? Certainly we are sharing information about all elements of that talking. Is the benefit greater than the costs? Certainly the security of the facility itself is of a far greater value to us overall.

Cochair MULLOY. We have two other panels coming on, so we're going to try and get in and out, each Commissioner five minutes, so try and give your answers crisply, short, so we can get moving through here.

Chairman D'Amato.

Chairman D'AMATO. I'm going to be crisp in my question. I have two quick questions, one for Dr. Weber.

To what extent is your agency gearing up to do a major review of China's S&T? I noticed we're talking about an analysis that's two, three, four years old, and they're moving so quickly. I heard you say something about a study this summer. I don't know whether that is on that level of criteria, but in your next budget submission, for example, which is now going through the appropriations process, the question is: Are there sufficient resources for the agency to go ahead and do a major new S&T assessment of China?

Dr. WEBER. The Report on Asia Science and Technology that I referred to will come out this summer. It's a fairly comprehensive report. Unfortunately in many ways it relies on vetted data that are internationally comparable. And, therefore, by their nature, will be several years old. So even in that report, using OECD and data from individual countries that have been fully vetted and comparable, the data will be from 2001 and 2002 generally. But it will be a comprehensive report that will provide good context and comparison.

It is very important in these kinds of data to look at trajectories; the individual points are not as important. So the trajectory showing rapid increases, we can expect to continue.

Regarding NSF's efforts and budget for these purposes, we do the biennial report to Congress. It's mandated. It's part of our budget. There has been increasing activity internationally, not just with China. Several chapters cover various indicators on international activities. These have been included for several iterations now and that will certainly continue.

Specifically for China, we sent an NSF staff member to the embassy in Beijing for about two months a year and a half ago. She went back last fall for another month looking at these kinds of data, interfacing with the Ministry of Science and Technology and other agencies. We're beginning to develop that relationship. We hope that the opening of our office in Beijing later this year will help move that process forward.

Chairman D'AMATO. Thank you. It does seem to me like the time is ripe for another major review by the agency. We'd like to examine that a little further with you.

I have a quick question for you, Mr. Rock. I understand you have an executive committee meeting this fall, as you do annually or biannually with the Chinese. I'm curious about how the agenda is set.

For example, it seems to me that some of the problems that China has, particularly in the area of the environment, they need a lot of help on the environment before they wreck it, and some areas of health and that sort of thing. Are we proactive in establishing the agenda as to what we think should be going on or are we kind of on the receiving end from the Chinese? How does that dynamic work?

Mr. ROCK. Thank you for that question because I think this is something we've really been looking at carefully. Our White House Science Advisor Jack Marburger is very engaged in this process overall. It's his view that we should be doing much more to set the priorities.

The Executive Secretariat meeting is really geared to look at the activities that the agencies already have underway and how we can extend those further. Going into the new areas is something that we do at the high level JCM discussions. We actually do a fair amount right now in the environmental area in particular. EPA has some excellent work that they're doing, air quality work, water quality management, emissions work, that sort of thing. It's excellent.

The Executive Secretariat meeting will be looking at extension of those existing activities. The next JCM will take on the bigger new areas, and I know that Dr. Marburger will be on top of that.

Chairman D'AMATO. When will the next JCM be, next year?

Mr. DRAGNICH. That would be two years from last October.

Chairman D'AMATO. Thank you.

Mr. DRAGNICH. It's a two-year cycle, and then the Executive Secretariat meets in the intervening year, so it will be October of this year that the Executive Secretariat meets.

Chairman D'AMATO. So there's plenty of time now to fashion an agenda that we think would be useful.

Mr. ROCK. Absolutely.

Chairman D'AMATO. Thank you.

Cochair MULLOY. Sir, could you identify yourself for the record?

Mr. DRAGNICH. Yes. I'm George Dragnich. I head the Office of Science and Technology Cooperation under Mr. Rock. I am the U.S. Executive Secretary for the Executive Secretariat.

Cochair MULLOY. Thank you very much.

Commissioner Dreyer.

Commissioner DREYER. A question for Dr. Weber. I was interested in your statement that the Chinese educational system is moving away from elitism. I take it you got that from official numbers?

Dr. WEBER. Yes, very much so. With more than 15 percent of their 18- to 20-year-old population now enrolled in higher education.

Commissioner DREYER. Beware of the official numbers because they are belied by what the Chinese are saying to each other in their newspapers. There was a recent report on the nine-year-compulsory education system, which concluded that China was way, way, way far away from its goal. It also found a large number of cases in which schools lied about the number of students they had because they get paid per student. The dropout rate has actually increased in some areas. Furthermore, there are a lot of complaints in the Chinese press about the elitism of the system because kids in urban areas have many more educational opportunities than those in rural areas. In fact, the government seems to have embarked on a practice of practical triage. They all but forget the rural areas, and the rural areas are still where 70 percent of the population lives.

You also have 120 million people with I don't know how many children who are migrant workers. These children do not have adequate access to education. So I would just ask you to bear these in mind when you say the system is moving away from elitism, because if you read what the Chinese press is saying, they're worried that it's moving toward greater elitism.

Cochair MULLOY. Thank you.

Commissioner Reinsch.

Commissioner REINSCH. Mr. Rock, I have a couple of questions for you. You referred to visa review in passing. Is that something that your Bureau participates in within the State Department for the people that are coming in pursuant to these agreements?

Mr. ROCK. Mr. Commissioner, my bureau doesn't do it directly, but I can give you a sense of how the process is done.

Commissioner REINSCH. I know you do that. I just wanted to know if you participated——

Mr. ROCK. My Bureau does not do it directly, no.

Commissioner REINSCH. Do you get involved at all in the departmental review of the Technology Alert List?

Mr. ROCK. What my Bureau does is to pass the documentation to our Defense Trade Controls Office, which is in our Nonproliferation Bureau and to each of the other components of the Bureaus that are responsible for export control throughout the Department.

Commissioner REINSCH. What documentation do you distribute?

Mr. ROCK. The individual proposals. The agreements themselves and the——

Commissioner REINSCH. I see.

Mr. ROCK. —proposals for each of the areas of cooperation from each of the Federal agencies.

Commissioner REINSCH. I'm a step removed from that. The Department maintains a list of technologies that it cares about, and it reviews some visa applications in light of that list. It seems to me that if you are the Science Bureau, among other things, that you would want to have some role in determining what is on and off that list, but you don't.

Mr. ROCK. Well, on behalf of the agencies that we represent, NASA for example and NOAA and USGS and the like, we're very interested in assuring that their programs can move forward as best as possible. But we realize the constraints, the technology constraints and the controls that need to be in place. So we are in the business of trying to move the cooperation forward as best we can, but we are not in the business of telling our export control people what should or should not be on that list, so it does create a certain tension between us and the other guys, as you imagine.

Commissioner REINSCH. I'm trying to increase that tension and I'm encouraging you to increase that tension. It seems to me that your role is not to decide what's proliferation sensitive and what isn't. Somebody else does that and that makes sense. But it seems to me you can make a meaningful contribution in talking to those people about what technology is already widely disbursed and what is not and what technology is generally available. And I assume what you do too, which is to let them know when a project is particularly in the interest of the United States Government and have it go forward.

Okay. Second question, if I may. You also mentioned in your testimony that one of the categories of the 26 relates to standards. Can you elaborate a little bit. Maybe this is not fair to ask you. Maybe I should ask somebody from Commerce, but can you elaborate or, if not, supply for the record what is covered by that, what actual activities are covered by that?

Mr. ROCK. Commissioner, the best thing for me to do would be to supply you for the record the summary of the NIST activities, with the National Institute for Standards and Technology, it is a part of the——

Commissioner REINSCH. It's all done by NIST?

Mr. ROCK. It's all done by NIST, yes.

Commissioner REINSCH. Okay.

Mr. ROCK. And it covers a wide range of activities. Most of it is exchange of personnel on the standard practices with regard to metrology and the standards measurement. These are not technology exchanges so much as they are information exchanges.

Commissioner REINSCH. Right. Now that's very important. This came up yesterday, if you recall if you were here, because a lot of us, including me, view standards as the next big trade barrier problem, not only with respect to China but primarily with respect to the EU. But to the extent that we can work with the Chinese to develop common standards or, more appropriately, our standards that really gives our exporters a leg up.

Mr. ROCK. I'm actually glad to hear you say that because NIST is my prime customer in all of our science-and-technology agreements. We have just recently had a discussion with them to ensure that they're as active as possible, specifically with the EU, since you mentioned it. This is an area that we think is particularly important. It's obvious that the commercial impact is huge as a result.

Commissioner REINSCH. Do you have some doubts about their enthusiasm?

Mr. ROCK. Not one bit, sir.

Commissioner REINSCH. Good.

Mr. ROCK. I went and met with the director himself, and he is fully committed.

Commissioner REINSCH. Good. Thank you.

Thank you, Mr. Chairman.

Cochair MULLOY. Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thank you very much, Mr. Chairman.

Thank you to our witnesses and thank you both also for your service. It's something that we all benefit from, so thank you.

Mr. Rock, who decides what scientists participate in these exchanges in programs? Is it all government-to-government scientists?

Mr. ROCK. I'm inclined to say it's all government-to-government scientists, but that really wouldn't be fair to the National Science Foundation and to Health and Human Services.

Let me just emphasize that the entire agreement, if you look at the dedicated funds, the entire agreement really is less than $50 million overall, over the past years of this study. And $38 million of that went to Health and Human Services, 28 million for NIH and another 5 million or so to CDC. Another 7 million goes to the National Science Foundation.

So reaching out to the scientific community in the case of biomedical and in the case of NSF's activity is far and away the bulk of the commitment in terms of resources under the agreement. Beyond that we are entirely driven by the priorities set by the Federal agencies themselves. And that's why it's a very important question about how we are pulling together what the Administration sees as priorities for cooperation as opposed to what each of the individual agencies feels they can achieve through a cooperative relationship with a Chinese counterpart.

We are, to some extent, captive to that right now simply as a result of limited resources.

Commissioner BARTHOLOMEW. And from the perspective of the Chinese government, it's the government that's deciding which scientists are participating?

Mr. ROCK. Absolutely.

Commissioner BARTHOLOMEW. This might not be the right question, but we've been hearing a lot about bringing students over, university students, graduate students. Do either of you know anything about the process by which those students are chosen in China who can go abroad to study? How they're identified, how they're chosen?

Mr. ROCK. I can't speak to the exact process. I can tell you that we processed 230,000 visas for the Chinese in 2004, and of those we issued 18,000 visas to Chinese students. It gives you a sense of the percentages. I have no doubt and all anecdotal information suggests that they are carefully selected for priority areas of science.

As I believe I mentioned to some of the Commissioners yesterday, I don't think that we do over-estimate how strategic that really is. I think there is a bit of letting a thousand flowers bloom, if you will, in getting the best and the brightest into U.S. university systems.

Commissioner BARTHOLOMEW. But they need some sort of Chinese government sponsorship or support in order to go abroad and study in an American university or Australian university. Again, it might not be fair questions to ask you, but I'm trying to understand that process.

Dr. WEBER. I can't speak to the official process, but most of the Chinese students coming to the United States are not supported with Chinese government funds. They're supported with family or private funds.

Commissioner BARTHOLOMEW. Okay. All right. Thank you, gentlemen.

Cochair MULLOY. A final question. I grew up in northeastern Pennsylvania and I grew up right around the post-Sputnik era, when there was a lot of Federal money that would help young people get educations, graduate educations. I got an NDA, a fellowship. One of my good friends got an NSF fellowship.

He went on and got his Ph.D. in chemistry, taught chemistry, became head of the chemistry at a mid-size university, and I think is now dean of the science and engineering—or somewhere. So your money invested in him really went quite far.

Now I know you have a $5.5 billion budget. And I think you still make grants for students to pursue graduate work. And we heard yesterday that more and more of the Chinese people who come here to get educated have incentives by the Chinese government to go back to China.

In your testimony you tell us that right now 8.7 percent of the total doctoral degree holders working in U.S. science-and-engineering occupations are from China. Do the U.S. taxpayers through the NSF give money to educate Chinese students as opposed to American students? Because when you get one of these fellowships it makes a big difference in your life. You can contribute a lot to your society for generations. The people he's trained have been assets for our society.

Do we give the Chinese students or other foreign students those NSF and, if so, how much? What is the percent that goes to America and what is the percent that goes to foreign?

Dr. WEBER. The support of graduate students is done in two ways by the National Science Foundation. One is through fellowships, which are given to individual students. And there is a citizenship or permanent residency requirement to apply for and receive those fellowships.

Each year NSF gives about 1,000 graduate research fellowships. Those are all going to U.S. citizens.

The other main mechanism for providing support for graduate students is through research grants. So a university professor will apply to NSF for a research grant. That budget can include support for postdoctoral or graduate student researchers. There is no citizenship requirement in that case. And so the NSF and, therefore, U.S. Government funds are in some cases being used to support foreign graduate students working at U.S. universities on projects led by U.S. researchers.

Cochair MULLOY. Let me just further elaborate on this because I think it's important. My son went to an elite university. He's in medical school now. But when he started he had to take all these science courses and math.

He would come back home and tell me, "Dad, they're all taught by people from abroad, and I don't understand what they're talking about. It's very difficult." The people who apply for these research grants, they may be foreign citizens at the university, and they might then choose to bring other foreign students to benefit from that. Would that follow? I think that would follow.

So is this of any concern to anybody, the fact that our systems are loaded with this makes it that the American students that might want to go into this and may stay here with their lives have less incentive or are not nurtured to go into this kind of stuff? And, if so, is that something we ought to address or think about how to address?

Dr. WEBER. That certainly is a big concern. As was discussed in yesterday's testimonies, one way of looking at this is we need to have a world-class, world-competitive higher education system that is advancing the frontiers of science and technology. We need to get good people from wherever we can. In that sense we're, the United States, is benefiting tremendously from the foreign talent that we're attracting here.

Many, many faculty at U.S. universities are from abroad. The National Science Foundation does not require that they be U.S. citizens in order to apply. They have to be employed at a U.S. institution. NSF grants go to U.S. institutions.

Cochair MULLOY. They go to a professor who applies. And then he can hire people with that grant, right?

Dr. WEBER. Yes. Yes.

Cochair MULLOY. So he may hire people from his home country?

Dr. WEBER. If those individuals came to work with that researcher as a postdoc or a graduate student, certainly, yes, he could use that support——

Cochair MULLOY. Is there a debate among the scientific community on whether this is a problem or whether we should be rethinking what we're doing here, or does everybody think this is the way it should go?

Dr. WEBER. The other half of your question was whether or not we shouldn't be encouraging and giving incentives to U.S. citizen students and researchers. The answer is absolutely, yes. It's not a situation where we have a long line of U.S. citizens waiting to get into the graduate degree programs to be postdocs, to be professors. It's a situation where there's a large demand for that. Without the foreign talent coming in, we wouldn't be able to fulfill that——

Cochair MULLOY. I just want to finish this up, because I think there's something going on here.

When I was in college the head of the history department encouraged me to take the Foreign Service exam, and that direction had an enormous influence on me. If a foreign professor is the head of some department, he may turn off the American kids who can't understand him, or whatever. I think there's some problem with nurturing our own students to go into this. I think people ought to be thinking about it in some way or another. Enough said, but I think there's an issue here that needs further discussion.

Thank you very much for being here, both of you. This has been enormously helpful.

We're going to take a five-minute break and then we have two other panelists, so thank you.

[Recess.]

PANEL VII: CHINA'S IPR PROTECTIONS AND THE U.S. ENTERTAINMENT INDUSTRY

Chairman D'AMATO. In our last two panels of this inquiry into China's high-technology development and what it means for U.S. economic and technological competitiveness, we will hear from experts on China's intellectual property rights protection.

On the current panel we have Mr. John Malcolm, Senior Vice President and Director of Worldwide Anti-Piracy Operations for the Motion Picture Association of America; and Darcy Antonellis, Senior Vice President of Worldwide Anti-Piracy Operations for Warner Bros. Entertainment, Incorporated.

We look forward to this perspective from the entertainment industry and note that the entertainment industry together with aerospace, is really the leading signature industry in the United States. What happens to it is of great interest to this Commission.

We'll put your full testimony in the record if you would summarize it in seven or eight minutes and then we'll go to Q&A.

Mr. Malcolm.

STATEMENT OF JOHN G. MALCOLM SENIOR VICE PRESIDENT AND DIRECTOR WORLDWIDE ANTI-PIRACY OPERATIONS MOTION PICTURE ASSOCIATION OF AMERICA ENCINO, CALIFORNIA

Mr. MALCOLM. Mr. Chairman, fellow Commissioners, I'm very pleased to have the opportunity to appear before you today on behalf of the Motion Picture Association of America and its international sister organization the Motion Picture Association to discuss China's progress in implementing effective intellectual property rights protection and enforcement, as well as its progress in opening its markets for legitimate film products.

The 1995 USTR negotiated intellectual property rights agreement and the November 1999 U.S. Government-China Agreement for China's entry into the World Trade Organization were intended to provide market access opportunities for American entertainment companies and to address the unchecked piracy of movies.

Since 1995 American entertainment firms have invested heavily in the Chinese market, exporting films to China, co-producing films in China, distributing Chinese films abroad, investing in the construction of new theaters and the modernization of old ones, hosting Chinese film festivals in the U.S., and sponsoring training sessions.

Despite extensive efforts and steady investments by the MPAA and its member companies in the audio/visual market in China, strong support from the U.S. Government, and continuous dialogue with Chinese authorities, we have only seen limited progress thus far with respect to both increased market access for American entertainment companies and the fight against movie theft, which still flourishes.

Strict market access barriers and rampant piracy continue to thwart efforts to deliver legitimate entertainment products in China, hurting both the Chinese and American film industries. Although box offices revenues for U.S. films in China were up in 2004, this did not begin to make up for the nearly 60 percent decline in theatrical revenues that our members experienced in China from 1996 to 2003.

As a result of Chinese-government-imposed trade barriers that limit the importation of legitimate film products, thereby giving pirates free rein to fill the great demand that exists in China for U.S. films, and an insufficient law enforcement response, piracy in China has reached levels not seen since 1995.

In 2004 it's estimated that our members lost $280 million due to piracy in China, an increase of over $100 million from the already deplorable losses that they suffered in 2003. As you no doubt are aware, the American motion picture industry is a vital component of our economy. The American broadcast and motion picture industries accounted for $108.4 billion to the 2001 U.S. gross domestic product. And the success of U.S. films abroad is a major facet of the industry's revenue.

While most U.S. industries struggle with trade deficits, the American motion picture industry has a trade surplus with every country with which we do business and directly employees approximately 500,000 U.S. workers. With respect to China, the reality is the trade in the theatrical market is essentially a one-way street.

As the box office potential for U.S. films in China remains anemic because of access restrictions and piracy, U.S. companies are importing Chinese films into the U.S. and other markets, which results in considerable revenue for Chinese producers and which helps the Chinese economy. Chinese films have done very well in the United States, grossing tens of millions of dollars and benefiting enormously from strong marketing and wide distribution arranged by U.S. distributors.

For example, in the U.S. alone *Crouching Tiger, Hidden Dragon* grossed $125 million. *Hero* opened at number one in the box offices as soon as it was released and grossed of $50 million. And to date *House of Flying Daggers* has grossed over $10 million.

In sharp contrast, the total box office generated in China for all U.S. films last year was about $60 million. And, by the way, U.S. companies are only allowed to receive 13 to 14 percent of that money, the precise amount to be determined by the Chinese government. From our perspective this is unacceptable. China must demonstrate its serious commitment to providing adequate market access for our film products and to effectively protecting them from being stolen on a massive scale.

Market barriers that invite piracy and prevent the legitimate distribution of U.S.-filmed entertainment must be removed.

I've outlined a number of specific proposals in my written submission about ways to eliminate restrictions on market access in a full and fair way and about ways in which the Chinese government could effectively combat piracy. They're fairly straightforward, such as an end to government-imposed film quotas and theater blackout periods; an end to restrictions on foreign investment and revenue sharing; an end to strict limits on the number of foreign importers and distributors who are permitted to operate within China.

They also call for increased enforcement efforts, the establishment of reasonable criminal thresholds, the imposition of deterrent sentences, and the dissemination of government-sponsored messaging to the Chinese public about the illegality of and real harms caused by copyright piracy.

I look forward to exploring some of these proposals with you today and to answering any questions you may have. Thank you.

[The statement follows:]

Prepared Statement of John G. Malcolm
Senior Vice President and Director, Worldwide Anti-Piracy Operations
Motion Picture Association of America, Encino, California

Dear Mr. Chairman and fellow Commissioners,

I am pleased to have the opportunity to appear before you today on behalf of the Motion Picture Association of America (MPAA), and its international sister organization the Motion Picture Association (MPA), to discuss China's progress in implementing effective intellectual property rights protection and enforcement, as well as its progress in opening its market for legitimate product.

The Motion Picture Association of America represents seven major studios that produce and distribute filmed entertainment—theatrical motion pictures, home video entertainment and television programming—all around the world including China. Our members include Buena Vista International, Inc., Metro-Goldwyn-Mayer Studios Inc., Paramount Pictures Corporation, Sony Pictures Releasing International Corporation, Twentieth Century Fox International Corporation, Universal International Films, Inc., and Warner Bros. Pictures International, a division of Warner Bros. Pictures Inc.

The 1995 USTR-negotiated intellectual property rights agreement and the November 1999 USG-China agreement for China's entry into WTO were intended to provide market access opportunities for American entertainment companies, including our members, and to address the unchecked piracy of movies. Since 1995, American entertainment firms have invested heavily in the Chinese market: exporting films to China, co-producing films in China, distributing Chinese films abroad such as the recent U.S. releases of "Crouching Tiger Hidden Dragon," "Hero," "House of Flying Daggers," and "Kung Fu Hustle," investing in the construction of new theaters and the modernization of old ones, hosting Chinese film festivals in the U.S., and sponsoring training sessions.

Despite extensive efforts and steady investments by the MPA and its member companies in the audiovisual market in China, strong support from the U.S. Government and continuous dialogue with Chinese authorities, we have seen only limited progress thus far with respect to both increased market access for American entertainment companies and the fight against the piracy of movies, which still flourishes. Strict market access barriers and rampant piracy continue to thwart efforts to deliver legitimate entertainment products in China, hurting both the Chinese and American film industries. Although box office revenues for U.S. films in China were up in 2004, this did not begin to make up for the 60% decline in theatrical revenues that our members experienced in China from 1996 to 2003.

As a result of Chinese government imposed trade barriers that limit the importation of legitimate filmed products, thereby giving the pirates free reign to fill the great demand that exists in China for U.S. films, and an insufficient law enforcement response, piracy in China has reached levels not seen since 1995. In 2004, it is estimated that our members lost $280 million (USD) due to piracy in China, an increase of more than $100 million (USD) from the already deplorable losses suffered in 2003.

As you, no doubt, are aware, the American motion picture industry is a vital component of our economy. The American broadcast and motion picture industries accounted for $108.4 billion of the 2001 U.S. GDP. The success of U.S. films abroad is a major facet of the industry's revenue. While most U.S. industries struggle with trade deficits, the American motion picture industry has a trade surplus with every country in which we do business, and directly employs approximately 500,000 U.S. workers.

With respect to China, the reality is that trade in the theatrical market is essentially a one-way street. At the box office potential for U.S. films in China remains anemic because of access restrictions and piracy, U.S. companies are importing PRC films into the U.S. and other markets, which results in considerable revenues for Chinese producers and which help the Chinese economy. Chinese films have done well in the United States, grossing tens of millions of dollars and benefiting enormously from strong marketing and wide distribution arranged by U.S. distributors. For example, in the U.S. alone, "Crouching Tiger Hidden Dragon" grossed over $125 million (USD); "Hero" opened at #1 in the box office as soon as it was released and grossed over $50 million (USD); to date, "House of Flying Daggers" has grossed over $10 million (USD). In sharp contrast, the total box office generated in China for all U.S. films last year was about $60 million (USD), and, by the way, U.S. companies are only allowed to receive 13% to 14% of that money, the precise amount to be determined by the Chinese government.

From our perspective, this is unacceptable. China must demonstrate its serious commitment to provide adequate market access for our filmed products and effective protection against piracy. Market barriers that invite piracy and prevent the legitimate distribution of U.S. filmed entertainment must be removed.

Because China has, thus far, failed to make any of these changes, the MPA joined the rest of the copyright industry members of the International Intellectual Property Alliance (IIPA) in supporting the IIPA's Special 301 recommendation that USTR immediately request consultations with China in the World Trade Organization, and that it place China on the Priority Watch List pending an out-of-cycle review to be concluded by July 31, 2005, at which time appropriate additional actions can be taken including the possibility of establishing a dispute settlement panel in the WTO.

I would now like to briefly review the current situation and provide some specific recommendations on what needs to be done.

MARKET ACCESS RESTRICTIONS SUFFOCATE LEGITIMATE MARKET

As I stated above, current government imposed restrictions on the importation and exhibition of foreign audiovisual content deprives Chinese consumers of access to legitimate audiovisual content, thereby creating opportunities galore for pirates to fill that existing need by providing stolen media containing uncensored and untaxed content. Legitimate market potential in China continues to be impacted most severely by:

(i) lack of competition in the distribution of film because the Chinese government permits only one film importer and two film distributors, both of which are components of the same monopoly managed by the State Administration of Radio Film & Television (SARFT);
(ii) a quota of 20 non-local films per year to be distributed on revenue sharing terms to be determined solely by the Chinese government;
(iii) limits on the retail sale of legal home entertainment; and
(iv) government-imposed restrictions on foreign investment, foreign channel carriage, and programming content in the television sector.

These restrictions on foreign audiovisual products tilt the market environment heavily in favor of pirates, who obey none of the government's regulations and restrictions, while capturing at least 95% of the U.S. audiovisual industry market's sales in China. The unchecked piracy of local and foreign films provides clear evidence that the current market access regime does not meet Chinese consumer demands and will cause the Chinese entertainment industry to suffer.

I would now like to offer specific recommendations as to what we believe the Chinese government must do to strengthen the market for legitimate audiovisual products and to combat widespread piracy:

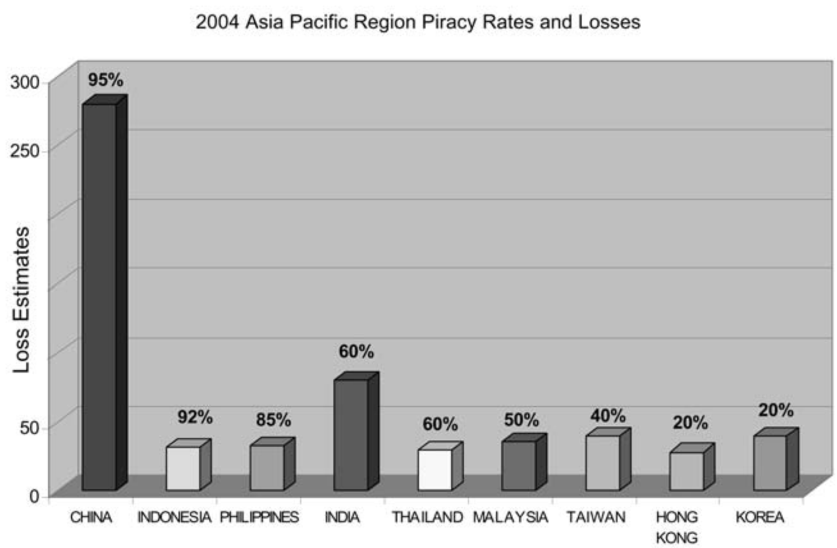
Market Access

- Set a fixed timetable for the removal of the limits, restrictions, and structural distortions on imported audiovisual products, and allow a free and competitive marketplace to develop in which Chinese consumers, not the Chinese government, are able to determine which films and other audiovisual products are most appealing to them.
- **Film:** (1) eliminate the government imposed import monopoly; (2) eliminate the government imposed distribution duopoly; (3) remove film import restrictions and the unreasonably low quota (currently 20 films per year) on the number of revenue-sharing films that are permitted into China; (4) eliminate government determination of box office revenue percentage shares; (5) eliminate government determination of which films will be imported and when they will be released; (6) institute a ratings system with age classifications which will operate quickly, efficiently, and transparently; and (7) eliminate "black-out" periods when new releases of non-local films are denied screen time.
- **Home Video:** (1) streamline and expedite the licensing process for retail outlets by designating one authority with the power to grant retail licenses; (2) ensure import duties are based solely on the value of the imported physical media, not on potential royalties which may never come to fruition; (3) remove restrictions on replication and home video licensing agreements; and (4) streamline and improve the censorship process.

- **Television:** (1) permit foreign satellite channels to be carried on local cable systems; (2) streamline and expedite the censorship process; (3) reduce local content restrictions; (4) continue to reduce investment limitations; and (5) eliminate the local uplink requirement.
- **Internet/E-Commerce:** (1) Designate one governmental body with administrative authority over matters relating to the Internet; (2) establish consistent, centralized, and transparent regulations of the Internet with policies that reflect and reinforce the provisions of copyright laws by protecting content and punishing infringers with stiff administrative criminal penalties, and which include potential liability for Internet service providers (ISPs) for piracy related offenses and satisfactory notice-and-takedown measures for websites offering pirated materials; (3) ensure guaranteed access to a secure environment for legitimate media suppliers to offer the products or services; and (4) implement prohibitions on registering, trafficking in, or using a domain name with bad-faith intent to profit from the goodwill of a trademark belonging to another entity (commonly known as cybersquatting); and (5) clarify existing ambiguities and cure deficiencies in the Copyright Law pertaining to the circumvention, alteration or deletion of electronic rights management systems and to temporary copies so as to comply with the clear letter and spirit of the protections afforded in the World Intellectual Property Organization (WIPO) Copyright Treaty.

PIRACY FILLS THE VOID

Piracy is ubiquitous in China, filling the void created by strict limitations on foreign access to the legitimate market. China has the highest piracy rate in the Asia Pacific region, estimated at 95% in 2004, and adequate measures are not being taken to address the problem. No legitimate supplier of films, whether local or foreign, can compete with pirates who pay no taxes, endure no censorship obligations, and bear none of the costs of running a studio.



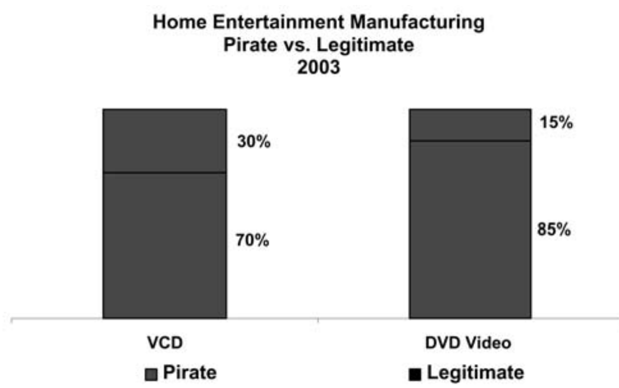
- **Optical Disc Piracy:** Optical disc piracy continues to be exceptionally high, the highest in the region. According to a 2003 article in The Hollywood Reporter, the legitimate home video market in China is only about 5% of the estimated total market of $1.3 billion (USD). Pirated DVDs of the latest U.S. theatrical titles are readily available within days, if not hours, of their initial release. Despite some efforts by local authorities, underground factories continue to operate around the clock producing thousands upon thousands of pirated discs.

China: Piracy/Manufacturing Capacity

	Licensed plants	DVD plants	Production lines	DVD lines
2003	71	32	569	65
2004	83	71	765	152

There is an immense illegal optical disc manufacturing capacity in China, far in excess of domestic demand. China's total optical disc manufacturing capacity from recognized and licensed replication facilities (not including blank CD–Rs) is 2.67 billion discs annually, which does not include the millions of discs that are produced in underground, unlicensed facilities. In addition to fulfilling the unmet demand for domestic consumption, huge numbers of these discs are illegally exported to other countries, thereby infecting those markets too.

Understanding and Solutions estimated that in 2003, 69% of the VCD and 85% of the DVD discs manufactured in China were pirate product.



Source: *Understanding & Solutions*

The abundance of pirate optical discs in China is evidenced by the low prices for those discs, lower than anywhere else in the region.

Asia Pacific Region: Prices for Pirate DVDs

Country	Pirate DVD (USD)	Country	Pirate DVD (USD)
Australia	7.30	South Korea	4.35
China	**0.60**	Malaysia	3.42
Hong Kong	2.56-3.85	New Zealand	7.50
India	2.67	Philippines	1.42
Indonesia	1.22	Singapore	7.00
Japan	8.93-13.40	Taiwan	4.42
		Thailand	3.75

- **Pirate Exports:** The export and transshipment of pirate optical discs from and through China continues to grow at alarming rates. Exports of pirated DVDs from China to the U.S., the UK, and other countries have increased steadily over the last three years and show no signs of abating. Although MPA appreciates the assistance of Customs, the fines and penalties that are generally levied against pirates who are apprehended are considered low and not deterrent.

- **Television Piracy:** There has also been a significant increase in cable and VOD piracy in China. Provincial television stations routinely make unauthorized broadcasts of MPA member company titles, often relying upon counterfeit "letters of authorization" or "licenses" from companies in Thailand, Hong Kong, and Taiwan, which purport to convey broadcast rights. There are approximately 1,500 registered cable TV operators in China and 45 digital TV operators, serving more than 100 million households, all of which routinely include pirate product in their programming. Very few enforcement actions have been taken to date.
- **Internet Piracy:** Internet piracy involving illegal hard good sales and unauthorized downloading and streaming of MPA member company films is also on the rise. A large number of Chinese ISPs host these infringing websites. In 2004, MPA sent out 3,905 cease-and-desist letters to ISPs in China, requesting the ISPs to "take down" infringing websites, compared with 444 such letters in 2003. While overall compliance rates are difficult to discern, we do know that when such notices were sent to non-P2P targets (mostly streaming sites), the compliance rate was a very disappointing 17%.
- **Losses Due to Piracy:** Theatrical feature films are released in a sequential pattern—first in cinemas, then in home video, and later in television. It is the hope of every film producer that the release pattern can generate revenues sufficient to recoup the investment in the film and, hopefully, return some profit for investors and for reinvestment into new projects. Piracy adversely affects every phase of the recoupment process. From 1998 to 2003, piracy-related losses to U.S. film companies topped $740 million (USD) in China. In 2004, piracy-related losses in China are estimated to reach $280 million (USD). Piracy is not only stifling foreign importers, it is crippling the entire Chinese film industry—studios and the cinemas.
- **Government Will:** Government recognition of the piracy problem, although improving, still has a long way to go. The bottom line is that China's actions have not produced substantial progress toward a significant reduction in copyright infringement levels, as had been promised by Vice Premier Wu Yi at the U.S.-China Joint Commission on Commerce and Trade (JCCT). Moreover, China has not met its WTO TRIPS commitment to provide effective enforcement, particularly criminal enforcement, against piracy "on a commercial scale," nor has it honored its continuing bilateral obligations as reflected in the 1995–1996 bilateral agreements and action plans. Although the MPA welcomed the 2004 announcement by Vice Premier Wu Yi of an IP protection campaign across China, and the establishment of a National IPR Protection Office (NIPO), and takes note of the fact that there has been a recent increase in raiding activity and better coordination of administrative enforcement efforts in various regions, those efforts, while welcome developments, have had little to no effect on the piracy situation. Criminal copyright cases against pirates are extremely rare in China, and there has been insufficient government messaging to Chinese consumers regarding piracy.
- **Lack of Deterrence:** Current law in China does not contain deterrent penalties and contains inordinately high criminal thresholds, which preclude effective prosecution and sentencing (more than 99% of raids currently result in administrative fines, most of which are quite low and do not act as a serious deterrent). The recently-amended Supreme People's Court's "Judicial Interpretations" do little to help the situation, lowering only slightly the monetary thresholds (which continue to be calculated at pirate prices, rather than legitimate retail prices) that must be achieved before a prosecution can be undertaken. There are additional problems regarding the definition of distribution, penalties/criminality of importing and exporting of pirate products, the rules with respect to repeat offenders, and other areas of the Interpretations. Unfortunately, we believe that these minor changes to existing law are highly unlikely to result in a sufficient number of criminal cases being brought or high enough penalties being imposed which might otherwise send a real message of deterrence. Finally, criminal enforcement of copyright piracy continues to be burdened by the fact that Articles 217 and 218 of China's criminal code require a demonstration that piracy is occurring for the purpose of making a profit, something very difficult to demonstrate in the online environment. TRIPS requires criminalization of "copyright piracy on a commercial scale"—not just piracy for the purpose of making a profit.

In our opinion, the Chinese government should take the following steps to help curb the rampant piracy situation that currently exists:

- **Fixed Timetable:** Establish a fixed timetable to reduce piracy from its current level of over 95%, setting as an immediate goal reducing piracy levels to less than 50% by the end of 2005.
- **Criminal Threshold:** Immediately reduce or eliminate the high criminal thresholds (and accompanying procedural hurdles) that prevent the effective application of the criminal law to audiovisual piracy—the only way to significantly reduce piracy in China. Sending major criminals to jail is key to bringing this form of large scale, criminal activity under control.
- **National Task Force:** Under Vice Premier Wu Yi's leadership, establish a national Anti-piracy Criminal Task Force to deter all forms of optical disc factory piracy, wholesale and retail piracy, and online piracy of software, books, music, games, filmed entertainment, and the like. This Anti-Piracy Task Force should engage in a transparent, well-publicized, and sustained national campaign to prevent and punish criminal acts of piracy occurring within the country and at its borders.
- **Criminal Code Amendment:** Amend the Criminal Code to clarify its full and effective application to all piracy crimes (including enterprise end-user piracy of software), thus bringing it into compliance with TRIPS.
- **Administrative Fines:** Significantly increase administrative fines for piracy and better utilize that process against all forms of piracy, including enterprise end-user piracy of software.
- **Copyright Law:** Through amending its copyright laws or implementing regulations, China should correct the deficiencies in its implementation of the WIPO Copyright Treaty and WIPO Performances and Phonograms Treaty, and should ratify those two treaties. As stated above, although China revised its copyright law in October 2001, deficiencies remain, including the unreasonably high threshold of commercial piracy necessary to trigger a criminal prosecution, and penalties that are not deterrent. China's failure to apply the criminal law to piracy is "in practice" a violation of TRIPS Articles 41 and 61 (requiring enforcement which "on the ground" deters further infringements, effective ex parte civil search orders, and specific deterrent "criminal" remedies). Further, China's copyright laws should (1) criminalize end-user piracy; (2) add reference to all the exclusive rights now provided in the law, particularly the new WIPO treaties rights and unauthorized importation; (3) add criminalization of violations of the anti-circumvention provisions and rights management information; (4) criminalize Internet offenses that are without "profit motive" but which have an adverse impact on rightholders "on a commercial scale"; (5) eliminate distinctions between crimes of entities and individuals; and (6) increase the level of penalties overall.
- **Public Awareness:** The government must make a much stronger effort to build consumer awareness of the dangers and penalties of engaging in piracy. Not only does piracy drain the national economy, it invariably fosters an expansion of other forms of criminal activity, including tax evasion and avoidance of censorship laws. All enforcement actions and prosecutions should be accompanied by heavy media coverage, spreading the message that the government considers piracy to be a serious offence. The Chinese government has demonstrated on innumerable occasions that, when it wants to do so, it can shape powerful forces in its society through enforcement efforts and extensive media coverage. It can do the same with piracy.

CONCLUSION

Mr. Chairman, on behalf of the Motion Picture Association of America, as well as the thousands of law-abiding people who work in the movie industry and whose livelihoods are threatened by piracy, I want to thank you again for inviting me to testify today. I would be happy to answer any questions you may have at this time.

Cochair MULLOY. Thank you very much, Mr. Malcolm.

Ms. Antonellis.

STATEMENT OF DARCY ANTONELLIS, EXECUTIVE VICE PRESIDENT DISTRIBUTION AND TECHNOLOGY OPERATIONS SENIOR VICE PRESIDENT, WORLDWIDE ANTI-PIRACY OPERATIONS WARNER BROS. ENTERTAINMENT INC., BURBANK, CALIFORNIA

Ms. ANTONELLIS. Thank you and good morning, Mr. Chairman and Commissioners. I'm honored to be here today on behalf of Warner Bros. Entertainment, one of the seven member studios that fund and work collaboratively with the Motion Picture Association, our trade organization.

The Commission's hearings over the last two days regarding China, its high-tech development, as well as its government's views towards IPR and foreign-market access are important issues that must be understood and addressed if our industry, the filmed entertainment industry, can hope to build viable businesses and partnerships in China.

While I know there are studio members who are experiencing the same level of frustration in the efforts to enter the China market, given Warner Bros. long history in the region, we hope to share some firsthand knowledge and experiences with you today.

Warner Bros. was the first studio to establish distribution arrangements in China. We opened our first office in Shanghai in the '20s. And since the mainland was reopened to foreigners, we have been expanding our participation in all areas of the entertainment spectrum, providing local employment and utilizing local services.

We were the first studio to film on location in the PRC with Steven Spielberg's *Empire of the Sun* and to release an American blockbuster, *The Fugitive*, in 1994. Today our priorities include support of the local China film industry, investment in local production and support of a local creative community to preserve the industry's art form.

We have invested heavily in bringing state-of-the-art multiplex cinemas to more than 30 cities so that consumers can experience high quality movie going. We've recently partnered with a local distributor to expedite delivery of high-quality DVDs in the market at competitive prices. And our international television distribution group has partnered with CCTV for television in-country distribution.

We have invested our resources and capital in China because we believe it has the potential to be a significant player in the filmed entertainment industry.

Contrary to some beliefs, the Chinese consumer has not only money to spend but also the willingness to spend it. Of its 1.3 billion population, China boasts an urban population of approximately 38 percent, which has been growing by one percent annually for the past decade.

In the decade post 1989, China's annual GDP growth rate had remained steadily high, between seven and 14 percent. The latest figure for 2004 was roughly 1.65 trillion. Consumer spending in '04 was up 13.3 percent over the previous year at 650 billion with disposable income increasing over 7.7 percent.

Where is this money being spent? Seventy-four billion roughly on dining. Another 74 billion on travel and tourism. Thirty on IT items such as PCs and iPods. And 9 billion on cosmetics.

Looking at the media space, 26 billion on cell phone usage and 2.2 billion on cable TV. Yet with all of that disposable income, the filmed entertainment industry's revenues are several magnitudes smaller, at a mere 180 million. That includes all releases both local and foreign.

Based upon other foreign industries prospering in the market, we believe given proper market access as well as IPR support, filmed entertainment can prosper in China and its new economy.

Philips, which has been allowed to make a hundred percent foreign investment in its China operations, saw its 2003 revenues rise 11.9 percent from '02 with China representing 20.6 percent of their worldwide revenues for 2004, or 7.5 billion. Likewise, Dell, Proctor and Gamble, Coca-Cola, and Yum Brands all have achieved similar acceptance and financial success in the China market.

Coke's China market share is now 10.7 percent of its global revenues. Clearly many industries have been allowed to flourish and have tapped into a very lucrative consumer base in China.

Now let's compare the situation to the filmed entertainment industry, as represented by the MPAA member companies. As John Malcolm testified earlier, our issues can be broken down into two components: Market access and Piracy.

The two are closely coupled. To promote market stability, let alone growth, both areas must be addressed simultaneously to provide a proper foundation for business development. As one of the largest creators and distributors of content around the world, we continue to experience challenges in China to build viable cinemagoing, theatrical, home video, and television distribution businesses with restrictions that impede acceptable market access and continue to allow the piracy market to develop.

Our competitors are the pirates. We accept that theft is always a component of our business plan. However, theft left unchecked and supported by new technology that facilitates the viral, illegal distribution of our copyrighted works makes it impossible to create a competitive strategy.

What's most encouraging based upon internal research conducted, was that Chinese consumers do recognize and are willing to pay for quality product. In fact, a statistically significant portion of those polled commented that if they knew that they could reliably purchase high quality DVDs that were available at cost-competitive prices, they would buy such product and avoid buying pirated product.

Looking more specifically at our issues, market-access restrictions covering both investment options and business-development options continue to be severe. Investment restrictions limit our control to operate as we would within a free market and create risk profiles that simply make even minority investments challenging.

Warner Bros. entered into joint ventures with the goal to construct high quality cinemas in several urban areas, to enable local citizens the ability to experience true cinema, versus the outdated and dirty theaters typically available. But to make these cinemas profitable and justify our construction costs, there must be a consistent flow of locally produced as well as foreign films available for exhibition.

Current film quotas, as John mentioned earlier, are approximately 20 per year for all foreign films, which, by the way, the state is currently evaluating and looking to reduce further to 14, and an extremely cumbersome censorship or approval process makes getting product to the market on time almost impossible.

As nice as these theaters are, by not having adequate product flow into the theatrical market on an expedited basis, we simply can't compete with the 2.6 billion disc DVD-manufacturing capacity in the market that helps to fuel pirate product flow. For our theatrical-distribution business, there are issues that revolve around the following: Release approvals—we are given specific dates when we can release a title; the censorship process is very complex; the levies that we must pay for importing our features; and, last, strict prohibitions on media buying and direct contact with the media to even promote the film.

Our home video distribution business in 2004 created a local joint venture intended to compete against the piracy market by offering DVDs for sale on an expedited basis and cost-competitively priced. These highly produced DVDs are made available in retail outlets identified to have the same goals as ours: Sell legitimate product at competitive prices and in a pleasing retail environment.

Here too, inconsistent audio/visual licensing parameters, restrictions on foreign ownership, unofficial yet observed caps on foreign home video releases, and import duties all represent obstacles to making this business viable.

And financially, on the piracy front, every title released in the U.S. is available in the pirate market in China. If a title is released first in the U.S., one can be assured that a pirated camcorded version was made and, via the Internet, downloaded in China to be used as the master for manufacturing pirated discs and are on the streets within 24 to 48 hours, all locally subtitled and locally packaged.

This is one reason why we are grateful for the recent passing of the Family Entertainment and Copyright Act, which makes camcording in the U.S. a felony.

Inconsistent enforcement activities and recently lowered yet potentially ineffective criminal thresholds make protection of our IP almost impossible. This lack of deterrence coupled with inconsistent messaging to consumers only facilitates piracy growth, both of hard goods and via the Internet.

In closing, the filmed entertainment industry and certainly Warner Bros. is willing and able to take up the challenges associated with new market development, but to do so we need market reform and legislative reform that supports IP protection and increases enforcement. In China the consumer's appetite for filmed entertainment is significant and increasing. Unfortunately without proper reforms and aggressive enforcement strategies, any new business scenario that we will offer is greatly compromised by an unrestricted and increasingly sophisticated piracy market.

I thank you for your time and attention.

[The statement follows:]

Prepared Statement of Darcy Antonellis
Executive Vice President, Distribution and Technology Operations
Senior Vice President, Worldwide Anti-Piracy Operations
Warner Bros. Entertainment Inc., Burbank, California

China's IPR Protections and the U.S. Entertainment Industry

Good morning, Mr. Chairman and Commissioners,

I'm honored to be here today on behalf of Warner Bros. Entertainment Inc., a filmed entertainment creator and distributor and owners of one of the largest commercial theatrical and television libraries in the world.

The Commission's hearings over the last two days regarding China, its high-tech development as well as its government's views towards IPR and foreign market access are important issues that must be understood and addressed if our industry, the filmed entertainment industry, can hope to build viable businesses and partnerships in China.

While all Hollywood Studios are experiencing the same level of frustration and disappointment in our efforts to enter the China Market, given Warner Bros. long history in the region, we hope to share some firsthand experiences with you today. Warner Bros. was the first Studio to establish distribution arrangements in China. We opened our first office in Shanghai in the twenties and since the Mainland was reopened to foreigners, we have been expanding our participation in all areas of the entertainment spectrum, providing local employment and utilizing local goods and services whenever possible. We were the first studio to film on location in the PRC with Steven Spielberg's "Empire of the Sun," and to release an American blockbuster, "The Fugitive," in 1994.

Today, our priorities include support of the local China film industry. Investment in local productions and support of the local creative community preserves our industry's art form. Today we've invested heavily in bringing state of the art multiplex cinemas to more than 30 cities so that consumers could experience quality moviegoing. We've recently partnered with a local distributor to expedite delivery of high quality DVDs into the market at competitive prices and our International Television Distribution group has partnered with CCTV, bringing American programming to the PRC and Chinese programming to an international audience.

We have invested our resources and capital in China because we believe it has the potential to be a major market for the filmed entertainment industry.

Contrary to some beliefs, the Chinese consumer has not only money to spend, but the willingness to spend it. Of the 1.3 billion people, China boasts an urban population of 38%, which has been growing by one percent annually for the past decade. In the decade post 1989, China's annual GDP growth rate has remained steadily high, between 7 and 14%, the latest figure (for 2004) $1.649 trillion. Consumer spending in 2004 was up 13.3% over the previous year, at $651.8 billion. Disposable income has risen 7.7% for urban residents to $1,138.4 trillion and 6.8% for rural residents, to $651.8 trillion.

And where is this money being spent? $74 billion on dining, another $74 billion on Travel and Tourism; $30 billion on IT items such as PCs, iPods, Digicams, etc., $9 billion on cosmetics and $2 billion on other luxury goods.

Looking at the media space, the Chinese consumers have spent $26 billion on Wireless phone usage, $2.2 billion on Cable TV; $1.2 billion on newspapers, and $298 million on online gambling. Yet with all of this disposable income, the filmed entertainment industry's revenues are several magnitudes smaller, at $180 million. This includes ALL releases, local and foreign.

Based upon other foreign industries prospering in the market, we believe given proper market access as well as IPR support, filmed entertainment can prosper as well. Philips, which has been allowed to make a 100% foreign investment in its China operations, saw its 2003 revenues rise 11.9% from 2002 to 2003, and China represented 20.60% of their worldwide revenue for 2004 or $7.5 billion.

Likewise, Volkswagen has done well in China, where it has been allowed to invest 50% of foreign funds in its venture. Its revenues have grown more than 53% from '02 to '03, in a year where total revenues only grew 4.9%. Dell, Procter and Gamble, Coca-Cola, Yum Brands—all have achieved similar acceptance and financial success in the China Market, and all those companies have been allowed to bring 100% foreign investment capital to do so. Coke's China market share is now 10.70% of its global revenues. Yum Brands is as high as $13.35%. Clearly, many industries have been allowed to flourish and have tapped into a very lucrative consumer base in China.

Now let's compare this situation to the film distribution industry. The data available illustrates both a clear and compelling story. In 2004, worldwide box office revenues were approximately $25 billion yet, of that, China box office was approximately $62 million or four tenths of one percent of total box office (see appendix—Table 1). Other statistics are encouraging and disheartening at the same time. While the GDP and Urban Per Capita Income has risen steadily, there has been a corresponding decline in box office revenues. While worldwide revenues have shown steady growth from 1998 through 2004, the China box office actually performed slightly lower in comparison to its 1998 level (see appendix—Table 2).

As represented by the MPA member companies, our issues can be broken down into two components: Market Access and Piracy.

The two are closely coupled. To promote market stability (let alone growth), both areas must be addressed simultaneously to provide a proper foundation for business development. As one of the largest creators and distributors of content around the world, we continue to experience challenges in China to build viable cinema-going, theatrical, home video and television distribution businesses with restrictions that impede acceptable market access and continue to allow the piracy market to develop. Our competitors ARE THE PIRATES. We accept this as most industry sectors do. Theft will always be a component of our business plan. However, theft left unchecked and supported by new technology that facilitates the viral, illegal distribution of our copyrighted works makes it impossible to create a competitive strategy.

What's most encouraging based upon research that Warner Bros. conducted to test the business plan to create a Home Video joint venture with a local partner was that Chinese consumers DO recognize and ARE willing to pay for quality product. In fact, a statistically significant portion of those polled commented that if they knew that they could reliably purchase high quality DVDs that were available at cost competitive prices, they would buy such product and avoid buying pirated product. Also, in some cases consumers today will buy the pirated feature, if they like it, they'll actually seek out a better quality product for their home library and throw out the pirated DVD. Consumers are ready, willing and able to spend their disposable income for the quality they perceive in seeing a movie or buying a DVD, legitimately, when they are able. Consumers have shown us that there is a steady demand and disposable income they will dedicate to legitimate product, provided it's available and cost competitive.

Looking most specifically at our issues, market access restrictions covering both investment options and business development options continue to be severe. Investment restrictions limit our control to operate as we would within a free market and create risk profiles that simply make even minority investments challenging.

China Film HG Corporation, the first-ever Sino-foreign JV entertainment company was created with the goal to construct high quality cinemas in several urban areas to enable local Chinese the ability to experience true cinema, versus the outdated and dirty theatres typically available. But to make these cinemas profitable and justify our construction costs, there must be a consistent flow of locally-produced as well as foreign films available for exhibition.

Current film quotas (approximately 20/year for all foreign film imports and the state is currently evaluating a further reduction to 14) and extremely cumbersome approval processes (covering areas like censorship) make getting a feature to market untenable.

As nice as these theatres are and using a release strategy that would release the title in China at the same time as the U.S., by not having adequate product flow out into the theatrical market on an expedited basis, we simply can't compete with a 2.6 billion disc capacity piracy manufacturing market.

For our theatrical distribution business, namely the entity that negotiates with exhibitors for screens and theatre access (which is state run), their issues revolve around:

- Release approvals—which includes specific dates that we are allowed to release a film
- The Censorship Process—which by virtue of its complexities and inconsistent guidelines makes getting a film cleared a unique process each time
- The Levies that must be paid for importation of the feature, which based on box office returns, renders almost all titles unprofitable
- And finally, strict prohibitions on media buying and direct contact with the media to promote the film.

In 2004, our Home Video distribution business created a joint venture with a local distributor to distribute DVDs on an expedited basis and competitively priced ($2.60 USD). These highly produced (not copies of camcordings with people walking through the frame) DVDs are made available in retail outlets that have the same goals as ours: to sell legitimate product at competitive prices and in a pleasing retail environment.

Here too, inconsistent audio/visual licensing parameters for retail licenses, restrictions on foreign ownership, unofficial yet observed caps on foreign home video releases allowed, and import duties all represent obstacles to making this business viable.

Finally, on the piracy front, every title released in the U.S. is available in the piracy market, uncensored, in China. When a title is released in the U.S., it is guaranteed that a pirated camcorder version will be posted onto the Internet triggering a massive supply chain with the title being downloaded in China and used as the master to manufacture pirated discs, complete with local subtitling and on the streets within 24 to 48 hours. This is one reason why we are grateful for the recent passing of the Family Entertainment and Copyright Act which makes camcording in the U.S. a felony.

Inconsistent enforcement activities and a recently lowered yet potentially ineffective criminal threshold make protection of our IP almost impossible. This lack of deterrents coupled with inconsistent messaging to consumers only facilitates piracy growth, both of hard goods and via the Internet as broadband access rapidly expands.

Our challenges are summarized as follows with recommendations for action:

Market Access—Market Reform

Challenges:

- ➢ The filmed entertainment industry is one of a few market segments yet to be reformed
- ➢ Foreign investment restrictions (minority ownership) inhibit business development
- ➢ Distribution of theatrical content is regulated by the state-run entities that maintain tight market access control and cumbersome regulations
  - ❍ These include:
    - Film quota of 20 titles for all foreign submissions (each Studio may get one or two titles a year)
    - Arbitrary "black-out" periods invoked without notice that restrict importation of foreign films
    - No documented and consistent censorship process (no ratings system available)
- ➢ Distribution of home video content is regulated by state-run entities that maintain tight market access control and cumbersome regulations
  - ❍ These include:
    - Audio/Visual license approvals are difficult to receive
    - Taxation levels can range from 50 to 75%
    - No documented and consistent censorship process (no ratings system available)
- ➢ Distribution of television content is limited by channel ownership restrictions and inconsistent distribution guidelines

Recommendations:

We have experienced first-hand that unless reform is endorsed at the highest levels of government within China, it is unlikely that the state-run agencies will change their current policies. Pressure must be applied for reform to support market access that will facilitate relaxing of restrictions that are listed above.

Piracy

Challenges:

- ➢ Massive Optical Disc Manufacturing Capacity (supports pirate market)
  - ❍ These include:
    - 2.6 billion disc capacity within China
    - Major exporter and supplier of pirated discs to key EMEA territories
    - Difficulty in tracing product for enforcement purposes
- ➢ Lack of Legal Deterrents
  - ❍ These include:
    - Highly profitable, often linked to organized crime
    - Criminal Threshold remains high even after modification
    - Low level fines
    - Little to no enforcement of TV or Cable piracy
    - No time limits on investigations
    - Enforcement training still requires support
    - Little to no government public relations messaging regarding IP respect and anti-piracy to consumers
    - Little use of government clout to control piracy yet test cases e.g. Hero show that government can curb illegal distribution
- ➢ Growing Internet Piracy
  - ❍ These include:
    - +90MM Internet users with +30% using broadband
    - No Internet regulations established to define legal code of conduct and ISP requirements
    - Rapidly increasing peer-to-peer file-swapping that is greater than Europe and the U.S. in absolute volumes

- Growing number of websites selling content illegally—in some cases hosted by established Chinese service providers whose stock is publicly traded on U.S. Exchanges.

Recommendations:

Whether its film, software, games or the design specifications for making a new automobile, the issue of China's acknowledgement and enforcement of intellectual property rights rest at the core of market access and growth. The U.S. must take a multi-tiered approach by addressing piracy on a legislative, legal or enforcement, market access, consumer awareness and business development perspective. Vice Premier Wu Yi, charged with Foreign Trade, IPR, and health, should be called to task on her publicly made commitments to curb piracy through multiple campaigns. At the 8th China International Fair of Investments & Trade in Xiamen, Vice Premier Wu Yi committed to crack down on IPR infringement. However, it is unclear if a strategy has been developed and plans put into action to support a long term and robust anti-piracy strategy.

In closing, the filmed entertainment industry and certainly Warner Bros. Entertainment, is willing and able to take up the challenges associated with new market development. But to do so we need market reform and legislative reform that support IP protection and increases enforcement.

In China, the consumer's appetite for filmed entertainment is significant and increasing. Unfortunately, without proper reforms and aggressive enforcement strategies, any new business scenario that we offer will be greatly compromised by an unrestricted and increasingly sophisticated piracy market.

APPENDIX

Table 1

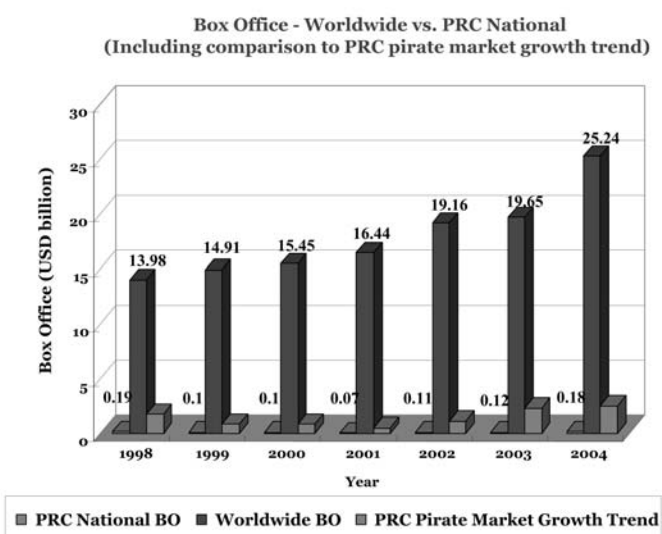
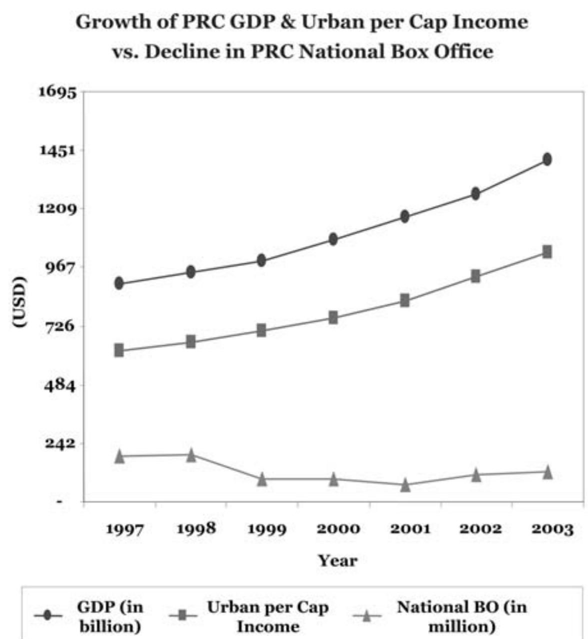


Table 2


Growth of PRC GDP & Urban per Cap Income
vs. Decline in PRC National Box Office
1695
1451
1209
967
726
484
242
-
(USD)
1997
1998
1999
2000
2001
2002
2003
Year
GDP (in billion)
Urban per Cap Income
National BO (in million)

Panel VII: Discussion, Questions and Answers

Chairman D'AMATO. Thank you both for your testimony and your written testimony is very detailed and complete. You lay out an extensive indictment of what's going on in China vis-à-vis our entertainment industry.

We had a hearing on this I think two or two and a half years ago. There has obviously been absolutely no progress since that date. It's an outrageous situation and cries out for some kind of U.S. Government action.

You lay out what the Chinese should do. Unfortunately, you don't give us what the United States Government should do to make this happen, because jawboning doesn't work.

And, by the way, I understand, Mr. Malcolm, on your Blackberry you just received a message about a new white paper on Beijing on this issue. Would you read the first section of that?

Mr. MALCOLM. Yes. I just on my way here today, my regional director in the Asia-Pacific Region told me that there is some consternation within the Chinese government on this issue. And so they've issued a white paper on intellectual property rights for the first time in ten years, which I suppose is a welcome development. And I have not had a chance to study it, but I note that in the summary that while certainly disappointing and perhaps as expected, the document itself contains all kinds of qualifiers.

For instance, one that leapt to my mind is one that says, quote: China has decided on a level of IPR protection appropriate for its own national situation.

So essentially, the Chinese government does, as it seems to do in many areas, decides what it wants to do, and that's what it will do and no more.

Chairman D'AMATO. And we can break the code on that, how much they're going to be doing. I guess the question I have is: It does not seem of course fair to the Chinese to curtail the importation of their film on this country. But, on the other hand, what do you do? Obviously the Chinese will not respond to anything unless it's more painful for them not to respond. So we haven't imposed any kind of pain in this area on the Chinese government. And certainly the Chinese government could do something in this area if it chose to, and it is not doing so.

Ms. Antonellis, you mentioned also that you are constructing a series of film theaters in China. Could you elaborate a little bit on the problems that you've had with the Chinese government in that respect?

Ms. ANTONELLIS. Certainly. Thank you. We created a joint venture for the purpose solely of constructing theaters, high quality theaters in a number of cities. As I mentioned, we have some 30 locations now.

And because it continues to be a volatile situation, in places where we have been given approvals for construction, with administration and commission changes within the state, what were approvals are now being questioned and in some cases construction progress has been stopped. And this has occurred literally within the last two weeks.

Chairman D'AMATO. I know that other Commissioners have some questions, but I just have one general question for both of you.

To what extent have you asked for assistance from the Federal Government, specifically in these areas, and what has been the response?

Mr. MALCOLM. On behalf of the MPAA we ask for assistance from the Federal Government all the time. We do work with the U.S. Trade Representative. We have supported the National Intellectual Property Alliance's recommendations to USTR that an out-of-cycle review be performed for China. We have briefings all the time with representatives in both the legislative and executive branch.

I am very heartened to see that, for instance, Congressman Portman has already come out with statements pending his confirmation hearing saying that China will be a priority. I know that there are some people of goodwill, such as Bill Lash at the Department of Commerce, that go over and use the bully pulpit. I would say that in many instances we are happy with the response we get, but Lord alone knows it's a big problem. There's a lot of work to be done.

Ms. ANTONELLIS. From the commercial side, and as John just mentioned, a number of those efforts to the USTR are really driven through the MPAA trade association.

From the commercial side from Warner Bros. we spend a large portion of our time dealing with the various state-run industry agencies on the China side, in constant negotiations. So whether it's the China Film Group, which is a state-run entity, as well as SARFT, the film, radio and television entity, for approvals, we try to get some changes to policy. That's where we've focused.

Chairman D'AMATO. Have you considered asking the Administration to take the Chinese to the WTO on intellectual property here?

Mr. MALCOLM. Yes. That's part of the IIPA's recommendation. It calls for an out-of-cycle review and then says, pending that expedited review or once the expedited review is completed, to take a look at the results and take appropriate action. And one of the possibilities, a distinct possibility, is to suggest setting up a dispute panel at the WTO.

Chairman D'AMATO. Do you agree with that?

Ms. ANTONELLIS. Yes.

Chairman D'AMATO. Thank you.

Commissioner Dreyer.

Commissioner DREYER. I was very interested in Mr. Malcolm's statement that the U.S. companies are allowed to receive only 13 to 14 percent of the box office, the total box office money in China, the precise amount to be determined by the Chinese government. Who the dickens agreed to that and why?

Mr. MALCOLM. Ms. Antonellis would probably know more about the history than I would. I'm not sure that it was something that we had an opportunity to agree to or not agree to, as opposed to having it imposed upon us, but she could provide a better answer, I'm sure.

Ms. ANTONELLIS. Yes. Akin to our current licensing arrangements, if you would compare those to another territories, obviously similar scenarios exist. However, the percentage or the splits, as we like to call them, between what the studios net from a distribution arrangement versus what is left for the local participants is somewhat skewed in our distribution in China.

At the time it was a function of market access. It was the only way that we were going to be able to get distribution. And because we've looked at the market so strategically, being able to get a toehold into that arena was more important.

Commissioner DREYER. I should say that many other industries have made the same mistake. So you're not alone, but it's nonetheless embarrassing.

Ms. ANTONELLIS. Somehow it doesn't make me feel better. Yes, I agree.

Commissioner DREYER. Understandably. Thank you.

Chairman D'AMATO. Thank you.

Commissioner Mulloy.

Cochair MULLOY. When we brought this issue up in 1995, you understand that China was not in the WTO. So when we complained about IPR violations then and they didn't respond, we threatened to block access for some of their goods to our market, and then they signed an agreement.

Now of course you can't do that because we're committed to have this open market in our WTO agreement with China, so our only solution would be to go to WTO, win the case, and then put on some barriers, whatever. Whatever the WTO would permit us to do.

There's another thing. I've been reading about the automobiles coming from China now. The big articles both in the *Wall Street Journal* and the *New York Times*. Just for the record, I think it's important to note that the same people who negotiated, what do you get, 20 films into China a year, the same people who negotiated that negotiated an agreement with China, WTO legal, that they can keep a 25-percent tariff on cars going from the United States to China, but China can ship cars from China to the United States and face a 2.5 percent tariff.

Now you wonder why people in Washington are finally beginning to wake up and say what is wrong with this system. Something isn't right.

But I think it's important for you, Mr. Malcolm, to distinguish between what China's failing to do with regard to what they agreed, which I think is mainly enforcement, these other things that you describe as market access, are they perfectly within their WTO agreement rights to keep those market access?

The industry agreed 20 films, that's all their obligated to do. Now the only way you can get that is if you offered them something else in a new round of negotiations, that they might give you more. But they're perfectly within their legal rights to do that to you. Is that correct?

Mr. MALCOLM. Mr. Commissioner, I'm on more comfortable ground with respect to the enforcement piece of this being in charge of global anti-piracy operation. So I don't want to tread into areas in which I'm not an expert.

Cochair MULLOY. Okay.

Mr. MALCOLM. I can talk about WTO and compliance with respect to enforcement, which is deficient.

Cochair MULLOY. Yes. It's a huge, a huge issue. But when you're talking market access, I think a lot of that is just the fact that we agreed that those market-access barriers could be in place, because our guys were bargaining for something else, I don't know what. We haven't seemed to have gotten a lot of access in any industry, but that's my understanding.

Do you have a different understanding, Ms. Antonellis?

Ms. ANTONELLIS. I think it's our understanding, though, with respect to some of those provisions that it is certainly, in our opinion, worth review. With respect to restraint of trade, there are some issues around those conditions dealing with actual the importation of our product to maintain a viable business, that again would warrant a review in terms of their WTO compliance.

Cochair MULLOY. Thank you, both.

Chairman D'AMATO. Thank you.

Commissioner Wortzel.

Commissioner WORTZEL. Appreciate very much both of you being here. I'm interested in a very limited aspect of this. I know it's all very important, but when I worked in the embassy in China the biggest producer of counterfeit DVDs and tapes and everything else in China, the biggest two were Buy E Studios, the People's Liberation Army movie studio run by the General Political Department of the People's Liberation Army and the People's Liberation Army Air Force Studio, I think in Shanghai. That earned them a lot of money. This is how they got a lot of their budget. We don't know how much.

So my question is: Are you able today to figure out who the counterfeiters are and where the money's going?

Mr. MALCOLM. Commissioner, in a number of instances, yes. I'm not going to say that some of it is not government, at least if not tacitly, approved or perhaps they derive funds from it. As Ms. Antonellis pointed out, approximately 2.6 to 2.7 billion disks are being produced, and that's out of licensed replicators. There are dozens if not hundreds of unlicensed replicators where we see millions of disks.

I'm sad to say that in the case of China a lot of it is going into the pockets of organized criminal figures who are quite dangerous and who pose security risks both domestically within China and internationally.

Ms. ANTONELLIS. Along those lines within the last couple of years the industry has availed itself to some technology that's actually allowed us to map the supply chain of the pirated market. And that's allowed us to show where discs originate from and how they flow to different countries. And, very honestly, China with its manufacturing capacity is a huge exporter of pirated product into some primary territories.

So our highest revenue-generating locations, like the U.K., for example, their production just from China accounts for 10 to 13 percent of all discs flowing in. So that's kind of a secondary issue, servicing both the local market, the China market as well as transshipping it to other territories.

Mr. MALCOLM. Commissioner, may I elaborate for just a moment? A lot of the disks both for domestic consumption and for export in China are coming out of replication machines. Replication machines are a million dollar plus piece of equipment. They're being run out of labs that essentially employ slave labor by organizations that have two costs on their mind: One, keeping those slaves alive and, two, corrupting officials. When those disks are exported outside of the country, they are being distributed by snakehead gangs that are well organized within China. And the welcoming committee whenever raids are conducted frequently involves high-powered weaponry. These are highly dangerous, highly organized people that are well funded.

Commissioner WORTZEL. But I take it that in the end what was once side money for the military has now turned into a big time organized crime business. Thank you.

Chairman D'AMATO. Thank you.

I seem to remember a couple of years ago we were told, yes, there's a problem in China, but they've been successful in cutting off the exports. Obviously that's been turned around if it ever was the case, and it's as bad today as it ever was. We're really at square one.

Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thanks, Mr. Chairman.

And thank you to our witnesses. My comment on the white paper is let's hope that the U.S. Government response is not what it usually does, which is to negotiate yet another MOU that is not worth the paper that it's written on.

This is an issue that has been going on for so long. I'm flabbergasted to hear these numbers. It's very frustrating for us to hear it year in and year out. I can only imagine how frustrating it is for all of you. It looks like there's a change in strategy in your industry and I commend you for having the guts to stand up and start talking about it now. Because it's quite clear that negotiating quietly is not getting anybody where they need to go.

I was going to ask a version of Commissioner Wortzel's question which was why do you think that getting market access is so much trouble? Is it because of concerns about freedom of expression and control over content or is it primarily because there are people who are benefiting financially from the piracy that's going on?

Ms. ANTONELLIS. All of the above. With respect to control of the market, to give you an idea, the local Chinese film market on average produces well over 200 films a year. Unfortunately only a small percentage of those films actually make it to theaters. The rest are put on shelves and exhibition is still extremely limited and state run.

We think it's a combination of factors. The first is to maintain tight regulation of just that sector, as well as, as you mention, it is big business and it is big business with money that resides and stays in country and with benefits that obviously we can't directly view. But we always approach the issue of what is a mutually beneficial situation. And because the piracy market is so robust, the reality is that they're seeing every one of our titles that the United States produces, so it's a difficult proposition to say what's in it for them.

This really, in our belief, gets down to the core to what your feeling is about intellectual property. If you have no respect for copyright, well, then there's the answer. And we've made a strategic decision, a business decision to aggressively enter the market to the extent that we can on all of our distribution outlets and stay there for a period. You're going to make a long-term investment and see what can be developed on the exhibition front. But that will only have limited success unless we can deal with the IPR side.

Commissioner BARTHOLOMEW. Mr. Malcolm, anything to add?

Mr. MALCOLM. Not really, Commissioner.

Commissioner BARTHOLOMEW. It's also interesting. Obviously we have huge economic interest in American cultural products being sold overseas, but we also know that people overseas love American cultural products. It's one way that we can help promote American interests more broadly than just the economic interests. It has consequences for all of us when you can't get your product in overseas.

Just recently, the Marketplace on NPR covered a story about a bust that had taken place that was in cooperation between American officials and Chinese officials. One of the main targets of the bust was an American who was responsible.

I'd love for you to comment if you can, and if you can't, I'll understand. I presume that the reason that was the case, that the Chinese authorities particularly cooperated on, was because it would be a way to come back and say, "But, see, it's not our problem; it's an American problem"; am I accurate on that?

Mr. MALCOLM. I'll be delighted to comment on the case. I'm sure that they were not displeased that the first major pirate that was prosecuted under criminal copyright theft happened to be an American, but it was an individual named Randy Guthrie, who comes from, I gather, a lovely and well-to-do family——

Commissioner BARTHOLOMEW. Very prominent.

Mr. MALCOLM. —and, for whatever reason, decided to strike out and make his fortune on his own and did it in a rather illicit fashion. It was an investigation that was a cooperative venture between ICE at the Department of Homeland Security and the Chinese authorities. It was successful. I applaud them for doing so. There's still a lot more work to be done.

Commissioner BARTHOLOMEW. Ms. Antonellis, anything to add?

Ms. ANTONELLIS. No.

Commissioner BARTHOLOMEW. Thank you. Thanks very much.

Chairman D'AMATO. Thank you.

Commissioner Reinsch.

Commissioner REINSCH. Thank you. Just as an aside I have a feeling the problem is in part less their lack of respect for copyright than that it's an alien concept. I think we've got a long way to go to persuade them that it's relevant, which is no comfort. I have a lot of sympathy for your dilemma.

I have just a narrower question. You mentioned I think in passing that the Chinese themselves produce some 200 films a year. Do they have a piracy problem with those?

Ms. ANTONELLIS. Yes, they do. The difference is that we have a handful of cases for example *Hero*, a locally produced title and most recently *Kung Fu Hustle*, where the state has engaged in an advance campaign touting the film and directly or indirectly a message is basically sent out that it's to be kept off the pirated market. And that's evident recently in the *Kung Fu Hustle* case study.

There were large revenues made in both cases from theatrical box office because market access was restricted on the piracy market to basically drive consumers to theaters. So they do have issues with local as well as foreign.

Commissioner REINSCH. Well, that's very interesting. You answered my next question, which was going to be whether there's differential treatment, and you've essentially said yes.

But it seems to me the implication of what you said is that the Chinese government is in a far better position to control this than they would suggest.

Ms. ANTONELLIS. Yes, we believe so.

Commissioner REINSCH. So when the money to be made is there, when it's their film, they are able to send the right signal to these people, whom they apparently know better than perhaps we think they do.

Ms. ANTONELLIS. Yes.

Commissioner REINSCH. Ah-ha. Well, that's very interesting. I think I'm not going to take it any further, though. We're short on time.

Chairman D'AMATO. Thank you, Mr. Reinsch.

I think it's sufficiently clear that the Chinese government if it doesn't have outright control over this whole thing could exercise substantial control over it to get it under control. And I think we ought to tag the Chinese government with responsibility for not making some progress in this area.

I want to commend Warner Bros. for your tenacity in staying in this market despite all this nonsense. You deserve more help than you've been getting from the U.S. Government.

I have an old theory in the Chinese case, you need to have an apples for oranges strategy. If they don't take our apples then we can keep their oranges out. They want to export cars into the American market. My sense is there shouldn't be any cars coming into the American market until they fix this. Maybe we should take a look at some of the other products. That's the only thing that gets their attention.

The other thing is I think you should go to the WTO, and that would be of some help.

I think that concludes this particular panel. Thank you very much for coming.

We would be interested in seeing that white paper.

Commissioner DREYER. Actually I downloaded it yesterday off the Internet and I gave it to Roger.

Chairman D'AMATO. I would ask for the unanimous consent that we include that white paper in the record.

Thank you very much.

Commissioner DREYER. Very interesting.

Chairman D'AMATO. Take a five-minute break.

[Recess.]

PANEL VIII: CHINA'S IPR PROTECTIONS AND IMPACT ON TECHNOLOGY DEVELOPMENT

Chairman D'AMATO. For our last panel of the day and of this session at Stanford we'll examine the role IPR protection plays in Chinese technological development. Dr. Pat Choate will present a commissioned paper on U.S.-China advance technology trade. By the way, Dr. Choate has also released a new book on *Hot Property: The Stealing of Ideas in the Age of Globalization*, right on point for this hearing.

Ted Fishman will discuss how China's strategy for IPR protection functions within China's larger economic and technological technology goals.

Why don't we go ahead and take seven or eight minutes each and then we'll go for questions.

Dr. Choate.

STATEMENT OF PAT CHOATE
CO-DIRECTOR, MANUFACTURING POLICY PROJECT
AUTHOR, *HOT PROPERTY: THE STEALING OF IDEAS IN AN AGE OF GLOBALIZATION*, SPERRYVILLE, VIRGINIA

Dr. CHOATE. Mr. Chairman, Members of the Commission, thank you very much. I'd like to note on the record my appreciation for Alfred Knopf and company sending copies of the book to the Commission. I would also note that the book comes out the middle of next week, so you've got about a five-day jumpstart on the public to get your copies up on eBay.

I'd like to talk about a country that does the following or has done the following: That provides incentives to steal IP, including cash; that creating important barriers to guarantee local markets and keep out other technology products; that provided no domestic patents to foreigners; no grant of copyrights to foreigners; no protection of trade secrets; no protection of trademarks to foreigners; no prosecution of IP theft; no right for civil remedies for foreigners.

That country is not China. That's the United States. When we founded this country, America was at its creation the great pirating and counterfeiting center of the world. Now the truth is that's how nations develop. America did it. Germany did it in the late nineteenth century. Japan did it in the middle twentieth century. And China's doing it today.

It's really in the sense the way that business is done and it is for us to recognize that. And if we're going to deny visas anyone we should deny visas to any foreign student that wishes to come here and study intellectual property history, because our forefathers devised ways to steal technology that others hadn't even heard of let alone applied in the world.

Now I would note in response to a question yesterday in which the President has said that innovation is the basis for national development. There was a President who said that and it was George Washington. His first message to Congress laid out his priorities for his Administration. They were: Industrial development, inland navigation. He called upon the Congress to create a patent and a copyright system, which they did 90 days after his message went forward.

Moreover, what you found in that Constitution, in that provision, it was based upon a constitutional provision. It was one of the few constitutional provisions that was enacted unanimously at the Constitutional Convention. The Authors and Inventors Clause is the only place in the Constitution where the word "right" is mentioned. The Bill of Rights was passed 18 months after that provision.

Moreover, it's a right that is defined by the Congress, something that was reaffirmed in the recent Sonny Bono case that was taken to the Supreme Court, a ruling of 7 to 2. It's a conditional right.

So it's very appropriate, I would think, to recommend to Congress how to define that right. And I have some thoughts on that that I will give you later on.

Now I would also note that our challenge today is that China is the global epicenter of pirating and counterfeiting. As to the actual numbers there, the Chinese government estimates that domestically the cost is 19 to 24 billion a year. This is a gross under estimation.

The real cost in China is somewhere in the range of six to eight percent, according to Interpol and in Europe, for example, it's eight percent. The real cost of goods sold, of counterfeit and pirated goods is $140 to $180 billion a year. That does not count the value of the theft of the foreign technology nor of the exports.

It's important to the United States for a very simple reason. We are as a people a volcano of creation: 4.5 percent of the world's population, we create half of the innovations. And according to the intellectual property creators in the last half of this century, we've created 90 percent of the major innovations, like the CAT scanner, et cetera.

In effect our economy is based upon innovation. Innovation is our competitive advantage, which means that it's imperative that that innovation be encouraged and it be defended. In my testimony I lay out the defenses and the way. Our forefathers set up a system that has worked remarkably well and it is that inside the United States inventors and copyright owners, authors and inventors, creative people, have the right of private action. They do not have to depend upon the government. They themselves can defend their rights. They can go to the court system and the Federal court system, which have integrity, and they can find justice.

Alexander Graham Bell fought 600 lawsuits defending the telephone, including three that went to the Supreme Court, and he won every one of those cases. That right and that ability, at putting it in the hands of the inventor, is very important. But internationally we set those rights country by country.

When we deal internationally it's imperative that our government assist and defend our inventors and our creative people. They cannot on their own deal overseas if other countries do not put into place the right of private action and the means, such as a judicial system, that will make that possible.

The second thing I would bring up on enforcement is that we are failing in this country to defend our inventors overseas. There has not been one single case brought by the United States on intellectual property matters since June of 2000 to deal with this issue. The Clinton Administration brought up 13 IP cases and prevailed on 13 cases.

It is very clear that if we go to the WTO on the China, the United States will prevail on that case. It's imperative that we do so.

We've cut our domestic enforcement in this country. The Counter Espionage Unit that we maintain on economic counter espionage, all of those agents have been assigned to the terrorism issue. We basically have nothing left on that.

The second thing then that's happening is at the same moment that we're seeing this great crime wave, and this is the great economic crime of the twenty-first century, is intellectual property theft, and it's particularly important to this country. What we're seeing is now their efforts underway to weaken our own patent laws, to weaken our defenses here in this country.

Congress I think made a great mistake in 1999. One of the things that they did is they began to try to harmonize the American patent system with that of Japan and Europe, not by raising their standards up but by lower our standards down. The most egregious thing there is we adopted something called the 18-month rule. When an inventor files a patent today, at 18 months the Patent Office is obligated to publish the application, including the details of how you replicate that patent on the Internet. It takes an average now of 27 months to run a patent.

So suddenly you have a situation for nine months and in some cases longer than a year, the inventor has their stuff up in a world filled with pirates and copyright thieves, and they have absolutely no defense. And the only defense they have if someone steals their innovation, they can go to the other country and try to bring a lawsuit. Well, you know what happens there.

This is stifling innovation. I can arrange with quite a number of inventors that are no longer seeking patents because to get a patent is to give it away. And then the problem that you have if you don't have the patent you're having trouble financing it.

Microsoft, IBM, and a handful of other companies are now supporting legislation that would weaken that even further. I would hope the Commission could take a look at that and make some recommendations.

I'll end my testimony with that.

[The statement follows:]

Prepared Statement of Pat Choate
Co-Director, Manufacturing Policy Project
Author, *Hot Property: The Stealing of Ideas in an Age of Globalization*
Sperryville, Virginia

Mr. Chairman and Members of the Commission:

Innovation is America's competitive advantage and intellectual property (IP) rights are the wellspring of that creativity. They underpin our economy and assure our national security.

For more than two centuries, America's unique system of intellectual property incentives and protections has fostered a volcanic outpouring of innovation and enterprise. Now, that creativity, and all that it makes possible, are threatened by other nations' massive and blatant violations of U.S.-owned intellectual property rights, by well-funded efforts to weaken U.S. intellectual property laws and by "reform" legislation enacted in 1999 that forces the U.S. Patent and Trademark Office to reveal the vital details contained in a patent application 18 months after it is filed, long before most patents are granted. This premature disclosure of inventors' most intimate secrets—while their creations lack the legal protections conferred by a patent—aids counterfeiters and pirates, penalizes U.S. inventors and discourages innovation. In effect, Congress unthinkingly legalized a major form of industrial espionage.

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*Pat Choate is the author of *Hot Property: The Stealing of Ideas in an Age of Globalization*, from which parts of this statement are drawn. Alfred A. Knopf, Inc. will release this book on April 26, 2005.

My analysis of China's protection of U.S. intellectual properties begins with an examination of the importance of those rights to the United States, the foundation and evolution of those protections, plus a review of the IP obligations that China willingly assumed when it joined the 148-member World Trade Organization (WTO).

In sum, China is not meeting its WTO intellectual property commitments. Indeed, China is pursuing a national development strategy based on the uncompensated, unapproved stealing of other nations' best ideas and technologies. China's failure to fulfill its WTO intellectual property commitments is not just a U.S. problem: It is one of equal significance to Europe, Japan and all other nations that value innovation. Fortunately, as discussed later, powerful remedies exist.

Innovation and Progress

How important are technological advances to America's development? They are vital. The cotton gin, interchangeable parts, the telegraph, electricity for the home and factory, mass production techniques, the airplane, television, computers, lasers, iPods, among millions of innovations, each profoundly changed the nature of work and life, not only in the United States but throughout the world.

Economists have measured the effects of technology on the American economy. The studies are distinguished by the use of differing techniques, different periods and different parameters. The constant in most of these studies is they examined three basic factors—labor, capital and technology—apportioning to each its relative contribution.

Nobel Economics Prize winner Robert Solow of Harvard University found that technological advancement, coupled with increased human capital improvements in the labor force, accounted for between 80–90 percent of the annual productivity increase in the U.S. economy between 1909 and 1949. Edward Denizen of George Washington University concluded that in the period 1929–1982 more than two-thirds of the productivity gains were due to advances in science and technology.

Whether the precise numbers of those two studies are correct, the important point made by each is that progress in knowledge and innovations were the primary factors behind the growth of America's economic productivity. And while quarrels exist among economists, historians, lawyers, and politicians as to the details of the American system of innovation—that is, are patent terms too long or short, is copyright coverage too broad or narrow, are trademarks useful or not—the fact remains that the Founding Fathers of this nation and their successors created a system of innovation that has worked better than any other.

The Great Economic Crime of the 21st Century

Intellectual property theft is the great economic crime of the 21st century. The FBI estimates that pirating and counterfeiting costs U.S. companies up to $250 billion per year. The European Union estimates such theft bleeds its economy of more than $400 billion annually.

Significantly, such theft is about more than money. Fake goods harm and kill people. Piracy and counterfeiting impede innovation. The result is fewer new medicines, fewer advances in science, fewer new products, fewer new music CDs, fewer new movies, less new software, and higher prices for whatever is created.

Pirates and counterfeiters also frustrate creativity. Their actions deny incentives—whether it is money, recognition, fame, or power—to the creators of new ideas who do the work and take the risks required to challenge the old with something new, different and better. Fakes destroy good jobs and the reputations of legitimate producers and goods.

Each year, the Office of the United States Trade Representative presents a listing of countries where intellectual property theft is blatant. That report (available over the Net at www.ustr.gov) reveals massive infringements of U.S.-owned intellectual properties by many nations.

A Constitutional Right in the United States

What is the legal foundation of U.S. patent and copyright protections? It is the U.S. Constitution.

The American Revolution almost failed because the fledgling nation lacked the capacity to manufacture the materials of war. Those demands had to be fulfilled by European producers and then smuggled across the Atlantic. By the War's end, the necessity for manufacturing self-sufficiency was so seared into the minds of George Washington and other Revolutionary leaders that when the Constitution was being drafted, they included a special provision to encourage domestic innovation and creativity. Article 1, Section 8 of The Constitution of the United States of America provides:

"The Congress shall have power to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries";

This is the only place in the body of the Constitution where the word "right" is mentioned explicitly. The Constitutional amendments that became known as the Bill of Rights were not ratified until almost the end of the third year of George Washington's first Presidential term and almost 19 months after passage of the first copyright and patent acts in 1790.

This twenty-seven-word clause is the legal basis for every patent and copyright ever issued in the United States. Congress may vary the terms and duration and thus render the contemporary definition of what is the proper balance between the public and private interests, but the Constitution guarantees every American's right to such protections. The Commerce clause of the Constitution is the basis for trademark protection.

A Golden Covenant

Ideas are intangible, even ephemeral, things. Yet, they are the fountainhead of all advances in literature, science, technology, agriculture, music, medicine, designs and even better mousetraps. And although ideas cannot be owned, the right to exclude others from producing the creations that flow from them can be—at least for a set time. Intellectual property law is about classifying the form an idea takes, the right to exclude others from its use, the enforcement of that right, the penalties for any infringements of that right, the allocation of responsibility for imposing that punishment, and, equally important, the attendant obligation of the intellectual property owner to society.

Although the protections take many forms, as a body they are called "intellectual property rights." Fundamentally, such rights, wherever they exist, are a basic social contract between society and someone who creates an idea—a golden covenant—by which the public grants that creator the right to exclude others from using their creation for a set period in exchange for the disclosure of its details, and ultimately the surrender of that property right, allowing the creation to enter the public domain. The hope is that by giving the author or inventor a property right for a limited time, while also making public their creation's most intimate details, the general state of knowledge will be advanced.

Four Types of Protection

Over time, four basic types of intellectual property protections have been created: copyrights, trademarks, patents and trade secrets. Each contains its own bundle of rights, backed by a body of law that is appropriate for specific types of intellectual products. Lawrence J. Siskind, a San Francisco intellectual property lawyer, has created a useful typology for distinguishing these four types of protection.

Imagine, he says, that Thomas Edison wrote a book about the process of incandescence. A copyright would protect Edison's literary or artistic creation, barring others from either copying or distributing his words or any illustrations in his book. But, a copyright would not forbid others from using the ideas in the book to create their own electric lights.

If Edison held a patent, however, he would possess "the right to exclude others from making, using, offering for sale, or selling" his invention in the United States or importing the invention into the country. Thus, a patent would give Edison the right to exclude others from using his idea for a set period in exchange, of course, for publicly disclosing its details. Edison's incentive is that he gets a chance to develop his idea and reap the financial reward during a prescribed period. The public's incentive to make such a grant is that knowledge is advanced by Edison's disclosure.

If Edison wanted to label his light bulb as the "Edison Bulb," he would seek a trademark. That could either be a word, a name, symbol or device to distinguish his idea or product from all others. While others could make and sell light bulbs, if they did not violate Edison's patent, they could not call their product an "Edison Bulb." That right would belong to him. Edison could also package his bulb in a distinctive way and that too would be protected as "trade dressing." Thus, when others sold their bulbs, they could not make or package them to appear as the "Edison Bulb."

If Edison chose to keep secret the details of how he made his light bulb, his customer list, his manufacturing processes, and any special formulas or designs, laws on trade secrets would protect him. But as Siskind points out, if he marketed the product and someone independently took it apart and figured out how his creation was made or worked, Edison would probably lose any legal rights. Coca-Cola, for example, has kept its formula secret, but relying on trade secret protections is risky.

Of course, there is much more to each of these basic protections. For instance, there are several types of patents—utility patents protect useful inventions, methods and processes. Design patents safeguard unique and ornamental shapes and designs. Patents also are given to those who invent or discover and asexually reproduce a distinct and new variety of plant.

Congress sets the length of protection for intellectual property and it varies by type. Utility and plant patents are generally valid twenty years from the date of application. Design patents last fourteen years from the date of grant. Copyrighted works registered after 1978 are authorized for the life of the author plus 70 years. Those registered before 1978 are secured for 95 years from the date the copyright was originally secured. For works made for hire, the copyright endures for 95 years from publication or 120 years from creation, whichever is shorter. Trademark rights can exist indefinitely if the owner continues to use the mark and re-registers it every ten years.

Enforcement

The Founding Fathers created both a right for IP owners and the private legal means for them to defend those rights in the courts. Thus, most U.S. intellectual property owners rely on their own attorneys, not their government, to defend their IP rights in the United States. Foreign infringers fully understand this difference. Former U.S. Patent Commissioner Bruce Lehman notes that foreigners "are particularly freaked by (patent) litigation." The reason is clear: U.S. Federal courts are far more difficult to subvert than U.S. politicians.

In the United States, private lawsuits to defend patents, copyrights, trademarks, trade secrets, masks and plant varieties are potent because the decision to act resides with the IP owner and the Federal courts are strong judicial bodies that can impose massive penalties. The strength of the courts is the judges, whose qualifications are reviewed and approved by the U.S. Senate. For more than two centuries, America's Federal judges have been capable, often brilliant and uncompromisingly honest.

To further ensure fairness, the courts have a strong appellate system, which allows an impartial and competent review of lower court decisions by panels of other judges. To provide a knowledgeable review of complex patent and trademark cases, Congress created the U.S. Court of Appeals for the Federal Circuit, which is located in Washington, D.C. Created in 1982, this court hears all appeals on patent and trademark cases.

Before the creation of this new court, the 11 appeals courts (now 12 in number) upheld only 40 percent of U.S. patents in litigation; afterward, the new Federal Circuit Court has upheld roughly 80 percent.

America's strong intellectual property laws and an equally strong judicial system are hazards for counterfeiters, pirates and infringers inside the U.S. The statistics of private patent suits illustrate why. Alexander I. Poltorak and Paul J. Lerner in **Essentials of Intellectual Property** estimate that only 1.1 percent of all patents are ever litigated.

Of that one percent that are litigated, almost 76 percent settle before going to trial, generally after an expenditure of $1 million or more by each side. Only four percent of all suits filed eventually do go to trial. The other 20 percent are either withdrawn or dismissed. Thus, only about 4/100 of one percent of patents are litigated.

Of cases where a patent's validity is challenged, Poltorak and Lerner report that litigation upholds 67 percent. When infringement is litigated, patent owners win 66 percent of their cases. These are very good odds for patent holders, and very bad ones for pirates, counterfeiters or infringers—at least in the United States.

Such low litigation numbers, and such high success rates for patent owners, are a positive reflection on the U.S. Patent and Trademark Office, signifying that its examinations are thorough and the patents it issues are strong—again, at least inside the United States.

When the first U.S. Congress created the first patent and copyright laws, they considered court-ordered civil sanctions sufficient to deter infringers. In 1909, Congress decided that civil sanctions were insufficient to stop some brazen copyright infringers, so criminal prosecutions were authorized as an additional deterrent. In 1992, Congress broadened the law, making copyright infringement a felony offense under Federal law "*if at least ten infringing copies or any type of copyrighted work with a value of $2,500 or more are made or distributed in a 180-day period*." The Economic Espionage Act of 1996 made the theft of trade secrets a Federal crime regardless of who benefits. Unlike copyrights, trademarks and trade secrets, no Federal law makes patent infringement a criminal act.

In addition to the civil suits and Federal criminal prosecutions, U.S. IP holders have another means to keep infringing goods out of the United States. Under Section 337 of the Tariff Act of 1930, the U.S. International Trade Commission is empowered to investigate allegations of patent, copyright, and trademark infringements of imported goods, plus the misappropriation of trade secrets. The Commission is an independent, quasi-judicial Federal agency that analyzes the effects of imports on the economy and directs actions against unfair trade practices, such as intellectual property infringement.

If an IP holder thinks that its rights are being infringed upon by unauthorized imports, it can file a formal complaint with the Commission. If the Commission votes to investigate, it appoints an Administrative Law Judge to preside over the proceedings and make an initial decision. Hearings are held and eventually the Commission makes a decision or a settlement is reached. Between the mid-1970s and January 2004, the Commission heard 505 cases involving alleged violations on items that range from integrated circuit chipsets to rodent bail stations (a better mousetrap). When the Commission finds there has been an infringement of a valid and enforceable U.S. patent, copyright, trade secret, or trademark, it orders the Customs Service to exclude that good from entry into the United States.

Other Federal enforcement of U.S. intellectual property laws has been reduced to the point of vanishing since the 9/11 attacks, as most of its resources were transferred to the war on terrorism.

Foreign Protections

A distinctive feature of intellectual property protections is they are of national origin, issued country by country. Consequently, having the protection of a patent, copyright, or trademark in the U.S. does not automatically mean that a creation is safeguarded elsewhere. Rather, IP owners must generally seek protection country by country.

Most important, many nations do not provide the legal means to enforce their trademarks, patents and copyrights. They have IP laws on the books, promise to enforce those laws, and then allow, even encourage violations. Their laws are niceties, as fake as the goods whose production they facilitate.

The major problem faced by American intellectual property owners is not one of inadequate protection inside the U.S., but the absence of such means in most developing nations. In such instances, U.S. intellectual property owners are forced to depend on the U.S. Government to act on their behalf. Only the Office of the United States Trade Representative can initiate a U.S. intellectual property case against other governments at the World Trade Organization.

Ironically, after leading the long, historic fight to put the WTO's IP protections into place, Washington is now strangely unwilling to use them. Since June 2000, the U.S. has not filed a single intellectual property case at the World Trade Organization, although the Office of the United States Trade Representative documents each year, country-by-country, their IP infringements and how this theft is permitted, even encouraged, by the national governments.

The World Trade Organization and Intellectual Property Rights

In response to the massive international theft of U.S.-owned intellectual properties, the United States in the 1980s and 1990s championed the creation of a new body of international laws and protections, called the Trade Related Intellectual Property System (TRIPS), which is administered by the World Trade Organization (WTO), and sets minimum IP standards for WTO members.

TRIPS came fully into force on January 1, 2005. The TRIPS agreement is the most significant intellectual property agreement of our time. It covers five broad areas: First, TRIPS defines the basic principles of how international intellectual property agreements will be applied. The main principle is national treatment—that is, governments will deal with foreigners and their own citizens equally. A corollary is called "most-favored nation"—that is, all foreigners will be treated equally. If the U.S. gives a trade concession to Mexico, it must also be willing to give the same concession to Chili, Brazil and all other nations. This mandate prohibits discrimination among nations.

Second, TRIPS ensures that adequate standards of protection are provided by all participating nations. To this end, TRIPS strengthened the provisions of the principal international agreements that existed before it was created, including the Paris Convention for the Protection of Industrial Property, which includes patents and industrial designs—setting new and higher standards. For copyrights, TRIPS included computer programs and databases. It expanded international copyright rules to include rental rights, thus taking pirates on directly. TRIPS also gave performers the right to prevent the unauthorized recording and use of their live performances for 50 years. With that, the WTO took on bootleggers.

TRIPS gives international protection for trademarks, defining what is eligible, plus the minimum rights nations must provide. When place names, such as "Tequila," "Scotch," and "Champagne" are used to identify a product, TRIPS provides special protections for those products as well. Industrial designs are protected by TRIPS for a minimum of 10 years and patents for at least 20 years. Nations must provide patents for both products and production processes, though they can exclude diagnostic, therapeutic techniques, surgical methods, plants, animals and biological processes for the production of plants or animals. Plant varieties, however, have TRIPS patent protections. A process patent extends to the product directly created by the process. The TRIPS Agreement allows governments to issue a patent-holder's competitor a compulsory license for a patented product or process, but only under strict and defined conditions.

Integrated circuit layout designs are protected for a minimum of 10 years under TRIPS. Governments are required to take all necessary steps to protect undisclosed information and trade secrets of commercial value. Finally and most important, Part 2 of TRIPS defines minimal standards. If any party to TRIPS wants higher standards and longer terms of protection for the intellectual properties, they can have it, provided they do not discriminate against or between foreigners.

The third part of TRIPS is enforcement. The agreement requires all signatory governments to enact laws that ensure the enforcement of this agreement and provide penalties that are sufficient to deter future violations. TRIPS enforcement requirements are defined in detail, including rules for getting evidence, provisional measures, injunctions, damages and other penalties. Under TRIPS, governments must provide courts that can review administrative decisions and order the disposal of counterfeit goods. Governments are also required to make willful trademark counterfeiting and copyright piracy criminal offenses, punishable with jail sentences and to prevent the import of counterfeit and pirated goods.

The fourth part of TRIPS is its dispute settlement procedures. If any nation thinks that any other nation is violating the TRIPS provisions, they can take their case to the WTO, where a three-person panel will hear the complaint. The loser in that complaint can file an appeal at the WTO and be heard by a new appeal panel. That decision is final. If a defendant nation loses the case, it must change its laws and practices or pay damages to the plaintiff nation. Those damages can be paid in cash, or the winning plaintiff nation can impose tariffs on a list of the defendants' imports sufficient to pay an amount set by the TRIPS dispute panel. The WTO can impose costly penalties on those nations that fail to uphold their IP agreements.

Fifth, the WTO provided special transitional arrangements while TRIPS was being introduced.

The WTO dispute settlement procedure is a powerful tool. If the U.S. believes, for instance, that China is not fulfilling its TRIPS obligations to provide protections against piracy and counterfeiting of U.S. IP, it can take a case to the WTO. And if the U.S. can prove that this theft is costing U.S. authors, artists, inventors and other IP owners multiple billions of dollars annually, it can ask for annual compensation in that amount for as long as the theft and China's institutional unresponsiveness continues. Moreover, the U.S. does not need China's permission or help to collect the money once a WTO verdict is issued. Under the WTO, the U.S. can impose a small tariff on every good imported from China and then distribute those funds to the U.S. victims. Or, it can impose large tariffs on a few Chinese imports. All that is required is national political will and lawyers who can prove to a WTO panel what the victims allege. Most important, such action is legal and conforms to the TRIPS agreement signed by China.

China's WTO TRIPS Compliance on Intellectual Property Protections

The Office of the United States Trade Representative's 2004 Report to Congress on China's WTO Compliance reveals that China is putting its framework of laws, regulations and implementing rules into compliance with the TRIPS Agreement. The problem noted in the report is "*Enforcement of these measures, however, remained ineffective in 2004*." The USTR pointed out that nearly three years after China's accession to the WTO U.S. right-holders uniformly say that intellectual property rights infringement in China is rampant. Witnesses also report that such violations are worsening. Although China has established three mechanisms for intellectual property rights enforcement, none is having a deterrent effect. Specifically, the USTR concludes,

- **Administrative Enforcement—**"*Although the central government continues to promote periodic anti-counterfeiting and anti-piracy campaigns, and these campaigns result in high numbers of seizures of infringing materials, they are largely ineffective*."
- **Criminal Enforcement—**"*At present, criminal enforcement has virtually no deterrent effect on infringers. . . . Partly because of these weaknesses in China's laws and regulations, China rarely pursues criminal prosecutions*."
- **Civil Enforcement—**"*U.S. companies continued to complain in 2004 that there is still a lack of consistent and fair enforcement of China's IPR laws and regulations in the courts. They have found that most judges lack necessary technical training and that court rules regarding evidence, expert witnesses and protection of confidential information are vague or ineffective. In addition, in the patent area, where enforcement through civil litigation is of particular importance, a single case still takes four to seven years to complete, rendering the new damages provisions adopted to comply with China's TRIPS Agreement obligations less meaningful*."

China's failure to meet its WTO TRIPS obligations is dearly costing foreign IP owners. The Chinese government estimates that in 2001 the market value of bogus goods sold in China was between $19 billion and $24 billion. The technology stolen to produce many of these goods has a far greater value, as does the harm done to the reputations of IP owners, plus the value of bogus sales outside of China. This estimate is a vast understatement of the true costs of the IP theft emanating from within China's borders.

Despite intense attempts over many years, U.S. diplomacy has not persuaded China's leaders to fulfill their TRIPS obligations. The result is a Chinese Potemkin village of protections—newly created national bureaucracies putting into place the forms, regulations and institutional mechanisms that real intellectual property protections systems have.

Yet, local officials have great power and often little connection with national authority. Viewed from their perspective, why should a local official take jobs away from neighbors, friends, family and constituents and give them to an unknown foreign corporation, inventor, author or artist whose operations may be elsewhere, maybe not even in China?

As for private enforcement of intellectual property rights, the very idea of patents, copyrights, trademarks and trade secrets are as novel to China as are ideas of constitutional rights, religious freedom and civil law. China is an old civilization. To graft the U.S. system of intellectual property rights onto China's ancient political culture may be as difficult and odd a task as trying to graft a grape vine unto a mature oak tree.

Professor William P. Alford of Harvard Law School, captures the essence of the problem in *To Steal a Book is an Elegant Offense*. He writes,

> "A system of state determination of which ideas may or may not be disseminated is fundamentally incompatible with one of strong intellectual property rights in which individuals have the authority to determine how expressions of their ideas may be used and ready access to private legal remedies to vindicate such rights."

China's culture, of course, can change, but to expect its political leaders to accept foreign notions of intellectual property laws, individual civil rights and private legal remedies as a central part of its political structure is not likely to happen soon, if ever. To expect the Chinese public to forego voluntarily the production or purchase of pirated and counterfeited products simply because some foreigner owns the exclusive use of an invention, trademark, trade secret or a copyright is too high a hope, at least in the near future.

If China's economy evolves as did Japan's, the Chinese may become interested in intellectual property protection when they develop proprietary technologies that they want to secure in other nations. Until then, foreign intellectual property owners must regard China as the great threat to their creations that it is.

Intellectual Property Rights Under Assault Within the U.S.

The assault on U.S. intellectual property rights and enforcement extends into the U.S. In a protracted legislative patent war during the 1990s, several foreign governments and large corporate interests tried to weaken U.S. patent protections, and continue to do so. Among other proposals, these interests sought to:

- Remove the U.S. Patent and Trademark Office from congressional oversight,
- Vest control of the patent function in a private corporation whose directors would be appointed by the President,

- Eliminate civil service protections for patent examiners,
- Shorten the term for U.S. patent protections,
- Award a patent to the first person to file an application rather than the person first to invent a new creation,
- Allow competitors to challenge the claims in a patent while the application is still under review at the Patent Office,
- Limit the ability of patent-holders to defend their rights in the courts,
- Publish the details of a patent application eighteen months after it is filed, even if no patent has yet been issued.

The 18-month provision was enacted into law in 1999. Today, the details of a U.S. patent application are made public, via the Internet, eighteen months after it is filed. Only those applications for a U.S.-only patent are exempt from this rule. Yet, the U.S. Patent Office takes an average of 27 months to issue a patent. Thus, an inventor has a period of 9 months when the secrets of the innovation are made known to the world and no protections exist. An inventor can sue the infringer after being awarded a patent, but often requires filing a case in foreign courts—a costly process. One consequence of this rule is that U.S. creations are being stolen before inventors have the protections of a patent. Equally important, many inventors are keeping their creations as trade secrets, thus diminishing the general knowledge.

The un-enacted proposed changes to U.S. patent protections remain a top U.S. lobbying priority of the Japanese government, the European Union and several transnational corporations and their business associations.

In the 1990s, advocates of **copyright** change persuaded Congress to lengthen the duration of copyrights, legislation the Supreme Court later ruled constitutional. An unintended consequence of the copyright extension is that much of the knowledge created in the last 75 years of the 20th century is frozen in copyrighted works whose ownership is unknown, that produces few if any royalties, is not digitalized, and thus remains largely unavailable to most potential users. Were the commercially inactive portions of that copyrighted knowledge base released into the public domain, existing computer technology could easily deliver it to the fingertips of anyone connected to the Internet. One option for releasing this vast body of knowledge would be to alter the copyright laws in a manner that returns the term of a copyright to a short period, such as 14 years enacted by the first U.S. Congress, but allow owners to review indefinitely, as is now done with trademarks. Owners of commercially viable works would likely renew. By not renewing, owners of non-commercial works could speed their creations into the public domain.

Recommendations

China is unlikely to have an effective system of intellectual property protections any time soon. TRIPS is a legal way for the U.S. to address China's failure to meet its WTO intellectual property obligations.

I recommend that the U.S. initiate a WTO case against China for failing to meet its TRIPS commitments. A WTO finding and the U.S. collection of damages would provide the Chinese government a substantial incentive to fulfill its TRIPS obligation. I also recommend that the collected damages be divided among the damaged U.S. IP owners, rather than be deposited in the U.S. Treasury. The victims deserve the compensation.

I also recommend that the USCC bring to Congress's attention the unintended damage created by the 18-month patent application disclosure rule and urge it to revert U.S. policy to that followed for more than two centuries—that is, the U.S. Patent and Trademark Office is obligated to keep the details of a patent application totally secret until a patent has been issued. If no patent is issued, that Office is to vigorously guard the application, allowing the inventor to protect the innovation as a trade secret.

Conclusion

Innovation is America's competitive advantage. U.S. domestic intellectual property protections must reflect that reality and our government must resist attempts to weaken the IP rights of its creative people.

Globally, the U.S. led other nations in creating a body of IP protections at the WTO. The time has come to test whether those protections are real. An intellectual property case against China is the ideal check as to whether TRIPS can work. If not, the U.S. needs to know and then act accordingly and quickly. Passivity on such a far-reaching threat is the most dangerous policy.

Chairman D'AMATO. Thank you very much, Dr. Choate.

Mr. Fishman.

STATEMENT OF TED C. FISHMAN
AUTHOR, *CHINA INC.: HOW THE RISE OF THE NEXT SUPERPOWER CHALLENGES AMERICA AND THE WORLD*
CHICAGO, ILLINOIS

Mr. FISHMAN. Good afternoon. What an amazing day this has been. I wrote a book *China, Inc.*, which came out in February, and now I have to revise every single page of it.

I have a prepared testimony. It links so much on what other people have said today, that I thought I would veer from it and build on the remarks that I've heard this morning. So with your indulgence I will do that.

First I want to thank the Commission. One of the experiences I've had in writing *China, Inc.* is that I've given a lot of talks around the country and a few hundred outings on the radio and television, too. I hear all kinds of voices on China and how people feel about China.

When I made the rounds in Washington when I began this project, I went to all kinds of places. There's a lot of intelligence about China in Washington, but it's all very atomized. There are the guys who worry about strategy, the guys who worry about trade, the guys who do cultural exchange. But I think your Commission alone is one of the few places in this whole country where our government is trying to figure out what should be the general national consensus about China in this country. Unless we have a general view and we could put together all of the different hats that people wear on China and figure out what's best for the United States, then we're not going to have a useful policy. Instead it'll be poached away bit by bit and we'll be working against ourselves.

That's very much true on intellectual property, because this is a perfect case in which we wear two hats. We wear hats as consumers in which many ways we benefit enormously from China's very loose, to use a charitable term, intellectual property regime, because it drives prices down for the consumers. I'll talk about that in a bit.

The first thing I want to say in general, though, is we should do a thought experiment which builds a little bit on what Dr. Choate said and that thought experiment is what we would do if we were making policy for the Chinese, what kind of intellectual property regime would we want for our country.

All governments think about what is the best of the welfare of their people. Bad governments do this to some degree, good governments try to do it entirely. And if you were the leader of 1.3 to 1.6 billion people—mostly poor people, desperately poor people—and you could give them the wealth of the world's most advanced, industrialized economies in entertainment, in pharmaceuticals, in industrial goods, in technologies, what would you do?

Would you say if there were no consequence to you—and there has been no consequence to the Chinese—would you enforce intellectual property laws or would you say, no, let all of this technology come here. I'll entertain my people, I'll keep them healthy, I'll make them smart.

There is a real logic in the Chinese position. If you are thinking about solutions on how to approach it that will benefit Americans you have to think that you are against a very mighty agenda on the part of the Chinese government. It is a policy of the Chinese government not to enforce intellectual property. It's an industrial policy. It's a welfare policy. It's an entertainment policy. It's a cultural policy. And any change that we want to make has to go against the full might of those agendas, of a government that fully sees itself acting in the interests of its people on this issue.

You might have noticed in some of the recent news on Japan, for example, I was just noticing this in the paper yesterday, that one of the things Japan wants to talk about with China in the midst of all of these protests and demonstrations is intellectual property. I can't help but think that one element of these demonstrations is a way to get the Japanese to back down on almost every item in their agenda.

There's quite a bit of vehement demonstration. The Japanese are being made to know that there are millions of people who can throw bottles and rocks at Japanese facilities and surround them any time they want should the Japanese press too hard on anything, including intellectual property.

I got a call this morning, interestingly enough, from a man who came to one of my readings. His name is Ron Hollis. He runs a company called QuickParts. He said, "Mr. Fishman, I have to talk to you about my recent trip to six cities in China." He's a manufacturer who makes prototype-molded parts, kind of the nuts and bolts of American industry. They're molded plastic, they're formed. He's got a laser machine that can create any kind of part on very short notice for a prototype.

He said, "You know, American manufacturers do not understand what's going on in China, that there is a very high level of sophistication." We've heard about it at the universities and at the high-tech firms of China, but in the mid-tech and the low-tech firm there's a very, very virulent strain of intellectual property theft going on that affects American industry.

He told me he couldn't go to any of the factories that he had visited and not see knock-off parts copied from his customers. They were simply there. Not only that, but he would take a poll wherever he went. And he would say, "Well, how many computer stations do you have in this factory," and there might be 40 or 50.

He said, "Well, how much have you paid for software." And it's not just Windows software or database software; these are the advanced, industrial design software packages, which run American industry.

Almost to a facility no one had paid anything for those factories. Now we just heard from the motion picture association and from Warner Bros. We know that their goods are pirated. We know that Microsoft goods are pirated. With apologies to them, it's very hard to get American consumers to weep for Microsoft or the motion picture industry.

In fact, when we have the opportunity to pirate from them without consequence, we do the same thing. That's what Napster was all about.

But if you think beyond the level of lost sales, which Dr. Choate was talking about, which is around an $80 billion calculus (China takes $80 billion worth of sales from companies that would sell them equivalent values of goods), if you go beyond that and you look at the competitive ramifications of it, that a Chinese factory working on a platform of counterfeit software or even an entire production line which counterfeited, is operating in an environment which they have no technology cost, competing against American manufacturers who have a very high technology cost. In these manufacturing facilities it can cost $50 to $60,000 a year on a single computer station to run some of the advanced costs.

Do the math. If there are 50 engineers working on those stations, it's already millions of dollars. But some of these places have hundreds. I went into an automobile factory in China, which with their 200 workstations each with thousands and thousands of dollars of pirated software on it, they are competing against auto parts makers, American automotive makers who have high technology costs. This is part of China's low-cost manufacturing machine. It's something you can't compete against.

You might be able to find a way to save labor, but you can't save on your technology cost. It's simply a cost that they don't have to bear, that we do, and it is kind of a competitive advantage, which is almost impossible to overcome.

I talk about some more examples of this in this my written testimony, the main focus of which is the mismatch between our economy, which is a knowledge economy and knowledge-based economy, and China's economy, which is a things economy. Some things we can talk about in the question and answer period are what are the remedies for this. You've talked about them in some ways already. I think the apples-for-oranges remedies are very, very important. You have to think, even rethink WTO.

If the Chinese are pirating our movies, maybe we put their movies in the public domain on day two. That's something that we ought to think about. And we ought to be very open-minded, working at the very top of our intelligence on this. Also figuring out how big a stick we're willing to carry in this, because the situation is just getting worse. Pirating is creating multibillion-dollar companies in China, and they now will compete against Americans at the highest level.

Thank you.

[The statement follows:]

Prepared Statement of Ted C. Fishman
Author, *China Inc.: How the Rise of the Next Superpower Challenges America and the World*
Chicago, Illinois

First, I want to commend the Members of this Commission, and its staff, for attaching high importance to the issue of technology transfer to China. You are certainly correct in regarding technology transfer as one of the most crucial issues in our relations with China and in our economic futures. In reporting my book, *China, Inc.: How the Rise of the Next Superpower Challenges America and the World*, I came to see the transfer of technology and other intellectual property to China as one of the most urgent problems in our economy. Without swift and forceful action to reverse the free—and by "free" I mean "no cost"—flow out of our knowledge economy into China, the United States will lose the heart of our economic strength and see a rapid diminution in our standard of living. I will come to some of the specifics of the argument further on. First, I would like to put my comments on technology transfer and intellectual property in context with a few general observations about China and the United States.

China now informs nearly every big question about America's future. Take your pick: the future of our financial system, the demands on our schools at every level, how we shop, how we make things, how we employ workers at home and around the world. Our national security, global prestige and persuasiveness are increasingly affected by China's new-found economic might and confidence and, more importantly, by how we see China's future prospects. Whatever China's weaknesses—and it has many—it is folly not to acknowledge that its long-term prospects will most likely build on its considerable strengths, and that the country will go richer, stronger and far more influential over the coming decades. It is all but inevitable, for instance, that China will overtake the United States as the world's largest economy. Simple math makes the point. With five or six times the U.S. population, China need only provide its people with one-fifth or one-sixth the average income of Americans to have the largest economic footprint in the world. There is much talk lately about the value of China's currency, with some U.S. manufacturers suggesting that the yuan is 40 percent cheaper against the dollar than it ought to be. Should China take the single step of letting its currency float freely on the world market, the per capita incomes of the Chinese will increase from one-thirty-eighth of the U.S. average, to one-twenty-seventh. That is still low enough to keep China as a low-cost factory floor for the world, but it nonetheless offers an enormous boost in China's economic footprint.

To date, looking over the last twenty years and arriving at the present—the economies of the United States and China have acted as great complements to one another. China has proved more than able at manufacturing the physical things of this world, often at low costs no other countries can match. American consumers benefit. On average, the China price returns about $600 in savings every year to American consumers. Those who spend more, save more. In contrast, the U.S. Government's recent tax cuts to individuals, designed to be an economic stimulus, returned half as much, and the country had to draw down from the treasury and add to our public debt to put that money in people's hands. China simply delivers it. So when we talk about how cheap technology transfers contribute to the Chinese low-cost manufacturing machine, we should admit that on one level Americans, and the rest of the world's consumers, benefit mightily.

First, I want to stress that I see no point in demonizing the Chinese for their own practices. They have solid reasons for doing business the way they do, and many of us would act in much the same way were we in the position the Chinese now find themselves in. Here's a simple thought experiment. Imagine you were the leader of between 1.3 and 1.6 billion people, most of them desperately poor and modestly educated. Suppose you could transfer to your people the jewels of the world's advanced industrialized nations, paying nothing for much of it and pennies on the dollar for some more. Suppose, in other words, you could steal the best technology, copyrighted materials, brand names and top entertainment for your wanting people. And imagine further that you had little expectation of being held to account for that theft. In contrast, you would be rewarded for it. In fact, that theft would make your country an ever-more desirable home for the very international fashion, technology and knowledge enterprises you were so liberally borrowing from. Anyone here would make that choice—the choice which the Chinese government and people made and still do make every day. One of the precepts of good leadership is to make one's people prosperous and capable, and the Chinese practices have followed that hands down. Remember, the incomes of the Chinese have risen four-fold in twenty years, the use of personal computers is widespread and expert and Chinese factories routinely run on the very same software that their competitors in America use. In all, China's creation of an extremely loose intellectual property regime has paid off handsomely. And, we must admit, impressively. It has been a key element of China's growth. Rather than fault the Chinese for the method of their progress, I suggest we offer admiration, grudgingly, but sincerely. Conceding their success, however, does not mean conceding. It is now time we exercise what means we have to enforce global rules that will also serve the American economy.

To understand the deep threat to the U.S., it helps to understand the mismatch between the Chinese economy and ours.

The U.S., and other rich industrialized countries, now bet our best dollars on the knowledge economy, the amorphously defined new world in which better ideas, not faster, cheaper hands, create jobs and wealth. Consider what an advanced economy like ours does best: make movies, produce television shows watched from Helsinki to Cape Town, turn out global pop stars. We design the software and processes that streamline the operations of giant retail chains and global high-tech manufacturers. We engineer advanced engines and the guts of the world's computers. We devise brands, durable corporate identities and fashions. We conjure new ways to move money and put it to work. We turn the most basic tasks into knowledge work. Modern printers, to note one example, rely heavily on the most advanced automated presses, computerized design tools and management and shipping for delivering materials efficiently to consumers and are as dependent on the latest software and technological innovations as a biotech lab. And those 2.8 million American workers who in recent years have lost their factory jobs? They don't learn new ways to use power tools. They are retrained in front of a computer; they learn to run the robots that do the jobs they used to do. You do not need to look at factory floors to see how deeply the knowledge economy reaches. Even that most ancient, and basic of all human tasks, farming, has been re-made by our knowledge economy. A farmer wakes in the morning to check weather and futures prices on PC with an Internet connection, he climbs into the cab of a $200,000 farm machine that makes its way through the fields using GSP navigational technology. Under the wheels grow crops that are as highly engineered as the most complex pharmaceuticals, and when they are harvested they move throughout the food distribution with an efficiency made possible by tracking, inventory and sales software. One American farmer, deploying the tools of our economy, developed in public and private laboratories and workshops can do the work of 20,000 Chinese farmers. Even when we produce the physical stuff of the world, we produce it most efficiently because of the knowledge products that emanate out of the 21st century American economy.

The trouble with this apparently successful state of affairs is that the stuff we do best exists nowhere and everywhere at the same time. Some of our most valuable things—software codes, pharmaceutical processes, car designs, digital movie files—weigh nothing and, as e-mail attachments, can move at the speed of light. To learn American ideas and procedures is all but the same as owning them. (Unless, of course, laws successfully prohibit their co-option.) In contrast, most of what China makes that finds its way into the world market is physical. The Chinese can borrow and steal the designs to our best products all they want. The statistics are well-known to this Commission. Add them up and the Chinese economy itself looks like a counterfeit economy, one in which the vast majority of goods branded as one thing are made by someone else. Everything from simply copied commodity products such as household cleaners, fashions, consumer and business technology to goods higher up the economic and technical food chain such as biotechnology, automotive and aerospace products all have their unofficial knockoffs in China. Sometimes the copying affects only bottom lines, sometimes the stakes are much higher, as in the case of false pharmaceuticals. China's drug industry is a complex mix of enterprises, some owned by the state, others private, and nearly all out of bounds of the licensing and quality control mechanisms of the world's major drug companies, whose products the Chinese copy. Copied drugs are sometimes excellent, and sometimes deadly. Both pose dangers. Bad copies kill patients, they also have the potential to kill American companies because bad drugs are now finding their way into the mix of real medicines, so that a vial of 30 pills bought at a local pharmacy in Chicago might have one or two bad pills made in a back room in Guangzhou. The patient death is bad in itself, but bad medicines also threaten American jobs and wealth. The legal repercussions may one day drive a blue chip company into bankruptcy. If that sounds far-fetched consider what the recent spate of drugs removed from the market have done to the share prices and liabilities of the companies behind them.

The amount of economic activity in China tied to pirating and counterfeiting is staggering. Stolen movies and software are the poster children of global piracy and in China they are everywhere. Hollywood's Motion Picture Association estimates that 95 percent of all movies seen in China are pilfered and that its members lost $178 million in potential revenue. DVDs are only the most visible items in the pirate and counterfeit economy. Ninety percent of all software running on Chinese computers has been pirated and bought openly in stores for around $3 a copy. Using a lost-sales calculus, which measures the losses to foreign companies by tallying the value of the dubious goods sold, the U.S. Department of Commerce estimates the loss to American companies at between $20 billion and $24 billion. The Department says the Japanese now lose even more: $34 billion. Add in the European Union and the number approaches $80 billion. Thomas Boam, who until recently served as the Minister Counselor for Commercial Affairs at the U.S. Embassy in Beijing, argues piracy and counterfeiting account for between 10 percent and 30 percent of the $1.4 trillion Chinese economy. Some estimates go much higher. I will explain further how these lost sales numbers undercounts the loss to the U.S. economy. We should also consider, however, how these calculations rest on a fiction, one which itself obscures the rationale the Chinese frequently offer for the intellectual property practices. In short, they argue that the real versions of the goods they copy are simply too expensive. With drugs it is a compelling argument. The Chinese government clearly believes that providing lifesaving drugs for a fraction of their American price is in the interests of its people. With things like DVDs the argument is a bit less compelling, but price is still the issue. Few Chinese would buy genuine goods if they had to pay the prices Americans do. At $20, a DVD movie in a U.S. store equals 10 days' wages for hundreds of millions of Chinese factory workers.

And there's the rub. What Americans make and what the world values moves very easily into the counterfeit economy. If Americans wanted to borrow and steal the physical stuff that China makes, we would have to march in with an army and commandeer Chinese factories and workers. Western powers and the Japanese tried that in the mid-19th and -20th centuries, respectively, and, happily, will not repeat the experiment. China, however, can in a sense colonize the developed world simply through careful study and a willingness to go its own way on intellectual-property protection.

The most hopeful group looking at China's prospects for reform are those that study the country's growing body of laws. Quite often lawyers attend my talks on China and tell me that the country is serious about following international standards and that its volume of legal mechanisms to punish transgressors is growing. They even point to some high profile cases in which international parties found some redress in Chinese courts. Yet, to an observer in the street, and to those who talk to American businesses that face China's version of enforcement, the story is not hopeful at all. Indeed, despite the proliferation of laws, the situation on the ground in China grows steadily worse. DVDs are everyone's favorite example. They are so cheap in China that foreigners are every bit as eager to buy them as locals. They also are one of the most visible exports from China's great counterfeiting machine. New laws have had no effect on the trade. Quite the opposite. The places they are sold no longer look like back-alley stalls but like Main Street retailers. Near Beijing's diplomatic row, two outdoor markets once famous for knockoff fashions have been combined into a large, bright department store-like building with escalators, tailors on site and merchants with business cards, international shipping accounts and full stocks of fake fashions, designer tableware, brand-name musical instruments and, of course, thousands upon thousands of fake Swiss watches. The most common punishment counterfeiters face is the confiscation of whatever products they have in stock. Sometimes a pitiful fine is levied. China's National Copyright Administration cites with much fanfare 52 raids on video shops in 2003, but the total fines amounted to $6,900, or an average of $132 for each offender.

With apologies to some of the other presenters at this hearing, I offer one trivial observation on the way to a more important one. It is nearly impossible to get the general public to feel sorry for Hollywood when the Chinese pirate American films and movies. Likewise, few in the world weep when big software corporations, such as Microsoft, Oracle and Adobe lose sales to pirates and counterfeiters. Yet, nearly every time one hears about the dangers of China's practices to the U.S. economy the story is told in terms of the lost sales to these sorts of companies. Missed entirely is the much bigger threat China's loose intellectual property regime poses to our whole economy. American companies are not just creators of intellectual property, they are buyers of it. It can cost millions, or tens of millions of dollars to purchase and service the software to run an American company. Yet, Chinese competitors often pay nothing for the same technology, because it is simply stolen. Walk into the vast majority of Chinese firms that run computers and one will see one work station after another stuffed with $2 versions of software that costs Western competitors hundreds of dollars to run.

China's loose intellectual property rules also transfer to Chinese industry valuable intellectual assets that can take American companies years and cost significant sums to develop. American automobile makers can spend half a billion dollars developing and building a new car, and take two years to do it. As soon as the car hits the market, Chinese manufacturers study it and look at how to copy it. Chery Motors, the company which will soon introduce Chinese built cars into the U.S. market has been accused by General Motors of pirating an entire GM car and beating GM to market with the Chery copy. It is not unusual for whole assembly lines to get duplicated in China, where the copiers need not worry about the cost of developing and designing the lines. Big business in the U.S. is vulnerable, but so are smaller firms where often one good idea, patented or kept proprietary in some other fashion, is the only truly valuable asset the firm has.

China's failure to police its intellectual property rules often looks less like ineffective government than a conscious policy to shift the highest value goods from other economies into the country. It is, in essence, the largest industrial subsidy in the world, and brilliantly, it costs the Chinese nothing. In 2005, China will most likely be the world's third-largest trading nation, and counterfeiters give the country's increasing number of globally competitive companies the means to compete against powerful foreign rivals that pay for their use of proprietary technologies. In a broader geopolitical context, China's counterfeiters deny the world's advanced economies, especially in the U.S. and Japan, the opportunity to sell to China the valuable designs, trademarked goods, advanced technology and popular entertainment that the Chinese urgently desire but cannot yet produce on their own. For the U.S., this mismatch is particularly punishing. Japan and Germany, which also suffer from China's policies, do not have the huge trade deficits with China that the U.S. does. One reason is because our export economy is far more dependent on the sale of highly valuable, intangible and easily copied goods. Japan and Germany make the machines China needs to run. America makes the software that runs those machines. It is far more difficult for us to get paid by Chinese users for what we make, though most of the rest of the world pays handsomely for it. Until we can get paid for what we make and the Chinese use, our deficits will worsen, not improve. Say, for example, that the value of the dollar drops against the Chinese yuan. Economists predict our trade situation will level out, but do not take into account that no matter what our goods cost, the Chinese will most likely continue to pay nothing for some of the most useful goods we make. And, as a result, their factories will continue to be able to beat even the most efficient American factories on price.

We now have a golden moment in which we can still use our power as China's most important customer to enforce a change in its intellectual property regime. Action ought to be forceful and unequivocal. Our trade deficit with China alone—not counting the rest of our trade with the country—is more than ten percent of the entire Chinese economy. That is an astonishing figure, and in it we can find strength to exert rules over our trade with China. That may require a radical rethinking of past agreements, some brinksmanship with quotas and tariffs and other remedies. Without action, however, the U.S. is likely to find our entire economy copied in China and Americans paid little for the brainwork imported to make it run.

Thank you.

Chairman D'AMATO. Thank you very much. Thank you both for your interesting testimony.

Commissioner Mulloy.

Panel VIII: Discussion, Questions and Answers

Cochair MULLOY. I have a couple questions. First I want to salute Dr. Choate. It's not often that we get a man who ran for Vice President of the United States to come and testify before the Commission.

Dr. CHOATE. It's not often that you get somebody who lost by 92 million votes.

Cochair MULLOY. How many votes did you get?

Dr. CHOATE. Almost nine million.

Cochair MULLOY. Nine million votes, all right.

Dr. CHOATE. That's definitely a mandate to stay in the private sector.

Cochair MULLOY. So we're delighted.

Dr. CHOATE. Thank you very much.

Cochair MULLOY. We did have this piracy problem in the United States when we started out, and domestically we protected it.

Dr. CHOATE. Yes.

Cochair MULLOY. It was foreigners. Maybe we were ripping off—Dickens always used to complain, I remembered. But what you have to understand is later we had the Paris Convention dealing with patents and the Bern Convention dealing with—that was in the late 1890s, in that period.

Dr. CHOATE. Right.

Cochair MULLOY. Then when we decided to create a WTO and give these developing countries and India and China access to our market at an MFN rate 2.5 percent, part of the deal was we have IPR interest in your country. Part of the deal is you protect those. So we created an international agreement. We weren't violating any international agreement when we were ripping of intellectual property rights in the 1800s. They are. They signed it. That's the difference. They should be enforcing it. And they should be giving

Americans the intellectual property protection that they signed up to give them. That's part of the deal. So that's why I feel its important for people to understand that distinction.

Dr. CHOATE. In my testimony, Commissioner Mulloy, I point out that we made a very explicit deal, as we did the GATT negotiations. And the explicit deal that we made, and we led the Europeans and the Japanese in getting this deal, is that the United States would withdraw all quotas on textile and apparel imports. We would end the old multifiber agreement in exchange for the developing world excepting TRIPPs, the Trade Related Intellectual Property Protections inside the WTO.

Cochair MULLOY. Right.

Dr. CHOATE. We set a ten-year phase-in. The end of the phase in was the 1st of January of this year. We've kept our part of the bargain. We have to have lost one million apparel and textile jobs in that ten-year period. We've gone from 1.6 down to barely 650,000 workers. That is a heavy cost. Incidentally, half of those workers are not finding themselves back into the economy.

It turns out that China, the largest beneficiary of that agreement on textiles is China. China now has 25 percent of our market. They're projected by 2010 to have 75 percent of our market unless something is done. And they have made no compliance on the intellectual property.

China promised us and China made a treaty with 147 other countries that it would adopt four sets of minimal standards and it would provide a judicial system that would operate. I think Commissioner Reinsch hit the point earlier. It is to try to impose on China a system of private rights, and private means to enforce those rights, that has no experience in the concept of a private right of speech, a private right of religion, a private right of politics. It's in effect as though we're trying to graft a grapevine on a redwood tree.

Now what I'm urging and suggesting is that we stress the system. If this TRIPPs not going to work——

Cochair MULLOY. And we know it.

Dr. CHOATE. —we need to know it. We need to stress the system and we need to stress it as quickly as we can.

Cochair MULLOY. Mr. Fishman, how does the lack of IPR protection in China for American products, how does that diminish and make Americans less willing to go into math and science in our own country?

Mr. FISHMAN. The lack of IPR protection in China influences almost any issue we have with China, and there are no small issues with China. On the education front, for example, if the value of your worldwide patents are diminished, then the value of the people who creates those patents is diminished.

China right now is the only robustly growing large economy in the world. You might put India up there, too. For the large companies around the world, they see the United States, Japan, and Western Europe as mature, rather slow growing economies, compared to China's robust ten percent—nine and a half, ten percent year over year. They are developing products for that market.

The CEO of Motorola told me the other day they don't outsource to China, they insource to China, which means they move innovation to China to serve that market. In that market they pay engineers one-sixth to one-tenth of what they pay engineers in the United States. And they know that their intellectual property that they develop in China migrates into the design of products and the supply chain very, very quickly.

If you're going to pay your highest-paid engineers in Schaumburg, Illinois ten times as much, you probably want to push as much engineering as you can into more affordable employment markets, which right now happen to be very big markets. And how in their right mind is going to stick to their centers where they have the highest costs.

I spoke to a convention of manufacturers and I just asked them how many of you would let your children do what you do? These were people who owned their own manufacturing businesses. In a room of about 200, only five hands went up.

You might ask the same thing of engineers in this country, many of whom were represented in the ranks of those manufacturers. Who in their right mind would encourage their kids to go be an engineer if they knew that there was a very large chance that any company that their children worked for would be looking to pay somebody one-sixth or one-tenth of their wage overseas.

Cochair MULLOY. Thank you both victim.

Mr. FISHMAN. Thank you.

Dr. CHOATE. Thank you.

Chairman D'AMATO. Commissioner Dreyer.

Commissioner DREYER. Dr. Choate, I hope you're not letting China off the hook too easily here when you say they have no tradition of intellectual property rights, because of course you're absolutely right historically. On the other hand, over the last ten years we've seen a fair number of suits of one Chinese citizen suing another Chinese citizen or a company for exactly that. If they know how to do it domestically and they know it's a crime, then I think they know internationally.

Additionally, the Chinese constitution does give citizens freedom of religion.

Dr. CHOATE. Right.

Commissioner DREYER. Albeit they find other ways to circumscribe it.

I think it's going to be very interesting to see these negotiations with the Vatican play out. I just hope the Vatican doesn't do what we saw our representatives from the film industry admitting to and saying, well, this is a strategic plan; we want a toehold in the market.

Dr. CHOATE. Um-hum.

Commissioner DREYER. Because I consider the Vatican to have a number of very, very bright diplomats and I would hate to see them get mouse-trapped on the bishop appointed.

But I do think we've been far too, "Oh, well, it's not in their tradition," forgiving of the Chinese. And I just wanted to be sure you didn't mean that.

Dr. CHOATE. No, no. On this issue I'm very unforgiving. Whether they have it in their constitution or whether they do it to their citizens, they made a commitment with us. They have taken the benefits of that commitment, which is going to be worth about 30 million jobs for them. And we've paid an enormous price. They owe us.

It's up to our government to force that issue. If there's any fault at this point, it's our fault for not forcing and enforcing our—it is here.

Mr. FISHMAN. Look, we have $170 billion trade deficit with China. That's not even our total trade. That's just our trade deficit, right. That's 14 percent of the Chinese economy. That is a huge stick.

Dr. CHOATE. Yes.

Cochair MULLOY. A hundred and sixty-two last year.

Mr. FISHMAN. Well, I'm projecting for this year, yes.

Chairman D'AMATO. Nearly three times the size of their entire defense budget, even in the inflated terms we understand it to be.

Mr. FISHMAN. We have this golden window now.

Commissioner DREYER. Theoretically the defense budget.

Mr. FISHMAN. We have this golden window that may not last forever, in which we are by far their most important customer. That window may close if we don't act soon.

Chairman D'AMATO. Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thanks very much, and thanks to our witnesses who have been sitting here for quite a while. I actually have a comment more than a question. Mr. Fishman, I think I probably disagree with your paradigm from the very beginning that the government is interested in the welfare of the people. My conception of the Chinese government is that it is these days interested in the welfare of the people only to the extent that bad welfare of the people threatens their hold on power.

Mr. FISHMAN. Well, maybe they're not incompatible.

Commissioner BARTHOLOMEW. I was struck by what you said. I don't know that the interests of the Chinese people are first and foremost in the minds of Chinese leaders when they're making a lot of these decisions, and that helps to explain some of how the decisions can be made without a whole lot of costs.

Mr. FISHMAN. Having said that, their per capita GDP has gone up fourfold in 20 years.

Commissioner BARTHOLOMEW. Yes. There is another issue of course. You talk about the leverage that we have given the size of the trade deficit and everything there. At some point as American job loss continues and our economy goes down, one would hope or think that they need to be concerned about the fact that people are not going to be consuming at the level that they are in order to maintain the market that they have here.

Mr. Chairman, the Cochairs did a great job in putting this together.

Chairman D'AMATO. Well, thank you very much, Commissioner. I'd like to thank both of our panelists. This is an issue that really I find embarrassing as an American, the fact that our government is unwilling and has been unwilling to actually make any kind of moves that are credible and effective in protecting the rights, intellectual rights and the property rights, of our citizens. It's really quite an embarrassment and it needs to be remedied; we're going to try and push as much as we can to get it remedied one way or another.

Go ahead, Commissioner Mulloy.

Cochair MULLOY. Yes, I just asked Dr. Choate about bringing this case and using the WTO. We paid a big price to get them in there. We ought to use it.

I'll tell you what my impression is. I was in the Clinton Administration at the Department of Commerce at a political level. I saw the way the USTR behaves. I think they have a proprietary interest in making the WTO look good. I don't think they are afraid that if we bring a case, it's like the emperor has no clothes. Then if it doesn't work, they'd be embarrassed or their creation doesn't work.

I personally think you bring the case and if you can't win the cases, then your policy is clear that that group won't work and we're going to do something else. That's my observation.

Dr. CHOATE. It's very much in our tradition to do that. The first patent act of 1790 turned out to be too uncomfortable. Thomas Jefferson worked. They changed it 1793. That didn't work. They changed it again in 1836. This is part of democracy and it's part of our tradition. If something doesn't work, you find something else. But you deal with the problem. The problem in this case is it's totally unacceptable to have our innovation stifled by another country violating an agreement and stealing it.

Chairman D'AMATO. At the same time that they're dependent to a large extent on their development on our economy, and we've allowed that to happen.

Dr. CHOATE. And selling the goods back here to us.

Mr. FISHMAN. Here is a provocative thought on that, which is how do American companies participate in the theft. When you go into a big box retailer and there's a DVD player there that costs $29 and the license fee on that DVD player is $12, and those are stacked from floor to ceiling in those factories, there are American companies who are winking and nodding at their Chinese suppliers for stealing on their behalf.

Cochair MULLOY. That's a great comment.

Chairman D'AMATO. I want to thank this panel for its testimony. I would also like to extend our appreciation as a Commission to the Hoover Institution; Stanford University Law School, in particular Julia Erwin-Weiner and Courtney Ewing for their assistance in arranging for the use of this facility.

We would also like to express the Commission's deep appreciation to Kareen Lambert, Wayne Fishburn, Heather Milnbarger, and Julie Wicklund of Cooley Godward and all the others who worked so hard to make this onsite visit possible.

Finally, a special thanks to the Commission's excellent program and administrative staff who worked long hours preparing the program and agenda. Thanks especially to Carmen Zagursky, who arranged for this hearing; our Associate Director, Kathy Michels; David Ohrenstein, our Trade Counsel; Scott Bunton, our Executive Director; M.L. Faunce, Davetta Vaughn and Romayne Houle, Staffing and Program Assistants; and Olivia Knight, Research Fellow, for their hard work. Lastly, thanks for the court reporters and the technicians for their help for these two days.

This concludes the hearing.

[Whereupon, at 1:00 p.m., the hearing was adjourned.]

Statement of Oded Shenkar
Ford Chair, Fisher College of Business, the Ohio State University

Intellectual Property Rights

Honorable Members of the Commission, the infringement of IPR by China, which takes the form of piracy, counterfeiting (trying to pass a pirated product as a genuine article), and related practices, is at the heart of the U.S.-China economic relationship, since, simply put, China is the world's number one violator while the United States pays the heaviest price of the infringement. The repercussions of IPR violations of are not merely economic, but carry over to the strategic, geopolitical and national security arenas. The problem has repeatedly featured on the agenda of U.S. trade negotiators, but in my opinion does not receive the attention it deserves. From the perspective of the U.S.' national interest, IPR violation should top the list of bilateral and global trade issues, ahead of exchange rate alignment, which seems to be the current focus of the U.S. Administration efforts, or any other trade related items. IPR violations by China should also be of primary concern to U.S. policymakers, businesses, individual copyright owners, and U.S. taxpayers who have been funding a substantial portion of domestic R&D expenditure only to see a substantial portion "borrowed" without compensation.

That China violates IPR is well known, but many do not recognize the scope of the problem. China is not the first or only nation to violate IPR, but it dwarfs other contenders, such as India and Vietnam, in the scale, scope and range of IPR violating goods. While U.S. media continue to showcase the bootlegging of DVDs (obviously a huge problem to the movie industry), Chinese outfits routinely copy anything from razor blades and cigarette lighters to pharmaceuticals, automotive components and even entire cars. China is able to do that because it possesses a unique combination of advanced production capabilities *and* widespread disregard for IPR. Typically, nations with advanced technological capabilities respect IPR to a reasonable (though variable) extent, while violating nations lack the capabilities and infrastructure to replicate technology- and capital-intensive products. China is the only nation which is *able and willing* to make high quality copies of complex industrial designs within a short time of accessing the necessary information (often by reverse engineering).

Various estimates put IPR violating production at ten to twenty percent of Chinese output, though the phenomenon, by nature, defies accurate quantification. For example, China is the leading source of U.S. custom seizures of counterfeit imports, but it is obvious that the goods apprehended represent a mere fraction of the actual volume of infringing products coming into the country, and that similar products routinely make their way into other markets, sometimes in broad daylight. Numbers are also difficult to come up with since many U.S. and other multinationals do not want to offend the Chinese authorities and are also fearful of repercussions should legitimate customers come to suspect their products as not being genuine.

The damage caused by IPR violations is enormous though often underestimated. Some of the costs include:

1. The substitution of a genuine product by a fake creates substantial revenue loss. The loss is not limited to the Chinese market (where it is estimated that almost half of foreign multinationals lose upward of twenty percent of local sales to violating products) as counterfeit and pirated goods are now exported en masse to global markets, especially (but not only) to those where IPR protection is lax. For U.S. car makers, whose better margins on "after market" components compensate for very slim manufacturing margins, the damage can be quite salient. Obviously, the cost is born by stockholders, legitimate suppliers, employees, dealers and more.

2. The violation of IPR allows competitors to undercut the prices charged by legitimate producers because they do not need to pay for development expense (for pirated and counterfeit goods) and/or trademark promotion (for counterfeit goods). Since development represents a substantial portion of final product cost in technology intensive industries, legitimate producers are placed at a significant disadvantage and may be pushed out of the market altogether.

3. When counterfeit products malfunction, as they often do, the reputation of the company and the brand associated with them suffer what might be irreparable damage. The damage here is almost incalculable as a company loses its pricing power and its long-term competitiveness erodes.

4. Pirated and counterfeit goods are often built to lower safety standards and understandably do not go through the rigorous standards required in the United States and other developed nations. The result is a substantial risk to consumers who might buy, for instance, a flammable toy, not to mention the risk represented by fake products such as pharmaceuticals, brake pads and the like.

5. IPR violating products increase the cost of doing business of legitimate players by necessitating legal and administrative expense in going after violators, not to

mention the litigation risk involved in plaintiffs charging the legitimate producer in not preventing the sale of a counterfeit under its name. Legitimate players also spend considerable dollars in trying to engineer their products in a manner that will make copying more difficult.

6. IPR violating goods compromise U.S. export controls because the technology transfer does not go through the documentation and certification oversight. The result may be that security related technologies will find their way into the wrong hands.

7. IPR violating goods create an opening for criminal and terrorist activities, as the enormous profit margins available from their sale attract international crime syndicates and global terror groups who view this line of business as an ideal opportunity to fund their clandestine operations.

All developed nations should be concerned with IPR violations, and to some extent they are. The United States is however the most vulnerable to IPR violations for a simple reason: It is the world's leading owner of IPR assets, from patents to brand equity. The United States has a very substantial surplus in technology flows, that is, the payments it receives for technology owned by U.S. entities (e.g., as part of a licensing agreement by a foreign user) far exceed the payments U.S. entities pay for foreign technologies. This means that the U.S. is the most susceptible to Chinese IPR infringement. For the same reason, it will be difficult to build a global coalition to combat IPR violations as other developed nations suffer less and are more likely to sacrifice IPR on the altar of the promising Chinese market.

Common wisdom suggests that the problem is temporary, that once China's transitional economy matures and its legal system evolves, IPR compliance will naturally occur. I beg to differ. For two thousand years, legal responsibilities in China rested with the executive branch; today's system is very much the same, with no separation of powers to speak of. It is naïve to assume that the system will change just because China is becoming a part of the global trading system. The country has already defied the economic presumption that it was impossible to attract substantial foreign investment without a proper IPR regime. The assumption that China will come to respect IPR because it will be in its interest to do so when it becomes an innovator may also be misplaced. I would argue that violating IPR rights enables Chinese companies to advance their competitiveness with minimal investment, in effect piggybacking on R&D investment made by foreign firms and governments (who in most countries carry much of the R&D expense directly, e.g., via government labs, and indirectly, e.g., via research funding). Put it another way, IPR violations constitute a direct subsidy enjoyed by Chinese manufacturers at the expense of U.S. taxpayers and stockowners. IPR violations are an oft neglected element in the so-called China price mystery, namely the ability of Chinese firms to price their products well below the cost of production in other locations. While labor cost, exchange rates and the like also play an important role in the “China price,” there is no question that especially for technology-intensive products, obtaining free technology confers a substantial discount. Finally, even if the problem is temporary, it may last long enough for many U.S. businesses to lose market share or go out of business.

Why doesn't the Chinese government do more to curb the practice? First, because the violations enable Chinese companies to climb the technological ladder despite modest R&D expenditure (China spends roughly 1% of GDP on R&D versus close to 3% in the United States). Second, a sudden halt of IPR violating production would trigger economic collapse in those Chinese localities that have become addicted to fake production, and the regime can ill afford the resulting unemployment and social unrest. Third, given the tenuous control of the central government in many rural areas, it may be argued that Beijing is incapable of putting an end to the practice even if it wanted to. As a result, the Chinese government would rather take its chances with the United States (and, to a lesser extent, other foreign governments), conducting occasional raids that don't get to the root of the problem, rather than face angry local constituencies who may challenge its rule.

The problem therefore may get worse before it gets better. Note, for example, that while most developing nations have shown incremental improvement in software piracy rates in recent years, China's violation rates have actually been on the increase. Given the rapid globalization of fake production, the scope of the problem is expected to broaden, as bogus products make their way into more markets. Enhanced Chinese compliance, if it were to happen, may be directed at protecting nascent Chinese players rather than foreign multinationals, in effect strengthening their competitive advantage. Finally, with organized crime and terrorist groups getting into the game, the consequences of benign neglect of IPR violations by China and its trade partners can be ominous. It is my humble opinion that we cannot afford to look the other way.

LOSING THE COMPETITIVE ADVANTAGE?
THE CHALLENGE FOR SCIENCE AND TECHNOLOGY IN THE UNITED STATES

FEBRUARY 2005

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LOSING THE COMPETITIVE ADVANTAGE?

THE CHALLENGE FOR SCIENCE AND TECHNOLOGY
IN THE UNITED STATES

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ABOUT AeA

AeA, founded in 1943 by David Packard, is the largest high-tech trade association in the United States with nearly 3,000 companies representing all segments of the industry and 1.8 million employees. Currently, AeA has 18 offices in and around the United States, as well as offices abroad in Brussels and Beijing. Our primary purpose is helping our members' top and bottom lines by providing the following services: Access to Investors; State, Federal & International Lobbying; Insurance Services; Government Procurement; Business Networking; Foreign Market Access; Select Business Services; and Executive Education.

AeA's unique grassroots network promotes and represents the business interests of America's technology industry. We provide competitive products and services to our members and lead in education and advocacy on a variety of high-tech business issues. They include: Sarbanes Oxley Section 404 reform; RFID initiatives; broadband deployment; preventing harmful Internet privacy legislation; making the research and development tax credit permanent; seeking updated export controls legislation; working with U.S. trade negotiators to achieve high-tech industry negotiating objectives within new international trade agreements; limiting the government's regulation and taxation of the Internet; promoting education reform; lowering capital costs for emerging technology companies; and supporting human resource and immigration policies that ensure access to the most qualified and highly educated workers.

From the well known giants of the high-tech world to the next generation of dynamic, smaller companies, AeA's members create products that promote innovation and efficiency in virtually every industry and business sector in the United States and throughout the world. The impact of high-tech products on people's everyday lives is immeasurable. High-tech products keep people safer and healthier, enable them to be more productive at home and on the job, and contribute to a better quality of life. Whether it is medicine or national security, education or agriculture, environment or entertainment, the high-tech industry is omnipresent and is inextricably linked to the advancement of modern society.

For information about AeA and the high-tech industry, please visit our website at www.aeanet.org.

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FOREWORD

The United States stands at a critical juncture in confronting its future in science and technology. As the largest representative of the high-tech industry in the United States, AeA will always be the first to credit the unique factors that make the U.S. economy the envy of the world in creating the innovations that advance society. But AeA would be remiss if it were not also among the first to warn the government, the media, the general public, and the industry itself when a serious problem exists that warrants our collective attention.

We are slipping. Yes, the United States still leads in nearly every way one can measure, but that does not change the fact that the foundation on which this lead was built is eroding. Our leadership in technology and innovation has benefited from an infrastructure created by 50 years of continual investment, education, and research. We are no longer maintaining this infrastructure.

The obvious advantage of leading in any race – be it a sprint or a marathon – is having everyone else scramble to catch up; the less obvious disadvantage is not being able to see how quickly those behind you *are* catching up.

The United States is the proverbial frog in the pot of water, oblivious to the slowly rising temperature. When the Soviets launched Sputnik, it was more like being thrown into a pot of boiling water – and we reacted. Today we have to act without the stimulus of an overarching, mobilizing event. Just because the threat is less obvious, doesn't make it any less real.

The United States can no longer coast if we hope to continue our leadership in science and technology. We at AeA are not – as much as we'd like to be – idealistically convinced that we can change the world with a single paper. We don't believe all of the issues that challenge American preeminence can be solved with one simple cocktail of policy reform. But we do believe that confronting the issues threatening future U.S. competitiveness *can no longer be deferred.*

In this regard, the focus of our report is on the analysis of the problem. While considerable time and effort was spent preparing the recommendations at the end of this report, we are more concerned about recognizing the nature of the challenges ahead. We believe that once the debate is started, the solutions will become obvious.

Policymakers, industry executives, community leaders, teachers, and parents need to recognize that the world is changing and that we had better adapt to this increasingly competitive environment if we hope to remain at the forefront of the technology revolution.

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Chairman of the Board
AeA, Advancing the Business of Technology

William T. Archey
President and CEO
AeA, Advancing the Business of Technology

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The dominance of the U.S. is already over. What is emerging is a world economy of blocs represented by NAFTA, the European Union, and ASEAN. There's no one center in this world economy. India is becoming a powerhouse very fast. The medical school in New Delhi is now perhaps the best in the world. And the technical graduates of the Institute of Technology in Bangalore are as good as any in the world. Also, India has 150 million people for whom English is their main language. So India is indeed becoming a knowledge center.

Peter Drucker
Fortune Interview, January 12, 2004[1]

The great benefits of globalization will accrue to countries and groups that can access and adopt new technologies . . . Those countries that pursue [policies that support the application of new technologies] could leapfrog stages of development, skipping over phases that other high-tech leaders such as the United States and Europe had to traverse in order to advance.

CIA's National Intelligence Council
Mapping the Global Future[2]

America needs to recognize that future innovation is not predetermined to occur in the United States. Even if we were doing everything right, we still face unprecedented competition from abroad.

AeA
Losing the Competitive Advantage?

EXECUTIVE SUMMARY

Losing the Competitive Advantage? explores the challenges the United States currently faces and, in many ways, is ignoring at its peril. Our purpose is to alert audiences that America's edge, particularly in science and technology, is increasingly at risk. AeA began this discussion in March 2004 with our report on offshore outsourcing. Our view then, as it remains now, was that offshoring is merely a symptom of a dramatically shifting global economy and the U.S. role within it. This report serves as a natural sequel, in that it addresses this big picture.

Many of the findings may sound vaguely familiar, even obvious; others may seem surprising. We analyze a number of competitiveness factors within these pages that, when taken in isolation as they so often are, would not necessarily constitute a crisis. But the interrelationship – the cumulative effect of these trends – makes the more compelling argument that the status quo is unsustainable, and that any reasonable person will see the need to act.

Even if the United States were doing everything right, the world still poses unprecedented competitive challenges. Ensuring future prosperity depends on decisions that move us forward today. As the legendary Wayne Gretzky once said, "I skate to where the puck is going, not to where it's been."[3]

In a rapidly changing global economy, the United States needs to address the implications of the following critical issues to prevent an impending slide in U.S. global competitiveness:

<u>Economic Reforms Are Transforming Other Countries' Economies and Making Them Dramatically More Competitive</u>
The United States has long urged the rest of the world to adopt free market principles. The good news is that many countries have now listened and represent new markets for U.S. products and services. Globalization has benefited no country more than the United States. But the bad news is, ironically, that many countries listened. They have entered the global economy and now aggressively compete against the United States – or soon will.

<u>Other Countries Are Adopting and Utilizing Technology To Enhance Their Economic Growth and Competitiveness</u>
These countries now invest heavily in their high-tech infrastructure and produce talented, highly educated workers and cutting-edge companies. **China graduates almost four times as many engineers as the United States** and offers lucrative tax breaks to companies conducting R&D there. India is pouring money into technology parks to lure back native talent and produce world class tech companies. South Korea has leveraged rapid technology diffusion to "leapfrog" into the global economy. **But the larger point is: a host of countries are catching up to the United States.**

<u>U.S. Federal R&D Funding That Spawned So Many Technological Breakthroughs in the Twentieth Century Is Faltering</u>
The Internet, MRI, the mouse, and GPS – to name a few – were born from federally sponsored research. R&D funding is vital in supporting innovation because it invests in the technologies that will advance society in the future. Unfortunately, R&D funding has declined over the last decade and a half and the priority has shifted to life sciences.

<u>If U.S. Workers Are To Compete in a World Economy That Is Knowledge Based and Driven by Technology, the American Education System Must Improve Substantially</u>
A highly skilled workforce is the lifeblood of any successful company, industry, or national economy. Regrettably, the American K-12 system is failing to provide the math and science skills necessary for kids to compete in the 21st century workforce, and the U.S. higher education system cannot produce enough scientists and engineers to support the growth of the high-tech industry that is so crucial to economic prosperity.

<u>For the Past 60 Years America Has Been the Beneficiary of an Influx of Many of the Most Talented Minds on the Planet. That Period Could Grind to a Halt Given Restrictive Immigration Policy, Tremendous Opportunities Abroad, and the Perception of Not Being Wanted</u>
Immigration policy post 9/11 has deterred foreign nationals from coming to the United States to study or work. They are choosing to go elsewhere and we lose when this happens. **Last year, foreign applications to American graduate engineering programs plummeted 36 percent. This is tragic because over 50 percent of doctoral engineering and math degrees awarded in the United States go to foreign nationals whose financial support makes many of these programs economically viable.** If we cannot graduate enough American workers, then we need to understand that keeping out foreigners is not the answer. **One out of five scientists and engineers in the United States are foreign born**. We cannot afford to lose their intellectual abilities, innovations, and ultimately, the hundreds of thousands of jobs they create.

INTRODUCTION

From the assembly line and airplane to the personal computer and Internet, many of the innovations that transformed the world in the twentieth century were born in the United States. The dynamic and entrepreneurial composition of the U.S. economy encouraged capital, labor, and creativity to flow efficiently to their most productive use. While many other countries insulated themselves from the global economy, the United States welcomed foreign direct investment, foreign students and workers, and competition onto its shores.

Following World War II, the majority of foreign governments supported uncompetitive industries, often attempting to manipulate the creation and direction of production. Meanwhile, the United States allowed for a flexible economy. It concentrated support on the factors of innovation by investing in a knowledge-based economy, funding research and development and scientific education.

The United States wisely has held on to many of the principles that created this success. The U.S. economy remains profoundly adaptive to change, and its flexibility in labor and capital markets is second to none. It continues to breed an entrepreneurial culture that the rest of the world envies and often tries to emulate.

The United States boasts a vibrant venture capital market with investors who are willing to support visionary, yet risky ideas and who play an active role through hands-on involvement. Not all ventures succeed, but that is the point; innovation flourishes best when people are allowed to fail. The ideas that do make it to the marketplace often produce benefits that far exceed their creator's intent.

The technological revolution of the 1990s created high-paying jobs, new products and services, new companies, and entirely new industries never dreamed of decades earlier. This directly resulted from the commitment by both the public and private sector to invest in new ideas, which helped make the United States the breeding ground for many of the scientific innovations of the twentieth century.

But that was yesterday. As the United States takes its leadership for granted, countries around the world have caught on and are catching up. While we begin to close our doors to the best and brightest minds, these talented individuals and the intellectual property and jobs they create here are lured elsewhere. As we cut funding for research and development (R&D) – a critical factor in the innovation that has driven our economy for a century – other countries are investing in R&D, scientific education, and high-technology infrastructure. While we continue to believe know-how and ingenuity are exclusive American brands, dozens of emerging nations are restructuring their economies and challenging our superiority. Americans may be surprised if the next revolutionary technology is produced abroad, but we should not be.

When one of America's strongest competitive advantages in the global marketplace is a knowledge-based economy, it does not bode well for the future when the United States neglects the infrastructure that supports its wealth creation. The irony is that the United States already has proven it can compete, but often needs fear to motivate it. In the 1950s, the Soviet Union challenged American leadership in technology by launching the world's first satellite, Sputnik. Americans feared the Soviets would use this space technology as a weapon. The United States met this challenge by launching a national program to improve math and science education, ultimately winning the space and technology race. In the late 1980s and early 1990s, fear abounded that Japan would become the world's dominant economy. U.S. businesses responded to the challenge by refocusing their efforts, adopting new technology, and innovating their products and processes.

America can certainly compete. It has the flexibility, pioneering spirit, and capital to win the race; but to do this America needs to recognize that future innovation is not predetermined to occur in the United States. Even if we were doing everything right, we still face unprecedented competition from abroad. Rather than face the new global economy unprepared, America needs to confront this competition head-on by supporting the innovation infrastructure. If we don't, America faces not just a continuing erosion of its manufacturing base, but also its lead in knowledge-based industries.

THE UNITED STATES FACES HEIGHTENED COMPETITION AS OTHER COUNTRIES ARE CATCHING UP

- ❖ Other countries that have historically been followers are now becoming leaders.
- ❖ China now graduates four times as many engineers as the United States, the European Union graduates three times as many, and South Korea – with 1/6th the population – graduates roughly the same number as the United States.
- ❖ U.S. dominance in awarding science and engineering doctoral degrees, technology patents, and patent citations is slipping.
- ❖ Emerging economies are finding they do not have to be the initial inventor of a technology to take advantage of it. They are leveraging the rapid diffusion of advanced technologies to promote innovation and economic competitiveness.

For nearly five decades following the Second World War, more than half the world's population lived and worked outside of the free market system. The Soviet Union and Eastern bloc, China, India, and much of Latin America and Africa either eschewed capitalism entirely or flirted with socialist policies that stifled competition and rejected global integration.

By the close of the twentieth century, all that had changed drastically. The end of the Cold War transformed more than just the Soviet Union and Eastern bloc countries. It attacked the legitimacy of command and control economies everywhere, and promoted the benefits of the free market system.

China, India, Eastern Europe, the Asian Tigers, and other so-called emerging economies all have learned that the road to economic prosperity, wealth creation, and social development is through the free market. Russia and much of Latin America and Africa have started down the road towards adopting free market systems. However, they are not yet entirely convinced of the benefits of capitalism. Their economies fluctuate toward or away from free market principles depending on which interests control public policy.

The United States had long urged the rest of the world to adopt free market principles, preaching the benefits of transparency, open competition, foreign investment, economic flexibility, and technological innovation. As political barriers fell and countries undertook economic reform, the global marketplace began to become truly global.

The good news for U.S. business is that many countries listened. **No country has benefited more from globalization than the United States.** Economic forces have compelled other countries to open their markets, slash tariffs, accept foreign direct investment, buy U.S. products, and adopt U.S. technology. However, the potentially alarming news for the United States is, again, that many countries listened. Globalization also presents unprecedented challenges to American preeminence. As global economic cooperation proliferates, so too does global competitiveness. **Countries that have entered the free market system now aggressively compete against the United States – or soon will.**

Leaders in these countries also learned that competition and innovation go hand in hand. By liberalizing their markets, they recognized that to remain truly competitive they also must invest in the innovation infrastructure. These countries now produce talented, highly educated workers and cutting-edge companies, and they realize that technological development is a virtuous cycle. The more a country opens its economy, the more it adopts innovative products and services. With technology adoption, comes development. The more development it spawns, the more robust and competitive its industries become. Capital is drawn in. Intellectual property is created. Innovation takes hold. New products and services are conceived. Wages and living standards rise.

Other countries are taking advantage of this formula to advance their own societies and provide opportunities for their domestic companies to compete globally. Indian software programmers, Chinese components manufacturers, Taiwanese consumer electronics makers, and South Korean online game developers all have reaped the benefits of an active national government investing in the innovation infrastructure.

In development circles, this is called "leapfrogging." Most of the industrialized world needed nearly a century to provide 90 percent of its population with telephone service, mainly via copper lines to households. Many developing countries will accomplish this in a fraction of the time and cost because advanced wireless and satellite technologies allow nations to leapfrog over yesterday's technology by utilizing the latest innovations. The implications are far reaching for U.S. competitiveness; the stagnant economy of yesterday could be the competitive rival of tomorrow.

Emerging countries are churning out more scientists, engineers, and technology workers to staff these nascent industries, while the numbers of students entering these fields in the United States has remained flat. The United States is cutting R&D funding while foreign governments are creating public-private partnerships to invest in R&D projects and persuade their brightest youth to pursue high-tech careers.

The implications are far reaching for U.S. competitiveness; the stagnant economy of yesterday could be the competitive rival of tomorrow.

U.S. policymakers, the media, and the public often underestimate the emerging competitive threat of nations like China and India. They believe U.S. companies flock to these destinations solely to exploit cheap labor. While partially true, this overlooks an additional fact; these and other countries increasingly offer skilled, educated, professional knowledge-based workers as well.

One needs to remember that the offshore outsourcing of software jobs did not begin because of the price of labor, but because of the drastic need for programmers to fix the Y2K problem in the late 1990s. The tight deadline involved and the lack of U.S. programmers forced companies to seek out all available skilled workers, wherever they could be found. And, while the current wage gap between a U.S. engineer and a Chinese or Indian engineer makes these developing countries attractive, this wage differential is narrowing, and skill sets will become the determining factor.

America no longer can rest on its laurels. The following statistics and anecdotes offer sobering evidence of the urgency with which U.S. policymakers must act.

Worldwide Engineering Degrees Awarded by Country
2000 or most recent

Rank	Country	Bachelor	% of World
1.	China	219,563	21%
2.	EU-15	179,929	17%
3.	Japan	104,478	10%
4.	Russia	82,409	8%
5.	India	82,107	8%
6.	**United States**	**59,536**	**6%**
7.	South Korea	56,508	5%
8.	Taiwan	26,587	3%
9.	Mexico	24,184	2%
10.	Poland	21,618	2%

Source: U.S. National Science Foundation

Other Countries Place a Greater Emphasis on Educating Science and Technology Workers

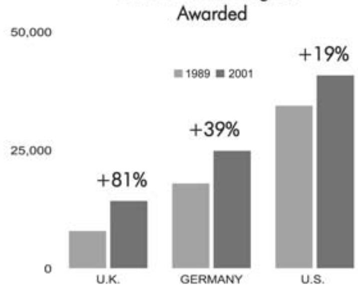
❖ When examining the number of people graduating with bachelor degrees in engineering, the United States trails other countries. While the United States is the largest world economy and the fourth largest country by population, it only ranks sixth in the number of bachelor degrees awarded in engineering in 2000, the most recent comparable data available. China graduates almost four times as many engineers as the United States. Japan with less than half of the population of the United States, graduates almost twice as many engineers. **South Korea – with 1/6th the population and 1/20th the GDP – graduates nearly the same number of engineers as the United States.**[4] Some U.S. executives argue that Chinese engineers, in some cases, are not of the same caliber as American or European educated workers. But as China expands and increases technical education, the gap is closing, and closing fast.

❖ Interest in studying science and engineering in Russia has surged. Presently, six applicants compete for each available place in Russia, compared to just two or three in the mid-1990s. The largest demand is for science and math courses. Graduation rates for science and engineering degrees in Russia are up by 11 percent in 2004.[5] However, Russia does face challenges that are holding its universities back, including the high concentration of older professors, the lack of new teachers, and limited funding.

❖ On a country-by-country basis, the United States still leads in science and engineering doctoral degrees granted; however significant portions of these are awarded to foreign nationals. Also, when combined, the EU-15 graduated more S&E doctoral degrees than the United States. The recent addition of 10 new countries to the European Union has increased the integration, competitiveness, and ultimately, the availability of skilled labor in the EU.[6]

❖ Furthermore, the number of S&E doctoral degrees awarded in Germany and the United Kingdom is growing faster than in the United States. Between 1989 and 2001, S&E doctoral degrees in the United Kingdom grew by 81 percent, in Germany by 39 percent, and in the United States by 19 percent.[7]

S&E Doctoral Degrees Awarded



Source: U.S. National Science Foundation

As Other Countries Sharpen Their Focus on Science and Technology, the United States Risks Losing Its Dominance in These Fields

❖ One way to measure the ascendancy of S&E in other countries is to observe the origin of S&E articles in academic journals. Science and engineering articles in the United States grew by 13 percent between 1988 and 2001, hitting just over 200,000 in 2001, while in Western Europe the number of S&E articles leaped by

Case Study – India

An Indian politician once asked Indira Gandhi: "Can the prime minister explain why Indians seem to thrive economically under every government in the world except hers?"[8] From the 1940s through the 1970s, India pursued socialist economic policies that discouraged foreign investment, stifled competition, and launched a mass exodus of its brightest citizens seeking opportunity abroad. Beginning in the 1980s and more dramatically in the 1990s, India reversed course by opening parts of its economy to the outside world, reducing the regulation that hindered business development, and investing in the factors of innovation. These reforms and investments have made India a potentially successful high-technology hub.

Four different parties have held power since 1991, each dedicated to a "Delhi consensus" of market reforms. India has eliminated the once famous "Permit Raj" that restricted market access by entangling companies in bureaucracy and charging over 100 percent tariffs on the majority of imports.[9] Tariffs have plummeted and inbound trade has skyrocketed. Domestic companies endured the growing pains of exposure to open competition and are now becoming globally competitive.

Once a regional vegetable products company, India's Wipro has expanded to become the global leader among offshore software service providers. Led by an Indian-born, Silicon Valley-trained former head of General Electric's medical scanner business, Wipro has achieved dominance by diversifying and integrating its services well beyond low value-added software coding. Like many Indian companies, Wipro realizes its low cost of labor advantage is fleeting; as education and income levels rise, eventually other emerging countries will seize the cost advantage. Wipro's goal is to remain a world class company by competing at the high end of the information technology value chain.[10]

India is now embarking on further reform to provide labor flexibility, freer flows of capital, and desperately needed infrastructure improvements. Public-private partnerships have invested in technical universities and communications infrastructure to create cutting-edge technology parks in places like Bangalore. This will only make India more competitive and alluring to investors and multinational companies. The highly skilled, Indian-born talent that once flocked to the United States is now returning home, turning America's brain drain into India's brain gain.

Case Study – China

As the inventor of gunpowder, rocketry, the compass, the printing press, and the mechanical clock, China historically has valued innovation. Because China was isolated from the rest of the world, these innovations did not spread as quickly as they later did in the West. But today, China is merging its culture of innovation with economic reforms that are opening its market to the world, and the world is taking note. China is already the world's manufacturing hub and now is moving up the production line to promote higher end technology firms, creating sobering competition for companies and workers around the world.

While it might seem that China has emerged virtually overnight as a serious competitor, China has undergone 25 years of economic reforms to adapt to a globally competitive environment. This modernization began in 1978 under the leadership of Deng Xiaoping, when the country first exposed its economy to international trade. Over time, the reforms eliminated most price controls, liberalized capital markets, adopted special economic zones, encouraged foreign investment, improved the infrastructure (with new roads, bridges, water, and sewer systems), and ultimately, raised the standard of living. In the early 1990s, China initiated the "Golden Bridge" project, a systematic plan to utilize the latest technology to create an integrated, digital economy.[11] It even began importing technology incentives from Silicon Valley, including stock options and R&D tax credits. Over the last several years, China's annual GDP growth rate stood between seven and nine percent.[12] Technology and innovation have been critical catalysts for this growth.

The good news is that a significant number of the new companies investing and building in China are American owned. These companies recognize the dual benefits of investing in China: access to low-cost, technically skilled labor and an enormous market of consumers with steadily rising incomes.

China admittedly is still in the early stages of penetrating high-tech markets with indigenous companies; but it has built a foundation and is progressing. In 2002, China surpassed the United States as the prime destination for foreign direct investment.[13] In 2004, it overtook the United States as Japan's largest trading partner.[14] By 2020, China's GNP is projected be second only to the United States.[15] These macroeconomic trends are helping some companies forge new ground. Shanda Interactive is the largest company for online games in China with an average of 1.2 million users logged in at a time. It succeeded by tailoring its business model to thrive in a country where piracy is rampant and credit cards and e-commerce are rare.[16]

How Valued Is Innovation?

Twice as many Chinese firms cite innovation as a top objective.

Percentage ranking innovation as one of top three goals:

Chinese companies	54%
U.S. companies	26%

Source: Based on survey results conducted by *IndustryWeek* and the Manufacturing Performance Institute

China also now graduates four times the number of engineers as the United States. Its native-born talent is returning home to exploit high economic growth rates and business opportunities that previously only could be found abroad. Many returnees not only have science and engineering skills, but also the management and entrepreneurial experience to create globally competitive companies. They will find an increasingly cooperative and forward thinking government, at both the national and local levels, willing to spur investment through tax incentives, research and development initiatives, and creation of technology parks.

Case Study – Russia

When the Soviet Union collapsed 15 years ago, Russian science and engineering were among the foremost in the world. The questions for the future became: to what purpose will these talents be refocused and how will such efforts be funded in the wake of the bankruptcy of the state-dominated economy? The following decade witnessed a painful transition to a market-based system with various attempts to privatize industry, root out corruption, and attract foreign investment into an economy where the rule-of-law was more an ideal than a reality.

Fifteen years later the results are mixed, but some high-tech companies have invested heavily in Russia. Likewise, indigenous firms have sprung up, exploiting highly educated scientific talent to compete in the global market for software and other high-technology services. Over the last several years, the Russian high-tech industry has grown by about 10 percent annually, and one U.S. executive sees remarkable similarities to where India was 10 years ago.[17]

With soaring oil revenues and pressure from interest groups, Russia now is investing more public funds into initiatives supporting scientific training, innovation, and high-technology growth.[18] These investments foreshadow an increasingly competitive economy, based on an incredibly talented technology workforce. The question for the future will be whether Russia continues the free market reforms begun in the early 1990s, or whether it reverts to command economics under the leadership of those who see free markets as a threat.

Case Study – Eastern Europe

Despite the old eastern bloc joke: "Capitalism is man exploiting man; communism is just the opposite," the former Soviet satellites vigorously embraced free markets when the Iron Curtain fell. Poland, Hungary, and the former Czechoslovakia, in particular, undertook a series of rapid reforms termed "shock therapy" that privatized dying industries, encouraged investment, and allowed competitive forces to flourish after 50 years of economic stagnation. Fifteen years later, these countries boast steady growth, high levels of foreign investment, profitable domestic companies, and membership in the European Union.

They have coupled these reforms with a dedication to their innovation infrastructure. As with Russia, the eastern bloc countries generated highly educated scientists and engineers even under communist rule. Built upon a long tradition of scientific inquiry, Poland has poured new investment into R&D, libraries, software, and scientific conferences. It invests public funds in nationally important R&D programs. These programs often originate from the private sector and are co-financed with foreign venture capital.[19] Hungary and the Czech Republic have followed similar paths, enacting high-tech friendly policies, investing public funds, and marketing their capabilities to tech firms throughout the world. The intense rivalry between these and other Eastern European neighbors to attract foreign capital has, in turn, made the entire region more competitive as each tries to promote its own Silicon Valley East.[20]

59 percent, surpassing the United States with 229,000 articles in 2001. The number of S&E articles in Asia more than doubled during this same period, with the number of articles in China quadrupling, albeit from a small base.[21]

❖ When examining the number of patents granted, the dominance of U.S. industry is slipping. U.S. corporations received 67 percent of all corporate U.S. patents between 1977 and 1988. However, the percent of patents awarded to U.S. corporations dropped to slightly more than half between 1988 and 2001, as patents granted to foreign corporations increased. Patents granted by the United States to applicants in Japan, Germany, Taiwan, France, the United Kingdom, and South Korea have increased over the past decade.[22]

❖ While the United States still dominates in the distribution of patent citations in S&E articles around the world, Western Europe is slowly gaining. In 1995, the United States accounted for 59 percent of all patent citations, Western Europe had 23 percent and Asia had 11 percent. By 2002, the number of patent citations attributed to the United States dropped by four percentage points to 55 percent, while Western Europe increased to 26 percent. Asia remained stable at 11 percent of the world's patent citations in S&E articles.[23]

Rapid Technology Adoption and Diffusion Is Allowing Other Countries To Leapfrog

One irony about leading edge technologies is that you do not have to be the initial inventor of a technology to become a world class competitor. Emerging countries are catching up to – and in some cases surpassing – the United States in adopting and diffusing information and communication technologies to spur their economies.

Throughout the twentieth century, the cost of land-based, copper wire phone lines remained prohibitively high for most developing countries, particularly in the hands of inefficient, state-owned monopolies. In the 1980s and 1990s, governments around the world privatized these industries and opened them to competition. This, combined with the development of highly advanced, lower cost technologies, has allowed countries to "leapfrog" from economic obscurity into the global economy.

This is true because technology diffusion is more than just penetration statistics. Diffusion plugs the entire nation into the economy. It connects consumers and producers more efficiently and in ways previously unimaginable. It promotes a more sophisticated, well informed, demand driven society that pushes companies to create innovative products and entirely new industries.

It is no coincidence that heavy public investment in the research and development that spawned computers and the Internet helped diffuse these technologies in the United States. This provided U.S. companies with the head start needed to develop innovative commercial uses for these technologies. To this day, the majority of leading computer hardware and software firms, as well as the largest online companies, are headquartered in America.

Certain countries have gained competitive advantages through rapid technology adoption and diffusion. National governments supported these efforts as a means to foster economic growth and development. Their indigenous companies then achieve first mover advantage in applications of the technology and reap the benefits as others scramble to catch up.

Science and Engineering Articles by Country
1988 - 2001

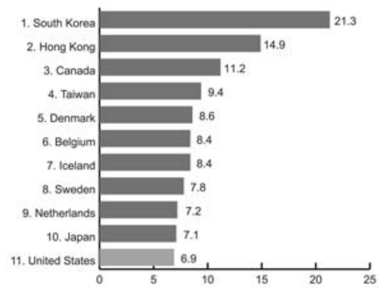
Country	1988	2001	Percent Change
United States	177,700	200,900	13%
Western Europe	143,900	229,200	59%
Asia	51,800	113,600	119%
China	4,600	21,000	354%
India	8,900	11,100	25%

Source: U.S. National Science Foundation

"Rapid technological advances outside the United States could enable other countries to set the rules for design, standards, and implementation, and for molding privacy, information security, and intellectual property rights (IPR)."

CIA's National Intelligence Council
Mapping the Global Future[24]

Broadband Penetration
Subscriptions per 100 Inhabitants
2002



Source: International Telecommunications Union

Two prime examples of this are broadband and cellular deployment. As illustrated below, these technologies are unique because the benefits of their diffusion are synergistic; they extend beyond their most direct application. If a U.S. competitor holds a strategic advantage in making plasma screen televisions, this may be a concern, but the effects are limited because it is not a networked technology.

The possibility that the next breakthrough technologies will be born abroad is ever more likely.

When a country builds highways, the economic benefits extend far beyond the profits made by the companies that laid the pavement. Commerce as a whole becomes more efficient. Broadband and cellular networks produce similar cascading benefits as more consumers are integrated into the economy and more companies vie to create applications for these networks.

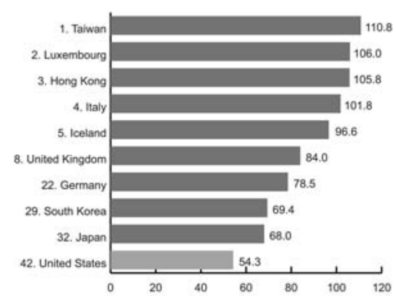
❖ The United States lags in the adoption of broadband access compared to select countries. The United States ranked 11th in the world in broadband penetration, with 6.9 subscriptions per 100 inhabitants in 2002, slightly behind Japan.[25]

❖ South Korea leads the world in broadband access, with penetration rates that are three times higher than in the United States – 21 subscriptions per 100 inhabitants in 2002.[26] Granted, many countries with higher broadband penetration rates benefit from higher geographic population densities, facilitating low-cost broadband penetration. However, third ranked Canada has similar urbanization densities as the United States but boasts almost double the penetration rate.

❖ Not only are South Korea and Japan ahead of the United States in penetration of broadband subscriptions, but also in its speed. Japan offered broadband access with 26 Mbit/second and South Korea offered 20 Mbit/second in July 2003, compared with 1.5 Mbit/second for the United States.[27]

❖ So South Korea has outpaced the rest of the world in broadband deployment. So what? How could this possibly threaten the United States? South Korea's rapid adoption of high technology allows it to do more than just brag internationally about having higher penetration rates than all of the world's great powers. Government investment in broadband rollout has transformed the domestic economy. The majority of South Korean citizens now access the Internet through low-cost, super high-speed connections.[28] This has locked producers and consumers into a seamless network that promotes innovation. South Koreans of all ages have developed a passion for online games, a service that only truly works over broadband connections. While such diversions might seem frivolous, the larger point is that *demand for a previously nonexistent service soared*. South Korean companies have used this domestic market as an incubator to further innovate

Cell Phone Penetration
Subscriptions per 100 Inhabitants
2003



Source: International Telecommunications Union their games. **At the forefront of this innovation, they now have gained competitive first mover advantages in taking these products global as other countries deploy broadband.**

❖ Among worldwide cell phone penetration rates, the United States ranks 42nd, with over half the population subscribing to cell phone service in 2003. This positions the United States behind Kuwait and ahead of Jamaica.[29] The slower penetration of cell phones in the United States is due to, in part, a high-quality, low cost landline system.

❖ Taiwan leads the world, with 111 cell phone subscriptions per 100 inhabitants.[30] This cell phone example is not only about penetration, but also about quality. Many of the leading countries also boast high quality next generation cell phone systems. Sweden, Finland, and South Korea all are home to globally competitive cell phone companies.

❖ **As the South Korean example illustrated, rapid technology diffusion often creates demand for innovative products and services.** Italy ranks fourth worldwide in cell phone penetration. As a result, Italian consumers have become highly sophisticated in demanding cutting-edge services. They want not only basic voice and data capabilities, but advanced chat, multimedia messaging, and real-time video streaming of soccer games. To achieve growth in such a saturated market, Italy's top cellular provider has met these local demands and now is aggressively expanding these services to customers in South America.[31]

"[A] nation's level of technological achievement generally will be defined in terms of its investment in integrating and applying the new, globally available technologies – whether the technologies are acquired through a country's own basic research or from technology leaders."

CIA's National Intelligence Council
Mapping the Global Future[32]

WHY IS THIS A PROBLEM?

As other countries begin catching up to the United States in science and engineering, and as they leverage technology diffusion to promote innovation and enhance competitiveness, the possibility that the next breakthrough technologies will be born abroad is ever more likely.

U.S. policymakers need to recognize that the world has become a more intensely competitive environment in a relatively short period of time. As the CIA's National Intelligence Council recently reported, by 2020 China's Gross National Product (GNP) is forecast to become the world's second largest behind the United States, and India's GNP is predicted to match or potentially surpass that of all European countries. Even Brazil and Indonesia are likely to muscle their way into the top tier of world economies. The report states unequivocally that "**the greatest benefits of globalization will accrue to countries and groups that can access and adopt new technologies.**"[33]

When assessing this new reality, we focus on the pervasiveness of change in the global economy. If you concentrate only on a particular emerging country, it becomes all too easy to extract a piece of data or to find that specific trend to reassure ourselves that there is nothing to fear. You might dismiss China's ascendancy as being built upon an unsustainable political system. You might console yourself that India will never become a world class power as long as vast pockets of its population cannot access modern infrastructure. Russia, you might argue, is one or two obstructive government interventions away from rejecting free market capitalism outright. And as for Eastern Europe, South Korea, or any of the other emerging countries? Their economies are miniscule compared to ours, you might argue. You might.

The problem is that these are just excuses that allow us to remain complacent. They let us overlook the bigger picture; all of these countries and dozens more are making unprecedented efforts to compete.

As such, policy needs to be directed toward initiatives that enhance the technological competitiveness of the United States in the future. Competing countries are now doing what the United States had done so well for decades – investing in future innovation. Many of the technologies the world enjoys today have been decades in the making. They often were born in the obscure environment of a federally funded laboratory and were later handed off to the entrepreneurs that could harness their commercial potential. As our competitors now borrow from this proven blueprint, the United States can no longer take its technological dominance for granted.

WANING COMMITMENTS TO R&D ARE THREATENING FUTURE INNOVATION

- ❖ SOME OF THE MOST REVOLUTIONARY INVENTIONS OF THE PAST CENTURY — THE INTERNET, MRI, THE MOUSE, DOPPLER RADAR, AND GPS, TO NAME A FEW — WERE BORN FROM FEDERALLY SPONSORED RESEARCH.
- ❖ TO A DANGEROUS DEGREE, THE UNITED STATES IS NOW TAKING FOR GRANTED ITS LEADERSHIP IN SCIENCE AND TECHNOLOGY.
- ❖ IN THE 2005 FEDERAL BUDGET CONGRESS CUT FUNDING — FOR THE FIRST TIME IN 16 YEARS — FOR THE NATIONAL SCIENCE FOUNDATION, THE LEADING PUBLIC SUPPORTER OF R&D.
- ❖ FEDERAL FUNDING PRIORITIES HAVE SHIFTED AWAY FROM TECHNOLOGY. IN 1981, HALF OF ALL FEDERAL R&D WENT TO TECHNOLOGY; BY 2003 THIS DROPPED TO ONE-THIRD.

At the end of World War II, the United States emerged virtually untouched by the physical destruction that ravaged Europe and Asia, vaulting it to the top of the world's power structure, both economically and militarily. Science and innovation proved integral to America's victory. Penicillin, the proximity fuse, and the atom bomb all played decisive roles in the war.

Scientific research enjoyed widespread popular support, which culminated in the creation of the National Science Foundation (NSF) in 1950, whose goal was "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes."[34] Since this time, the NSF, and federally funded research in general, have played a crucial role in the development of the U.S. military and economy.

Policymakers of the 1950s and 1960s understood that funding scientific and technological research represented an investment in the future and in national security. After the Soviet Union launched Sputnik, this funding became critical in fighting the Cold War. The United States realized that the only way to compete militarily with the Soviet Union was to enhance its technical capabilities and to "out innovate" them. This strategy required significant government involvement in funding technologies that would not elicit practical applications, quite possibly for decades.

R&D funding is vital in supporting innovation and the advancement of the technology industry, which bolsters the U.S. economy and even the military. President Reagan recognized this in the 1980s when he significantly increased R&D funding and provided the United States with a bold vision of achievement and advancement.

Consider what federally funded R&D has created and the time required for just two innovations: fiber optics and the Internet. Federal funding of solid-state physics and ceramics/glass engineering in the late 1960s created the knowledge base for widespread use of fiber optic cable in the 1990s. The Department of Defense began experimenting with the design of a decentralized file and data sharing network in 1969, leading to the explosive diffusion of the Internet 25 years later.

While critics of publicly funded R&D argued at one time that it was tantamount to "picking winners and losers," funding research does not necessarily favor a specific application or company proposal. It funds the ideas and unexplored fields that may generate specific innovations or commercial applications down the line. No one would argue that federal support for the Internet favored one product or company over another. This research laid the foundation upon which the marketplace later decided that, for example, Amazon.com had a sustainable business model while Webvan.com did not.

Innovation Resulting from U.S. Federally Funded Research

Innovation	Funder
The Internet	DARPA/NSF
Web Browser	NSF
Bar Codes	NSF
Fiber Optics	NSF
Routers	NSF
MRI	NIH/NSF
Doppler Radar	NSF
Speech Recognition	NSF/DARPA
Nanotechnology	NSF
Computer Aided Design	NSF/DARPA
Global Positioning Satellites	DARPA
The Mouse	DARPA

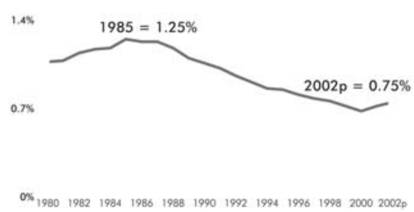
Note:

NSF = National Science Foundation
DARPA = Defense Advanced Research Projects Agency
NIH = National Institutes of Health

Unfortunately, U.S. research and development funding reached its pinnacle in the 1980s, and our focus on future innovations has been slipping ever since. With the end of the Cold War, federal funding commitments for R&D have declined, especially in engineering and physical sciences. In November 2004, Congress even cut the 2005 budget of the National Science Foundation by $105 million, the first cut in 16 years, despite the Bush Administration's proposed increase.[35]

The United States is neglecting the factors of innovation that have made us a world power. **These reductions in federal R&D spending will directly harm the competitiveness of the United States in the world economy.** As the following data indicate, the United States is slowly losing its lead in science and technology.

Federal Funding of R&D as a Percent of GDP
1980 - 2002p



Source: U.S. National Science Foundation

R&D Funding by Federal Government Declines

The federal government is the primary funding mechanism for supporting basic research in the United States. Basic research serves to strengthen the innovative capacity of companies, increasing the capability of a firm to understand and absorb scientific and technical knowledge. While basic research plays an important role in building the foundation of technological advancement, it does not always lead directly to the creation of new products and services. As such, funding for basic research by industry is sporadic. Therefore, continued government support for basic R&D funding is necessary for continued advancement.

❖ U.S. federal funding of R&D has declined over the past two decades. It peaked in 1987 at $75 billion, and still was below this peak by 2002 at $71 billion, adjusted for inflation to 1996 dollars.[36]

❖ The decline of federal R&D funding is even more glaring as a percent of the U.S. economy. Federal R&D funding represented 1.25 percent of GDP in 1985, a full half percentage point higher than 2002 when R&D represented 0.75 percent of GDP.[37]

> *"Practical innovation more than anything else is the reason America achieved preeminence while other well-endowed landmasses lagged or failed. America's emergence from a rural backwater to a position of dominance is not to be explained by the access to physical resources or population, since Russia, China, Australia, Canada, Brazil, Argentina and South Africa were also richly endowed but failed to develop anywhere near as rapidly."*
>
> \- Harold Evans
> *They Made America*[38]

R&D Funding by Industry Slips During the Recession

❖ The recent recession has had a downward effect on R&D funding by the private sector. Industrial supported R&D fell by $8.4 billion, from $172 billion in 2000 to $163 billion in 2002.[39] This pull-back will affect the ability of industry to innovate and deliver new products and services.

❖ The federal R&D tax credit has served an important role in encouraging private industry to engage in R&D that might otherwise be cost prohibitive. It also supports risk taking because not all R&D ventures yield an immediate product. Although the tax credit was enacted in 1981, it has always retained "temporary" status and has in fact been allowed to expire twice.[40] This hurts companies' ability to plan for future R&D projects. In direct contrast, China's R&D tax credit is permanent, allowing companies to reduce uncertainty and plan investment decisions far into the future.[41]

❖ The good news is, the United States is moving in the right direction. President Bush has proposed in his FY 2006 budget to make the R&D tax credit permanent.

Federal R&D Priorities Shift Away from Technology

❖ Federal R&D funding has shifted away from technology – engineering, physical sciences, and math and computer science. In 1981, technology R&D represented 48 percent of the federal government's R&D and life sciences represented 36 percent. By 2003, these priorities had switched, with technology R&D at 32 percent of federal R&D funding and life sciences at 54 percent.[42]

❖ While it is commendable to support research that directly benefits the physical health of Americans – and such funding should continue – **technology R&D remains vitally important to the *economic health* of the nation. It creates many of the cutting-edge technologies that now bolster the economic and industrial strength of the United States.**

Federal R&D Funding by Field
Percent of Total Funding
1981 vs. 2003

	1981	2003
Technology	48%	32%
Life Sciences	36%	54%

Note: Technology = Engineering, physical science, and math and computer science

Source: U.S. National Science Foundation

WHY IS THIS A PROBLEM?

These trends are undercutting the future of the U.S. technology industry and, ultimately, the U.S. economy. R&D offers far-reaching benefits that extend beyond the direct impact of discovery for the company or research institution.

Government investment plays an indispensible role in building the foundation of a knowledge-economy by investing in ventures, concepts, and ideas often years before a commercially viable product or service is available. As discussed, the Department of Defense and the National Science Foundation supported the Internet for over 20 years before it became commercially feasible and was opened to the public. The development of Magnetic Resonance Imaging (MRI) technology was based on 35 years of government funding through the National Institutes of Health, from 1955 to 1990. As a result, 60 million patients a year are grateful for such persistence.[43]

The U.S. government is supporting research into advanced materials by exploring the basic structure and properties of matter at the molecular, atomic, and even subatomic level. This research is the foundation of the nascent nanotechnology industry and has led to the creation of composite materials and high-tech ceramics. These materials already are critical components in such products as jet airplanes and cell phones and will play an important role in future innovations.

When the government provides the foundation and funding for innovation, the U.S. economy benefits as businesses convert these innovations into new products, services, and, sometimes, new industries. Why would we want to stifle these advancements?

THE U.S. WORKFORCE IS INCREASINGLY UNPREPARED FOR THE 21ST CENTURY ECONOMY

- THE U.S. GOVERNMENT, PRIVATE INDUSTRY, THE MEDIA, AND THE GENERAL PUBLIC MUST CONFRONT THE CURRENT CRISIS IN TEACHING SCIENCE AND TECHNOLOGY TO OUR STUDENTS; IF WE DO NOT, OUR LEAD IN SCIENCE AND TECHNOLOGY IS AT RISK.
- U.S. HIGH SCHOOL SENIORS RANK AT OR NEAR THE BOTTOM IN COMPARABLE MATH AND SCIENCE SCORES WORLDWIDE.
- AMERICAN UNIVERSITIES ARE NOT GRADUATING ENOUGH SCIENTISTS AND ENGINEERS TO SUPPORT GROWTH IN THE HIGH-TECH INDUSTRY.
- FOREIGN NATIONALS WHO HAVE PREVIOUSLY FILLED THIS VOID ARE FINDING OPPORTUNITIES ABROAD AS BUREAUCRATIC BARRIERS KEEP THEM OUT OF THE UNITED STATES.

A highly skilled workforce is the lifeblood of any successful company, industry, or national economy. The United States historically has been the breeding ground for many of the world's most innovative companies, in large part, because it offered a diverse pool of talented, highly educated workers. **But evidence of a decline is surfacing, precipitated by three gathering trends: an increasingly ill-prepared domestic workforce; a steadily depleting stock of high-skilled and educated foreigners; and an aging population.**

> *"[W]e're falling behind. We're not keeping up with other countries in our investment in science and engineering. The science and math scores for our high school graduates are disastrous. We're underfunding research in the physical sciences, and we're lagging seriously on publications in these sciences. This is a problem for our economy, and we have to think about where we want to be 20 to 40 years from now."*
>
> \- Susan Hockfield, *President, MIT*
> *BusinessWeek* Interview, October 4, 2004[44]

Policies promoting the free flow of trade, capital, and knowledge can go only so far in creating an innovative, entrepreneurial environment. They are necessary – but not sufficient – conditions to attract cutting-edge industries in an increasingly global economy. Why? Because many other countries now offer similar incentives. As emerging nations integrate themselves into the rules-based system of global trade and investment, America's leadership in this realm is challenged.

As countries liberalize capital markets, lower tariffs and other trade barriers, and pursue less interventionist regulatory policies, the tipping point in choosing where to locate the next cluster of innovation could be the education and skill level of the workforce. Silicon Valley remains an important location for technology companies, despite the high cost of living, because it offers access to qualified workers.

As the reaction to Sputnik attests, the United States, when motivated, has the capability to rededicate itself to improvements in the strategically critical fields of math and science. Congress responded to that threat by passing the National Defense Education Act in 1958. This legislation made available $1 billion – an astonishing figure for the time – to pay for college loans, scholarships, and scientific equipment for public and private schools, focusing on the study of math, science, and foreign languages.[45] This unprecedented, large-scale federal involvement in the realm of education sparked a dialogue for reforming school curricula and reshaping classroom materials and activities. The collaboration between classroom teachers and research scientists represented a fundamental shift in the educational process.

Today, the American educational system is in danger of reverting to the lax times of the pre-Sputnik era. Sadly, this is not a new phenomenon. America's "dirty little secret" is that the United States has frequently struggled to persuade sufficient numbers of its citizens to pursue highly technical careers.[46] It has been able to mask these deficiencies by welcoming the best and brightest foreign talent to come study, work, and explore new ideas and research fields in the United States. Not only has this bolstered U.S. innovation, it has created hundreds of thousands of jobs as these immigrants found companies on U.S. soil. It also produces benefits far beyond the economic realm. **Foreign nationals who return home with an American education tend to retain positive impressions of the United States as they become leaders in their own countries.**

Just when the competition for the brightest minds in the world has reached a fever pitch, the United States has raised the barriers and bureaucratic red tape to their admission. Understandable security concerns must be balanced against their consequences for long-term U.S. competitiveness. The State Department must work with Congress to allow more scientists, researchers, and engineers into the United States to complement the domestic workforce available for future innovation.

Because these highly skilled individuals are a critical link in the U.S. innovation infrastructure, policymakers must understand that reversing the long-held commitment to promoting immigration and cultural exchange is a national security risk itself.

Additionally, national policy needs to be viewed through the prism of education as a life long process, especially in a global economy that portends to be very different from that of the twentieth century. Through the high growth period spanning the 1940s to the 1970s, workers in all advanced industrial economies tended to follow linear career paths within a particular industry or even one company. In the more dynamic information economy, this trend could all but vanish.

> *"College will continue to be a good investment for a great many Americans in the years ahead. But with improvements in K-12 education, an expensive college education need not be the only way to obtain a middle class job."*
>
> \- Richard J. Murnane & Frank Levy
> *Teaching the New Basic Skills*[47]

In the past, the skills workers learned were good for decades. Now, workers need to constantly adopt new skill sets. Increasingly, the success of an individual, a company, or a nation will be measured by how well they can adapt to new conditions and potential career shifts.

Formal education from kindergarten through college will remain crucial in preparing future generations of workers, but education will not end there. The flexibility of the American workforce has served the United States well, and it will have to become even more flexible. This will require creative solutions to stimulate continuous education and retraining programs to prepare workers and employers to compete in the knowledge-based economy.

This section offers the following statistical indications that U.S. education objectives need to be addressed and reexamined.

K-12 Education in Math and Science Is Not Up to Par

❖ The education of the workforce starts with K-12. Without a strong background in math and sciences, K-12 students will have trouble earning technology degrees and, ultimately, technology jobs. **In an information economy the majority of jobs – not just those specifically in high tech – require some grounding in science and math.**

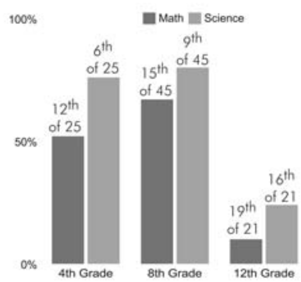
❖ While U.S. students in the 4^{th} and 8^{th} grades have improved their proficiency in math and science, they still have a ways to go. The National Assessment of Educational Progress (NAEP) reported that 32 percent of 4^{th} graders and 29 percent of 8^{th} graders tested proficient in math in 2003.[48]

❖ More troubling is that 12^{th} graders perform even worse. The most recent NAEP data available for 12^{th} graders show a decline in both math and science scores. **For example, the data show that 21 percent of 12^{th} graders were proficient in science in 1996. By 2000, this number dropped to 18 percent,** according to the most recent data available.[49]

❖ When comparing U.S. K-12 students to their international counterparts, a similar trend emerges. **While U.S. students in the 4^{th} and 8^{th} grades score in the top percentile, 12^{th} graders score at the bottom in math and science.**[50]

❖ U.S. 12^{th} graders perform even worse when compared with their international counterparts in physics, ranking last among the 16 countries participating.[51]

International Rankings in Math and Science, U.S. as a Percentile of Total Countries



Source: Third International Mathematics and Science Study (TIMSS)

The U.S. Higher Education System Is Not Preparing Enough Students for Careers in High Tech

❖ The United States benefits from having many of the best colleges and universities in the world. However, just as the K-12 system is not preparing students for tech degrees, America's colleges and universities are not graduating enough tech workers.

❖ High-tech industry employment grew by 50 percent between 1990 and 2002. During this time, the number of engineering bachelor degrees awarded in the United States fell by six percent and physical science degrees grew by just three percent. The only saving grace for the tech industry was that math and computer science degrees grew by 41 percent during this same time. In part, this was due to the growth of the new Internet and Internet-related industries.[52]

❖ At the doctoral level, the growth rate slowed for engineering, as well as for math and computer science degrees. Doctoral engineering degrees grew by five percent between 1990 and 2002, and math and computer science degrees grew by nine percent, compared to a growth rate of 55 percent in engineering and 60 percent in math and computer science between 1985 and 1990.[53] However, as seen below, many of these graduate students are foreign nationals who may be forced to return home.

Higher Education Costs Are Outpacing Family Incomes

❖ Rising costs in higher education could further exacerbate these downward trends. According to a recent report by the College Board, a non-profit association of educational institutions, the average cost of attending a four-year public university (including tuition, fees, and room and board) jumped 7.8 percent or $824 in the 2004-2005 school year, to $11,354, adjusted for inflation. This follows three previous years of costs rising at similar rates.[54]

❖ Meanwhile, the burden on families to pay the costs of higher education has grown disproportionately. In 1990 the average total cost of attending a four year public university was $7,178 and the median family income was $40,865, both adjusted for inflation. In 2003, these numbers stood at $10,720 and $43,318 respectively, corresponding to a 49 percent rise in higher education costs but only a 6 percent increase in median family income.[55]

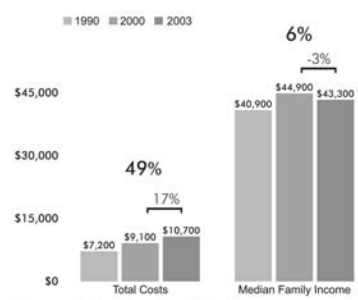
❖ The United States has historically recognized the value of promoting higher education for qualified young Americans whose academic merit is ample but whose financial resources are lacking. Federal Pell grants, money targeted for lower income students, have long served this purpose. Regrettably, the funding for this program has not matched the demand of increasing numbers of qualified applicants. In 1980-1981, a Pell grant covered 35 percent of the total annual cost of attending a public university. By 2003-2004, this had fallen to 23 percent.[56]

❖ In December 2004, the Department of Education announced a new formula for calculating financial aid that will eliminate federal Pell grant scholarships for an estimated 80,000 to 90,000 low-income students. On January 15, 2005, the President proposed a plan that will hopefully redress this issue by increasing Pell Grant funding over the next five years.[57]

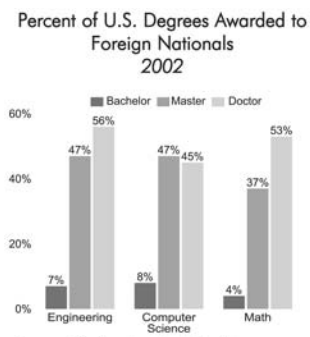
Foreign Nationals Are Critical to Our Educational System, Our Workforce, Intellectual Property Development, and Job Creation

❖ The lackluster growth in technology degrees is compounded by the fact that foreign nationals make up an important pool of qualified talent, yet U.S. immigration laws create barriers for these workers to stay and work here. If current policies are continued, foreign nationals will no longer provide this safety valve, and the United States will experience a brain drain as U.S.-educated foreign graduate students are forced to leave.

Higher Education Costs Rose Faster Than Family Income



Source: College Board and U.S. Census Bureau



Source: U.S. Department of Education

❖ Foreign nationals received over 50 percent of doctoral engineering and math degrees awarded and over 40 percent of doctoral computer science degrees awarded. These students represent the best and the brightest in their field of study, yet as foreign nationals, they need to navigate the complex immigration process to remain, and those not yet in the United States face even higher barriers.[58]

> *"Our immigration policy took a giant step backward because of fears associated with September 11. Making it hard for graduate students to come here does not make America safer. It makes us weaker."*
>
> \- Roger McNamee
> *Venture Capitalist*[61]

❖ The limited growth of technology degrees in the United States and the high proportion of foreign nationals in master's and doctoral programs illustrate the importance of foreign nationals to companies and universities seeking qualified talent.

❖ **Foreign-born individuals represent one of every five scientists and engineers in the United States, accounting for over 1 million workers who contribute a tremendous amount of knowledge, talent, and innovation to the U.S. economy, ultimately creating hundreds of thousands of jobs.** This immigration keeps highly skilled workers in the United States.[59]

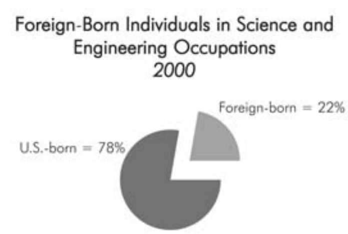
❖ Almost half of the Nobel Prizes awarded to researchers in the United States between 1901 and 1991 were won by foreign-born individuals or their direct children.[60]

The United States Raises the Barriers for High-Skilled Immigration

❖ In the post-9/11 environment and during the recent recession, the United States has raised the barriers for skilled laborers entering the country. Fewer workers and students are applying for visas, and the rejection rates for those who do apply are higher. Student visas declined 27 percent between 2001 and 2003, a loss of 80,000. For those with specialized skills, the number of accepted visa applications also dropped by 27 percent, from 225,000 in 2001 to 165,000 in 2003. This means that 60,000 fewer high-skilled people entered the United States during this time.[62]

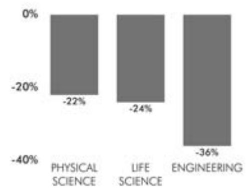
❖ **Outdated and overly bureaucratic immigration laws, the perception that the United States is less welcoming of foreigners, and heightened competition from foreign universities have lead to a decline of foreign nationals studying in the United States.** According to a survey by the Council of Graduate Schools, 88 percent of U.S. graduate schools reported an overall decrease in international student applications for the fall of 2004. Engineering and physical sciences suffered some of the largest decreases. Graduate engineering programs reported a 36 percent decline in the number of international applications.[63]

❖ These declines forecast not only an irreplaceable loss in available talent, but a financial shortfall as well. Loss of such significant revenue from foreign nationals jeopardizes the long-term viability of many U.S. science and engineering graduate programs.



2000 data are the most recent available.
Source: U.S. National Science Foundation

Decline of Foreign Graduate Applications to U.S. Schools
2003-2004



Source: Council of Graduate Schools

❖ While it is understandable that 9/11 and a recession would make America more leery about immigration, policymakers need to be aware of the unintended consequences of this pull-back from the global workforce. These high-skilled and highly educated workers help create innovation, wealth, and more jobs. Immigrants helped found Intel, Sun Microsystems, Yahoo!, and Google – to name a few. **If we shut these people out of the United States, we only end up pushing the jobs overseas.**[64]

❖ In the United States, the bureaucracy and barriers to immigration continue to grow. H-1B visas are those reserved for high-skilled workers entering the United States on a temporary basis. The U.S. Citizenship and Immigration Services received enough H-1B visa petitions to meet their congressionally mandated cap of 65,000 for FY 2004 on February 17, 2004, meaning no new H-1B visa applications were available between February 17, 2004 and October 1, 2004.[65] In FY 2005, the congressionally mandated cap was hit on the same day that H-1B visas became available, October 1, 2004.[66] The issue is that after hitting the cap, no new H-1B visas are available. If a U.S. company needs a specialized worker that only could be filled by a foreign national, the company would have to hire the person in his or her native country, creating a foreign job instead of a U.S. job.

What Has Immigration Given Us?

Name / Title	Company	Employees	2003 Sales
Andy Grove Co-founder & Chairman	Intel	79,700	$30.1b
Vinod Kholsa Co-founder	Sun Microsystems	35,000	$11.4b
Jerry Yang Co-founder & Director	Yahoo!	5,500	$1.6b
Sergey Brin Co-founder & President	Google	1,600	$1.0b

Source: Hoovers Online

Visa Applications for High-Skilled Categories
2001-2003

	Applications	Percent Refused	Accepted
Exchange Visitors (J-1 visas)			
2001	279,500	7.8%	257,700
2002	278,600	10.5%	249,300
2003	295,600	15.9%	248,600
Other High-Skilled Work Visas			
2001	248,400	9.6%	224,600
2002	203,600	11.9%	179,300
2003	200,200	17.8%	164,600

Data are rounded.

Source: U.S. National Science Foundation

❖ Congress took a step in the right direction in November of 2004 by expanding the H-1B program by an additional 20,000 visas for foreign nationals who have received their master's or doctoral degree in the United States. It remains to be seen if this will meet the high skill needs of the U.S. tech industry, since the industry requested a number closer to 50,000.[67]

Other Countries Take Advantage Immigration

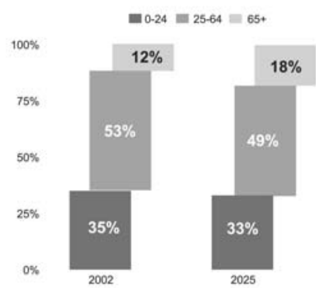
❖ Even if the U.S. immigration process were as efficient as it could be, the United States still faces unprecedented competition from abroad. Other countries are investing heavily in world class universities and fostering cutting-edge companies, taking a page from the development path of the United States. These rival universities and companies are aggressively competing for talented students and skilled workers. And more often than ever before, they are winning.

❖ In contrast to the bureaucracy of U.S. immigration, Japan took proactive steps to make it easier for highly skilled workers to immigrate, allowing employment and residency for an indefinite period. The number of foreign high-skilled workers in Japan grew by 10 percent, from 248,000 in 1999 to 274,000 in 2003. This is particularly telling for a country that has traditionally shunned immigration.[68]

Demographic Data Show an Aging Workforce with Implications for Science and Engineering

The United States, like most developed nations, will experience large demographic changes as the baby boom generation ages. Their retirement will create increased competition for skilled workers and exacerbate the future skilled worker shortages in the United States. Workers with the right skills in S&E will be in high demand.

U.S. Population by Age



Source: U.S. Census Bureau

As companies compete for talent, some will lose. The lack of available qualified workers will stifle U.S. innovation and advancement. It also could force businesses to devise alternatives to fill their workforce needs, including increasing their workforce in other countries – offshoring.

❖ The proportion of the U.S. working age population is shrinking. The percentage of Americans who are 65 or older will grow from 12 percent of the population in 2002 to 18 percent in 2025. This means that there were 4.4 people in the working age population (25-65) in 2002 for every retired person (65+); by 2025, this is projected to drop to 2.7. To maintain the same proportions in 2025 as in 2002, the United States would need 110 million more 25-64 year-olds in the population.[69]

❖ Similar demographic trends will also occur in the European Union and Japan. But these mature economies are unlikely to pose the greatest competitive threat to the United States in the coming years. Countries highlighted in this report – including many of the emerging economies in Asia – have younger populations.

WHY IS THIS A PROBLEM?

Other parts of the world exalt science and engineering. **In the United States, far too often, these are seen as careers for geeks and nerds.** This is tragic. This type of attitude embraces ignorance, and ignorance is poison to an economy that runs on technology and innovation. What we cannot figure out is: how is it not "cool" to create something that no one 10 or 20 years before had even conceived of? How is it not rewarding to look at a product, service, or procedure and say – with pride – that you were a part of its creation?

In educating our children, we would be wise to exalt the accomplishments of America's great inventors and innovators. Instead of enticing our children to pursue science and engineering with statistics about how hard the classes are or how likely they are to flunk out, educators would better serve themselves and our country by focusing on how scientists and engineers make life changing contributions to society. Instead of scaring freshman by telling them to look left, then right, and realize that at least one of those peers will not graduate, why not remind them that in this country one of those two – if not themselves – might just be the next Edison, Einstein, or Gates?

As long as American culture reinforces the stereotype that only geeks and nerds go into science and engineering, we should not be surprised when we cannot produce enough of these individuals to create the next wave of breakthrough technologies.

If we cannot shatter this stereotype and our native talent continues to steer clear of technical professions, then we need to understand that keeping out foreigners is not the answer. If we kept out Andy Grove, Intel might not be the company that it is today. If we kept out Sergey Brin, Google might not have been created here. How does this help the American economy? That is the problem, it doesn't.

CONCLUSION

In August 2004, Americans witnessed the startling defeat of the U.S. men's basketball team by both Puerto Rico and Argentina at the summer Olympics. Here was a sport the United States had always dominated, a game America invented. Yet, the team seemed unprepared to accept the possibility that a gold medal would not fall into its lap as a birthright. The Americans were shocked that players from other countries – many of whom had significant experience playing in the United States – had now closed the talent gap. The U.S. squad was woefully unprepared to compete against upstart teams who frankly played a more cohesive, team game. Many a commentator rationalized that at least this might serve as a wake-up call that times had changed and the United States better adapt and compete or it might fail to earn even a bronze medal in the future.

The realization that the United States no longer dominates internationally in basketball may bruise our national pride somewhat, but losing our competitive edge in the global business climate is far more devastating. Technological innovations have created entirely new industries and are largely responsible for the dramatic increases in productivity that help raise wages and standards of living.

The United States is not preordained to lead the world in economic or technological advancements. We achieved this lead over the last 60 years by focusing on those factors that made us highly competitive. We fostered a technically skilled workforce by educating American youth in math and science and by welcoming, not shunning, highly-skilled talent from around the world. We recognized that investment in research and development was critical in promoting technological innovation. And we understood that innovation – taken in its broadest sense as the open acceptance of change and new ideas – is what fuels our economy.

We are still in the lead, but it is a precarious one. Already other countries are challenging us in key technology arenas. If we don't act now to maintain our competitive edge, we should not be surprised if the next wave of breakthrough technologies is created abroad.

U.S. policymakers and industry leaders need to recognize that as we neglect our technology infrastructure – skilled labor, R&D, and a business friendly environment – many countries are adopting economic reforms and are directly competing with the United States for foreign talent, innovation, and technology products and services. Unless this realization hits home, American losses will not be confined to the basketball court.

AeA'S RECOMMENDATIONS FOR IMPROVING U.S. COMPETITIVENESS IN SCIENCE AND TECHNOLOGY

If *Losing the Competitive Advantage?* makes no other lasting impression, then we hope it underscores the urgency that America's capacity to produce the innovations of tomorrow relies on robust and visionary policy decisions today.

As representatives of many of the nation's innovators and entrepreneurs, we at AeA appreciate bold vision and long-term planning. At the same time, we are well aware that policy does not exist in a vacuum. We face significant obstacles in just recognizing that a problem exists. Compounding this, the current U.S. federal budget deficit constrains the type of policy vision that once challenged Americans to send a man to the moon. This requires a sea change in the way we formulate solutions.

Fortunately, we do not actually have to strive for something we have never done before. We merely have to rededicate ourselves to the policies and priorities that have historically sustained our economic growth. Budget deficits existed in the late 1950s when Congress enacted the programs that invested in education and helped win the space and technology race. Deficits existed throughout the 1980s when the federal government invested in the innovation infrastructure that spurred the technological advancements of the 1990s.

We realize the resources needed to fix this problem are not in abundant supply. But current fiscal shortfalls do not preclude enacting the policy initiatives advocated here, especially those with no significant budgetary impact. The cost of neglecting these investments is even higher: declining U.S. competitiveness in the world economy.

The approaching crisis did not sneak up on us overnight; it has evolved over the past decade and a half. We need to decide where we want the United States to be in the coming decades. If we hope to continue as the world's leading science and technology economy, we need to act now.

AeA dedicates itself to spearheading debate on the issues most critical to the advancement of high technology in the United States. We have stood among the vanguard in addressing offshore outsourcing, radio frequency identification, and the effects of corporate governance provisions on small- to medium-sized companies. We now call upon the Administration, Congress, the high-tech industry, and leaders in academia to act now for the future of U.S. competitiveness in a changing world.

While no country can totally control the forces governing world commerce, innovation, and competitiveness, the chances for success improve by being prepared. We can educate our domestic workforce, utilize the worldwide pool of skilled labor and knowledge, and rebuild a system that supports innovation and technology adoption. As competing countries do this, they will continue to close the gap, but this is not entirely to be feared. Nations that open their doors to free markets open their doors to U.S. products and services.

These trends can provide incredible benefits to the United States if we act appropriately. Every threat outlined in this paper is also an opportunity. In this context we propose the following:

I. SUPPORT HIGH-SKILLED IMMIGRATION

Lower Barriers for Immigration of High-Skilled Individuals

❖ As the number of foreign graduates in science and engineering continues to grow and as the number of foreign graduates inside the United States remains high, U.S. companies need to be able to draw on all of these graduates. Science and engineering graduates are the foundation of technology advancement and provide many positive external benefits to the company and country where they work.

❖ If companies cannot find enough qualified workers domestically and the barriers to employing foreign workers remain high, companies will go to where the workers are located.

❖ The United States also needs to decrease the bureaucratic and regulatory barriers delaying, preventing, and discharging high-skilled workers from entering the U.S. workforce. The U.S. government needs to invest in the technology and equipment to expedite the screening process, eliminating unnecessary delays. It also needs to change bureaucratic and burdensome rules that impede legitimate immigration such as deemed exported licenses for individuals. A deemed export is any release of technology or source code subject to the Export Administration Regulation to a foreign national within the United States. Such release is deemed an export to the home country or countries of the foreign national. Immigration is a critical component for maintaining a strong and vibrant technological workforce.

Give Green Cards to All U.S. Trained Master and Doctoral Students

❖ Accredited U.S. colleges and universities award 8,000 doctoral and 56,000 master's degrees in science and engineering to foreign nationals per year.[70] Instead of sending these people back to their countries, they should be given a Green Card to stay in the United States. These people will make significant contributions to the economy and workforce. The United States benefits by keeping them here.

II. ENGAGE PROACTIVELY IN GLOBAL TRADE MECHANISMS TO ENSURE OTHER COUNTRIES COMPETE FAIRLY

Promote Stronger Enforcement of Intellectual Property Protection Worldwide

❖ Intellectual Property is typically the core asset of any high-tech company. From patents and copyrights to software and trade secrets, intellectual property forms the basis of the knowledge economy. Far too often, foreign legal systems do not adequately protect the owner of these valuable creations, resulting in the loss of literally billions of dollars. The Business Software Alliance estimated that 36 percent of software worldwide was illegally pirated in 2003. This translates to a $29 billion loss in revenue. In China, this figure is 92 percent and the revenue loss is estimated at $3.8 billion.[71] Digital technology has made intellectual property theft that much easier on a wide scale. When foreign companies and consumers can steal this hard earned property, the profitability and, ultimately, the competitiveness of U.S. companies suffer.

Conclude the Doha Round of Global Trade Talks

❖ The United States economy has gained greatly from liberalization of trade worldwide and from the rules-based system facilitated by the World Trade Organization (WTO). The Doha round of trade talks broke down in the summer of 2003 as negotiations on agriculture and certain service sectors reached an impasse. As a result, the United States risks losing momentum in further opening global markets to U.S. products and services. While selected bilateral negotiations can produce beneficial results, a more comprehensive approach to trade is still needed. U.S. trade representatives must continue to work with developing countries to achieve broader global integration. Additionally, while much has been gained by welcoming countries like China into the WTO, only through constant vigilance can the United States, and the U.S. high-tech industry, ensure that countries abide by the rule of law.

III. CHAMPION DRAMATIC IMPROVEMENTS IN THE U.S. EDUCATIONAL SYSTEM

Alter the Attitudes of Young People Towards Careers in High Tech

❖ Educators, parents, and business leaders need to promote the benefits and rewards of pursuing a career in science and technology. All too often, these careers are seen as the domain of nerds and geeks, instead of inventors and leaders. Our attitudes even discourage people from these fields by promoting how hard they are instead of how rewarding they can be. The United States would benefit tremendously from a series of industry-sponsored public service announcements exalting science and technology careers.

Improve Math and Science at K-12 Level To Adequately Prepare the U.S. Workforce and Provide Students with the Necessary Background for Degrees in Science and Technology

❖ Today's workforce needs more technical skills and ability than ever before. From doctors to mechanics and lawyers to manufacturers, technology touches all occupations, requiring more advanced skills. Only those with the proper background and education will succeed in this highly technical environment.

❖ To increase the number of science and engineering students, the United States first needs to provide all students an adequate foundation in math and science. This situation is similar to 1958 when President Eisenhower mandated a national program to improve math and science education, following the launch of Sputnik. The U.S. needs a "son of Sputnik" mandate today.

❖ The No Child Left Behind Act took a bold stab at reforming the U.S. educational system. But this is only a first step. Congress only partially funded NCLB. We need to fully fund it.

❖ We also need to drastically improve the academic ability of our 12th graders. It is appalling that less than 20 percent of our kids graduate high school proficient in science. We should strive to achieve a goal of at least 30 percent of our 12th graders testing proficient in math and science within five years.

Create the Human Capital Investment Tax Credit To Promote Continuous Education

❖ As this paper has argued, an educated workforce is crucial for the United States to maintain its competitive advantage in high technology. In addition to policies aimed at the K-12 level and at colleges and universities, policymakers need to recognize the value of on-the-job training and continuous education programs for enhancing the skill set of the American workforce.

❖ Companies often lack incentives to invest in educating and retraining workers as they risk losing that return on investment if the worker subsequently leaves the firm. By providing human-capital investment tax credits, the U.S. government can encourage companies to retrain workers by reducing or eliminating out-of-pocket costs. At the forefront of technology innovation, companies are often the best predictor of what skills will be most valuable in the future.

❖ Continuous retraining, education, and skills acquisition ensure that fewer technology workers will find themselves suddenly displaced with no skills to participate in the constantly shifting high-tech industry. Furthermore, society would benefit from the continuous education of workers, which also increases productivity and decreases downtime between jobs.

IV. SUPPORT RESEARCH AND DEVELOPMENT

Promote Federal Funding for Basic Research

❖ Basic research is the pure study of a topic for the sake of knowledge, as opposed to searching for a specific development or product. As such, basic research is the foundation on which innovation and advancement occur with tremendous externalities that can yield benefits beyond the research itself. Because basic research generally involves the most uncertainty and is the least likely to foster immediate commercial value, businesses are reluctant to fund basic research initiatives. The federal government needs to fill this void and continue to provide support for all fields of basic research.

Increase Funding for the National Science Foundation, Specifically for Physical Sciences, Engineering, and Math and Computer Science Research

❖ While federal funding for physical sciences, engineering, and math and computer science research has slowly increased, the majority of new funding supports life sciences research. Federal research in the physical, engineering, and math and computer sciences needs to have the same level of funding commitment as life sciences. R&D breakthroughs in these fields increase the economic and industrial strength of the United States. As examples in this paper illustrate, this ultimately benefits the American people.

❖ The National Science Foundation Authorization Act of 2002 authorized the doubling of the NSF budget by 2007. Instead of doubling the funding for the NSF, Congress in November of 2004 cut funding. The United States needs to make good on its plan to increase the NSF budget to $9.8 billion by FY 2007.[72]

Increase Grants and Funding for College and University Research To Support Academic R&D and Facilitate Graduate Education

❖ An essential component to supporting universities, undergraduate and graduate programs, and students is the funding of academic research. The money spent on R&D in higher education helps spur innovation and product development. In addition, research money provides graduate students the funding they need to attend school, helping to make graduate programs more affordable. Furthermore, the federal government should advertise that this money is available, just as the military advertises for recruiting.

Make the R&D Tax Credit Permanent

❖ Companies play a critical role in funding and performing research and development in the United States. Many U.S. trading partners and developing countries – including China – offer more generous and permanent R&D tax incentives than the United States. Enactment of a strong, permanent U.S. R&D tax credit will encourage private R&D investment and will provide companies with long-term certainty in their tax planning, something that is lacking in our current system of temporarily renewing the tax credit. We are encouraged by the recent Bush Administration proposal in the FY 2006 budget to make the R&D tax credit permanent.

V. PROMOTE TECHNOLOGY DIFFUSION

Provide Industry the Incentives To Promote Broadband and Cellular Penetration

❖ Countries like South Korea and Italy have realized enormous competitive advantages by investing heavily in broadband and cellular deployment. Just as the interstate highway system dramatically increased the efficiency and productivity of the U.S. economy half a century ago, so too can efficient communications networks have the same positive effect today.

❖ Broadband and cellular diffusion also foster competitive advantages by creating demand for cutting-edge products and services. As examples in this paper illustrate, it is no coincidence that countries with high penetration rates have produced globally competitive companies.

VI. IMPROVE THE BUSINESS CLIMATE IN THE UNITED STATES

Reform Section 404 of Sarbanes-Oxley

❖ While there are many worthwhile provisions in Sarbanes-Oxley and the intent is laudable, many small and medium-sized companies have serious concern with Section 404 and the expense of the internal control reporting requirements. Small and medium-sized companies are disproportionately burdened by Section 404, and these provisions need to be examined to ensure a proper balance between accountability and bureaucracy.

Address the Rising Costs of Health Care for U.S. Business

❖ The dramatic rise in health care costs for U.S. businesses, particularly over the last three years, has put these costs in a new spotlight. The future of health care and the health care debate will now have to incorporate the reality that these health care costs for U.S. companies could greatly undermine their international competitiveness. Many foreign competitors do not incur these costs. Whatever options this debate considers, it must be cognizant of the impact of American competitiveness on the world stage.

Reward Risk Taking by Supporting Stock Options

❖ No industry has benefited more than the high-tech industry from the use of stock options. Stock options provide employees with a direct link to the growth and profitability of companies. They also are an essential tool for attracting and retaining the best workforce, especially for small businesses and start-ups who do not always have the capital to compete on salary alone.

❖ Already China and India have learned from the successful use of stock options in Silicon Valley and are using it to attract and retain businesses and employees.

❖ The current regulatory efforts to expense stock options put significant burdens on American companies, with a direct effect on their bottom line. The regulation will force many companies to end their stock option plans for the rank-and-file employees, the primary recipients of stock options. It also puts American companies at a disadvantage when competing with foreign companies that can offer this incentive package.

Stop Raiding the U.S. Patent and Trademark Office for General Funds Revenue

❖ Patents play an integral role in the new knowledge-based economy. Patents help protect and identify ownership of innovation. An efficient patent system helps reward individuals and companies that are on the forefront of the technology revolution. Unfortunately, the current U.S. patent system is broken. The U.S. Patent and Trademark Office (PTO) lacks sufficient numbers of patent examiners and attorneys to process all the incoming patent applications. The average time required to secure a patent is two to three years, a delay that ends up stifling innovation.

❖ Currently, the fees collected from patent applications are diverted to the general treasury. Instead of siphoning this revenue away from the PTO, these fees, or some portion thereof, should remain with the PTO. Consequently, as the number of applications increases, PTO revenue would rise proportionally and it could hire more examiners and attorneys to process these additional applications. Expediting the process will help unlock the creativity and drive of inventors, and mitigate the risk that competing countries will issue the initial patent.

VII. HOLD A SPUTNIK 2005 SUMMIT

The Decline of U.S. Competitiveness Needs To Be Addressed at a Sputnik 2005 National Summit

❖ We call upon federal and state policymakers, the U.S. business community, educators, workers, and anyone else dedicated to U.S. competitiveness to convene a national summit. This summit would focus on strategies to improve U.S. competitiveness across the spectrum of issues addressed in this paper. This includes K-12 education, higher education, worker training and retraining programs, research and development funding and priorities, immigration policy, technology diffusion, the domestic business climate, and the implications of other countries' adopting free market principles and utilizing advanced technologies. This summit should put forth concrete proposals to be implemented by the Administration, Congress, and other key groups, such as academia, school boards, parents, teachers, and the business community.

NOTES

The following is an extensive, but by no means exhaustive, list of sources for the research conducted to produce this paper. We have provided citations for all instances in which we used specific data, quotations, or material that could be primarily attributed to one or two sources. The analysis of historical and economic trends, the current state of the global economy, and the benefits derived from technology result from research spanning a multitude of sources not necessarily cited here.

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Dear Sirs:

On behalf of the many U.S. businesses represented by our associations, we thank you for the opportunity to comment on the draft "Implementation Measures for Government Procurement of Software." As you may recall, our associations strongly supported China's accession to the World Trade Organization (WTO) and led the fight in the United States in support of permanent normal trade relations with China. While we appreciate China's many efforts to meet many of its WTO commitments and foster a more positive U.S.-China economic relationship, we are very concerned that the draft Implementation Measures represent a step backwards.

The proposed Implementation Measures would severely restrict market access by non-Chinese companies in a manner that goes far beyond the procurement practices of the United States. Such a discriminatory procurement regime would effectively close the door for most, if not all, U.S. companies and other non-Chinese companies to sell software products and services to China's largest purchaser, the Chinese Government. Software piracy rates exceeding 90% in China already cost U.S. software companies billions of dollars in sales. Effective denial of the ability to sell to China's government market would render meaningless to U.S. and other foreign software companies China's efforts to promote the use of legally purchased software in its government.

Non-discriminatory, transparent, merit-based and technology-neutral procurement in software and all industries is not only important to U.S. companies, but to each country's own economic and technological development. Access to the best products and services from around the world is critical to spur technological progress, growth and higher living standards.

It is our understanding that the draft Implementation Measures represent the first of what will likely be a series of sectoral rules promulgated by the Chinese Government to implement its new government procurement law, which requires, with limited exceptions, that its government purchase only domestic goods, services and public works. This law is applicable to every services and goods industry from which the Chinese Government procures and has very significant ramifications for all U.S. industries seeking access to China's government procurement market.

The government procurement law and the Implementing Measures strike us as moving in precisely the wrong direction from China's WTO accession pledge, yet unfulfilled, to "initiate negotiations for membership in the GPA [Government Procurement Agreement] . . . as soon as possible." We are particularly concerned that now, more than three years from its WTO accession, China has yet to begin the process for GPA accession and has proposed procurement regulations that severely restrict access by non-Chinese companies.

As concerns in the United States increase over the growing U.S. trade deficit with China, the Chinese Government's closure of its government procurement market in software and other industries appears to undermine Premier Wen Jiabao's pledge to foster an improved U.S.-China trade relationship based on increasing, not restricting, market access for U.S. exports, and to be inconsistent with the spirit of openness China embraced in joining the WTO. We hope that the Chinese Government will quickly renew its commitment to open, inclusive, non-discriminatory and transparent procurement policies by commencing negotiations to accede to the GPA and suspending adoption of the Implementation Measures and any similar discriminatory procurement rules. There are several upcoming, high level meetings between the U.S. and Chinese governments at which we hope significant progress can be made in this area.

We greatly appreciate the opportunity to provide these comments and look forward to working with the Chinese Government to implement a non-discriminatory government procurement regime in software and other sectors in a manner that fulfills China's commitment to fair and open trade.

Respectfully,

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Potential Scenarios for a WTO Case Against China's Mandatory Implementation of the WAPI Standard

Technical Barriers to Trade

The WTO Technical Barriers to Trade (TBT) Agreement directs WTO members to ensure that mandatory standards do not have the effect of creating "unnecessary obstacles to international trade." Further, the TBT Agreement mandates the use of international standards whenever possible and requires WTO members adopting standards that are inconsistent with international standards to notify other WTO members when such standards may have a significant effect on international trade. The proposed Chinese WAPI standards clearly create significant barriers to trade. In addition, as the Chinese standards differ in significant respect from the IEEE standards and will prohibit the importation of all existing Wi-Fi enabled equipment, China should have made the necessary notification through the WTO. To date, no such notice has been provided.

National Treatment

GATT Article III prohibits the adoption of any internal regulation that discriminates against imported goods. To the extent that foreign manufacturers are denied access to the details of the Chinese standards, are prevented from obtaining the certification necessary to sell their products in China, and/or are forced to obtain access to the Chinese market through a joint venture partner (with the likelihood of forced technology transfer), the implementation of the WLAN standards is inconsistent with the Article III national treatment requirement. Such a mandate is also inconsistent with commitments in China's WTO Protocol of Accession not to condition the right of importation on performance requirements, including the use of local content or the transfer of technology.

Trade-Related Investment Measures

The WTO Agreement on Trade-Related Investment Measures (TRIMs) prohibits the use of local content requirements. To the extent that Chinese co-production requirement mandates the use of Chinese goods in producing WLAN products that may be sold in China, it would appear to be inconsistent with this requirement. Again, such a mandate is also inconsistent with specific commitments in China's WTO Protocol of Accession not to condition the right of investment on performance requirements of any kind, including the use of local content or the transfer of technology.

Graduate Education and the National Science Foundation

Graduate Student Enrollment in the United States

The latest available data[1] (2002) pertaining to U.S. science and engineering (S&E) graduate student enrollment shows:

- Graduate student enrollment in U.S. S&E programs reached a new peak at nearly 455,000 students in fall 2002.
- Sixty-eight percent of these students, or 310,000—the second-largest numerical number in the last 20 years—were U.S. citizens and permanent residents in fall 2002.
- The increase of 15,500 U.S. citizen and permanent resident graduate students between 2001 and 2002 represented the largest numerical gain since 1992.
- Thirty-two percent, or 145,000—all-time highs for both proportion and number—of U.S. S&E graduate students were temporary visa holders in fall 2002.
- Fields with the highest numbers of temporary visa holders in fall 2002 included engineering (58,262), computer sciences (26,801) and social sciences (18,011).

National Science Foundation Support of Graduate Students

Although NSF's $5.65 billion budget currently accounts for 4 percent of total Federal science and technology investment and nearly 50 percent of non-medical basic research conducted in academe, the agency supported only 26,500, or 6 percent, of the nation's science and engineering graduate students in 2002. Based on available data, NSF estimates that about 70% of its supported graduate students are U.S. citizens or permanent residents.

Support Through Education-Oriented Programs

Many NSF-supported graduate students receive support through programs designed specifically to catalyze graduate education and related activities in science, technology, engineering, and mathematics (STEM) fields. Activities funded through such programs range from direct support including fellowships to institutional awards that foster improved graduate educational experiences at host institutions. If applicable, fellowships provided through such programs total $40,500 annually—$30,000 as stipend and $10,500 for educational costs, e.g., tuition or health insurance. Several of these programs have defined citizenship requirements.

Examples of programs tailored to national STEM educational goals in which only U.S. citizens, nationals, and permanent U.S. residents are eligible to fully participate include:

- **Graduate Research Fellowship (GRF)** offers approximately 1,000 new graduate fellowships annually that provide three years of support for graduate study leading to research-based master's or doctoral degrees. In FY 2004, GRF supported a total of 2,295 students.
- **Alliances for Graduate Education and the Professoriate (AGEP)** supports alliances of Ph.D.-granting institutions to develop and implement innovative models for recruiting, mentoring, and retaining minority students in STEM doctoral programs and/or to develop strategies to identify and support underrepresented minorities desiring an academic career. During the 2003–04 academic year, 5,994 Ph.D. students were enrolled in AGEP alliances. In the same academic year, 702 Ph.D. students graduated from AGEP alliances.
- **Federal Cyber Service: Scholarship for Service (SFS)** provides funding to academe to award scholarships to undergraduate or graduate students in information assurance and computer security fields as well as to improve the quality and increase the number of such professionals. SFS support the final two years of undergraduate study, two years of master's-level study, or the final two years of Ph.D.-level study. Over 540 students have entered the SFS program.
- **NSF Graduate Teaching Fellows in K–12 Education (GK–12)** provides fellowships and training to enable graduate students in STEM disciplines to acquire skills to prepare them for professional and scientific careers. Through interactions with teachers in K–12 schools, graduate students improve communication and teaching skills while enriching STEM instruction in K–12 schools. In FY 2004, GK–12 supported 947 students.
- **Integrative Graduate Education and Research Traineeship (IGERT)** supports STEM undergraduate and graduate students as well as host institutions providing research-based graduate education and training activities in

[1] Science Resources Statistics INFOBRIEF, "Graduate Enrollment in Science and Engineering Fields Reaches Peak; First-Time Enrollment of Foreign Students Declines." NSF 04–326, June 2004. At http://www.nsf.gov/statistics/infbrief/nsf04326/start.htm. Accessed May 16, 2005.

emerging STEM areas. The program catalyzes cultural change in graduate education by establishing innovative new models for graduate education and training in collaborative, interdisciplinary environments. In FY 2004, IGERT supported 1,386 students.

- **East Asia and Pacific Summer Institutes for U.S. Graduate Students (EAPSI)** supports up to 175 fellowships to provide U.S. S&E graduate students firsthand research experiences in Australia, China, Japan, Korea and Taiwan, an introduction to the science and science policy infrastructure of the respective location, and an orientation to the culture and language. NSF's counterpart foreign funding agencies coordinate with hosting universities and research institutes, arrange logistics, and provide about two-thirds of the funding for these programs. The China Summer Institute started in 2004, and NSF will send 30 U.S. students to China this summer.

Support Through Research-Oriented Programs

Other NSF-supported graduate students are funded through research programs, including individual and collaborative research projects, centers, or facilities awards, and assist principal investigators, senior researchers, or postdoctoral associates in performing research. In general, no citizenship requirements exist for principal investigators (PIs), co-principal investigators (coPIs), post-doctoral researchers, technicians, or graduate students on research awards. Currently, about 90% of PIs and CoPIs supported by NSF are U.S. citizens or permanent residents.

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WHITE PAPER ON IPR PROTECTION

The [People's Republic of China] State Council Information Office published on April 21, 2005, a white paper titled New Progress in China's Protection of Intellectual Property Rights. The nine-chapter report discusses the policies adopted and actions taken by the government to protect IPR during the past decade. The last white paper on this topic was published in 1994.

New Progress in China's Protection of Intellectual Property Rights

Foreword

The intellectual property system is a basic legal system that promotes mankind's economic development, social progress, scientific and technological innovation, and cultural prosperity. As science and technology is developing rapidly worldwide and the pace of economic globalization is accelerating, the status of the intellectual property system in economic and social life has reached a historical high. The protection of intellectual property rights (IPR) has drawn wide attention of the international community.

China is a country with a long history of civilization. Over the past several thousand years, vast numbers of outstanding Chinese scientists, inventors, men of letters and artists have made enormous contributions to mankind's development and progress with their splendid intellectual achievements. The Chinese government and people are keenly aware of the value of inventions, creations, and science and technology.

The IPR protection system was established at a comparatively late date in China, but has developed rapidly. Major progress has been made in IPR protection since the late 1970s, when China initiated the reform and opening-up policies. An IPR system has been gradually established, and is promoting healthy economic development and overall social progress.

In order to help the international community have a better understanding of the real situation regarding China's IPR protection and make a proper judgment, we hereby give a brief introduction to and explanation of related issues.

I. Basic Situation of the Protection of Intellectual Property Rights

China has always adopted a responsible attitude to actively promoting IPR protection. While adhering to the international rules on IPR protection, China has decided on a level of IPR protection appropriate for its own national situation, and made great efforts to balance the interests among intellectual property creators, users and the general public, so as to create a benign circle for the creation and use of intellectual property.

Major progress has been made on IPR protection in China over the past years thanks to concerted efforts made by people from all walks of life.

—A relatively complete system of laws and regulations that covers a wide range of subjects and is in line with generally accepted international rules has been established and keeps improving. Since the 1980s, the state has promulgated and put into effect a number of laws and regulations covering the major contents in IPR protection. These include the "Patent Law of the People's Republic of China," "Trademark Law of the People's Republic of China," "Copyright Law of the People's Republic of China," "Regulations on the Protection of Computer Software," "Regulations on the Protection of Layout Designs of Integrated Circuits," "Regulations on the Collective Management of Copyright," "Regulations on the Management of Audio-Video Products," "Regulations on the Protection of New Varieties of Plants," "Regulations on the Protection of Intellectual Property Rights by the Customs," "Regulations on the Protection of Special Signs," and "Regulations on the Protection of Olympic Logos." China has also promulgated a series of relevant rules for the implementation of these laws and regulations, and their legal interpretation. As a result, the system of laws and regulations on IPR protection in China has been continuously improved. In 2001, around the time when China was admitted into the WTO, in order to provide effective legal protection to IPR, the country made comprehensive revisions to the laws and regulations regarding IPR protection and their legal interpretation. While more emphasis is given to promoting the progress of science and technology and innovation with regard to legislative intent, content of rights, standards of protection and means of legal remedy, the revisions brought the laws and regulations into conformity with the WTO's "Agreement on Trade-related Aspects of Intellectual Property Rights" and other international rules on IPR protection.

—A coordinated and efficient work system and a law enforcement mechanism have been established and improved. In its practice of IPR protection, a two-way parallel protection mode, namely, administrative and judicial protection, has emerged in China. Several departments in China are assigned with the duty to protect IPR. They include primarily the State Intellectual Property Office, State Administration for Industry and Commerce, Press and Publication General Administration, State Copyright Bureau, Ministry of Culture, Ministry of Agriculture, State Forestry Administration, Ministry of Public Security, General Administration of Customs, Supreme People's Court and Supreme People's Procuratorate. For many years these departments have done effective work in their respective fields. To further strengthen IPR protection, in 2004 China established the State IPR Protection Work Team headed by a vice-premier of the State Council, responsible for planning and coordinating the work regarding IPR protection throughout the country. Its office, located in the Ministry of Commerce, handles the routine work of the team.

In recent years, the state has increased work contacts between administrative law enforcement organs and public security organs and people's procuratorates with respect to IPR protection. In October 2000, the relevant departments jointly issued the "Notice on Strengthening Cooperation and Coordination in the Work of Investigating and Dealing with Criminal Cases that Infringe Intellectual Property Rights," which contains clear provisions on relevant issues. In July 2001, the State Council promulgated the "Regulations on the Transfer of Suspected Criminal Cases by Administrative Law Enforcement Organs," which includes clear provisions on how the administrative law enforcement organs should transfer suspected criminal cases to public security organs in a timely fashion. In March 2004, the relevant departments jointly issued the "Opinions on Increasing Work Contacts between Administrative Law Enforcement Organs and Public Security Organs and People's Procuratorates." A work mechanism involving the coordination of administrative law enforcement and criminal law enforcement has been established, creating a joint power to deal with IPR infringements. This ensures that suspected criminal cases enter the judicial process promptly. In recent years, the judicial organs have adjudicated a large number of IPR infringement cases according to law. In civil cases, the infringed parties have received timely compensation for their financial losses, and IPR-related crimes have been effectively combated.

—Administrative law enforcement has been strengthened in IPR protection. As gradual improvements are made in the legal system on IPR protection, China has shifted its focus from legislation to law enforcement. Administrative law enforcement has been enhanced through the combination of routine management and supervision with special crackdown campaigns. In August 2004, the Chinese government decided to launch a special one-year campaign to protect IPR across the country from September 2004 to August 2005. It was decided at the national TV and telephone conference on rectification and standardization of the market economic order convened by the State Council on March 31, 2005 that the campaign was extended to the end of 2005. With unified planning, the relevant departments have investigated and dealt with major IPR infringement cases, focusing on major fields in the protection of trademark rights, copyrights and patent rights, on major links in the import and export of goods, all types of exhibitions and wholesale markets of commodities, and on key places where producers and sellers of counterfeit goods were known to be concentrated. Their quick action and strict law enforcement efforts have dealt a blow on IPR offenders, achieving positive results.

—Efforts are being made to heighten the awareness of the general public about IPR. The Chinese government attaches great importance to publicity concerning IPR. Beginning in 2004, the state designated the week from April 20 to 26 every year as the "week for publicizing the importance of IPR protection." By making wide use of newspapers, magazines, television, radio and the Internet, and through holding seminars and knowledge contests, and making public interest advertisements, the government carries out publicity and education among the general public regarding IPR protection. The aim is to create a social atmosphere in which labor, knowledge, talent and creation are respected, and heighten the awareness of the general public regarding IPR.

—Actively fulfilling the international obligations to protect IPR. China has taken an active approach to joining major international conventions and agreements on IPR protection. Following its accession to the World Intellectual Property Organization in 1980, China joined in succession more than ten international conventions, treaties, agreements and protocols, such as the "Paris Convention for the Protection of Industrial Property," "Patent Cooperation Treaty," "Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure," "Locarno Agreement Establishing an International Classification for Industrial Designs," "Madrid Agreement Concerning the International Registration of Marks," "Nice Agreement Concerning the International Classification of Goods and Services for the Purpose of the Registration of Marks," "Protocol Relating to the Madrid Agreement Concerning the International Registration of Marks," "Agreement on Trade-related Aspects of Intellectual Property Rights," "International Convention for the Protection of New Varieties of Plants," "Berne Convention for the Protection of Literary and Artistic Works," "Universal Copyright Convention," and "Convention for the Protection of Producers of Phonograms Against Unauthorized Duplication."

While strictly executing its international obligations in IPR protection, China has devoted great efforts to adjusting and improving international rules regarding IPR protection in order to let all countries of the world share the fruits and benefits brought about by the progress of science and technology. In recent years, China has held talks, and engaged in exchanges and cooperation with other countries, international organizations and foreign-invested enterprises in the field of IPR. At the suggestion of the United States, starting in 2003, China and the U.S. have held a round-table conference on IPR every year, and reached agreement on many IPR-related issues at the two round-table conferences. In 2004, China and Europe held their first round of talks on IPR in Beijing. Initial agreement was reached between the two sides on matters of cooperation related to IPR. Relevant Chinese departments have established good cooperative relations with corresponding departments in several countries, and international organizations such as World Intellectual Property Organization and International Union for the Protection of New Varieties of Plants. In September 2003, a mechanism was established for regular contact and coordination between relevant Chinese departments and foreign-invested enterprises. Under the mechanism, a meeting is held every three months to solicit comments and suggestions from the foreign-invested enterprises on issues related to IPR protection.

II. Patent Protection

With the establishment of the China Patent Office in 1980, China's patent work has developed continuously over 25 years. On April 1, 1985, the "Patent Law of the People's Republic of China" went into effect. Following that, China promulgated several patent-related laws and regulations, such as the "Rules for the Implementation of the Patent Law," "Regulations on Patent Commissioning," "Procedures for the Administrative Enforcement of Laws Concerning Patents," and "Regulations on the Implementation of Customs Protection of Patent Rights." China has twice made revisions to the "Patent Law" in the light of the requirements of social and economic development so as to enable it to improve continuously.

By mainly relying on its own resources, China has established a relatively complete and independent patent examination system in a short period of time. On January 1, 1994, China became a member state of the "Patent Cooperation Treaty." The China Patent Office is China's agency dealing with cases involving the Patent Cooperation Treaty, performing international patent searches and preliminary examinations. Meanwhile, China has established a fairly comprehensive system for patent work. Relevant departments of the State Council and local governments have established patent administrative organs in accordance with the provisions of the "Patent Law." China now has more than 5,000 people working in patent agencies, and a service system mainly providing patent commissioning, patent information, patent technology transfer intermediary and patent technology evaluation services has taken initial shape.

China's patent work has realized leapfrogging development. From April 1, 1985 to the end of 2004, the State Intellectual Property Office handled 2,284,925 patent applications with an average annual increase of 18.9 percent. Of these, 1,874,358 were domestic applications, and 410,567 came from other countries, accounting for 82 and 18 percent, respectively. Patent applications in China had exceeded two million by March 17, 2004. It took China 15 years for patent applications to reach one million. But it took only four years for the number to double. In 2004, the State Intellectual Property Office handled 353,807 applications, an increase of 14.7 percent over the previous year, which saw 308,487 applications. Of these, 278,943 were domestic applications, accounting for 78.8 percent of the total and an increase of 11 percent over the previous year, which saw 251,238 applications. Foreign applications numbered 74,864, accounting for 21.2 percent of the total and an increase of 30.8 percent over the previous year, which saw 57,249 applications. From 1994 to 2004, the State Intellectual Property Office handled, in total, 7,131 international applications for patent rights, of which 1,592 such applications were handled in 2004. International patent applications that entered China via the channel of the Patent Cooperation Treaty totaled 157,770. Of these, 32,438 applications were submitted in 2004.

By the end of 2004, the State Intellectual Property Office had approved 1,255,499 patents. Of these, 1,093,268 were domestic ones, and 162,231 were from other countries, accounting for 87.1 and 12.9 percent of the total number of approved patents, respectively. The numbers of invention patents, utility model patents and exterior design patents that had been approved were 185,412, 651,224 and 418,863, accounting for 14.8, 51.9 and 33.3 percent respectively. In 2004, the State Intellectual Property Office approved 190,238 patents, an increase of 4.4 percent over the previous year, which had 182,226. It approved 151,328 domestic patents, an increase of 1.2 percent, compared with 149,588 in the previous year. At the same time, it approved 38,910 foreign patents, an increase of 19.2 percent over the previous year, which saw 32,638.

The "Regulations on the Protection of Layout Design of Integrated Circuits" went into effect in China on October 1, 2001. By the end of 2004, the State Intellectual Property Office had received 682 applications for the registration of layout design of integrated circuits. It registered 571 of them, and issued related public notices as well as certificates to the applicants. In 2004 alone, the State Intellectual Property Office received 244 applications for the registration of layout design of integrated circuits. It registered 205 of them, and issued related public notices as well as certificates to the applicants.

In recent years, patent administration departments at all levels have strengthened administrative enforcement of the law in this respect. In particular, they have launched crackdowns on infringements of patent rights of food and medicines, which are closely connected with people's health and lives. They have made great efforts to investigate and deal with cases that infringe upon the patent rights of key technologies and cases that had widespread repercussions. They have also conscientiously investigated and dealt with infringements and counterfeits of patent rights of inventions, utility models and exterior designs. Following the State Council's unified plan, in August 2004, the State Intellectual Property Office issued the "Work Program on Strengthening Enforcement of the Laws on Intellectual Property Rights and Launching a Special Law Enforcement Campaign." All subsidiary departments under the State Intellectual Property Office were mobilized to participate in the campaign. By the end of that year, local intellectual property offices had checked 10,251 industrial venues and examined 2,081,537 commodity items. By the end of 2004, local patent administration departments across the country had accepted 12,058 cases involving patent infringement and patent disputes, and 10,411 of the cases, or 86.3 percent, were resolved. In 2004, local patent administration departments accepted 1,455 cases involving patent disputes, and 1,215 of them were resolved. They also dealt with 3,965 cases of patent counterfeits, and 358 cases of unauthorized use of others' patents.

III. Trademark Protection

Great progress has been made in China's trademark protection work since November 1, 1979, when China resumed the unified registration of trademarks. The "Trademark Law" went into effect on March 1, 1983. The Chinese government promulgated the "Rules for the Implementation of the Trademark Law" in March 1983 to help with the implementation of the law, and in 1988 revised it for the first time. In February 1993, the Standing Committee of the National People's Congress (NPC) made the first revision to the "Trademark Law" to include service trademarks in the work of trademark protection, strengthen efforts to crack down on trademark infringement and counterfeiting, and improve the trademark registration procedures. In July 1993, the Chinese government made revisions to the "Rules for the Implementation of the Trademark Law" for the second time to bring collective trademarks and certification trademarks into the scope of legal protection of trademarks, and added to it provisions on the protection of "trademarks well known to the public."

In October 2001, the NPC Standing Committee made revisions to the "Trademark Law" for the second time to include three-dimensional trademarks and color combination trademarks in the scope of trademark protection and offer greater protection to well-known trademarks. The revised "Trademark Law" also stipulates that the trademark system shall be used to protect geographical marks, judicial examination shall be added for the certification process of trademark rights, and greater efforts shall be made to crack down on trademark infringement and counterfeiting, thus bringing the relevant provisions of China's "Trademark Law" in line with the principles of WTO's "Agreement on Trade-related Aspects of Intellectual Property Rights." In August 2002, the Chinese government again revised the "Rules for the Implementation of the Trademark Law" and renamed it "Regulations for the Implementation of the Trademark Law."

In accordance with the provisions of the "Trademark Law" and the "Regulations for the Implementation of the Trademark Law," the State Administration for Industry and Commerce formulated or revised several administrative rules and regulations, including the "Trademark Assessment Rules," "Provisions on the Recognition and Protection of well-known Trademarks," "Procedures for the Management and Registration of Collective Trademarks and Certification Trademarks," "Procedures for the Implementation of Madrid Agreement for the International Registration of Trademarks," and "Procedures for the Administration of the Printing of Trademarks."

As improvements are made in the legal system concerning trademarks and as the general public's awareness about trademarks is heightened, applications for trademark registration in China have soared in recent years. In 1980, applications for trademark registration were only a little more than 20,000. The number reached 132,000 in 1993. In the five years from 2000 to 2004, applications for trademark registration quickly exceeded the key marks of 200,000, 300,000, 400,000 and 500,000, and came to 1,906,000 finally. It means an additional 256,000 applications were submitted in these five years over the total submitted during the 20 years from 1980 to 1999. It accounts for 53.6 percent of the total number of applications submitted from 1980 to 2004. In 2004, 588,000 applications were filed for trademark registration, 136,000 more than the previous year and an increase of 30 percent. The number of applications in 2004 was 2.17 times that in 2001, when China joined the WTO. By the end of 2004, China had had 2,240,000 registered trademarks.

As the investment environment in China is constantly improved, especially after China joined the WTO, both the number of applications for trademark registration from foreigners and the number of registered foreign trademarks have kept increasing. In 1982, there were 1,565 foreign applications for trademark registration in China. The number exceeded 20,000 in 1993 and exceeded 60,000 in 2004. Before 1979, only 20 countries and regions had 5,130 trademarks registered in China. By the end of 2004, 129 countries and regions had had 403,000 trademarks registered in China. This represents almost an 80-fold increase over that in 1979, accounting for 18 percent of the total number of registered trademarks in China.

China has actively fulfilled its obligations to protect internationally well-known trademarks since it joined the "Paris Convention for the Protection of Industrial Property." In handling cases involving objections and disputes over ownership of trademarks as well as trademark management, the State Administration for Industry and Commerce has certified more than 400 well-known trademarks, effectively protecting according to law the legitimate rights and interests of owners of foreign and Chinese well-known trademarks. In 2004 alone, it certified and offered protection to 153 well-known trademarks, of which 28 were brand names of foreign enterprises. Meanwhile, administrative organs of industry and commerce at all levels regard the protection of well-known trademarks as their priority and have made greater efforts to protect them. They have severely cracked down on all kinds of illegal acts that have infringed upon the rights and interests of well-known trademarks.

For years, administrative organs of industry and commerce at all levels across China have fully exploited their advantages in trademark administrative law enforcement—complete networks, simple procedures and high efficiency. Focusing on the protection of the right to exclusive use of registered trademarks, and dutifully carrying out their responsibilities, they have investigated and dealt with a large number of trademark infringement and counterfeiting cases, effectively protecting the right to exclusive use of registered trademarks of both foreign and domestic trademark owners, and safeguarding the legitimate rights and interests of consumers. From 2001 to 2004, administrative organs of industry and commerce at all levels across China dealt with 169,600 cases that violated the trademark laws and regulations. Of these, 113,000 cases involved trademark infringement and counterfeiting (12,000 cases involved foreign trademarks), and 56,600 cases were other types of violations of trademark laws and regulations. They confiscated and destroyed 529 million pieces (sets) of counterfeiting trademark logos, and transferred 286 cases involving 300 people to judicial organs to pursue their criminal responsibilities. In 2004, in accordance with the unified plan and arrangement of the State Council on IPR protection and that of the State Administration for Industry and Commerce on the protection of the right to exclusive use of registered trademarks, administrative organs of industry and commerce at all levels across China launched three special campaigns that focused on the protection of well-known and foreign-related trademarks, and on dealing with infringements of trademarks of food and medicine. The campaigns effectively protected the right to exclusive use of registered trademarks. According to statistics, in 2004, administrative organs of industry and commerce across China investigated and dealt with 51,851 law-violation cases involving trademarks. Of these, 5,494 concerned foreign trademarks, a 2.6-fold increase of that in 2003. Of the 51,851 cases they investigated, 11,680 were common violations of the trademark laws and regulations. The rest of the cases, altogether 40,171, involved trademark infringement or counterfeiting, an increase of 51.66 percent over 2003. They confiscated and disposed of 38,951,800 pieces (sets) of illegal trademark logos, confiscated 280,800 tools such as moulds and press plates used for the infringement, and confiscated and destroyed 5638.53 tons of items that had been used for the infringement. They transferred to judicial organs 96 cases involving 82 people to pursue their criminal responsibilities.

IV. Copyright Protection

China's legal system for copyright protection was gradually established in the 1990s, with the implementation of the "Copyright Law" as a hallmark in this process. In recent years, China has made revisions to the "Copyright Law." It has also promulgated a number of regulations with legal effect, such as "Regulations on the Protection of Computer Software," "Regulations for the Implementation of the Copyright Law," "Procedures for the Implementation of Administrative Sanctions Concerning Copyright," and "Regulations on the Collective Management of Copyright." The promulgation and implementation of these legal documents have laid a solid legal foundation for copyright protection.

At present, China has formed a three-level copyright administrative management system: the State Copyright Bureau, copyright bureaus at the provincial level and the prefectural (city) level. Governments of various provinces, autonomous regions and municipalities directly under the central government have constantly consolidated their copyright administrative management departments and made improvements to the system of copyright administrative management and law enforcement.

In recent years, China's copyright administrative management departments at all levels have strengthened their administrative enforcement of the copyright law. They have increased cooperation with other government departments, such as the departments of public security, industry and commerce, the customs, press and publications, and cultural departments. As a result, a mechanism of law enforcement whereby different departments are coordinated in combating copyright infringement and piracy has gradually taken shape. The copyright administrative management departments have always maintained the pressure on copyright infringement and piracy. They have launched several campaigns to crack down on pirated discs, textbooks, reference books, software, illegal duplication and selling of audio-video products, selling of smuggled audio-video products and Internet infringement practices. Positive achievements have been made. According to incomplete statistics, from 1995 to 2004, copyright administrative management departments at all levels confiscated 350 million pirated copies, accepted 51,368 cases of infringement and resolved 49,983 of them. In 2004, they accepted 9,691 cases of infringement, resolved 9,497 of them and imposed administrative sanctions on the infringers in 7,986 cases. These included the investigation and punishment of two Chinese enterprises that had infringed upon the copyright of the Microsoft Corporation of the United States and other major cases.

While establishing and improving its copyright legal system and strengthening its copyright administrative management, China also attaches great importance to the establishment of a copyright public service system. At present, China has established a copyright public management and service system consisting of copyright collective management organs, copyright agencies, copyright protection associations, professional associations and organizations of copyright holders. In 1988, the Copyright Agency of China was established. In 1990, the Copyright Research Society of China was established and its name was changed to Copyright Society of China in 2002. In 1993 the China Copyright Society of Works of Music was established. And in 1998, the Copyright Protection Center of China was established. At present, writers' associations, such as China Federation of Literary and Art Circles, China

Writers' Association and China Film Association as well as professional associations of book publishers, producers of audio-video products and software developers have established their own copyright protection organizations. Copyright societies have been established in more than 20 provinces (autonomous regions, municipalities directly under the central government) and some major cities. Preparatory work is under way to establish China's collective copyright management organizations of works of the written language and of audio-video products.

V. Intellectual Property Rights Protection for Audio and Video Products

Persistent piracy of audio and video products in spite of repeated bans is a problem of international significance. The Chinese government attaches great importance to IPR protection for audio and video products, treats crackdown on piracy of audio and video products as an important task in IPR protection and has made continuous efforts to carry it out. In recent years, China has gradually established a whole set of systems for the management of audio and video products, which mainly includes an IPR protection system, audio and video business license system, exclusive publication right system, duplication authorization system, SID code system, censorship system for imported audio and video products, the system of awards for informants, the system of uniform anti-counterfeit labels for audio and video products, the system of registration and filing of audio and video products in storehouses, and the system of inspection of, report on and keeping the public informed of illegal audio and video products.

In August 1994, the government promulgated the "Regulations on the Administration of Audio and Video Products," and amended it in December 2001. In accordance with the relevant laws and regulations, including the "General Principles of the Civil Law," "Copyright Law," "Criminal Law" and "Regulations on the Administration of Audio and Video Products," the Press and Publication General Administration, Ministry of Culture, General Administration of Customs and Ministry of Commerce respectively and jointly issued a series of administrative regulations, such as the "Regulations on the Administration of Publication of Audio and Video Products," "Measures for the Administration of Wholesale, Retail and Renting of Audio and Video Products," "Measures for the Administration of Import of Audio and Video Products" and "Measures for the Administration of China-Foreign Cooperative Distribution Enterprises of Audio-Video Products," providing both legal and administrative groundwork for the business and protection of audio and video products.

In light of the rapidly developing audio-video market, the government has step by step readjusted its administration of the audio-video industry. The "Regulations on the Administration of Audio and Video Products" provides for the division of functions in the administration of the industry. In 1998, the State Council further sorted out the administrative system on the principle of "streamlining, efficiency and unification," clearly assigning the administration of audio-video products' production, publication and duplication to the Press and Publication General Administration; and that of wholesale, retail, renting, showing and import of audio-video products to the Ministry of Culture. Following the suit of the central government, the local governments have also readjusted their administrative systems in this regard. So far, China has initially established market management networks at the central, provincial, prefectural and county levels. In most areas, investigation squads have been set up to keep watch on cultural markets, including the market for audio and video products. They sincerely perform the duties of supervision and administration on the audio-video market.

Since the 1990s, the publication market supervision authorities and cultural administration authorities have cooperated closely with other relevant departments in making sustained efforts to enforce order in the audio-video market. As a result, the order of the audio-video market has been gradually improved, the number of pirated audio-video products clearly reduced, and the circulation of original copies greatly increased. According to incomplete statistics, from 1994 to 2004, nine CD duplicating enterprises had their duplication business licenses revoked, and 200 illegal CD production lines were discovered. In August 2004, under the unified arrangement of the special IPR protection campaign, the Ministry of Culture drew up an overall plan for an intensive crackdown on infringements in the audio-video industry, in accordance with which it guided and coordinated with key cities and areas in strengthening law enforcement, and discovering and closing down a large number of underground storehouses and distribution networks of illegal audio-video products. In 2004, cultural market inspecting and management authorities throughout the country inspected audio-video businesses on 555,368 occasions, confiscating 154 million copies of audio-video works. On January 12, 2005, the Ministry of Culture and the Office of the National Working Group on Intellectual Property Rights Protection launched a nationwide campaign to destroy illegal audio-video products, during which over 63.35 million copies of such products were destroyed.

VI. Protection of New Varieties of Agricultural and Forestry Plants

Proceeding from the actual conditions of China and on the basis of earnestly summing up and borrowing from international experience, the Chinese government has set up and carried out a series of systems and measures for the protection of new varieties of plants, thus fully guaranteeing the legitimate rights and interests of the investment bodies involved. On October 1, 1997, the government began implementing the "Regulations on the Protection of New Varieties of Plants," greatly expanding the scope of IPR protection in China.

To supplement the implementation of the "Regulations on the Protection of New Varieties of Plants," the Chinese government has in succession promulgated and implemented such regulations as the "Rules for the Implementation of the Regulations on the Protection of New Varieties of Plants (Agriculture)," "Rules for the Implementation of the Regulations on the Protection of New Varieties of Plants (Forestry)," "Regulations on Agency of New Agricultural Plant Variety Rights," "Regulations on Handling Cases of Infringement of New Agricultural Plant Variety Rights," and "Regulations of the Ministry of Agriculture on the Work of the Reexamination Board for New Varieties of Plants," providing legal guarantees for the rapid development of new varieties of plants.

In recent years, the government has set up the Office of Protection of New Varieties of Plants and the Reexamination Board for New Varieties of Plants at the Ministry of Agriculture and State Forestry Administration, respectively, forming an institutional protection system combining examination and approval agencies, law-enforcement organizations, intermediary service organizations and other rights protection organizations. Meanwhile, a technological support system has been established, which includes the Center for the Preservation of Breeding Materials of New Varieties of Agricultural Plants, Center for Testing of New Varieties of Plants and its 14 sub-centers, and the Center for the Testing of New Varieties of Forest Plants and its five sub-centers and two molecule determination labs. To ensure scientific and authoritative examination of plant variety rights, and drawing on the international standards for testing new varieties of plants, the relevant authorities have, based on the actual conditions of China, formulated guides for testing 57 new varieties of plants, including corn, rice, poplar and peony, of which 18 have been promulgated and implemented as national or industrial standards.

The government has issued and implemented five lists of protected new varieties of agricultural plants and four lists of protected new varieties of forest plants, which cover 119 genera and species, including 41 agricultural plants and 78 forest plants. The numbers are far higher than the minimum numbers required by the "International Convention for the Protection of New Varieties of Plants."

By the end of 2004, the Ministry of Agriculture had handled 2,046 applications for plant variety rights. The number of applications handled in 1999 was 115, and by 2004 it reached 735, indicating an average annual increase of 44.9 percent. Among all the applications, there were 1,875 for field crops, 87 for vegetables, 52 for fruit trees and 32 for decorative plants. A total of 2,174 applications were from scientific, technological and educational institutions, and 772 from enterprises and individuals, which included 32 from foreign enterprises and individuals. After examination, 503 applications were granted the variety rights.

By the end of 2004, the State Forestry Administration had handled 305 applications for variety rights, including 64 from France, Germany, the Netherlands, Belgium and the United States, and granted 72 new plant variety rights. The involved plants included Chinese rose, peony, Christmas flower, azalea, poplar, Chinese chestnut, apricot, eucalyptus and walnut. Of them, 253 applications were for decorative arbors, accounting for 82.95 percent of the total. The applications were mainly from Chinese research institutions, foreign individuals engaging in breeding and Chinese universities, which respectively accounted for 50.2 percent, 14.4 percent and 11.1 percent of the total.

Since 2001, the government began experimental law enforcement on the protection of new varieties of plants in 12 selected provinces and municipalities, and then gradually spread the work across the country. By the end of 2004, 17 provinces (autonomous regions and municipalities directly under the central government) had handled 863 cases of infringement of new agricultural plant variety rights and of faking new agricultural plant varieties.

VII. Customs Protection of Intellectual Property Rights

In September 1994, China began to carry out border protection of IPR. At present, the Chinese customs houses have established a complete system of IPR-related law enforcement measures, which includes such links as examination of customs declaration bills and certificates, inspection of imported and exported goods, detention and investigation of right-infringing goods, punishment of illegal importers and exporters, and disposal of right-infringing goods.

In October 1995, China promulgated and implemented its first ever "Regulations on the Protection of Intellectual Property Rights by the Customs," and began to establish its system of IPR customs protection in accordance with WTO rules. In 2000, the NPC Standing Committee amended the "Customs Law of the People's Republic of China," defining the functions of IPR customs protection from the legal perspective. In December 2003, the Chinese government promulgated the revised "Regulations on the Protection of Intellectual Property Rights by the Customs," which strengthened the customs houses' power in investigating and dealing with right-infringing goods, reduced the burden on the proprietors of intellectual properties in seeking customs protection, and defined the functions of the customs houses, the judicial and other administrative organizations. Later, the General Administration of Customs formulated the "Measures for Implementation" of the revised regulations, which clearly provided for such issues mentioned in the revised regulations as keeping business secrets, filing of international registered trademarks, collecting and returning of security deposit, and the payment of relevant fees by the proprietors. In September 2004, the Chinese government promulgated the "Regulations on Implementation of Administrative Penalties," which clearly provided administrative penalties for infringements on IPR in importation and exportation. The "Interpretations on Several Issues in Practical Application of Laws in Criminal Cases of Infringement on Intellectual Property Rights" was promulgated by the Supreme People's Court and the Supreme People's Procuratorate in December 2004, which further clearly stipulated the criminal responsibilities of agencies importing or exporting right-infringing goods. By then, a legal system for IPR customs protection geared to the needs of economic and social development had been basically established.

China has established and improved its law enforcement mechanism for IPR customs protection. First, it has established a central filing system for IPR customs protection. As long as the IPR proprietors have filed their IPR with the General Administration of Customs, the port customs have the power to detain imported or exported goods that infringe on the filed IPR. By the end of 2004, the General Administration of Customs had confirmed 6,257 files of IPR for customs protection. Second, a model combining active protection with passive protection is implemented in law enforcement. Besides detaining import or export goods suspected of IPR infringement, the customs can also investigate and deal with illegal import and export of right-infringing goods within the scope of their powers and duties. Third, law enforcement organizations have been founded and improved, and the building of IPR law enforcement teams enhanced. By the end of 2004, all the customs houses directly under the General Administration of Customs had set up relevant departments for the management of IPR protection, and 11 of them had set up special organizations for IPR protection. Some customs houses with adequate conditions had stationed liaison officers on site. A system of IPR law enforcement has taken shape on three levels, namely, the General Administration of Customs, customs houses directly under it, and grassroots customs posts.

To curb right infringements and piracy in import and export links, the port customs all over China focus law enforcement on import and export of fake and pirated products. From 1996 to 2004, the Chinese customs ferreted out 4,361 cases of right infringement in import and export, which involved 630 million yuan. Since 2000, the number of cases discovered by the customs has increased by 30 percent annually. The customs have effectively cracked down on the illegal import and export of right-infringing goods, preserving order at ports, and safeguarding the interests of proprietors.

In offering IPR border protection, the Chinese customs attach great importance to liaison and cooperation with proprietors and relevant organizations and associations of proprietors, and have enhanced their communication and coordination with IPR authorities and their cooperation and exchanges with foreign border law enforcement authorities. So far, the Chinese customs have signed memorandums of cooperation on IPR protection with such proprietors' organizations as the Motion Picture Association of America, and have cooperated with them successfully. The Chinese customs have cooperated on many occasions in law enforcement with IPR-related administrative and criminal law enforcement authorities, such as IPR management authorities and public security organs, effectively cracking down on illegal and criminal IPR infringement. The Chinese customs have signed agreements of mutual assistance in administrative law enforcement with the customs of the European Union countries, the United States and other countries, which contain the provisions on IPR customs protection. The Chinese customs have also actively conducted information exchange and law enforcement cooperation regarding IPR protection with the customs services of other countries.

VIII. Public Security Organs Act on Criminal Infringement on Intellectual Property Rights

In recent years, the Chinese public security organs have adopted a series of measures to crack down on all kinds of criminal IPR infringement, continuously enhanced their law enforcement standards and abilities, and safeguarded the sound development of the socialist market economy.

In 1998, to step up the fight against criminal IPR infringement, and in accordance with the provisions of the "Criminal Procedure Law," the Ministry of Public Security established a specialized department to organize, guide and coordinate the fight against criminal IPR infringement, and supervise over the handling of serious cases. Local public security organs at all levels, from the top downward, have set up specialized investigation teams for receiving, filing and investigating such criminal cases. From 2000 to 2004, the Chinese public security organs cracked 5,305 cases of criminal infringement on IPR, which involved nearly 2.2 billion yuan, and arrested 7,100 suspects. Among them, there were 4,269 cases concerning infringement on the exclusive rights of trademark ownership, which involved 1.18 billion yuan, and 5,564 suspects were arrested. A number of suspects were found guilty of the production and sale of fake or inferior products and illegal business operation, and sentenced accordingly.

Since November 2004, the Ministry of Public Security has launched a one-year national campaign against criminal infringement on the exclusive rights of trademark ownership, cracking some cases of criminal IPR infringement that were of widespread and baneful repercussions and involved large amounts of money. These cases included: production of fake Gillette razor blades cracked by the public security organs of Zhejiang Province, production of fake Adidas and Nike sports shoes cracked by the public security organs of Fujian Province, production of fake Cisco (USA) electronic products cracked by the public security organs of Guangdong Province, and production of fake brand name liquors, including Wuliangye, cracked by the public security organs of Sichuan Province.

As more and more foreign companies are investing, selling their products and building enterprises and R&D centers in China, the Chinese public security organs have gradually established a system of regular communication and coordination with IPR proprietors, earnestly listening to their opinions and suggestions. Since December 2002, together with relevant associations of enterprises with foreign investment, the Ministry of Public Security has held three forums on "Protection of Intellectual Property Rights against Crimes" and published forum declarations, improving communication and coordination in this field.

In view of increasing transnational and trans-border criminal cases of IPR infringement, the Chinese public security organs attach great importance to international law enforcement cooperation in the fight against IPR infringement, and have conducted cooperation with the law enforcement organizations of various countries in assistance in investigation and collection of evidence, exchange of information and judicial assistance. In July 2004, working together with the Immigration and Customs Enforcement of the Department of Homeland Security of the United States, the Chinese public security organs successfully cracked a serious case of suspected sale of pirated DVDs in Shanghai, arrested seven suspects headed by an American citizen, raided three places where pirated DVDs were hidden, and confiscated over 210,000 pirated DVDs.

IX. Judicial Protection of Intellectual Property Rights

In recent years, the Chinese procuratorial organs have earnestly exercised their duties of examination of arrests and prosecutions in cases of criminal IPR infringement, as well as legal supervision over relevant criminal lawsuits in accordance with law, handled a large number of cases of suspected criminal IPR infringement. From 2000 to 2004, the procuratorial organs at all levels approved the arrests of 2,533 people suspected of criminal IPR infringement, and instituted prosecutions against 2,566 suspects. In 2004, the arrests of 602 people suspected of criminal IPR infringement were approved, and prosecutions against 638 suspects were instituted. In the same year, procuratorial organs around China launched a special drive to supervise cases involving production of fake products and IPR infringement, during which they urged relevant administrative law enforcement organs to transfer suspected criminal cases to public security organs according to law, supervised the filing of cases that should have been filed by the public security organs according to law, made sure that suspected criminal cases entered judicial proceedings in time, and investigated some criminal cases of conniving and covering up production and sale of fake products and of IPR infringement involving government functionaries abusing their powers.

For many years, the Chinese people's courts at all levels have continuously strengthened work in IPR-related civil and criminal trials under the principle of "justice and efficiency." Through handling a large number of IPR-related cases, they have protected the legitimate rights and interests of Chinese and foreign IPR proprietors equally, punished acts of IPR infringement and severely cracked down on criminal IPR infringements, making unremitting efforts to realize social fairness and justice.

Since the handling of the first case of a technological contract dispute in 1981, the Chinese courts have continuously expanded the range of IPR-related trials to include cases concerning copyright, trademarks, patents, unfair competition, computer software, new varieties of plants and integrated circuit layout designs, thus establishing the status of court trials in the handling of IPR-related cases. From 1998 to 2004, courts throughout the country concluded 38,228 IPR-related civil cases of first instance and 2,057 criminal cases of first instance involving IPR infringement in accordance with Section Seven, Chapter III of the "Specific Provisions" of the "Criminal Law," handing down sentences to 2,375 criminals. Among these cases, in 2004, 8,332 civil IPR-related cases of first instance and 385 criminal cases of first instance involving IPR infringement in accordance with Section Seven, Chapter III of the "Specific Provisions" of the "Criminal Law" were concluded, and 528 criminals were punished. In the same year, the Chinese courts also concluded 932 criminal cases of production and sale of fake or inferior goods, punishing 1,453 criminals involved, and concluded 1,434 criminal cases of illegal business operation, punishing 2,103 criminals. A considerable proportion of the above two types of cases also involved criminal IPR infringement.

To correctly apply laws and make law enforcement standards coherent, and based on its experience in handling IPR-related cases, the Supreme People's Court of China has formulated a series of relevant judicial interpretations in accordance with the law, and improved a series of important IPR-related law application principles, which have played an important role in the timely settlement of new problems emerging from the handling of IPR-related cases and in guiding the correct handling of IPR-related cases by the people's courts at all levels. For example, the "Several Provisions on Law Application for Stopping Patent Infringement before Litigation" promulgated by the Supreme People's Court in June 2001 provided judicial measures for stopping right infringements and effectively preventing more losses on the part of proprietors. The "Interpretation of Several Issues Regarding Specific Law Application in Handling Cases of Illegal Publications" promulgated by the Supreme People's Court in December 1998 defined the standards of condemnation and penalty for criminal offences of copyright infringement. The "Interpretation of Several Issues Regarding Specific Law Application in Handling Criminal Cases of Intellectual Property Rights Infringement" jointly promulgated by the Supreme People's Court and the Supreme People's Procuratorate in December 2004 properly reduced the condemnation standards for the crimes of IPR infringement strictly in accordance with the provisions of the "Criminal Law" and in light of China's actual conditions and judicial reality, increased the applicability of the relevant provisions of the "Criminal Law," and provided a concrete applicable legal basis for handling criminal cases of IPR infringement, and was thus of great significance for effectively cracking down on crimes of IPR infringement.

The Chinese courts put special emphasis on the professional training of IPR judges. After many years of judicial practice and systematic training, a contingent has been formed of highly competent IPR judges who speak foreign languages, and have an intimate knowledge of the law, rich judicial experience and expertise in science and technology. Relatively complete IPR-related judicial departments have been gradually established, providing a strong personnel and organizational guarantee for effective IPR-related judicial work.

The Chinese courts have continuously enhanced international exchanges and cooperation in the field of IPR-related judicature, learning and borrowing from the useful experience and successful practices of foreign countries. The Supreme People's Court actively conducts friendly cooperation with the World Intellectual Property Organization and European Union, and has hosted several seminars and training courses on IPR, the results of which have been encouraging. These seminars and training courses have effectively promoted the enhancement of China's IPR judicial protection, and continuously pushed the level of its IPR-related judicial work to a new high.

Conclusion

Practice over the past two decades and more has shown that the Chinese government has made arduous efforts to protect IPR. China has achieved a noticeably great improvement in IPR protection, which took the developed countries several decades and even over a century to attain. However, the Chinese government is clearly aware that, in a large developing country with a population of 1.3 billion, relatively backward economy and low level of science and technology, a complete IPR protection system cannot be established overnight. China has a long way to go in this regard, and is faced with heavy tasks in IPR protection.

At present, there are still IPR infringements in certain areas and fields in China, some of which are very serious. The awareness of the importance of IPR in Chinese society as a whole needs to be further enhanced. Meanwhile, China's IPR protection work is facing new challenges in the course of economic globalization and rapid development of science and technology worldwide. In accordance with the requirements of the concept of scientific development, the Chinese government will adopt more effective policies and measures in the process of building a well-off society in an all-round way and developing a harmonious society, exerting efforts to raise its IPR protection work to a new level.

For many years China has received active support and assistance from the international community in the establishment of its IPR protection system. In the future, the Chinese government will continue to earnestly execute its international obligations in this regard, enhance its cooperation with various countries and international organizations with a more active, open attitude, and join hands with them in promoting the establishment of a sound system and environment favorable for IPR protection worldwide.

STATUTORY MANDATE OF THE U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

Pursuant to Public Law 108–7, Division P, enacted February 20, 2003

RESPONSIBILITIES OF THE COMMISSION.—The United States-China Commission shall focus, in lieu of any other areas of work or study, on the following:

PROLIFERATION PRACTICES.—The Commission shall analyze and assess the Chinese role in the proliferation of weapons of mass destruction and other weapons (including dual use technologies) to terrorist-sponsoring states, and suggest possible steps which the United States might take, including economic sanctions, to encourage the Chinese to stop such practices.

ECONOMIC REFORMS AND UNITED STATES ECONOMIC TRANSFERS.—The Commission shall analyze and assess the qualitative and quantitative nature of the shift of United States production activities to China, including the relocation of high-technology, manufacturing, and R&D facilities; the impact of these transfers on United States national security, including political influence by the Chinese Government over American firms, dependence of the United States national security industrial base on Chinese imports, the adequacy of United States export control laws, and the effect of these transfers on United States economic security, employment, and the standard of living of the American people; analyze China's national budget and assess China's fiscal strength to address internal instability problems and assess the likelihood of externalization of such problems.

ENERGY.—The Commission shall evaluate and assess how China's large and growing economy will impact upon world energy supplies and the role the United States can play, including joint R&D efforts and technological assistance, in influencing China's energy policy.

UNITED STATES CAPITAL MARKETS.—The Commission shall evaluate the extent of Chinese access to, and use of United States capital markets, and whether the existing disclosure and transparency rules are adequate to identify Chinese companies which are active in United States markets and are also engaged in proliferation activities or other activities harmful to United States security interests.

CORPORATE REPORTING.—The Commission shall assess United States trade and investment relationship with China, including the need for corporate reporting on United States investments in China and incentives that China may be offering to United States corporations to relocate production and R&D to China.

REGIONAL ECONOMIC AND SECURITY IMPACTS.—The Commission shall assess the extent of China's "hollowing-out" of Asian manufacturing economies, and the impact on United States economic and security interests in the region; review the triangular economic and security relationship among the United States, Taipei and Beijing, including Beijing's military modernization and force deployments aimed at Taipei, and the adequacy of United States executive branch coordination and consultation with Congress on United States arms sales and defense relationship with Taipei.

UNITED STATES-CHINA BILATERAL PROGRAMS.—The Commission shall assess science and technology programs to evaluate if the United States is developing an adequate coordinating mechanism with appropriate review by the intelligence community with Congress; assess the degree of non-compliance by China and [with] United States-China agreements on prison labor imports and intellectual property rights; evaluate United States enforcement policies; and recommend what new measures the United States Government might take to strengthen our laws and enforcement activities and to encourage compliance by the Chinese.

WORLD TRADE ORGANIZATION COMPLIANCE.—The Commission shall review China's record of compliance to date with its accession agreement to the WTO, and explore what incentives and policy initiatives should be pursued to promote further compliance by China.

MEDIA CONTROL.—The Commission shall evaluate Chinese government efforts to influence and control perceptions of the United States and its policies through the internet, the Chinese print and electronic media, and Chinese internal propaganda.

LIST OF WITNESSES, COMMUNICATIONS, AND PREPARED STATEMENTS