

Staff Research Study

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Office of Industries
U.S. International Trade Commission

TELECOMMUNICATIONS EQUIPMENT: U.S. PERFORMANCE IN SELECTED MAJOR MARKETS

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Executive Summary

This staff study assesses the performance of the U.S. telecommunications equipment industry in the global market as a whole and in seven major U.S. export markets: the European Union (EU), Canada, Japan, Korea, Mexico, China, and Taiwan. The industry encompasses transmission and switching equipment that comprise the telecommunications network as well as terminal equipment such as facsimile machines and telephone sets that attach to the network.¹ The study covers the structure of the U.S. and relevant foreign industries as well as trade patterns, trade agreements, nontariff barriers, and markets. It also addresses in detail factors affecting industry performance such as exchange rate fluctuations, technological innovation, labor productivity, infrastructure development, regulatory environment, installed base of equipment, and domestic market size.

Industry Profile

Global production of telecommunications equipment expanded from \$119 billion in 1993 to \$187 billion in 1997 in response to increased demand in every major market for telecommunications equipment. Greater demand has resulted primarily from the privatization of telecommunications service providers, the liberalization of regulations that formerly restricted competition for service providers, and rapid technological advances that allow new telecommunications services while fostering competition for old services. The United States is the world's largest producer of telecommunications equipment, followed in size by the EU and Japan. The share of global production by these three producers increased from 80 percent to 82 percent during 1993-1997.

The telecommunications equipment industry has become increasingly globalized in recent years. This trend has been fueled by the liberalization of telecommunications service markets which encourages allows the entry of new service providers, who, in turn, provide greater opportunities for nontraditional suppliers. Most major telecommunications equipment producers market their products globally and many have located production facilities within major markets in order to better serve customers as competition for sales intensifies. Competition for the U.S. industry in third country markets comes primarily from established EU suppliers and more recently from Japanese and Korean firms. Increasingly, both U.S.- and foreign-based equipment producers have moved production of low-end commodity-type equipment to lower wage economies such as China, Malaysia, the Philippines, or Mexico.

Key Indicators of U.S. Performance

- The share of the rapidly expanding global telecommunications equipment market composed of U.S.-produced equipment increased from 31 percent to 33 percent during 1993-97, the EU's share decreased from 29 percent to 28 percent, and Japan's share increased from 20 percent to 21 percent. U.S. production steadily grew from \$36 billion to \$61 billion during this period. Although U.S. production consists of a full range of equipment, it is concentrated in high-technology switching and transmission equipment for both wireline and wireless networks.

¹ For the purposes of this paper, transmission equipment does not include broadcasting equipment or copper and fiber optic cable and terminal equipment does not include personal computers.

Domestic production of customer premises equipment (CPE) has primarily been in technologically sophisticated areas where U.S. companies are world leaders.

- U.S. exports of sector equipment nearly doubled during 1993-97, reaching \$13.1 billion. Expanding global demand and increasing U.S. competitiveness has allowed the United States to maintain a trade surplus in this sector since 1994. This surplus was \$3 billion in 1997.
- Increased automation, faster assembly equipment, and wider use of computers in the production process in recent years have significantly increased productivity and enhanced the competitiveness of the U.S. industry. Productivity gains during 1993-97 allowed U.S. output of communications equipment to increase 70 percent while the workforce expanded only 7 percent.
- Computer-telephony integration (CTI), the interconnection of computers via the telecommunications network, is one of the fastest growing segments of the telecommunications equipment industry. U.S. companies such as Cisco, Bay Networks, and 3Com, which produce CTI-related equipment, experienced very strong growth during recent years and have become global industry leaders in products related to CTI. During 1993-97, the combined revenues for Cisco, 3Com, and Bay Networks grew from \$2.3 billion to \$11.7 billion, an average annual increase of 50 percent.
- Wireless communications equipment is another rapidly expanding market segment that accounts for an increasing share of U.S. production, although the success of the largest U.S. producers has been mixed. Lucent's share of the global wireless infrastructure market nearly doubled in the last 2 years, reaching 13 percent, while that of Motorola decreased from 18 to 14 percent. Motorola's marketshare for wireless handsets suffered even greater losses during this period dropping from 34 percent to 21 percent. Much of this loss resulted from the rapid transition from analog to digital in the EU which provided an advantage to EU-based competitors such as Ericsson and Nokia.

External Policies Affecting the Industry

- Three agreements were signed during 1997 that are likely to have a significant effect on international telecommunications equipment trade and markets: the Information Technology Agreement (ITA), the Basic Telecommunications Services Agreement, and the Agreement on Mutual Recognition between the United States of America and the European Community. U.S. telecommunications equipment producers are expected to directly benefit from the trade enhancing effects of each of these agreements. The ITA will eliminate import duties on most information technology products, including telecommunications equipment by the year 2000. The Basic Telecommunications Services Agreement ensures market access for telecommunications service providers and establishes procompetitive regulatory principles in 65 countries. The MRA between the United States and the EU provides for the mutual acceptance of procedures used to determine the network compatibility of telecommunications equipment.
- The 1996 Telecommunications Act (Act) permits the regional Bell operating companies to offer long distance service once they meet certain requirements designed to open the local exchange markets to competition. The Act removes major impediments to competition and will almost

certainly have a positive impact on sales of telecommunications equipment by creating alternative local and long distance networks.

U.S. Trade with Major Markets

- U.S. sector exports increased to each of the 7 major markets covered in this report during 1993-97, although the rate of growth varied widely. U.S. exports to Mexico increased by a factor of 4, exports to the EU increased by 220 percent, while exports to Canada, Japan, and Korea more than doubled.
- Despite this growth, imports from the United States, as a share of total imports, decreased in 3 of the 4 major Asian markets (Japan, Korea, and China) while the U.S. share of Taiwan's imports held steady. The decreasing U.S. share is largely the result of greater competition from wireless equipment producers based in the EU and Canada. The U.S. share of total sector imports increased in the EU, Canada, and Mexico.
- U.S. exporters report that significant trade barriers existed in China, Korea, and Japan during 1993-97. U.S. exports of sector equipment to China were restricted by import duties that ranged from 9 percent to 50 percent and nontariff barriers such as import quotas and domestic content requirements. Korean trade barriers reported by the U.S. industry included discriminatory government procurement policies, lack of intellectual property protection, and a nontransparent regulatory process. Japan's largest purchaser of telecommunications equipment, Nippon Telegraph and Telephone Corporation (NTT), buys almost exclusively from its traditional domestic suppliers. Further, U.S. manufacturers report that NTT restricts imports from foreign suppliers by over-engineering and under-documenting specifications for NTT-specific standards.

CHAPTER 1

INTRODUCTION

Purpose of Study

This study examines the performance of the U.S. telecommunications equipment industry at a time when the global market for telecommunications products is undergoing a major transformation. Driven by the privatization of telecommunications services, the elimination of most import duties, the liberalization of the regulatory environment,² and the rapid evolution of technology, this transformation provides unprecedented opportunities and risks for U.S. companies. These factors have increased industry and market globalization whereby equipment producers that formerly confined most manufacturing and sales to their home country now, to a much greater extent, produce equipment, source components, and sell products throughout the world. This trend is likely to continue since many regulatory changes designed to open markets have only recently been implemented.

The privatization of telecommunications services and regulatory changes affecting service providers profoundly affect the equipment industry. Telecommunications services have traditionally been provided by governments or heavily regulated monopolies whose prices and rates of return were government-controlled. As such, they had little incentive to cut costs, increase efficiency, or introduce new products and services. Service providers in the major markets, typically produced their own equipment or purchased from a small group of favored national suppliers. Many of the major equipment suppliers that dominate the industry today, including Lucent Technologies and Northern Telecom (Nortel) in North America; Siemens, Alcatel, Ericsson, and Philips in the EU; and NEC, Fujitsu, Hitachi, and Oki Electric in Japan, developed in this type of protected market.

Privatization has radically altered the market for telecommunications services and has increased sales of equipment by raising capital that governments can use to fund investment in telecommunications infrastructures. Further, privatization puts these services in the hands of entrepreneurs who are driven to upgrade equipment to effectively compete for market share. The liberalization of restrictions on foreign and domestic investment further expands capital inflows while fostering competition by increasing the number of new service providers. These new market entrants further increase sales of telecommunications equipment by creating alternative infrastructure to compete with incumbents. Incumbent service providers, in turn, are compelled to re-evaluate long-standing relationships with equipment vendors in the light of the new market conditions, thereby creating opportunities for more efficient producers that offer superior products. Service providers in this more competitive market are far more likely to choose equipment suppliers based on business considerations rather than national affiliation.

Although telecommunications markets as a whole are becoming more open and trade barriers are being reduced, significant restrictions remain. Tariffs remain high in China--the world's fastest growing major market for telecommunications equipment, Korean trade regulations are often

² Regulatory liberalization for telecommunications services is intended to facilitate market entry by new service providers both foreign and domestic.

nontransparent and government procurement policies are often discriminatory, and Japan's major service provider--NTT--restricts most purchases to its traditional family of suppliers.

This paper will analyze the structure of the U.S. telecommunications equipment industry and that of the domestic industries in the EU, Canada, Japan, Mexico, China, Korea, and Taiwan.³ The performance of the U.S. industry as measured by trends in exports and market share is used to determine the competitive status of the U.S. vis-à-vis other major producers and the extent to which foreign markets have been opened to U.S. exports and investment. Various indicators of industry performance are also examined such as trends in production, consumption, trade, U.S. market share, and level of foreign investment. The paper discusses distinctive characteristics of the telecommunications equipment industry including firm size, level of integration and productivity, as well as factors affecting trade such as exchange rate fluctuations, technological innovation, tariffs, labor costs, infrastructure development, regulatory environment, level of training in the workforce, installed base of equipment⁴, and market size. The paper will also describe existing trade and investment barriers, trade agreements, and regulatory environments so that performance can be evaluated in the context of these factors.

This analysis provides insights into the extent to which the market performance of U.S. producers is determined by their competitive fitness and the degree to which it is hampered by discriminatory trade and market practices. Guaranteeing transparent regulatory processes, removing government controls, and eliminating barriers to trade and investment ensures that free market forces will dictate the success or failure of firms in the global market. These forces are more likely to reward firms that embody attributes such as efficiency, creativity, and responsiveness to consumer demands and make choices based on sound business practices. The payoff for the right choices is now far greater and the penalty for wrong choices is far costlier than before.

Three international treaties signed in 1997 will likely be key determinants of the global market for telecommunications equipment: the Information Technology Agreement (ITA), the Basic Telecommunications Services Agreement, and the Mutual Recognition Agreement (MRA) between the United States and the EU. Each of these agreements is intended to open markets and increase competition. The ITA provides for the elimination of tariffs by the year 2000 on most information technology products, including telecommunications equipment. It has been signed by 43 countries representing well over 90 percent of the world trade in information technology products. The ITA should positively affect U.S. telecommunications equipment exports by eliminating tariffs as high as 8 percent in the EU and in excess of 25 percent in developing countries such as Indonesia, Malaysia, and Thailand.⁵

The Basic Telecommunications Services Agreement (The agreement) was signed by 70 countries that account for over 95 percent of world telecommunications services revenue.⁶ The agreement, which took effect January 1, 1998, ensures market access for telecommunications service providers of local, long distance, and international service on both a facilities and resale basis. The agreement

³ For the purposes of this report, the EU is considered a single economic unit composed of the 15 current members.

⁴ Installed base refers to equipment that is already in use.

⁵ *Most-Favoured-Nation Tariff Schedules, Annexes to Final Act Embodying the Results of the Uruguay Round of Multilateral Trade Negotiations (Marrakesh Protocol)*, Marrakesh, Apr. 15, 1994.

⁶ Office of the United States Trade Representative (USTR), "Statement of Charlene Barshefsky: Basic Telecom Negotiations," Feb. 15, 1997, found at <http://www.ustr.gov/agreements/telecom>, retrieved Dec. 19, 1997.

also establishes procompetitive regulatory principles for 65 countries based on those set out in the U.S. 1996 Telecommunications Act and allows foreign-based companies, including those from the United States to acquire, establish, or hold a significant stake in telecommunications service providers around the world.⁷

U.S. telecommunications equipment producers are likely to benefit from the agreement because increased market access will bring new service providers into the market. These new providers will offer experience, new technology and capital, allowing telecommunications networks to be upgraded and expanded more rapidly than would have been possible otherwise. The agreement will also fuel the development of new networks, both cellular and wireline, where traditional equipment suppliers will not have the advantage of an installed base. U.S.-based vendors such as Lucent, Motorola, Qualcomm, and Hughes are competitive suppliers of wireless and/or wireline equipment and are considered to be well positioned to benefit from these opportunities.

The Mutual Recognition Agreement (MRA) between the United States and the EU specifies the conditions under which the United States and the EU will accept the results of conformity assessment procedures in six sectors, including telecommunications equipment.⁸ The draft agreement was initialed on June 20, 1997 and is to enter into force after both Parties have exchanged letters confirming the completion of their respective procedures for this agreement.⁹ The MRA covers all telecommunications equipment capable of being connected to the public telecommunications network as well as radio transmitters subject to equipment authorizations by either country.¹⁰ The MRA would eliminate duplicative equipment testing and reduce the time and costs associated with product approval.

The U.S. telecommunications equipment industry has been a key contributor to the overall health of the economy in recent years and the implementation of these agreement is likely to fuel the continued growth of this sector. It provided over 276,000 jobs and produced over \$61 billion in goods during 1997. These numbers will likely grow as technological advances and deregulation continue to expand the global market.

Data and Scope

There is no universally accepted definition of the telecommunications equipment industry or the products included in that industry. Although, most definitions include certain basic components of the industry such as wireline and wireless switches and terminal equipment such as telephone sets and facsimile machines, there is disagreement, regarding the inclusion of products such as broadcast equipment, fiber optic cable, or radar equipment. Convergence between telecommunications and computer technology makes it even more difficult to determine generally accepted classifications for these products.

⁷ Ibid.

⁸ Most companies currently require that telecommunications equipment designed for connection to the public switched telephone network undergo an approval process before it can be sold in that market.

⁹ "U.S., EU Initial Mutual Recognition Agreement at Denver Summit," *Inside U.S. Trade*, June 27, 1997, found at <http://www.insidetrade.com/sec-cgi>, retrieved Dec. 20, 1997.

¹⁰ *Agreement on Mutual Recognition Between the United States of America and the European Community*, found at <http://www.ustr.gov/agreements/telecom>, retrieved Dec. 19, 1997.

The scope of the industry used for this study includes most wireline network and terminal equipment, including switching and transmission equipment, as well as telephone sets, facsimile machines, and parts for these products. Also included are most types of wireless telecommunications infrastructure and terminal equipment such as transceivers and cellular telephones. Communications satellites, optical fibers, fiber optic cable, and broadcast equipment were not included in the telecommunications equipment data and discussions presented in this study. For the most part, this report divides the industry into subgroups consisting of wireless network and terminal equipment and wireline network and terminal equipment with network equipment further subdivided into transmission and switching equipment. Transmission equipment is used to transport a signal, switching equipment selects the path or circuit that the signal will take, and terminal equipment refers to the telephone sets, facsimile machines, and other devices that attach to the network.¹¹

Production data was taken from two publications: *Telecommunications: A Profile of the Worldwide Telecommunications Industry* and *Yearbook of World Electronics Data* by Reed Electronics Research (Reed). Reed provided Commission staff with a list of product numbers from the *Harmonized Tariff Schedule* (HTS) that corresponded to the products used for its production data so that trade and production data could be matched and used to derive apparent consumption. The official statistics of the U.S. Department of Commerce were used along with official trade data from individual countries to determine patterns of trade. To ensure that data presented in each chapter represents identical, or nearly identical, product groups, the same data source was used for each country's key indicators whenever possible.

Production, trade, and consumption values for Canada, Japan, China, Korea, and Taiwan have been converted to U.S. dollars at 1996 exchange rates, rather than the average rate for each year, in order to eliminate distortions in market and production trends caused by exchange rate fluctuation during 1993-97.¹² Average annual exchange rates were used for the EU and Mexico because the data was not available in a form that would allow conversion to U.S. dollars at a constant exchange rate.

Organization

Chapter 2 profiles the structure of the U.S. telecommunications equipment industry covering topics such as industry concentration, globalization, productivity, R&D, principal products, and the trend toward industry consolidation. Other sections within the chapter discuss trade, the market, and trade agreements affecting the industry. Chapters 3 through 9 focus on the industry, markets, and trade of seven major U.S. export markets for telecommunications equipment beginning with the EU, and followed by Canada, Japan, Korea, Mexico, China, and Taiwan. Chapters 3 through 9 are similar in structure to Chapter 2, although a non-tariff barriers section has been included and specific trade agreements between each country and the United States are discussed.

¹¹ Other industry sources divide the industry into subgroups that encompass different sets of products and this report has used these alternative groupings where it is not possible to subdivide the industry as described above. Alternative industry subdivisions include "customer premises equipment" (CPE), which is roughly comparable to terminal equipment although it includes the growing portion of switching and transmission equipment that is located at the customer's site. "Enterprise solutions" commonly refer to telecommunications hardware and software designed for business applications while wireless "infrastructure" equipment covers any wireless equipment with the exception of telephone handsets or other terminal equipment.

¹² The use of current rather than constant exchange rates would have had a particularly distortive effect on trends in the Japanese market where the value of the yen increased 22 percent vis-a-vis the U.S. dollar between 1995 and 1997. All exchange rates used in this study are average annual market rates from the International Monetary Fund's *International Financial Statistics*.

CHAPTER 2

UNITED STATES

The United States is the world's largest producer and consumer of telecommunications equipment and is widely recognized as an industry leader in the development and manufacture of leading-edge-technology products. The U.S. share of world consumption has remained stable at 31 percent in recent years although its share of total production increased by 2 percent to 33 percent during 1993-97. Japan's share of global production increased from 20 percent to 21 percent, during this period while that of the EU decreased from 29 percent to 28 percent (figure 2-1). In recent years, U.S. firms¹³ have greatly expanded both their exports and their global presence as trade and investment barriers have been removed thereby presenting new opportunities in foreign markets.

Industry Structure

The U.S. telecommunications equipment industry comprises a large and diversified group of producers that differ by size, level of integration, nationality of ownership, and range of products. A few large multinational companies such as Lucent Technologies¹⁴ (Lucent), Motorola, and Northern Telecom (Nortel) dominate the sector and supply most of the equipment purchased by the major consumers, the telecommunications service providers. Each of these companies produces a wide range of products and is capable of delivering complete network systems.¹⁵ The rest of the industry includes a growing number of small- to medium-sized companies that produce a more limited range of finished products or components. Many of these smaller manufacturers supply products to the major producers. For example, Lucent purchased \$6 billion worth of products and components from an estimated 64,000 U.S.-based firms during 1995 alone.¹⁶ Some midsized producers such as Cisco, 3Com, and Bay Networks¹⁷ have focused their production on fast-developing market segments and core competencies where their relatively smaller size and flexibility provide an advantage over larger multi-product firms in a rapidly changing market.

Industry globalization continues to change the structure of the industry as equipment markets expand throughout the world and the emergence of more competitive service providers create new opportunities for equipment manufacturers. Most major telecommunications equipment manufacturers market their products throughout the world and many firms have located a major share of their production outside of the country in which they are headquartered. The U.S. industry includes a large number of foreign-headquartered companies that located manufacturing operations

¹³ For the purposes of this paper, all firms that manufacture telecommunications equipment in the United States are considered part of the U.S. industry regardless of the location of the company headquarters or parent company.

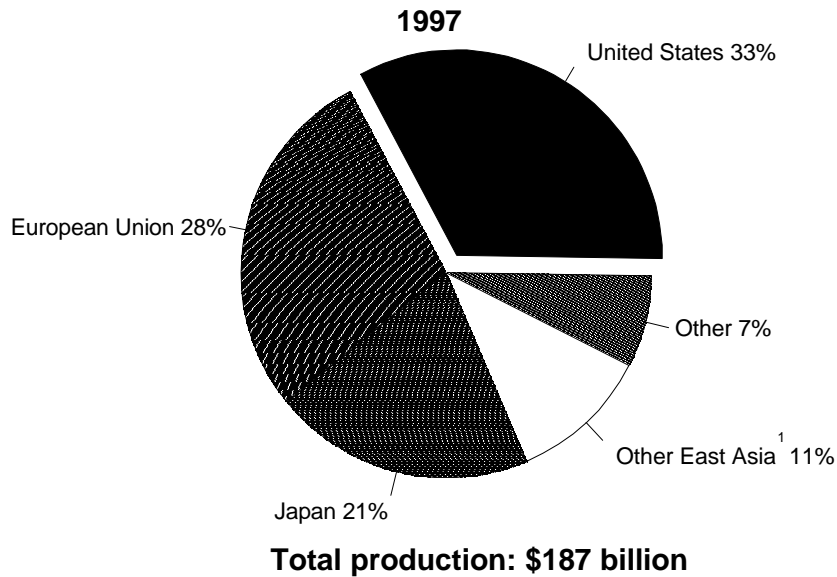
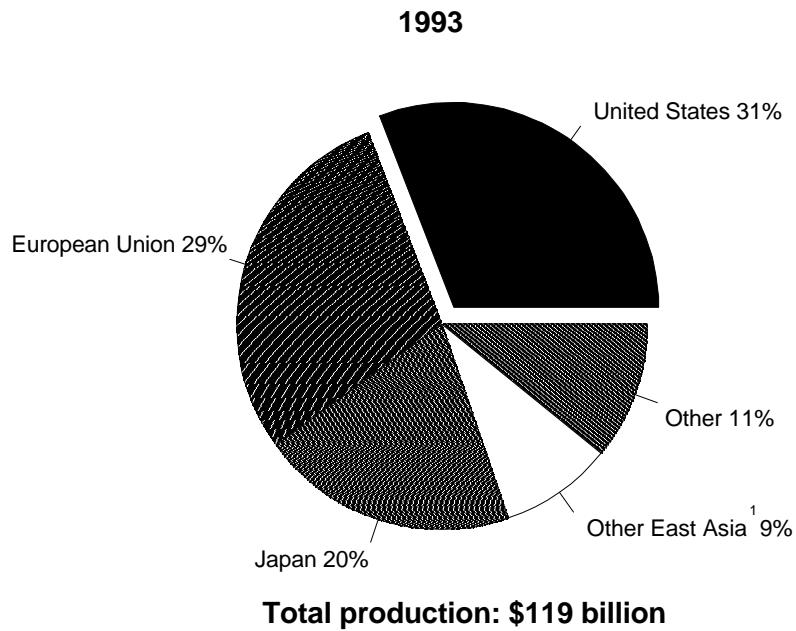
¹⁴ Lucent Technologies was formerly AT&T Systems and Technology Group. It was spun off in 1996.

¹⁵ Motorola primarily produces wireless equipment, whereas Lucent and Nortel produce a full range of wireless and wireline equipment.

¹⁶ Industry representative, telephone interview by USITC staff, Jan. 30, 1997.

¹⁷ Bay Networks was acquired by Nortel in August 1998.

Figure 2-1
Telecommunications equipment: Shares of world production by the United States and other major producers, 1993 and 1997



¹ Includes China, Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand, and Taiwan.

Source: Estimated by USITC staff based on Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 5th ed., and Reed Electronics Research, *Yearbook of World Electronics Data 1995, 1996, and 1997*.

for high technology telecommunications products in the United States to benefit from a highly educated workforce and to take advantage of the huge U.S. market¹⁸ (table 2-1). For example, Canadian-based Nortel employs 25,000 in the United States and Swedish-based Ericsson employs 8,200. Both companies manufacture a wide range of network and terminal equipment and conduct research and development (R&D) in the United States.¹⁹ Similarly, U.S.-headquartered firms such as Lucent and Motorola have established production facilities outside the United States for a variety of reasons including access to lower-wage labor, proximity to important markets, and avoidance of high tariffs on telecommunications products. Lucent maintains manufacturing and repair facilities in 19 foreign countries, and Motorola produces cellular and paging equipment in at least 9 countries outside the United States.²⁰

U.S. production of telecommunications equipment steadily increased from \$36 billion to \$61 billion during 1993-97, an average annual growth rate of 14.1 percent.²¹ Although U.S. production consists of a full range of telecommunications equipment, it is concentrated in high-technology products.

Table 2-1
Selected U.S. telecommunications equipment producers with foreign-headquartered parent

U.S. Company	Location of foreign-headquartered parent
Alcatel Network Systems, Inc.	France
Siemens Stromberg Carlson Siemens Rolm Communications, Inc.	Germany
Ericsson Network Systems	Sweden
Racal Datacom, Inc.	United Kingdom
Fujitsu Network Transmission Systems Hitachi (U.S.) Inc. NEC America	Japan
Northern Telecom (Nortel) Gandalf Systems	Canada

Source: Compiled by the staff of the USITC.

Major sectors of U.S. telecommunications equipment production include central office switching equipment, mobile telephone switches and transceivers, and carrier line equipment such as modems and multiplexers. The U.S. industry also produces a major share of the world output of cellular and

¹⁸ Industry representatives, interviews by USITC staff, Raleigh, NC, Aug. 4, 1997.

¹⁹ Industry representatives, interviews by USITC staff, Richardson, Texas, May 13, 1997.

²⁰ Industry representative, telephone interview by USITC staff, Jan. 30, 1997, and Lucent Technologies, Inc. and Motorola Inc., 1997 10-K Forms.

²¹ Estimated by USITC staff based on Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry* (Surrey: Reed Business Information, 1997), and U.S. Department of Commerce (USDOC), "MA36P and M3- 1," (various issues), *Current Industrial Reports*.

personal communications service (PCS)²² telephones and other sophisticated customer premises equipment (CPE). The principal CPE products manufactured in the United States include modems, private branch exchanges (PBX's), voice processing equipment, and video communications equipment.²³ Commodity-type equipment such as single-line residential phones, simple facsimile machines, answering machines, and certain parts tend to be produced by U.S. and foreign firms in lower wage economies such as Mexico, Malaysia, and the Philippines. The strongest competition faced by the U.S. industry in foreign markets comes primarily from established EU-based suppliers such as Ericsson, Nokia, Siemens, and Alcatel; Canadian-based Nortel and, to an increasing extent, from Japanese and Korean firms.

Increased labor productivity has been a major factor contributing to the competitiveness of the U.S. industry. Production worker employment in the communications equipment sector²⁴ increased by only 7.4 percent to 276,000 during 1993-97. However, total sector output expanded 70 percent during the same period, thereby increasing real output per production worker by an average of 11.9 percent per year to \$539,819²⁵ (figure 2-2). The steady growth of U.S. worker productivity has resulted from increased automation, faster assembly equipment, and wider use of computers in the production process.²⁶ Further, productivity has been boosted by the greater economies of scale associated with increased output of U.S. manufacturers.

One of the primary factors driving demand for telecommunications equipment has been the continuous introduction of new products and services made possible by technological advances. These advances have resulted largely from the U.S. industry's enormous investment in R&D in response to increasing domestic and international competition. Lucent and Motorola, the two largest R&D investors in the sector, together spent \$6.4 billion on R&D during 1997.²⁷ The telecommunications equipment industry invests an average of 10 percent of its revenues on R&D, whereas, the total for all U.S. manufacturing industries that engage in R&D is approximately 3 percent.²⁸ Many companies in the most highly competitive sectors of the industry spend a substantially greater share of their revenues on R&D. For example, Alcatel, Nortel, and Ericsson typically spend 13 to 15 percent of their revenues on R&D whereas Qualcomm, a leading U.S. manufacturer of wireless telecommunications equipment and the developer of CDMA²⁹ technology, invested over 20 percent of its 1995 and 1996 revenues in R&D.³⁰ The large number of high tech

²² PCS is similar to cellular technology except that it divides a coverage region into many more cells, allowing for smaller and less expensive handsets than cellular technology. Although in the United States PCS is traditionally associated with a digital signal and cellular, an analog, this distinction is blurring with the addition of a digital network overlay in all major markets. EMC Publications, *World Cellular Market Report* (Kingston-upon-Thames: EMC Publications, 1996), pp. 9 and 12.

²³ USDOC, *U.S. Industry and Trade Outlook*, (New York: McGraw-Hill, 1998), p. 31-8.

²⁴ The communications industry as defined by SIC 366 is primarily composed of the telecommunications equipment covered in this paper although it also contains a number of additional products such as broadcasting and signaling equipment.

²⁵ U.S. Bureau of Labor Statistics, *Current Employment Statistics*, and USDOC, "MA36P and M3-1," (various issues), *Current Industrial Reports*.

²⁶ Industry representatives, interviews by USITC staff, Lynchburg, VA, June 24, 1997, and Plano, TX, May 12, 1997.

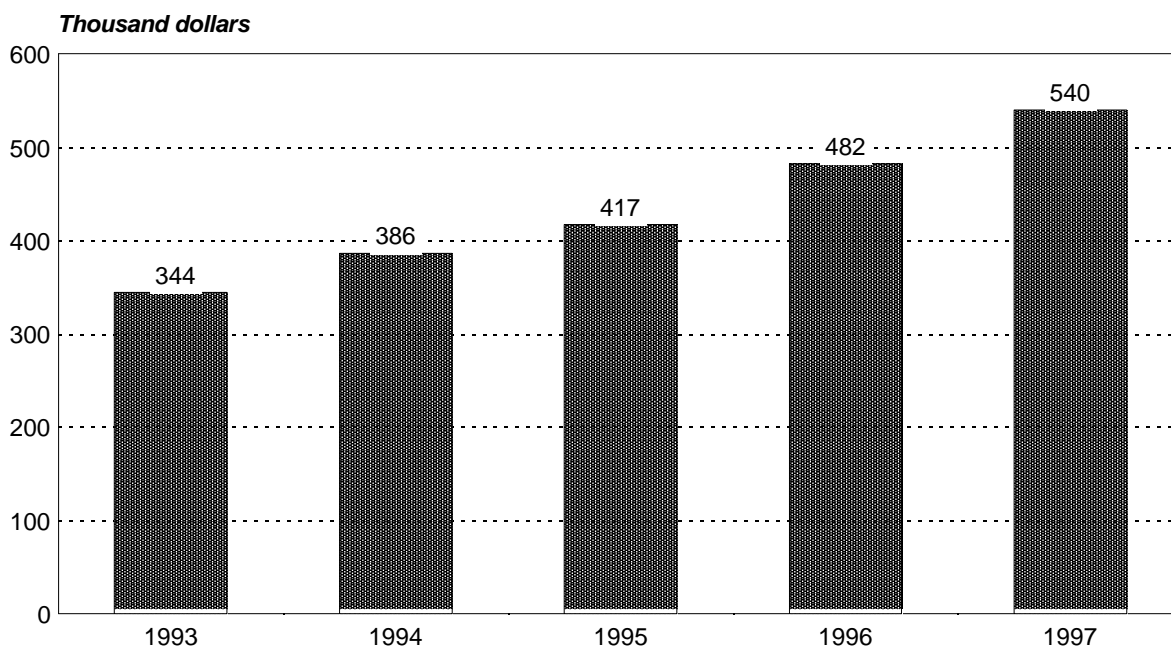
²⁷ Lucent and Motorola, 1997 Annual Reports.

²⁸ Information Technology Industry Council (ITIC), *Information Technology Industry Data Book 1960-2006* (Washington, DC: ITIC, 1996), pp. 10 and 15, and National Science Foundation (NSF), *Science and Engineering Indicators-1996* (Washington: NSF, 1996), Appendix A, p. 20.

²⁹ Code division multiple access (CDMA) is a type of digital cellular telephone technology.

³⁰ Industry representatives, interviews by USITC staff, Richardson, TX, Research Triangle Park, NC, and San Diego, CA, May 13 and Aug. 4, 1997.

Figure 2-2
Communications equipment: U.S. output per production worker in constant (1993) dollars



Source: U.S. Department of Commerce, *Current Industrial Report*, and Bureau of Labor Statistics, *Current Employment Statistics*, and *Producer Price Index*.

industries and top-ranked universities in the United States provide a rich source of R&D engineers and make the United States an attractive location for the production of leading-edge telecommunications equipment.³¹ During 1995, 980,000 scientists were engaged in R&D in the United States in all disciplines while the comparable figures for Japan, Germany, and France were 535,000, 255,000, and 145,000 respectively.³²

Although the revenues of most major telecommunications equipment producers continue to increase as the global market expands, greater competition has already begun to put downward pressure on prices and profitability. Motorola announced that it will lay off 15,000 employees during 1997-98 in an effort to regain its competitive status and, despite increased sales, Ericsson announced that it will eliminate 10,000 positions in 1998 because profitability has not been satisfactory.³³ Increased competition is also likely to force the industry to eliminate the large amount of surplus capacity in certain industry segments, such as central office switches.³⁴

Computer-telephony integration (CTI) has also had a major impact on the industry in recent years. CTI has been driven by the exploding popularity of the Internet and the growing number of services associated with it including long-distance telephone service and video-conferencing. U.S. companies such as Cisco, Bay Networks, and 3Com, which produce CTI-related equipment, have experienced very strong growth during recent years and have become global industry leaders. During 1993-97, the combined revenues for Cisco, 3Com, and Bay Networks grew from \$2.3 billion to \$11.7 billion,

³¹ Ibid.

³² ITIC, *Information Technology Industry Data Book 1960-2006*, p. 32.

³³ "Ericsson to Cut 10,000 Jobs," *CNN*, Dec. 3, 1997, found at http://cnnfn.com/hotstories/companies/wires/971203/ericsson_wg/, retrieved Dec. 3, 1997.

³⁴ USDOC, *U.S. Industry and Trade Outlook*, p. 31-6.

an average annual increase of 50 percent.³⁵ This rapid growth is likely to continue into the foreseeable future as new services emerge from this segment of the industry. Certain major telecommunications equipment companies have tried to reap the synergies associated with CTI by pairing with smaller companies that focus on computer networks. For example, Ericsson has formed joint ventures and strategic alliances with a number of U.S. companies including Intel, Texas Instruments, Tellabs, and Hewlett Packard; Cisco has partnered with Alcatel; and Siemens has formed a joint venture with Newbridge Networks.³⁶

The industry has also been characterized by a trend toward consolidation. This trend is being driven by many factors including price declines, surplus capacity, increasing competition, and the challenges of establishing universal market presence and providing one-stop shopping.³⁷ Major mergers in the industry between U.S. and foreign-based firms include Alcatel's (France) purchase of DSC and Nortel's (Canada) acquisition of Bay Networks. These transactions will increase Nortel's Internet product line and enhance Alcatel's capability as a supplier of digital switching equipment and business management systems while increasing the U.S.-market presence of both.³⁸ Other notable mergers and acquisitions have paired U.S.-based firms and are designed primarily to achieve dramatic growth and to dominate rapidly expanding markets. Cisco Systems has successfully implemented such a strategy and 3Com's purchase of U.S. Robotics was largely undertaken to maintain competitiveness in the data network market. Cisco has increased its revenues nearly 100 fold since 1990, largely through the acquisition of at least 25 companies.³⁹

Trade

Total U.S. trade in telecommunications equipment increased from \$13.4 billion to \$23.1 billion during 1993-97 in response to growing demand in the United States and each of its major markets. U.S. exports nearly doubled to \$13.1 billion during this period, an average annual increase of 19 percent while imports grew at a more modest annual average of 10 percent reaching \$10.1 billion. The rapid growth of exports produced a trade surplus in 1994 that steadily grew to \$3.0 billion in 1997.

Overall trade growth can be attributed largely to reductions in tariff and non-tariff barriers, to industry globalization which increases the number of cross-border shipments between parent companies and subsidiaries, and to the proliferation of strategic alliances between firms manufacturing in different countries. The trend toward globalization has affected the composition of traded products by increasing two-way trade in the same type of products, such as wireless equipment and modems. Globalization and strategic alliances have also encouraged trade in parts. Total U.S. trade in telecommunications equipment parts increased 66 percent, to \$5.3 billion, during 1993-97.

³⁵ "The Electronic Business Top 200," *Electronic Business*, July 1998, pp. 86-89.

³⁶ Industry representative, interview by USITC staff, Richardson Texas, May 12, 1997, and Eric J. Savitz, "Net Threat," *Barron's Online*, Oct. 13, 1997, found at <http://interactive.wsj.com>, retrieved Oct. 17, 1997.

³⁷ USDOC, *U.S. Industry and Trade Outlook*, p. 31-7.

³⁸ Melissa Poszgay, "Alcatel Buys DSC Communications in Latest Consolidation Move," *Communications International Reports*, June 4, 1998, found at <http://www.totaltele.com>, retrieved June 17, 1998.

³⁹ "Cisco Fact Sheet" and "Summary of Acquisitions," found at <http://cio.cisco.com/warp/public/750>, retrieved June 30, 1998.

The largest markets for U.S. telecommunications equipment exports, the EU, Canada, Mexico, and Japan, each grew significantly during 1993-97, although their aggregate share of U.S. sector exports decreased from 53 percent to 50 percent as demand for U.S. products in other markets outpaced growth in the four largest (figure 2-3). Exports to Canada and Mexico nearly doubled during this period, spurred by the North American Free Trade Agreement (NAFTA) and the Canada-United States Free-Trade Agreement (CFTA) tariff reductions. Exports to the EU and Japan increased by 73 and 64 percent, respectively, reflecting growing demand in both markets for high-technology equipment and the leading position held by U.S. producers in these industry segments.

Latin America has been one of the fastest growing regional markets for U.S. telecommunications products. U.S. exports to Latin America, excluding Mexico, increased by more than 250 percent, to \$2.0 billion during 1993-97, and exports to Brazil during this period increased by a factor of almost 6. The expansion of the Brazilian market has been driven largely by constitutional reforms that have encouraged major foreign and domestic investment in the telecommunications sector.⁴⁰ Other rapidly growing major markets include Israel and Hong Kong, which increased purchases of U.S. exports by almost 300 percent and 500 percent, respectively, during 1993-97.

U.S. telecommunications equipment exports consist primarily of high value-added equipment, of which the largest groups are parts, cellular telephones, transceivers, and modems, which together comprised 58 percent of the 1997 total. U.S. exports of parts increased from \$1.8 billion to \$2.8 billion during 1993-97, aided by the globalization of manufacturing facilities and increased outsourcing of parts from foreign producers. The rapid expansion of cellular networks in most countries has spurred an increase in U.S. exports of cellular telephones and transceivers from \$2.1 billion to \$4.9 billion during 1993-97.⁴¹ U.S. exports of modems steadily increased in value from \$443 million to \$1.1 billion during 1993-96 before decreasing in 1996-97 to \$1.0 billion. This downturn was the result of a 12- percent decrease in the price of modems that reduced the total value despite a 10 percent increase in volume.⁴²

U.S. import sources for telecommunications equipment have changed appreciably since 1993 (figure 2-4). Although Canada and Japan remain the two largest sources of imports, Canada's share of the U.S. total has far surpassed that of Japan, having increased from 13.4 percent in 1993 to 20.9 percent in 1997, while Japan's share fell from 34.1 percent to 16.2 percent. Canada's growing presence in the U.S. market can be attributed in part to the CFTA and to the increasing competitiveness of the Canadian industry following the reorganization of Nortel, Canada's dominant equipment producer. Nortel's reorganization increased productivity in recent years by consolidating its Canadian and U.S. facilities into a smaller number of larger, more specialized, and more efficient operations.⁴³ Specialization of production has contributed to increased trade between Canada and the U.S. because many components and subassemblies are manufactured in plants located in one country and shipped to the other country for final assembly.⁴⁴

⁴⁰ USDOC, International Trade Administration, National Trade Data Bank, "Brazil: Leading Sectors for U.S. Exports and Investments," Stat-USA Database, found at <http://www.stat-usa.gov/BEN>, retrieved June 2, 1998.

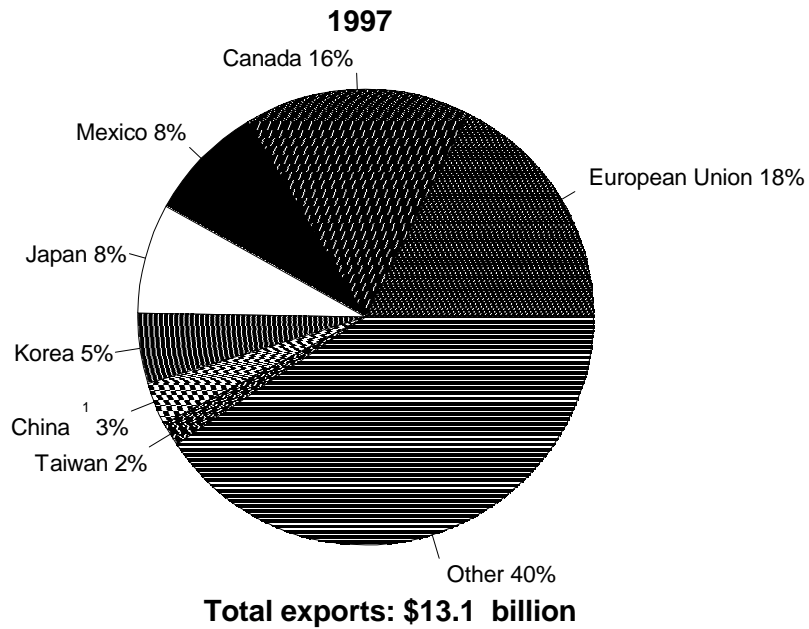
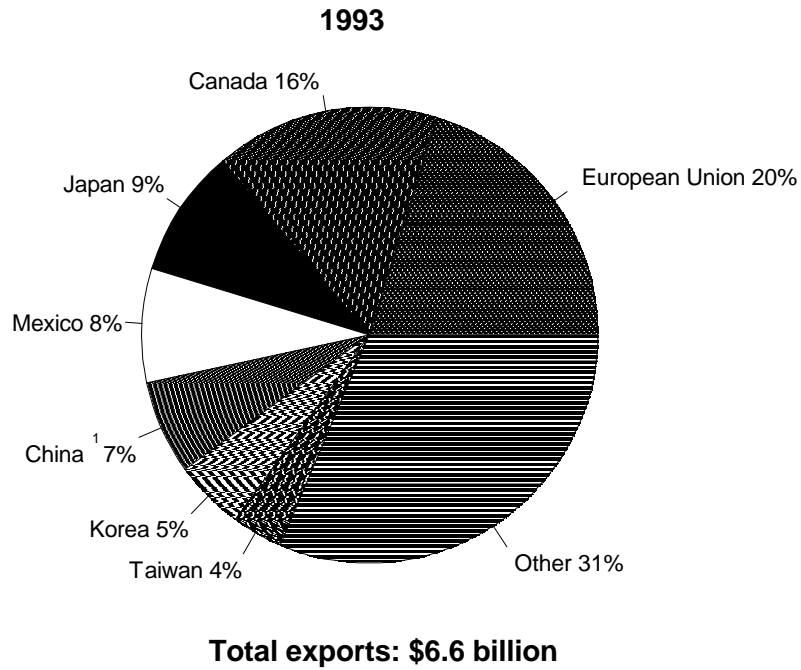
⁴¹ Prior to 1997, cellular telephones were grouped with certain transceivers in *Schedule B* of the Census Bureau's foreign trade statistics and were not broken out as a separate category. They have been included in the 1997 value for transceivers cited above in order to more accurately describe the trend in this product grouping.

⁴² The average unit value of modems has steadily decreased from \$282 to \$190 during 1993-97.

⁴³ Northern Telecom (Nortel), *The Anatomy of a Transformation*, 1996.

⁴⁴ Industry Canada, *Sector Competitiveness Framework: Telecommunications Equipment Industry* (Ottawa: Industry Canada, June 1997).

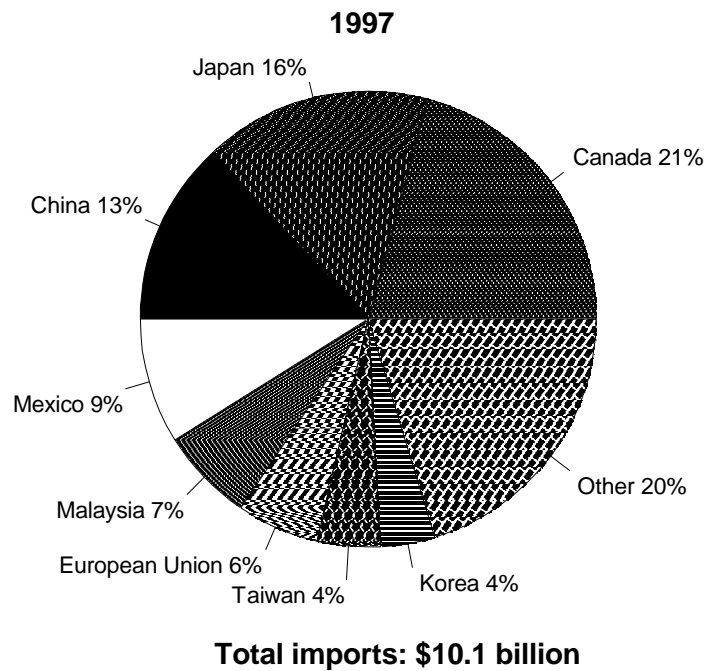
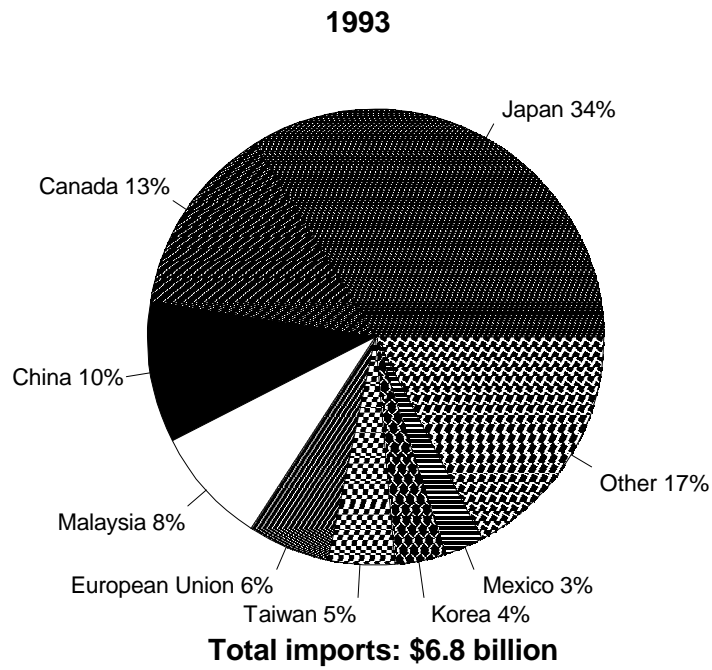
Figure 2-3
Telecommunications equipment: U.S. export markets, 1993 and 1997



¹ Does not include Hong Kong.

Source: Compiled by USITC staff, based on official statistics of the U.S. Department of Commerce.

Figure 2-4
Telecommunications equipment: U.S. imports, by principal source, 1993 and 1997



Source: Compiled by USITC staff, based on official statistics of the U.S. Department of Commerce.

Japan's loss of U.S. market share has resulted primarily from growing competition from other Asian producers and from the relocation of low-end telecommunications equipment production from Japan to lower wage Asian countries.⁴⁵ The steady appreciation of the yen during 1989-95 contributed to the offshore movement of manufacturing facilities for telecommunications equipment--particularly for facsimile machines. U.S. imports of facsimile machines from Japan dropped off sharply following this relocation. During 1993, Japan supplied 79 percent of U.S. facsimile machine imports which totaled \$1.1 billion while Malaysia and Thailand supplied 2 percent and 10 percent, respectively. In 1997, Japan's share of the \$845 million total dropped to 46 percent while that of Malaysia and Thailand increased to 24 percent and 16 percent, respectively.

Heavy investment in Chinese production facilities by every major telecommunication equipment manufacturer has made China one of the world's leading exporters of telecommunications equipment and significantly increased its share of U.S. imports during 1993-97. Although Malaysia's exports to the United States steadily grew during the period, its share of the expanding U.S. import total decreased slightly, in part because of greater competition from China and Mexico in low-end CPE such as telephone sets and answering machines. Mexico has substantially increased its importance as a foreign source of telecommunications equipment for the United States. U.S. imports from Mexico expanded from \$193 million to \$909 million during 1993-97 due to growing investment in production facilities by multinational telecommunications equipment producers such as Lucent, Ericsson, and Motorola.

Although the EU is the world's second largest producer of telecommunications equipment, it accounts for a relatively small share of U.S. imports, 5.7 percent in 1997. With a few exceptions, such as Ericsson and Nokia, the major EU-based producers have concentrated on sales in their home markets where they face less competition than they do in the United States. This is changing as home markets in the EU become less protected and more open to competition, forcing domestic firms to seek new markets more aggressively. Further, EU firms such as Ericsson, Alcatel, and Siemens have chosen to manufacture many of their higher value-added products such as cellular and switching equipment in the United States because many of these products require customization to specific customer requirements. This is especially true for products that are manufactured to standards not widely used in Europe. For example, most digital cellular equipment produced in the EU is based on the GSM standard which is incompatible with the TDMA and CDMA standards that are widely used in the United States.

U.S. imports are composed primarily of telephone sets, both corded and cordless; parts; radio transceivers; facsimile machines; and cellular telephones. Collectively, these products comprised 91 percent of U.S. telecommunications imports in 1997. U.S. imports of cordless and corded telephones increased from \$2.1 to \$2.9 billion during 1993-97 while parts for telephonic apparatus increased from \$808 million in 1993 to \$1.9 billion in 1997. Imports of radio equipment parts and radio transceivers have increased every year since 1993 each reaching \$1.2 billion in 1997. Facsimile machine imports fluctuated throughout the period, decreasing by 24 percent between 1993 and 1997 to \$811 million, while cellular telephone imports increased by 107 percent to \$1.0 billion in 1997 despite a slight decrease during 1995-96.

⁴⁵ Industry analyst, interview by USITC staff, New York, NY, Dec. 15, 1997.

Market

The United States is the world's largest market for telecommunications equipment. During 1993-97, the U.S. market expanded from \$36.4 billion to \$58.3 billion, an average annual rate of 12.5 percent (table 2-2). The market is characterized by rapidly changing technology, evolving industry standards, frequent new product introductions, and innovative methods of building and operating telecommunications systems for network and business operators.⁴⁶ Most of the telecommunications equipment consumed in the U.S. market is also produced in the United States; imports accounted for 17.0 to 19.5 percent of consumption during 1993-97.

Market growth is being driven by many factors including the increased demand for telephone lines; wireline network upgrades; the roll-out of new wireless infrastructure; and the conversion from analog to digital. Greater competition has accelerated this process by making telecommunications service providers more responsive to customer demands and more willing to risk new technologies in order to maintain market share. During 1992-96, the number of telephone lines per 100 inhabitants in the United States increased from 56.5 to 64.0, an increase of 26 million lines.⁴⁷ Much of this increase is attributable to the growing number of Internet users and telecommuters who have added second telephone lines.⁴⁸ The increased duration of telephone calls and greater bandwidth demands associated with the growing popularity of the Internet has put further strains on existing networks. The network was originally designed for voice calls that typically last three minutes or less while the average Internet connection exceeds 20 minutes.⁴⁹ Further, the vast amount of data transmission required by Internet users requires far greater precision than is necessary for voice telephony.⁵⁰ The conversion from analog to digital is also driving sales of wireline telecommunications equipment, such as central office switching and transmission equipment, which

Table 2-2
Telecommunications equipment: U.S. production, imports, exports, and apparent consumption, 1993-97

Year	Production	Imports	Exports	Apparent consumption	Ratio of imports to consumption
	-----Million dollars-----				Percent
1993	36,217	6,843	6,593	36,467	18.8
1994	42,323	8,191	8,432	42,082	19.5
1995	47,315	8,586	10,363	45,538	18.9
1996	54,984	9,031	10,852	53,163	17.0
1997	61,356	10,068	13,082	58,342	17.3

Source: Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, and official statistics of the U.S. Department of Commerce.

⁴⁶ Lucent Technologies, Form 10-K, 1996, pp. 10-11.

⁴⁷ International Telecommunications Union (ITU), *World Telecommunication Development Report* (Geneva: ITU, 1998), p. A-7, and ITU, *World Telecommunication Development Report* (Geneva: ITU, 1994), p. A-6.

⁴⁸ MultiMedia Telecommunications Association (MMTA), *1997 MultiMedia Telecommunications Market Review and Forecast* (Arlington, VA: MMTA, 1997), p 38.

⁴⁹ Kumar Shah, "The Internet/Intranet Opportunity for Local Carriers," *TeleTimes*, Vol. 12, No. 2, found at <http://www.usta.org/interopp.html>, retrieved Sep. 15, 1998.

⁵⁰ James Harry Green, *The Irwin Handbook of Telecommunications*, 3d ed. (Chicago: Irwin, 1997), p. 54.

increased in value by 56 percent to \$13.5 billion during 1993-97.⁵¹ These developments led the major U.S. public service providers to invest \$23.6 billion in 1996 in almost every type of network equipment.⁵²

Wireless equipment is the fastest growing sector of the U.S. telecommunications equipment market and the number of wireless subscribers in the United States more than tripled to 52 million during 1993-97.⁵³ Demand for cellular and Personal Communications Service (PCS) equipment has been driven by steadily declining prices, enhanced services, and steadily increasing coverage. Although U.S. production of wireless equipment continues to grow, the success of the largest U.S. producers in the market has been mixed. Lucent's share of the global wireless infrastructure market has nearly doubled in the last 2 years, reaching 13 percent, while that of Motorola has decreased from 18 percent to 14 percent.⁵⁴ Motorola has suffered even greater loss of market share in the wireless handset market where its share dropped from 34 percent to 21 percent.⁵⁵ A large part of this market was lost to producers from the EU, most notably Ericsson and Nokia.

The principal customers for telecommunications network systems and components are network operators that provide wireline and wireless local, long distance, and international telecommunications service.⁵⁶ There were more than 1,300 local exchange service providers and 600 long distance carriers in the United States during 1997,⁵⁷ although the 10 largest service providers account for the majority of telecommunications equipment purchases. The major suppliers of public telecommunications network systems to the U.S. market are Lucent, Nortel, NEC, DSC Communications, and Alcatel.⁵⁸ These companies along with Siemens and Ericsson also dominate the global market for network systems.⁵⁹

Traditional network suppliers such as Lucent and Nortel have a clear advantage over new competitors in much of this market because of their huge installed base of equipment. Lucent switches, for example, currently serve approximately 120 million of the 171 million lines in the United States.⁶⁰ This ensures future sales because upgrades and replacement equipment will generally be compatible with existing equipment. Although this advantage is still formidable, it is diminishing as new service providers enter the market and construct new networks and as established operators insist on open systems that are compatible with equipment from multiple vendors.

The market for low-end customer premises equipment (CPE) such as fax machines, telephone sets, and answering machines is more mature than the market for network equipment and is generally characterized by intense competition and declining prices, whereas much of the high-end CPE is rapidly evolving and is increasingly affected by innovations in computer technology. For example,

⁵¹ MMTA, *1998 MultiMedia Telecommunications Market Review and Forecast* (Arlington, VA: MMTA, 1998), p. 64, and MMTA, *1997 MultiMedia Telecommunications Market Review and Forecast*, p. 39.

⁵² ITU, *World Telecommunication Development Report* (1998), p. A-71.

⁵³ Donaldson, Lufkin, and Jenrette, *The Wireless Communications Industry* (New York: Donaldson, Lufkin, and Jenrette, Spring 1998 and Winter 1994-95).

⁵⁴ *Ibid.*

⁵⁵ *Ibid.*

⁵⁶ Lucent Technologies, Inc., 1997, Form 10-K, p. 7.

⁵⁷ Federal Communications Commission (FCC), *Statistics of Communications Common Carriers* (Washington, DC: 1997), p. vi.

⁵⁸ MMTA, *1997 MultiMedia Telecommunications Market Review and Forecast*, p. 61.

⁵⁹ Lucent Technologies, Inc., 1997, Form 10-K, p. 7.

⁶⁰ *Ibid.*, p. 3, and ITU, *World Telecommunication Development Report* (1998), p. A-11.

many PBX and key systems have changed from proprietary to open systems to meet the needs of customers who want to customize these systems and combine them with the rest of their communications equipment.⁶¹

Market prospects for the United States will largely be determined by the successful implementation of the 1996 Telecommunications Act. The 1996 Telecommunications Act (Act) represents the first time since the Communications Act of 1934 that legislation regarding the telecommunications industry has been significantly altered.⁶² Among other things, the Act permits the regional Bell operating companies to offer long distance service once they meet certain requirements designed to open the local exchange markets to competition. Although the Act removes major impediments to competition and will almost certainly have a positive impact on sales of telecommunications equipment, it is still too soon to reliably predict the size of the impact. Many telecommunications service providers have postponed major purchases until they can revise their business plans under the new regulatory environment and await answers to the many unresolved issues related to the Act.⁶³ However, increased competition in the long distance market and the possibility of greater competition in the local market are likely to continue to drive investment in telecommunications networks. In light of this, the International Telecommunications Union estimates that U.S. telecommunications service providers will invest an estimated \$51 billion during 1996-2000.⁶⁴

⁶¹ USDOC, *U.S. Industry and Trade Outlook*, p. 31-8.

⁶² There have been several important legal actions with major effects on the industry, most notably the consent decree agreed to by the Department of Justice and AT&T in 1982. MMTA, *1997 MultiMedia Telecommunications Market Review and Forecast*, p. 14.

⁶³ USDOC, *U.S. Industry and Trade Outlook*, p. 31-3.

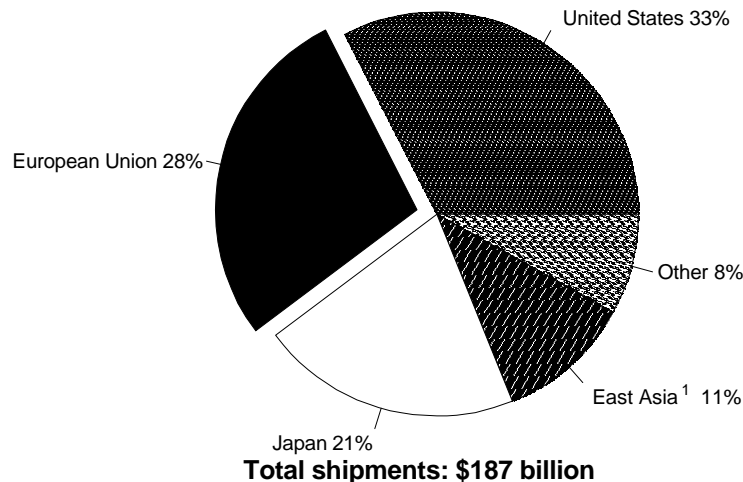
⁶⁴ ITU, *World Telecommunication Development Report* (1997), p. A-83.

CHAPTER 3

EUROPEAN UNION

The European Union (EU) is the second largest telecommunications equipment producer in the world (figure 3-1). In 1997, EU production amounted to almost \$52 billion, or 28 percent of total global production. France and Germany, the largest telecommunications equipment producers in the EU, together accounted for almost 44 percent of total EU production in 1997.⁶⁵ Other leading EU producers include the United Kingdom, Sweden, Italy, Finland, and Spain. Network transmission and switching equipment presently account for over one-half of EU production of telecommunications equipment,⁶⁶ and wireless communications, especially cellular communications, is the fastest growing sector. Less capital-intensive customer premises equipment (CPE), especially telephone and facsimile equipment, accounts for less than 20 percent of EU production. EU countries, similar to the United States, import much of their low-end CPE equipment from East Asia.

Figure 3-1
Telecommunications equipment: Shares of world production by the European Union and other major producers, 1997



¹ Includes China, Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand.

Source: Estimated by USITC staff based on Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, and Reed Electronics Research, *Yearbook of World Electronics Data* 1995, 1996, and 1997.

⁶⁵ Estimated by USITC staff based on official data of the European Union; Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 4th ed. (Surrey: Reed Business Information, 1997), pp. 14-27; European Association of Manufacturers of Business Machines and Information Technology Industry (EUROBIT), *European Information Technology Observer* (Frankfurt: EUROBIT, 1997), pp. 1-200; and EU industry representatives, telephone interviews by USITC staff, Nov. 12, 1997.

⁶⁶ EU industry representatives, telephone interviews by USITC staff, Nov. 12, 1997 and May 5, 1998.

Traditionally, the government-owned telecommunications service providers in a number of EU countries maintained preferential equipment procurement and supply relationships with a handful of local telecommunications equipment producers. However, recent EU efforts to create a competitive telecommunications service market have attracted increased investment by EU and foreign-based telecommunications service providers, including U.S.-based companies. This is likely to have positive implications for competitive EU and foreign producers of advanced technology telecommunications equipment in their sales to these service providers.⁶⁷ U.S.-based producers compete very well in the European Union, especially in higher technology segments of the market: the United States' share of EU imports increased from 22 percent in 1993 to 44 percent in 1997.⁶⁸

Industry Structure

The largest EU-based telecommunications equipment manufacturers are Alcatel⁶⁹ (France), Siemens (Germany), and Ericsson (Sweden), each accounting for over 20 percent of total EU production, and Nokia (Finland), which accounted for over 10 percent (table 3-1).⁷⁰ Other notable EU-based producers are Robert Bosch (Germany), Matra Nortel Communications (France),⁷¹ GPT (United Kingdom), and Italtel (Italy).⁷² Major U.S.-headquartered firms, such as Lucent Technologies and Motorola, also have production operations in the EU (table 3-2), including joint ventures with EU-based companies.⁷³ Other important foreign-based companies with a manufacturing presence in the EU include Northern Telecom (Canada) and NEC and Fujitsu (Japan).

Alcatel and Siemens are especially strong in markets for wireline transmission and public switching equipment while Ericsson and Nokia hold strong competitive positions in the fast-growing mobile communications sector. Historically, Siemens and Alcatel (and its predecessors⁷⁴) benefited from the national procurement policies of their primary customers, the government-owned telecommunications authorities, which were also the monopoly providers of services in their

⁶⁷ Cross-ownership of telecommunications service providers within the European Union is already widespread as dominant providers have been gearing up for competition. For instance, France Telecom owns 90 percent of Belgium's Mobistar and 35 percent of Greece's Panafon; STET of Italy owns 79 percent of Greece's Stet Hellas; Telenor of Norway owns 39 percent of Ireland's Digiphone; and Vodaphone of the United Kingdom owns 45 percent of Greece's Panafon.

⁶⁸ Based on official data of the European Union and Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*.

⁶⁹ Previously named Alcatel Alsthom SA, the French-based company was renamed Alcatel in 1998.

⁷⁰ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, p. 170.

⁷¹ Canadian-based Northern Telecom Ltd. (Nortel) owns 50 percent of Matra Nortel Communications.

⁷² Netherlands-based Philips significantly reduced its exposure in the telecommunications equipment sector in 1996 but still produces optical fiber and markets certain terminal equipment, much of which is imported from Southeast Asia and Mexico. *Communications Week International*, Nov. 25, 1996, and EU industry officials, telephone interviews by USITC staff, Dec. 16, 1997 and July 8, 1998.

⁷³ Other U.S.-based companies that manufacture telecommunications equipment in the EU include Harris and Hughes.

⁷⁴ Alcatel (previously named Alcatel Alsthom) resulted in 1988 from the merger of several French telecommunications equipment firms and their acquisition of the worldwide telecommunications equipment manufacturing operations of International Telephone and Telegraph Corporation (now ITT Corp.).

Table 3-1**Telecommunications equipment: Major producers in the European Union, selected products, and headquarter country**

Company name	Selected products	Headquarter country
Lucent	Wireline, wireless network and terminal equipment	United States
Motorola	Wireless network and terminal equipment	United States
Nokia	Wireless network and terminal equipment	Finland
Alcatel	Wireline, wireless network and terminal equipment	France
Matra Communication	Satellite, wireless, infrastructure and terminal equipment	France
Robert Bosch	Business premises equipment and wireless equipment	Germany
Siemens	Wireline, wireless network and terminal equipment	Germany
Italtel	Wireline, wireless network and terminal equipment	Italy
Philips	Terminal equipment	Netherlands
Ericsson	Wireline, wireless network and terminal equipment	Sweden
GPT	Wireline, wireless network and terminal equipment	United Kingdom
Northern Telecom (Nortel)	Wireline, wireless network and terminal equipment	Canada

Source: Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, company annual reports, and other sources.

Table 3-2**Telecommunications equipment: U.S.-headquartered producers in the European Union and selected products**

Company name	Selected products
Cisco	Network equipment
DSC ¹	Network equipment
Harris	Wireline and wireless network equipment
Hughes	Wireline, wireless, and satellite network and terminal equipment
IBM	Business premises equipment, and network equipment
Lucent Technologies	Wireline, wireless network and terminal equipment
Motorola	Wireless network and terminal equipment

¹ DSC was acquired by Alcatel in September 1998.

Source: Company annual reports.

respective countries.⁷⁵ This enabled them to establish strong installed-base positions in their home markets. However, the EU's efforts to create a competitive telecommunications market are expected to radically influence the structure of these relationships by creating significant opportunities for new suppliers of telecommunications equipment to the EU in the future.⁷⁶

The adoption of the European Commission's directive on full competition in March 1996 was an important event in the EU's liberalization efforts. Under this directive, all telecommunications services, including voice telephony, were opened to competition from both domestic and foreign suppliers on January 1, 1998, and new service providers were granted the right to build their own telecommunications infrastructure.⁷⁷ Telecommunications services other than voice telephony were liberalized in July 1996. The EU's liberalization efforts are expected to significantly modify the present structure of the industry and market by increasing the number of competing service providers, thus providing new customers for telecommunications equipment producers.⁷⁸ Liberalization also will encourage the traditional telecommunications services operators to increase their sources of supply for telecommunications equipment by pressuring them to upgrade present capabilities and add new services to meet consumer demand in the more competitive marketplace.⁷⁹ This will be especially beneficial for U.S. telecommunications equipment suppliers, which are globally recognized for incorporating advanced technologies and innovative solutions.⁸⁰

The prospect of increased competition in the EU telecommunications market has already caused many EU producers to restructure and significantly reduce employment in the EU telecommunications equipment sector. The total workforce in the EU has fallen steadily over the past decade to an estimated 230,000 in 1997, which represents a decrease of 8 percent since 1992, and 36 percent since 1980.⁸¹ Much of the employment loss results from the improved productivity of major EU-based telecommunications equipment firms driven, in part, by increased foreign and domestic competition in their home markets.⁸² The transfer of manufacturing and assembly operations for more labor-intensive, low-end CPE equipment to lower wage East Asian countries

⁷⁵ Annemarie Roobeek and Jeroen Broeders, "Telecommunications: Global Restructuring at Full Speed," in *The Structure of European Industry*, ed. H. W. de Jong (Dordrecht: Lluwer Academic Publishers, 1993), pp. 273-306, and EU industry representatives, telephone interviews by USITC staff, Nov. 12, 1997.

⁷⁶ *Ibid.*, and telecommunications equipment analyst, Deutsche Morgan Grenfell, interview by USITC staff, Sept. 25, 1997.

⁷⁷ EC Commission Directive of February 28, 1996, amending Commission Directive 90/388/EC regarding the implementation of full competition in telecommunications markets (96/19/EC, OJ L 74/13, 22.03.1996), and Commission Directive of 16 January 1996 amending Directive 90/388/EC with regard to mobile and personal communications (96/2/EC; OJ L 20/59, 26.01.1996).

⁷⁸ U.S. and EU telecommunications industry representatives, telephone interviews by USITC staff, Nov. 4-7, 1997 and July 8, 1998, and investment analysts, interview by USITC staff, New York, NY, Sept. 25, 1997.

⁷⁹ *Ibid.*

⁸⁰ *Ibid.*

⁸¹ Roobeek and Broeders, "Telecommunications: Global Restructuring at Full Speed," pp. 273-306; EU industry representatives, telephone interviews by USITC staff, Nov. 12, 1997; European Commission, *Panorama of EU Industry 1995-96* (Luxembourg: Office of Official Publications of the European Communities, 1995), pp. 10-25; EUROBIT, *European Information Technology Observer*, p. 1; and European Commission officials, telephone interview by USITC staff, Nov. 12, 1997 and July 7, 1998.

⁸² *Ibid.*

has also reduced employment in the industry. This trend allows EU firms to concentrate on corecompetencies in higher value technologies and equipment.⁸³

Alcatel and Siemens compete fiercely with U.S.-based Lucent Technologies for worldwide market share of both wireless and wireline network equipment.⁸⁴ Each holds about 9 percent of the global market for network equipment.⁸⁵ Alcatel and Siemens have a large installed base of equipment in the EU, particularly in France and Germany, the largest EU markets. This provides the two EU manufacturers with a distinct advantage over competing suppliers for sales of telecommunications technology and equipment to major network service providers, such as France Telecom and Deutsche Telekom, in the upgrade of previously installed network systems. However, according to some analysts, Lucent experiences a global competitive advantage over EU producers of network telecommunications equipment in leading-edge technology.⁸⁶ It also has a comprehensive product portfolio that is capable of performing to a variety of standards.⁸⁷ This enhances the firm's ability to provide systems solutions and integrate network designs across disparate technology platforms, including wireless and wireline systems.⁸⁸ In Europe, only Ericsson comes close to duplicating the breadth of Lucent's capabilities.⁸⁹ Alcatel and Siemens lacked the range of wireless infrastructure systems and installed base to be considered in the same category as Lucent and Ericsson during 1993-97. However, in 1998, Alcatel announced an agreement to buy U.S.-based DSC Communications Corp. to broaden Alcatel's product line while increasing its share of the U.S. telecommunications equipment market.⁹⁰

Ericsson and Nokia, with relatively small home markets, receive a larger share of their total revenues from overseas sales than other major EU companies. These two companies, along with U.S.-based Motorola, specialize in mobile equipment and have consequently benefited from the global boom in cellular communications to a greater extent than Alcatel and Siemens, whose primary focus until recently has been on the much slower growing EU wireline markets for transmission and switching equipment.⁹¹ Ericsson is particularly strong in both wireless infrastructure and terminal equipment. Meanwhile, Nokia continues to strengthen its position as a premier wireless handset supplier with a product mix that is predominantly digital, and appears to be gaining global market share at the expense of smaller competitors in Asia.⁹²

⁸³ EU industry representatives, telephone interviews by USITC staff, Nov. 4-7, 1997 and July 8, 1998.

⁸⁴ U.S. and EU telecommunications industry representatives, telephone interviews by USITC staff, Nov. 4-7, 1997 and July 8, 1998; and investment analysts, interview by USITC staff, New York, NY, Sept. 25, 1997.

⁸⁵ James P. Parmelee, "Lucent Technologies Opportunities Appear Limitless," *Deutsche Morgan Grenfell Report*, Dec. 10, 1997, pp. 6-7.

⁸⁶ U.S. telecommunications analysts, interview by USITC staff, New York, NY, Sept. 25, 1997.

⁸⁷ *Ibid.*

⁸⁸ Parmelee, "Lucent Technologies Opportunities Appear Limitless," pp. 6-7.

⁸⁹ EU industry representatives, telephone interviews by USITC staff, Nov. 4-7, 1997 and July 8, 1998.

⁹⁰ Melissa Pozsgay, "Alcatel Buys DSC Communications in Latest Consolidation Move," *Bloomberg News*, June 4, 1998, found at <http://wwwtotaltele.com/>, retrieved June 4, 1998.

⁹¹ EU industry representatives, telephone interviews by USITC staff, Nov. 4-7, 1997 and July 8, 1998, and Marc A. Cabi, "Ericsson," *Deutsche Morgan Grenfell Report*, Aug. 1997, pp. 1-4.

⁹² Marc A. Cabi and Anthony R. Chiasson, "Nokia: Solid Margin Expansion Drives Q2 EPS Strength," *Deutsche Morgan Grenfell: U.S. Equity Research*, Aug. 7, 1997, pp. 2-3.

EU manufacturers Ericsson and Nokia gained a competitive edge in the cellular market when the European Telecommunication Standards Institute (ETSI) created the Global System for Mobile

Communication (GSM) technology as the European-wide cellular standard.⁹³ ETSI's early adoption of digital mobile standards drove the rapid growth of GSM in Europe, and benefited European manufacturers who could achieve economies of scale in their home market.⁹⁴ Conversely, the United States was late to adopt digital standards, and its "laissez faire" approach led to a mix of incompatible digital standards.⁹⁵ This put some U.S. producers of digital handset cellular equipment at a disadvantage in foreign markets, because they lacked a large, homogenous home market base.⁹⁶ The EU digital-cellular market is now valued at roughly \$15 billion.⁹⁷ The cellular terminal market in the EU is dominated by Nokia and Ericsson. Other important suppliers to the EU in the cellular terminal market include Netherlands-based Philips, and the Japanese companies, Sony, Panasonic, and Pioneer.

The huge expenditures associated with research and development (R&D) and the acquisition of new technologies have altered the structure of the EU telecommunications industry by increasing the number of strategic mergers and acquisitions. Such strategic restructuring provides companies with rapid access to new technological skills, thus allowing an early market presence.⁹⁸ R&D expenditure among the leading EU network equipment producers has ranged from 10-15 percent of total revenues over the past several years.⁹⁹ These expenditures have become increasingly burdensome for EU producers as the cost of R&D continues to grow for each new product generation and the time span between product development and obsolescence continues to diminish.¹⁰⁰ Certain government programs have attempted to address this problem for EU-headquartered manufacturers by supporting collaborative R&D for the development of new telecommunications equipment and technologies, but these appear to have had little effect on the industry so far.¹⁰¹ However, EU companies are also increasingly investing in joint-ventures with U.S. and Japanese companies to gain access to new technologies, share research costs, and increase their competitiveness. For instance, in 1997, Alcatel established an alliance with Cisco Systems, Inc., based in San Jose, to increase its exposure in the fast growing networking market.¹⁰²

⁹³ The GSM standard was the first major pan-European mobile communications project. Introduced in eighteen European countries, it has created a single market with over 300 million potential customers. Early players in the development of GSM included the major European companies Ericsson, Nokia, Alcatel, and Philips, but many other manufacturers offered GSM mobiles and hand portables. Gautam Naiik, "Once Again, U.S. Trails Europe in Cellphone," *Wall Street Journal*, Oct. 1, 1997, p. A15.

⁹⁴ International Telecommunications Union (ITU), *World Telecommunication Development Report, 1997* (Geneva: ITU, 1997), p. 18.

⁹⁵ Investment analysts, in-person and telephone interviews by USITC staff, New York, NY, Sept. 25, 1997 and July 9, 1998.

⁹⁶ Ibid.

⁹⁷ Ibid., and ITU, *World Telecommunication Development Report (1997)*, p. 18.

⁹⁸ Investment analysts, in-person and telephone interviews by USITC staff, New York, NY, Sept. 25, 1997 and July 9, 1998.

⁹⁹ This is roughly equivalent to the corporate R&D expenditures of competitors in the United States and Japan. EU industry representatives, telephone interviews by USITC staff, Nov. 4-7, 1997, company annual reports, and other sources.

¹⁰⁰ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, pp. 14-27.

¹⁰¹ For example, the EU Framework for Research and Development Program is investing over \$2 billion on information technologies over the next 5 years. EU official, telephone interview by USITC staff, Nov. 7, 1997.

¹⁰² Telecommunications industry analyst, telephone interviews by USITC staff, July 21-23, 1998.

The opening of European telecommunications service markets to competition is providing opportunities for U.S. and other foreign firms to increase sales in the EU through both investment in European manufacturing operations and through exports. In a number of instances, labor-intensive operations have been located in southern Europe where the EU's labor and startup costs tend to be lowest.¹⁰³ Although separate data do not exist for the telecommunications equipment sector alone, estimated sales by European affiliates of U.S.-based audio, video, and communications equipment firms exceeded \$3 billion in 1993.¹⁰⁴ Affiliates in the Netherlands, Germany, the United Kingdom, and France accounted for the largest portions of such sales. European affiliates of U.S. firms also accounted for a significant portion of U.S. exports to Europe. Estimated U.S. exports shipped to affiliates of U.S.-headquartered audio, video, and communications equipment firms in Europe amounted to over \$500 million in 1993.¹⁰⁵ Germany and the United Kingdom accounted for the largest portion of that total.

EU production of telecommunications equipment increased at an average annual rate of 11 percent, to \$52 billion, during 1993-1997, although it increased by just 5 percent from 1996 to 1997 (table 3-3).¹⁰⁶ Apparent consumption grew at the same average annual rate as production since both exports and imports approximately doubled during this period.¹⁰⁷ Accelerating growth in demand for wireless systems, data communications, and higher end terminal (such as key systems) and PBX equipment spurred increased shipments in the period as telecommunications service providers prepared for competition in 1998.

Table 3-3
Telecommunications equipment: European Union production, imports, exports, and apparent consumption, 1993-97

Year	Production	Imports	Exports	Apparent consumption	Ratio of imports to consumption
-----Million dollars-----					Percent
1993	34,566	5,160	8,007	31,719	16.3
1994	39,470	6,539	10,881	35,128	18.6
1995	45,014	6,715	11,857	39,872	16.8
1996	49,425	7,853	13,616	43,662	18.0
1997	51,830	8,304	15,727	44,407	18.7

Source: Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, official data of the European Union, and USITC staff estimates.

¹⁰³ U.S. industry representatives, telephone interviews by USITC staff, Oct. 14, 1997.

¹⁰⁴ USDOC, Bureau of Economic Analysis, *U.S. Direct Investment Abroad, Operations of U.S. Parent Companies and Their Foreign Affiliates, Preliminary 1993 Estimates* (Washington, DC: GPO, 1997), Table II.E 4.

¹⁰⁵ *Ibid.*, Table II.H 6.

¹⁰⁶ USDOC, *U.S. Industry and Trade Outlook 1998* (New York: McGraw-Hill, 1997), pp. 31-1 to 31-33.

¹⁰⁷ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, pp. 14-24 to 14-29.

Trade

Liberalization of telecommunications equipment markets in Asia and Latin America and the adoption of the European GSM standard for mobile telephony by over 130 foreign telecommunications services operators have enabled EU equipment producers to complement sales in their own domestic markets with increased trade opportunities.¹⁰⁸ During 1993-97, EU exports of telecommunications equipment increased at an average annual rate of 18 percent to \$16 billion in 1997 (table 3-3), making the EU the world's largest exporter accounting for almost one-half of total world exports.¹⁰⁹ Meanwhile, EU imports rose by an average rate of nearly 13 percent to over \$8 billion, resulting in a EU trade surplus of \$7.4 billion in 1997. The EU has maintained a trade surplus in this sector throughout the period.

Asia was the leading supplier of imports to the EU on a regional basis with 28 percent of the total followed by North America with 24 percent.¹¹⁰ EU imports of telecommunications equipment from the United States increased at an average annual rate of 34 percent to \$3.6 billion (table 3-4). Recent trade patterns show that, while the EU is in the process of balancing its trade with Asia,¹¹¹ its trade deficit with North America, particularly the United States and Canada, is persisting. The EU's trade surplus in sector equipment results largely from developing-country export markets in eastern Europe, Asia, and Latin America. Despite the recent currency difficulties of emerging East Asian economies such as Thailand, Malaysia, and Indonesia, industry analysts do not believe that the long-term trends of EU-Asia trade will significantly change.¹¹²

Table 3-4
Telecommunications equipment: European Union's trade with the United States, 1993-97

Year	Imports from the United States	Exports to the United States	U.S. share of European Union imports	U.S. import share of apparent consumption
	-----Million dollars-----		-----Percent-----	
1993	1,133	334	22.0	3.6
1994	1,567	388	24.0	4.5
1995	2,601	629	38.7	6.5
1996	3,384	811	43.1	7.8
1997	3,623	996	43.6	8.2

Source: Estimated by USITC staff based on official data of the European Union.

Imports represented almost 19 percent of EU telecommunications equipment consumption in 1997 (table 3-3). The United States was an important source of these imports, accounting for 44 percent of the total, and over 8 percent of total EU consumption (table 3-4). Imports from the United States included advanced digital wireline transmission and switching technology, wireless infrastructure and terminal equipment, and satellite communications equipment. Japan and East Asia were other

¹⁰⁸ Ibid., pp. 14-25.

¹⁰⁹ ITU, *World Telecommunication Development Report* (1997), p. 16.

¹¹⁰ USDOC, *U.S. Industry and Trade Outlook 1998*, pp. 31-1 to 31-33.

¹¹¹ Ibid.

¹¹² EU industry representatives and investment analysts, telephone interviews by USITC staff, July 8-10, 1998.

important sources of imports for the EU, accounting for approximately 15 percent, and 13 percent of EU imports, respectively.¹¹³ Although Japanese producers supplied some network transmission and switching equipment, including fiber optic transmission equipment, much of the equipment imported into the EU from Japan and other East Asian countries consisted of facsimile machines, telephone sets, including cellular handsets, and other terminal equipment.

Until recently, EU tariffs on telecommunications equipment were significant barriers to trade. The final Uruguay Round bound rates of duty for the EU for telecommunications equipment range from zero to 6 percent ad valorem for wireline equipment to 6.5 percent ad valorem for wireless network and terminal equipment. EU tariffs on telecommunications equipment will be eliminated under the Information Technology Agreement.

Asia, led by China and Japan, is the largest regional destination for EU exports of telecommunications equipment, accounting for one-quarter of the total.¹¹⁴ The United States absorbed over 6 percent of EU exports in 1997.¹¹⁵ The fastest growing markets for EU exports are Eastern Europe, which has increased its share of EU exports from less than 2 percent of the total in 1989 to over 12 percent in 1997, and Latin America, where market opportunities are beginning to expand. EU exporters are particularly attracted to the market potential for telecommunications equipment in Central and Eastern Europe and the Newly Independent States. Governments in these areas view their poorly developed telecommunications systems as obstacles to economic growth and development and have targeted them for increased investment and upgrading.¹¹⁶ Because French, German, and other western European producers were traditionally the primary suppliers of telecommunications equipment to the countries of Central and Eastern Europe, those producers now benefit from their substantial installed base in those regions. There is also a strong demand for cellular equipment in Central and Eastern Europe, which plays to a major strength of the EU telecommunications equipment industry. The Telecommunications Research Center in the United Kingdom characterizes the eastern European market as a potential rival to the EU and Asia predict they will be the largest in the world by the year 2000.¹¹⁷ This is of particular interest to the EU telecommunications equipment industry, since its most important regional export market, Asia, is currently undergoing a financial crisis, which could reduce future purchases of telecommunications equipment.

Trade Agreements and Nontariff Barriers

U.S. companies have long alleged that procurement policies and standards and testing regulations in the EU are discriminatory. The procurement policies of the telecommunications service providers

¹¹³ Estimated by USITC staff, based on Reed Electronics Research, *A Profile of the Worldwide Telecommunications Industry*, and EC Commission, *Panorama of EU Industry 1995/96*, p. 10-26.

¹¹⁴ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, pp. 14-26, and USITC staff estimates based on official data of the USDOC and the European Union.

¹¹⁵ *Ibid.*

¹¹⁶ USDOC, *U.S. Industry and Trade Outlook 1998*, pp. 31-1 to 31-33.

¹¹⁷ Many eastern and central European countries have set goals to reach EU teledensity levels by early in the next century, and some, such as Poland, Hungary, and the Czech Republic are making significant progress toward that goal. USDOC, *U.S. Industry and Trade Outlook 1998*, pp. 31-1 to 31-33.

allegedly have favored domestic national suppliers in their purchases of network equipment,¹¹⁸ while telecommunications type approval requirements,¹¹⁹ electromagnetic compatibility (EMC) standards,¹²⁰ and electrical safety requirements by some EU countries allegedly have violated the WTO Agreement on Technical Barriers to Trade.¹²¹ U.S. companies also have asserted that these countries impose duplicative and burdensome certification, testing, and conformity assessment procedures on non-EU suppliers of telecommunications equipment to protect favored domestic suppliers.¹²²

The United States has recently concluded agreements with Germany and the EU to resolve disagreements related to procurement and standards-related measures. On October 1, 1996, Acting USTR Barshefsky announced that agreement had been reached with Germany to reform its procurement system, which had been cited under Title VII of the Omnibus Trade and Competitiveness Act of 1988 for its failure to implement its telecommunications equipment procurement obligations under the GATT.¹²³ The United States and the European Union signed a Mutual Recognition Agreement (MRA) on June 13, 1997, covering six sectors, including telecommunications equipment.¹²⁴ Under each agreement, U.S. and EU standards organizations will be permitted to test and certify products for one another's market to eliminate duplicative testing.¹²⁵ U.S. trade officials estimate that the six agreements will save U.S. manufacturers more than \$1 billion a year, mostly in telecommunications equipment trade, and will also sharply reduce the

¹¹⁸ Office of the United States Trade Representatives (USTR), *1997 Trade Policy Agenda and 1996 Annual Report*, pp. 186-187.

¹¹⁹ In most EU markets, all telecommunications equipment to be connected to the public switched telephone network is required to go through a type approval process before it can be sold and installed.

¹²⁰ In 1989, the EC Commission issued an EMC directive which was implemented into national laws in the early 1990s. Despite a five-year phase-in period, laboratories able to test conformance with this standard are reportedly booked for months in advance in some important markets, such as Germany.

¹²¹ Telecommunications Industry Association (TIA) representative, interview by USITC staff, Washington, DC, Sept. 10, 1997; and Oct. 17, 1998.

¹²² *Ibid.*

¹²³ Under Title VII of the Omnibus Trade and Competitiveness Act of 1988, USTR annually reviewed compliance by foreign governments with the Government Procurement Code, to identify countries whose government procurement discriminates against U.S. goods and services. Pursuant to Section 7004 of this Act, Title VII expired on April 30, 1996. Prior to its expiration, Title VII trade sanctions were imposed for the first time by the Clinton Administration against the EU for discriminatory government procurement practices in the telecommunications sector. These sanctions remain in place. USTR, "Monitoring and Enforcing Trade Laws and Agreements," *Fact Sheet*, Sept. 30, 1997, pp. 6-7.

¹²⁴ Although U.S. and EU officials initialed the MRA on June 13, 1997, the MRA was not officially signed until May 12, 1998. The telecommunications annex to the U.S.-EU MRA includes any product intended for connection to the public telecommunications network in order to send, process, or receive information, including analog and digital equipment using wired connection (telephones or modems) or radio connection (mobile phones), as well as satellite terminal equipment and radio transmitters. Two additional sections of the MRA, covering electromagnetic compatibility and electrical safety, would also affect telecommunications equipment trade between the United States and the EU. Information Technology Industry Council (ITI), "US-European Union Mutual Recognition Agreements (MRAs)," *ITI Public Policy Documents*, June 13, 1997, and USTR, *Mutual Recognition Fact Sheet*, June 20, 1997.

¹²⁵ For further information on the MRA, including transition periods, see *Agreement on Mutual Recognition Between the United States of America and the European Union*, found on at <http://www.ustr.gov/agreements/mra/mra1.pdf>.

time required to get products to market.¹²⁷ The agreement was supported by a broad spectrum of the U.S. telecommunications equipment industry.¹²⁸

Market

The major consumers of telecommunications equipment in the EU, as indicated previously, are a heavily concentrated group of network providers, the formerly government-owned national telecommunications service monopolies. Most of these telecommunications service operators are either in the process of privatization, or, in the case of the United Kingdom, have already completed privatization. In 1996, five European firms were among the 15 largest operators in the world: Deutsche Telekom (Germany), France Telecom, British Telecom, Telecom Italia, and Telefonica (Spain).¹²⁹ The top 10 public telecommunications operators in the EU accounted for almost 80 percent of EU services revenues in 1996.¹³⁰

Change in the telecommunications service sector is slowly taking place as the traditional operators are themselves vigorously expanding into new activities to meet growing competition from new entrants with the opening of EU telecommunications markets to competition on January 1, 1998. New operators have been established in several EU markets, including Mercury and Vodaphone in the United Kingdom. Further, alternative telecommunications service operators are rapidly emerging in France, Germany, and several other EU countries from the energy and transportation sectors that already own relatively extensive private communications systems and rights of way.¹³¹ These alternative network operators promise to be an important source of renewed growth for EU network equipment suppliers. More recently, new customers for telecommunications equipment in the EU have included less regulated providers of value-added services, consisting of a large number of companies, mainly in mobile communications, data transmission, and information technology.

During 1993-97, EU apparent consumption of telecommunications equipment increased at an average annual rate of 9 percent to \$44 billion (table 3-3). The steady growth in consumption during the period was due primarily to modernization of existing infrastructure in the southern part of the EU and rapid expansion of new network operators in larger member states, such as Germany and France, in preparation for EU telecommunications liberalization in 1998.¹³² Growth in consumption of telecommunications equipment during the period was highest in the wireless and data communications sectors while apparent consumption of network equipment actually declined in the more mature wireline sector of the market.¹³³

Some EU industry representatives have expressed concern that the portion of EU apparent consumption of telecommunications equipment accounted for by imports has increased from

¹²⁷ ITU, "US-European Union MRAs;" and USTR, *Mutual Recognition Fact Sheet*.

¹²⁸ TIA representative, interview by USITC staff, Washington DC, Sept. 10, 1997.

¹²⁹ ITU, *World Telecommunication Development Report (1997)*, p. A-84.

¹³⁰ *Ibid.*

¹³¹ Herbert Ungerer, "Liberalization of International Infrastructure and Services. The Perspective of EU Competition Policy," presentation at International Telecoms Pricing and Facilities Conference, London, Oct. 3, 1996.

¹³² USDOC, *U.S. Industry and Trade Outlook 1998*, pp. 31-1 to 31-33.

¹³³ *Ibid.*

16 percent in 1993 to almost 19 percent in 1997 (table 3-3).¹³⁴ However, as previously indicated, some of the growth in import penetration is due to increased sales in the EU of lower-end terminal equipment such as facsimile machines, telephone sets, and other terminal equipment from East Asian countries. Meanwhile, EU firms are concentrating on more advanced network wireless and wireline equipment.¹³⁵ However, the U.S. import share of EU apparent consumption has increased steadily throughout the period, reaching 8.2 percent during 1997. This has occurred as EU imports of U.S.-manufactured network transmission and switching equipment in both the wireline and wireless segments are increasing, which is of much concern to the EU industry, which competes in these same sectors.¹³⁶ EU imports of U.S. telecommunications equipment as a share of both total sector imports and apparent consumption both rose in 1997 (table 3-4) .

Liberalization of the EU's telecommunications service markets is expected to reinvigorate EU demand for central office switches, particularly for voice trunking, as well as newer advanced transmission and switching technologies, such as ATM core switch deployment.¹³⁷ New entrants to the market, such as electric power companies, which already have established internal communications networks along their own rights-of-way, would like to enter the voice services market and build and use Asynchronous Transfer Mode (ATM) infrastructure to connect their commercial customers.¹³⁸ Traditional telecommunications service providers facing increased competition are accelerating the modernization of their infrastructures to achieve productivity gains and thus improve competitiveness. Such improvements in the infrastructure also could restore growth to the network equipment market. Fiber optic systems will be increasingly implemented in large network backbones, cable television, and the Internet in the near to mid-term future, according to many experts.¹³⁹

Since penetration of basic telecommunications services in the EU is relatively high,¹⁴⁰ the main emphasis of European telecommunications service providers will be on establishing or enhancing a broadband integrated high-speed digital network to facilitate data, voice, and video communications in both the cellular and data communications markets.¹⁴¹ This will increase the demand for high-technology equipment. Because U.S. suppliers have a comparative advantage in the most advanced high-technology equipment sectors compared to their EU and Japanese rivals, they will be well positioned to capitalize on these developments in the EU markets.¹⁴²

In the wireline network equipment market, video, multimedia applications and services, online services, and the Internet are increasing demand for infrastructure upgrades.¹⁴³ This has, in turn, increased pressure on operators to increase bandwidth. Consequently, demand is growing for the following equipment:

¹³⁴ EU industry representatives and investment analysts, telephone interviews by USITC staff, July 8-10, 1998.

¹³⁵ Ibid.

¹³⁶ Ibid.

¹³⁷ Ibid.

¹³⁸ Ibid.

¹³⁹ Ibid.

¹⁴⁰ MultiMedia Telecommunications Association (MMTA), *1997 MultiMedia Telecommunications Market Review and Forecast* (Arlington, VA: MMTA, 1997), pp. 158-159.

¹⁴¹ Ibid.

¹⁴² U.S., European, and Japanese industry representatives, telephone interviews by USITC staff, Feb. 14, 1997, and U.S. telecommunications equipment industry investment analysts, interviews by USITC staff, New York, NY, Sept. 25, 1997.

¹⁴³ EUROBIT, *European Information Technology Observatory 1997*, pp. 42-45.

- digital switches that support multiple media for voice, wireless, and data;
- intelligent networking technology that alleviates congestion from online service and Internet usage;
- remote access applications and surveillance applications using ISDN; and
- new generation public ATM switches equipped to handle switched virtual circuits, enabling more enhanced services from public networks.¹⁴⁴

The mobile telecommunications infrastructure market experienced double digit growth in 1997 and is expected to continue expanding in the foreseeable future. Enhancements and extensions of existing GSM networks are driving strong growth in the demand for base stations and have compensated for the declining analog cellular infrastructure business. Finally, increased mobility requirements both within and outside the office environment are creating a need for better communications with remote workers, boosting demand for remote access.

Although the GSM cellular market has been dominated by EU-based manufacturers, U.S.-based Lucent is developing a next-generation GSM base station based on technology it acquired in 1996. Analysts believe the product will substantially boost Lucent's competitiveness in the GSM market.¹⁴⁵ The introduction of Lucent's new GSM base station could also enhance the company's position with emerging wireless carriers in the EU market.

The EU already benefits from a well developed infrastructure. Nevertheless, several trends suggest there will be an expansion in future market demand for telecommunications equipment, including equipment supplied by U.S. and other foreign producers.¹⁴⁶ First, as an increasing number of EU countries liberalize their telecommunications service markets, opportunities for foreign suppliers should increase as new service providers enter the market and traditional service providers attempt to increase and upgrade their service offerings to meet the new competition. Second, the market for mobile telecommunications is continuing to expand across the EU and this growth is expected to continue to grow in the future, particularly in the areas of personal communications services. Finally, telecommunications service providers require increasing broadband capabilities to meet increasing business and consumer demand for multimedia and intelligent services that allow increased customer control over service selection. This, in turn, will provide growing opportunities for networking and other information technology products, an area where U.S. companies have a competitive advantage.

¹⁴⁴ Ibid.

¹⁴⁵ Parmelee, "Lucent Technologies Opportunities Appear Limitless," p. 11.

¹⁴⁶ EUROBIT, *European Information Technology Observatory 1997*, pp. 42-45.

CHAPTER 4

CANADA

Canada is the United States' largest trading partner and was the top single-country destination for U.S. telecommunications equipment exports each year during 1993-97. U.S.-based producers have been very successful in the Canadian market. Imports from the United States comprised 73 percent of Canada's total telecommunications equipment imports in 1997, and while U.S. equipment producers have cut back some of their investments in Canadian production, they have made significant investments in Canada for research and development (R&D). Opportunities for U.S. manufacturers in the Canadian market are expected to increase over the next few years as the effects of the North American Free Trade Agreement (NAFTA) become more apparent and Canada's market, particularly for state-of-the-art equipment, continues to grow.

Industry Structure

Canadian production of telecommunications equipment increased from \$2.5 billion in 1993 to \$3.7 billion in 1997, an average annual growth rate of 10 percent (table 4-1).¹⁴⁷ Although wireline equipment comprised 71 percent of the total in 1997, the production of wireless equipment is expanding at an average annual rate of 14 percent versus 9 percent for wireline. Increased domestic production can be attributed in part to rising demand stemming from the recent liberalization of Canadian telecommunications services markets and the addition of new Canadian cellular service providers.¹⁴⁸ Increasing international demand, especially for personal communication services (PCS) products, also is driving growth in Canadian wireless equipment production.¹⁴⁹

Canada's telecommunications equipment industry comprises approximately 330 firms employing approximately 44,000 people, of which about 30 firms account for over 90 percent of the industry's output.¹⁵⁰ The industry is considered to be very competitive internationally due to its strong technology base, the presence of globally competitive producers such as Northern Telecom (Nortel), and its sophisticated domestic market.¹⁵¹ Nortel is Canada's largest telecommunications equipment manufacturer and is considered Canada's leading global competitor, generating 89 percent of its \$10.7 billion 1995 revenues outside of the country.¹⁵² Nortel is vertically integrated, producing a wide range of telecommunications equipment, and is particularly competitive in public network

¹⁴⁷ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 4th ed. (Surrey: Reed Business Information, 1997), p. 60, and Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 5th ed. (Surrey: Reed Business Information, 1997), p. 2.59. All data are presented in constant 1996 U.S. dollars (U.S. \$1 = C \$1.36).

¹⁴⁸ Canadian Embassy official, telephone interview by USITC staff, Dec. 18, 1997.

¹⁴⁹ Industry Canada, "Structure and Performance," Jan. 26, 1997, found at <http://www.strategis.ic.gc.ca>, retrieved Feb. 10, 1997.

¹⁵⁰ Industry Canada, *Sector Competitiveness Framework: Telecommunications Equipment Industry* (Ottawa: Industry Canada, June 1997), pp. 4 and 8.

¹⁵¹ U.S. Department of Commerce (USDOC), National Trade Data Bank (NTDB), Market Research Reports, Industry Sector Analysis, "Canada- Central Office Switching Equipment," Stat-USA Database, Feb. 1995, found at <http://www.stat-usa.gov>, retrieved Feb. 3, 1997.

¹⁵² Industry Canada, "Telecom Equipment Industry is World Class," Sept. 24, 1996, found at <http://strategis.ic.gc.ca/SSG/id1079e.html>, retrieved Dec. 12, 1997.

Table 4-1
Telecommunications equipment: Canadian production, imports, exports, and apparent consumption, 1993-97

Year	Production	Imports ¹	Exports	Apparent consumption	Ratio of imports to consumption ¹
-----Million dollars-----					Percent
1993	2,540	1,477	1,726	2,291	64.5
1994	2,715	1,825	2,228	2,312	78.9
1995	3,200	2,228	2,740	2,688	82.9
1996	3,517	2,667	3,443	2,741	97.3
1997	3,730	3,176	3,920	2,986	106.4

¹ See trade section for discussion of Canadian imports.

Source: Estimated by USITC staff based on Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 4th ed., p. 60, Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 5th ed., p. 2.59, and Stats Canada, Canadian Trade Statistics, various years. All data are presented in constant 1996 U.S. dollars (U.S. \$1 = C \$1.36).

switching products.¹⁵³ Mitel Corporation and Newbridge Networks Corporation are other internationally competitive Canadian manufacturers and are strong in certain niche markets such as private telephone switching systems and multiplexers, respectively.¹⁵⁴ U.S.-based Harris produces wireless telephone systems in Canada.¹⁵⁵ Canada's major telecommunications equipment producers are listed below in (table 4-2).

Table 4-2
Telecommunications equipment: Major producers in Canada, selected products, and headquarter country

Company name	Selected products	Headquarter country
Harris Corporation	Wireless infrastructure	United States
Mitel	Private branch exchanges (PBXs)	Canada
Newbridge Networks	Multiplexers	Canada
Northern Telecom (Nortel)	Central office switches, transmission equipment, wireless infrastructure and equipment	Canada

Source: Compiled by USITC staff.

The Canadian industry underwent significant restructuring and rationalization in the past few years to cut costs, increase productivity, and reduce significant overcapacity. In this restructuring, Nortel consolidated its 20 domestic-scale Canadian manufacturing facilities to 4 world-scale plants.¹⁵⁶ At the same time, foreign-based firms Motorola and Ericsson, of the United States and Sweden,

¹⁵³ Industry Canada, *Sector Competitiveness Framework: Telecommunications Equipment Industry*, p. 15.

¹⁵⁴ USDOC, "Canada- Central Office Switching Equipment."

¹⁵⁵ Industry Canada, "Open to Foreign Investment," Sept. 24, 1996, found at <http://strategis.ic.gc.ca/SSG/id1084e.html>, retrieved Dec. 12, 1997.

¹⁵⁶ Industry Canada, *Sector Competitiveness Framework: Telecommunications Equipment Industry*, pp. 12 and 19, and Industry Canada official, E-mail correspondence with USITC staff, Sept. 8 and Sept. 18, 1998.

respectively, closed their Canadian manufacturing facilities.¹⁵⁷ As a result, employment in the industry has declined as firms are increasingly contracting out the manufacturing of specialized digital products.¹⁵⁸

The telecommunications equipment industry is Canada's most R&D-intensive sector, and R&D expenditures for telecommunications equipment producers often exceed 15 percent of the value of shipments. The \$1 billion these firms spend annually on R&D accounts for 20 percent of Canada's total industrial R&D.¹⁵⁹ Government science policies, including an R&D tax credit, have been very influential in domestic and foreign-based companies' decisions to maintain a significant amount of R&D activities in Canada.¹⁶⁰ In fact, although foreign investment in production has decreased in recent years, many foreign firms have invested in R&D facilities in Canada to take advantage of Canada's well-trained workforce in the telecommunications sector and R&D tax credits.¹⁶¹ Major world producers such as Motorola, Ericsson, and Siemens perform R&D through Canadian affiliates.¹⁶² For example, one of Motorola's Canadian subsidiaries has an R&D facility focusing on wireless equipment production and research, and Ericsson's Canadian investments include a cellular technology R&D center employing 450 persons.¹⁶³ Canada has no reported barriers to investment in the telecommunications equipment industry.

Trade¹⁶⁴

Canada's telecommunications equipment imports rose at an average annual rate of 21 percent during 1993-97 reaching \$3.2 billion (table 4-1). The United States is, by far, the largest source of Canadian telecommunications equipment imports and accounted for most of this increase. Canadian

¹⁵⁷ Ibid.

¹⁵⁸ Industry Canada, *Sector Competitiveness Framework: Telecommunications Equipment Industry*, p. 12.

¹⁵⁹ In contrast, the Canadian manufacturing industry as a whole spends approximately 2 percent of the value of its shipments on R&D. Industry Canada, *Sector Competitiveness Framework: Telecommunications Equipment Industry*, p. 1, and Industry Canada, "Telecom Equipment Industry is World Class." The dollar figure is in constant 1996 U.S. dollars.

¹⁶⁰ Canada's Scientific Research and Experimental Development tax credit has been particularly important to telecommunications equipment producers because of their considerable R&D requirements. Industry Canada, *Sector Competitiveness Framework: Telecommunications Equipment Industry*, p. 10.

¹⁶¹ The Scientific Research and Experimental Development Tax Credit is considered generous by international standards. Industry Canada, "Structure and Performance," and Industry Canada, *Sector Competitiveness Framework: Telecommunications Equipment Industry*, p. 10.

¹⁶² Industry Canada, *Sector Competitiveness Framework: Telecommunications Equipment Industry*, p. 8.

¹⁶³ Ibid., and U.S. International Trade Commission (USITC), *Advice Concerning the Proposed Modification of Duties on Certain Information Technology Products and Distilled Spirits*, USITC publication 3031, 1997, p. 4-15.

¹⁶⁴ All trade data in this chapter are based on Statistics Canada trade data. These relatively detailed data provide for in-depth analysis of trends. Using Statistics Canada data also allows for consistent international comparison of Canada's trade with its various trading partners over the 5-year period. U.S. Department of Commerce data on U.S. exports to and imports from Canada that differ from Statistics Canada data are provided in footnotes. Data are presented in constant 1996 U.S. dollars (U.S. \$1 = C \$1.36).

imports from the United States grew at approximately 23 percent per year during 1993-97, reaching \$2.3 billion in 1997, 73 percent of the total (table 4-3).¹⁶⁵

Table 4-3
Telecommunications equipment: Canadian trade with the United States, 1993-97

Year	Imports from the United States	Exports to the United States	U.S. share of Canadian imports	U.S. import share of apparent consumption
	-----Million dollars-----		-----Percent-----	
1993	1,028	1,044	69.6	44.9
1994	1,180	1,391	64.7	51.0
1995	1,504	1,763	67.5	56.0
1996	1,907	2,403	71.5	69.6
1997	2,321	2,765	73.1	77.7

Source: Stats Canada, Canadian Trade Statistics, various years. Data are presented in constant 1996 U.S. dollars (U.S. \$1 = C \$1.36).

The increase in Canadian telecommunications equipment imports from the United States was due in part to U.S. suppliers' preferential access to the Canadian market due to the FTA and NAFTA.¹⁶⁶ Nortel's rationalization of its North American manufacturing operations over the past decade was also a significant factor.¹⁶⁷ In this rationalization, Nortel began to concentrate specific product segments in facilities in Canada and the United States, but left final product assembly and testing in both countries, resulting in vastly increased U.S.-Canada trade in parts and subassemblies.¹⁶⁸ Many of the products sent from the United States to Canada were subsequently re-exported, as Nortel tends to supply non-North American markets from its Canadian facilities.¹⁶⁹ In fact, rising imports of parts and subassemblies, many of which are later exported as finished goods, led Canada's ratio of telecommunications equipment imports to consumption to exceed 100 percent by 1997.

Wireless and wireline imports from the United States grew at average annual rates of 38 percent and 15 percent, respectively, during this period. In 1997, approximately 40 percent of telecommunications equipment shipped to Canada from the United States were wireless products. The rapid growth in wireless equipment imports from the United States can be attributed in part to Nortel's U.S. wireless equipment production facilities. Nortel invested \$104 million in these facilities between 1993 and 1995. This investment resulted in a 57 percent increase in exports from

¹⁶⁵ However, according to the USDOC, U.S. telecommunications equipment exports of products in this report to Canada rose from \$1.0 billion in 1993 to \$2.1 billion in 1997, or at an average annual rate of 19 percent. The difference in Industry Canada and USDOC data is most likely attributable to variations in product definitions as well as data collection methods.

¹⁶⁶ Canadian Department of Foreign Affairs and International Trade, "Information Technologies and Telecommunications," 1996, found at <http://www.dfait-maeci.gc.ca/TRAD...sh/strategy/20sequp.htm#Canadian Position>, retrieved Oct. 19, 1997.

¹⁶⁷ Nortel, "Northern Telecom's Transformation 1985-95," handout to USITC staff, 1996.

¹⁶⁸ Industry Canada official, E-mail correspondence with USITC staff, Sept. 18, 1998.

¹⁶⁹ Ibid.

Nortel's U.S. manufacturing operations, with many of these exports going to Canada to satisfy the Canadian market or to be shipped on to third countries.¹⁷⁰

Imports from Japan, the EU, and Mexico comprised 5 percent, 4 percent, and 4 percent, respectively, of Canada's total telecommunications equipment imports in 1997 (figure 4-1). Imports from Mexico rose at an average annual rate of nearly 70 percent during 1993-97.¹⁷¹ The sharp increase in imports from Mexico was most pronounced during 1995-96 (81 percent), following the implementation of the NAFTA and the Mexican peso devaluation of December 1994.¹⁷² Imports from the EU rose from 3 percent to 4 percent of total Canadian telecommunications equipment imports during 1993-97, due in large part to the addition to the EU on January 1, 1995, of Sweden and Finland, which are home to globally competitive telecommunications equipment producers Ericsson and Nokia, respectively. Canadian imports from Japan rose 27 percent from 1993-94 but then fell at nearly 8 percent per year from 1994-97, thereby eliminating the earlier increase. The drop from 1994-97 can be partly attributed to Japanese producers' increasing tendency to supply the Canadian market from facilities located in other Asian countries and in the United States.¹⁷³ Japanese producers increased shipments from plants in the United States, which had been set up in response to U.S. trade pressures. Japanese firms also increasingly exported lower cost, commodity-type equipment from lower wage Asian countries, to which they had moved much production from Japan to cut costs.¹⁷⁴

Imports also rose to meet demand for new equipment generated by the liberalization of Canada's telecommunications services sector and the resulting entry of new services providers.¹⁷⁵ Wireless equipment imports grew the most quickly, at an average annual rate of close to 33 percent, whereas wireline imports grew at just over 16 percent per year. As a result, the share of Canadian telecommunications imports accounted for by wireless products rose from 25 to 36 percent during the period. Wireless transmission and reception apparatus were the fastest growing segments of Canada's wireless product imports, whereas the fastest growing segment of Canada's wireline imports were facsimile machines. Canada's imports of telephone sets and parts of wireline transmission and reception apparatus also grew rapidly during 1993-97.

Because the Canadian market is relatively small, Canadian producers rely on exports to recover their R&D costs and to attain economies of scale.¹⁷⁶ In fact, approximately 90 percent of Canada's telecommunications equipment producers export some portion of their products.¹⁷⁷ For example, Harris exports most of its wireless telephone systems, which are geared toward lower density geographic areas, to developing countries in Africa and Asia.¹⁷⁸ Canadian telecommunications equipment exports increased at an average annual rate of nearly 23 percent during 1993-1997, reaching \$3.9 billion (table 4-2). Canada's exports of wireless equipment grew at 37 percent a year

¹⁷⁰ Nortel, "Nortel in the United States: Contributing to America-- Themes and Facts," handout to USITC staff, 1996.

¹⁷¹ Estimated by USITC staff based on Statistics Canada, Canadian Trade Data, various years.

¹⁷² Estimated by USITC staff based on Statistics Canada, Canadian Trade Data, various years, and official statistics of the USDOC.

¹⁷³ Industry Canada official, E-mail correspondence with USITC staff, Sept. 18, 1998.

¹⁷⁴ Ibid.

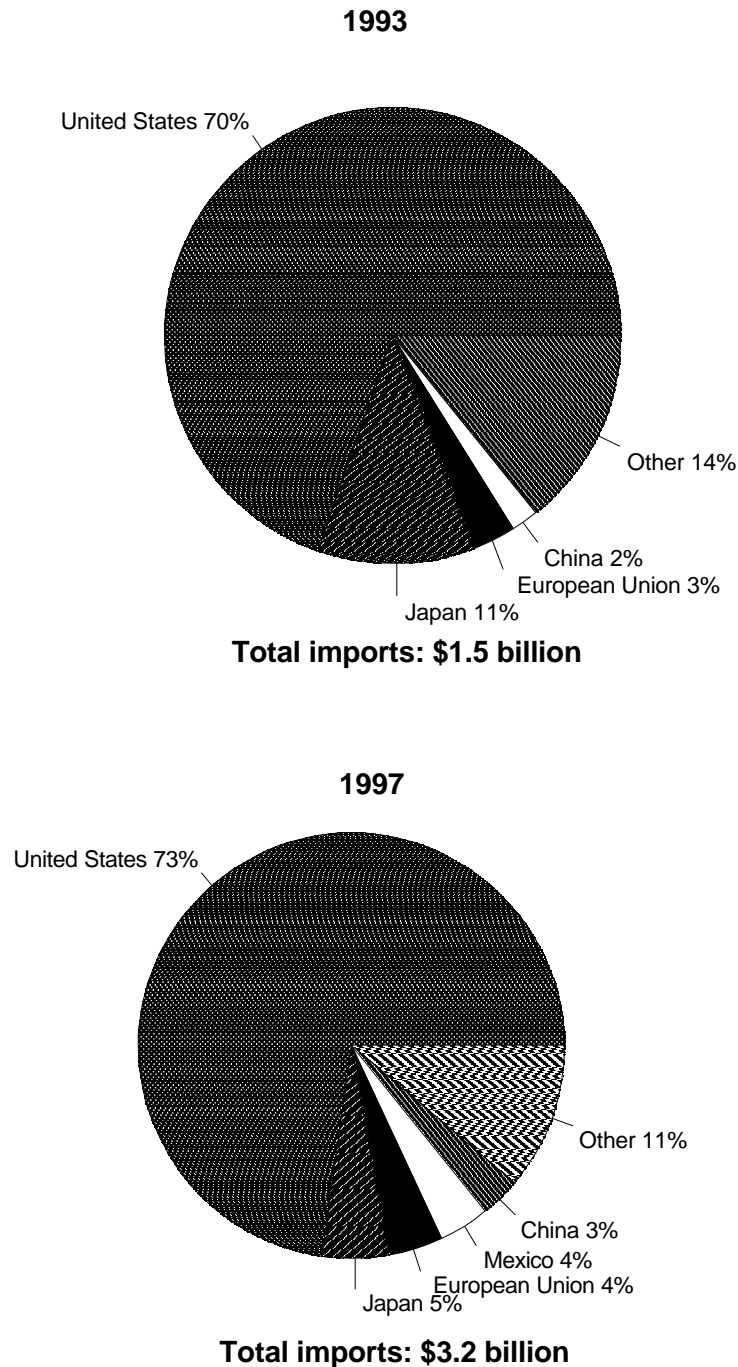
¹⁷⁵ Canadian Embassy official, telephone interview by USITC staff, Dec. 19, 1997.

¹⁷⁶ Industry Canada, "Foreign Market Penetration- Telecommunications Equipment: Executive Summary," Nov. 28, 1996, found at <http://strategis.ic.gc.ca/SSG/it2769e.html>, retrieved Dec. 5, 1997.

¹⁷⁷ Industry Canada, "Trade is Key to Canada's Prosperity," Sept. 24, 1996, found at <http://strategis.ic.gc.ca/SSG/id1085e.html>, retrieved Dec. 12, 1997.

¹⁷⁸ Canadian industry representative, telephone interview by USITC staff, Dec. 16, 1997.

Figure 4-1
Telecommunications equipment: Canadian imports, by principal source, 1993 and 1997



Source: Estimated by USITC staff based on official data of Statistics Canada. Data are presented in constant 1996 U.S. dollars (U.S. \$1 = C \$1.36).

to \$1.1 billion, whereas exports of wireline equipment grew more slowly, at approximately 19 percent per year, to \$2.8 billion. Facsimile machines were Canada's fastest growing wireline export sector, followed by parts of wireline transmission and switching equipment. The United States is Canada's largest export market for telecommunications equipment, and accounted for approximately \$2.8 billion, or 71 percent of Canadian 1997 telecommunications equipment exports.¹⁷⁹ This is due in large part to the increased market access afforded by the Canada-United States Free-Trade Agreement (FTA) and NAFTA, the size and proximity of the U.S. market, common equipment standards, and commercial ties.¹⁸⁰ Canadian exports to the United States increased at an average annual rate of 28 percent during 1993-97 in large part due to the increased trade between Nortel plants.¹⁸¹ Wireless products comprised an increasingly larger portion of Canadian telecommunications exports to the United States, rising from 17 percent to 29 percent of total telecommunications exports during the period. Other markets for Canadian telecommunications equipment include the EU, China, and Brazil, which accounted for 6, 4, and 3 percent of Canadian telecommunications equipment exports in 1997, respectively (figure 4-2).

Trade Agreements and Nontariff Barriers

In addition to the Uruguay Round Agreement, Canada and the United States are signatories to three agreements affecting their trade in telecommunications equipment, the 1989 FTA, the 1994 NAFTA, and the 1997 Information Technology Agreement (ITA). The FTA eliminated tariffs in 1989 on most telecommunications equipment traded between the United States and Canada and remaining tariffs were eliminated on January 1, 1998.¹⁸² Although the FTA addresses the phase out of tariffs on products meeting origin requirements, the NAFTA clarifies rules of origin related to telecommunications equipment.¹⁸³ The ITA eliminates U.S. and Canadian tariffs on third country trade in most telecommunications equipment as of January 1, 2000. U.S. industry has reported no nontariff trade barriers for U.S. telecommunications equipment in the Canadian market.¹⁸⁴

¹⁷⁹ However, according to USDOC data, U.S. telecommunications equipment imports from Canada rose from \$914 million in 1993 to \$2.1 billion in 1997, or at an average annual rate of 23 percent.

¹⁸⁰ Industry Canada, "Foreign Market Penetration- Telecommunications Equipment: Executive Summary," and Industry Canada, *Sector Competitiveness Framework: Telecommunications Equipment Industry*, p. 14.

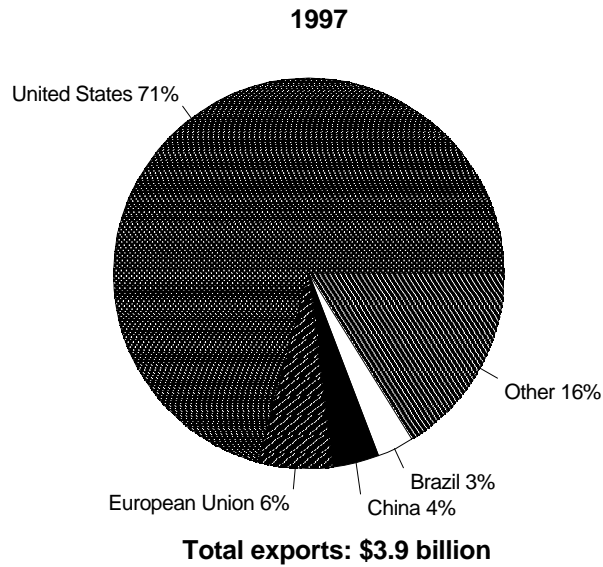
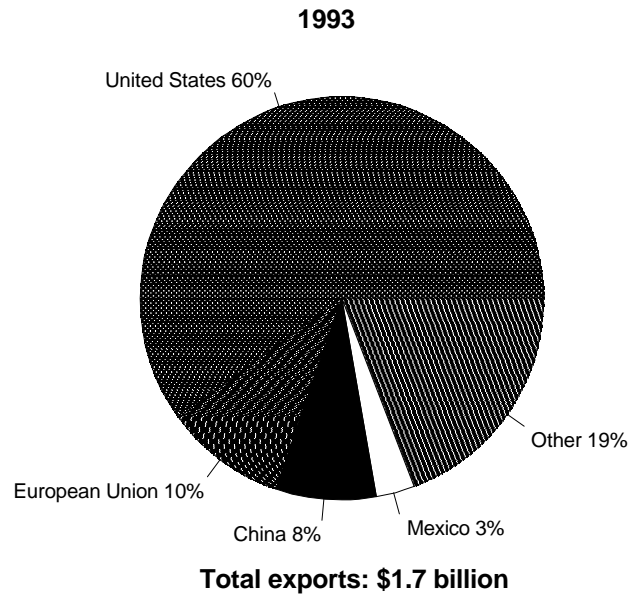
¹⁸¹ Industry Canada official, E-mail correspondence with USITC staff, Sept. 18, 1998.

¹⁸² Industry Canada, "NAFTA and the Telecommunications Equipment Sector," May 28, 1996, found at <http://strategis.ic.gc.ca/SSG/it00788e.html>, retrieved Dec. 5, 1997.

¹⁸³ The FTA's rules of origin were cumbersome and less clear, preventing U.S. telecommunications equipment suppliers from taking full advantage of the FTA trading environment. Most notably, the NAFTA eliminated the value content requirement of the FTA that was considered costly and burdensome to the telecommunications equipment industry. In its place the NAFTA requires that, to receive preferential treatment, non-North American telecommunications equipment inputs must undergo sufficient transformation in a NAFTA country to result in a specified change of tariff classification. A few exceptions exist. For further information, see U.S. International Trade Commission (USITC), *Industry & Trade Summary: Telecommunications Equipment*, USITC publication 2820, Oct. 1994, p. 28. For details on the NAFTA regarding telecommunications equipment see Industry Canada, "NAFTA and the Telecommunications Equipment Sector."

¹⁸⁴ Office of the United States Trade Representative (USTR), *1998 National Trade Estimate on Foreign Trade Barriers*, found at <http://www.ustr.gov/reports/nte/1998/contents.html>, retrieved Dec. 5, 1997.

Figure 4-2
Telecommunications equipment: Major Canadian export markets, 1993 and 1997



Source: Estimated by USITC staff based on official data of Statistics Canada. Data are presented in constant 1996 U.S. dollars (U.S. \$1 = C \$1.36).

Market

The Canadian market for telecommunications equipment grew from \$2.3 billion during 1993-97 to \$3.0 billion in 1997, or by an average annual rate of 7 percent.¹⁸⁵ The Canadian market is similar to that of the United States; it is very mature, users demand sophisticated products, and demand for wireless equipment is increasing rapidly. Growth in Canada's market for wireless equipment averaged 13 percent per year whereas growth in the market for wireline equipment averaged 4 percent. However, wireline equipment demand is not entirely dampened; Canada's 1993 deregulation of the long distance service market allowed new entrants to compete and prompted service providers to install new wireline networks within Canada.¹⁸⁶ The market for central office switching equipment remained flat during the period, and while Canadian manufacturers continue to satisfy the majority of domestic demand for central office switching equipment, imports have supplied a growing share of demand since 1993. This increase in imports is due in part to the termination in 1994 of a 45-year-old preferred supplier agreement between Bell Canada Enterprises (BCE), Canada's major telecommunications service provider, and Nortel, allowing all companies to bid competitively on BCE contracts.¹⁸⁷ The rising demand for wireless equipment was due in part to increasing demand for PCS equipment by service providers that want to deploy the newest technologies to attract a larger share of the rapidly growing number of subscribers.¹⁸⁸

Imports comprised a growing share of the Canadian telecommunications equipment market during 1993-97. In fact, the increasing amount of telecommunications equipment being imported into Canada by Canadian firms for re-export, sometimes after further assembly, caused the value of imports to exceed the total value of the Canadian market by 1997.¹⁸⁹ Imports from the United States comprised nearly 80 percent of the Canadian market for telecommunications equipment in 1997 (table 4-3) and were largely composed of parts and subassemblies for incorporation into finished products destined for export.

Most telecommunications equipment purchases in Canada are made by telecommunications service providers, the largest of which is BCE, the major provider of local and long distance telecommunications services in Canada.¹⁹⁰ BCE owns 51 percent of Nortel, Canada's largest telecommunications equipment producer. Other major service providers and equipment purchasers are Telus and BC Telecom. Some industry analysts believe the elimination in 1994 of the preferred supplier agreement relationship between Nortel and Bell Canada caused Canadian production of some telecommunications equipment, such as central office switches, to decline due to greater import competition.¹⁹¹

A variety of factors are expected to cause the Canadian market for telecommunications equipment to grow and could create opportunities for U.S. producers. Like the United States, Canada must

¹⁸⁵ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 4th ed., p. 32.

¹⁸⁶ Canadian industry representative, telephone interview by USITC staff, Dec. 22, 1997.

¹⁸⁷ USDOC, "Canada- Central Office Switching Equipment."

¹⁸⁸ Canadian industry representative, telephone interview by USITC staff, Dec. 22, 1997.

¹⁸⁹ *Ibid.*

¹⁹⁰ BCE provides telecommunications services through its subsidiaries including Bell Canada, BCE Mobile Communications, Bell Canada International, and Telesat Canada. BCE also has minority investments in several other major telecommunications service providers. BCE Inc, 1996 Annual Report.

¹⁹¹ USDOC, "Canada- Central Office Switching Equipment."

upgrade its infrastructure to transmit growing amounts of data, and will likely increase its demand for leading-edge technologies and equipment including packet switching equipment and ATMs.¹⁹² Wireless demand is growing and the number of Canadian PCS users is expected to increase from 1 million in 1995 to 3.5 million by 2000. To meet this growing demand, the Canadian Government awarded nine new digital PCS licenses in December 1995, four for broadband and five for narrowband services.¹⁹³ Growth in the Canadian PCS market will benefit U.S.-based producers of such equipment, relative to other foreign producers, due to compatible PCS standards between the two countries.¹⁹⁴ Wireless communications are particularly important in Canada because of the lack of a wireline infrastructure in the country's sparsely populated northern regions.¹⁹⁵ As of 1996, cellular networks reached more than 90 percent of Canada's population.¹⁹⁶

Canada's increasing demand for and competition in telecommunications services is expected to drive future demand for telecommunications products, particularly for the most technologically advanced equipment. U.S. Government sources predict that demand will increase opportunities for both world-class Canadian companies and U.S. companies that have been the primary source of Canadian imports.¹⁹⁷ Further, in 1996 the Canadian Department of Industry adopted the U.S.-developed CDMA as an approved standard in Canada for cellular and data networks operating in the 800 MHz band, which should benefit U.S. producers that provide equipment for this standard.¹⁹⁸ Finally, on May 1, 1997 the Canadian Radio-Television and Telecommunications Commission (CRTC) issued rulings to open up to competition Canada's \$7.5 billion local telephone services market, which should increase demand for equipment by new and current service providers aiming to compete by using state-of-the-art equipment. This could potentially benefit U.S. equipment manufacturers.¹⁹⁹

Although U.S. producers stand to gain from these trends in the Canadian market, they will lose their FTA and NAFTA tariff preferences in the Canadian market relative to other foreign suppliers on January 1, 2000, as Canada eliminates its remaining telecommunications equipment tariffs under the ITA. This could increase competition for U.S. firms in the Canadian market from European and other foreign telecommunications equipment producers.

¹⁹² MultiMedia Telecommunications Association (MMTA), *1997 MultiMedia Telecommunications Market Review and Forecast* (Arlington, VA: MMTA, 1997), p. 170.

¹⁹³ USDOC, NTDB, Market Research Reports, International Market Insight, "Canada- Personal Comm Services Expand," Stat-USA Database, Feb. 26, 1996, found at <http://www.stat-usa.gov>, retrieved July 21, 1997.

¹⁹⁴ USDOC, "Canada- Personal Comm Services Expand."

¹⁹⁵ MMTA, *1997 MultiMedia Telecommunications Market Review and Forecast*, p. 170.

¹⁹⁶ Industry Canada, "Wireless Communications in Canada," Sept. 24, 1996, found at <http://strategis.ic.gc.ca/SSG/id1075e.html>, retrieved Dec. 5, 1997.

¹⁹⁷ USDOC, NTDB, Market Research Reports, International Market Insight, "Canada's Telecom Infrastructure," Sept. 20, 1996, found at <http://www.stat-usa.gov>, retrieved July 21, 1997.

¹⁹⁸ EMC Publications, *World Cellular Market Report: CDMA 800 and 1900 Markets*, July 1996, p. 81.

¹⁹⁹ USDOC, Office of Telecommunications, "The Canadian Telecommunications Market," Aug. 1997.

CHAPTER 5

JAPAN

The Japanese telecommunications equipment market, valued at \$36 billion²⁰⁰ in 1997, is the third largest globally after the United States and the European Union (EU). Despite Japan's economic slowdown, the telecommunications industry continues to expand and has been outperforming the rest of the economy in recent years.²⁰¹ The growth of the Japanese market from 1993 to 1997 was aided by regulatory liberalization affecting certain equipment sales and telecommunications services, increasing use of the Internet and cellular systems, and growing investment in infrastructure by the Japanese Government and private industry. Market growth for services and, subsequently, equipment, is expected to continue in the foreseeable future.²⁰²

Despite this growth, the Japanese telecommunications equipment market traditionally has been relatively closed to U.S. and other foreign producers, whose market shares remain very low. U.S. import penetration of the Japanese market was only 5 percent in 1997 and U.S. investment in manufacturing operations in Japan remains almost nonexistent. However, the relatively large size of the Japanese market ensures that it will remain important for U.S. producers. In 1997, Japan was the third largest market for U.S. telecommunications equipment exports after Canada and Mexico. Although Japan has no import tariffs on telecommunications equipment, U.S. firms allege various nontariff barriers to their sales in the Japanese market. Nonetheless, changes in Japan's telecommunications business climate and market could provide substantial new opportunities for U.S. equipment producers.

Industry Structure

Total Japanese telecommunications equipment production grew from \$24.3 billion in 1993 to \$38.3 billion in 1997, averaging 12 percent annually (table 5-1).²⁰³ Japan is the third largest telecommunications equipment producer in the world after the United States and the EU, accounting for slightly more than 20 percent of the world total in 1997 (figure 5-1). Japanese production growth averaged slightly more than 1 percent during 1993-94, increased to nearly 20 percent during 1994-96, and slowed to approximately 8 percent during 1996-97. The bulk of Japan's telecommunications equipment production is comprised of wireline equipment, valued at \$23.9 billion in 1997, compared with wireless equipment production of \$14.4 billion that year. However, Japan's 22 percent annual growth rate for wireless equipment production outpaced the 8 percent annual growth of wireline equipment production during 1993-97. During the 5-year

²⁰⁰ All production and trade data in this chapter are given in constant 1996 U.S. dollars (U.S. \$1 = ¥ 109).

²⁰¹ U.S. Department of State telegram, "Overview of Japanese Telecommunications Market," message reference No. 004803, prepared by U.S. Embassy, Tokyo, June 22, 1998.

²⁰² Ibid.

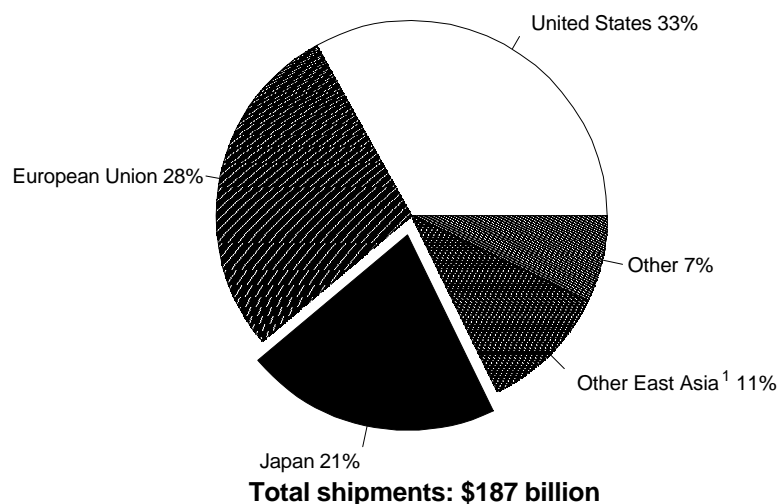
²⁰³ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 4th ed. (Surrey: Reed Business Information, 1997), p. 62, and Reed Electronics Research, *Yearbook of World Electronics Data* (Surrey: Reed Business Information, 1996 and 1998).

Table 5-1
Telecommunications equipment: Japan's production, imports, exports, and apparent consumption, 1993-97

Year	Production	Imports	Exports	Apparent consumption	Ratio of imports to consumption
	----- <i>Million dollars</i> -----				<i>Percent</i>
1993	24,284	1,253	7,539	17,998	7.0
1994	24,606	1,738	7,306	19,038	9.1
1995	27,945	2,692	5,678	24,959	10.8
1996	35,633	3,913	5,356	34,190	11.4
1997	38,312	3,870	6,470	35,712	10.8

Source: Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 4th ed.; Reed Electronics Research, *Yearbook of World Electronics Data*; and Ministry of Finance, *Japan Exports and Imports*, various issues. Figures presented in constant 1996 U.S. dollars (U.S. \$1 = ¥ 109).

Figure 5-1
Telecommunications equipment: Shares of world production by Japan and other major producers, 1997



¹ Includes China, Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand.

Source: Estimated by USITC staff based on Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, and Reed Electronics Research, *Yearbook of World Electronics Data* 1995, 1996, and 1997.

period, production of cellular telephones, base stations, and pagers increased at average annual rates of 43 percent, 40 percent, and 12 percent, respectively, to meet growing domestic demand.

The slow growth of wireline equipment production in Japan has resulted largely from the relocation of low-end, commodity-type equipment production such as telephone sets and facsimile machines to lower wage Asian countries including Malaysia, Indonesia, and China. This shift was primarily in response to the steady appreciation of the yen during 1990-96.²⁰⁴ At the same time, Japan's production of higher end wireline transmission and switching equipment grew at an average annual rate of approximately 15 percent from 1993-97. Part of this growth can be attributed to purchases by Nippon Telegraph and Telephone (NTT), Japan's main domestic service provider, as it converted its wireline network from analog to digital.²⁰⁵

Japan's telecommunications equipment industry is dominated by a small number of large Japanese-based producers that manufacture telecommunications equipment in addition to a diverse range of products. The four biggest firms, NEC, Fujitsu, Matsushita, and Toshiba, were among the world's top 20 telecommunications equipment suppliers in 1997.²⁰⁶ Other large producers include Hitachi, Oki Electric, and Ricoh.²⁰⁷ Most of these firms produce a wide variety of wireline and wireless transmission, switching, and terminal equipment, even manufacturing products that are unprofitable in order to retain complete product lines (table 5-2).²⁰⁸ Japanese manufacturers outsource very little to unaffiliated suppliers, and most smaller producers are members of tightly knit industry groups that supply components to the large firms.²⁰⁹ Other important producers in the wireless terminal market include Sony and Pioneer.

Telecommunications equipment production in Japan traditionally has had a strong domestic focus, due in large part to the relationship between the major equipment producers and NTT, the country's single largest telecommunications equipment purchaser. Because NTT's procurement has been relatively stable and large-scale, Japanese firms have produced equipment almost exclusively for NTT, have designed much of their higher end equipment to NTT's proprietary standards, and have had little incentive to enter the competitive global market.²¹⁰ While this relationship has allowed Japanese producers to dominate the domestic market, it has hindered their global competitiveness in higher end equipment.

²⁰⁴ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, p. 62, and Japanese industry representatives and investment analysts, telephone interviews by USITC staff, Oct. 1996- Feb. 1997.

²⁰⁵ The conversion was completed in December 1997. Communications Industry Association of Japan (CIAJ), "Digital Conversion of Network Completed," *CIAJ Quarterly*, May 1998, found at <http://www.ciaj.or.jp/ciaj/ciaj-e/quart/ci001083.html>, retrieved June 30, 1998, and Louis Ross, Merrill Lynch Japan analyst, E-mail correspondence with USITC staff, July 20, 1998.

²⁰⁶ "Top 50 Equipment Manufacturers, Ranked by Revenue," *Communications Week International*, Nov. 24, 1997, p. 31.

²⁰⁷ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, p. 170.

²⁰⁸ However, several firms in the electronics sector are accruing a great deal of losses in some of these product areas and may find it difficult to stay in unprofitable business lines as credit difficulties in Japan continue. Ross, interview by USITC staff, New York, NY, Dec. 15, 1997, and E-mail correspondence to USITC staff, Aug. 14, 1998.

²⁰⁹ These industry groups are often referred to as *keiretsu*. Ross, interview by USITC staff.

²¹⁰ Ross, "Japan's Telecommunications Industry: Where It's Been and Where It's Going," June 1997, p. 31.

Table 5-2
Telecommunications equipment: Major producers in Japan and selected products

Company name	Selected products
NEC	Digital switching systems, wireline terminal and transmission equipment, wireless infrastructure and terminal equipment
Fujitsu	ATM switching systems, wireline terminal and transmission systems, wireless infrastructure and terminal equipment
Matsushita Communication Industrial	Cellular telephones, telephone sets and systems, pagers, radio systems, network equipment
Toshiba	Switching equipment
Hitachi	Switching equipment
Oki Electric	Wireless and wireline network and terminal equipment
Ricoh	Facsimile machines

Source: Compiled by USITC staff based on ITU, Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, various company annual reports, and company World Wide Web sites.

Japanese producers have had far more success in foreign markets with lower end consumer premises equipment (CPE), such as facsimile machines, which benefit from Japan's advanced, low cost manufacturing processes.²¹¹

This domestic market focus is beginning to change and Japanese producers are becoming more internationally competitive in higher end telecommunications products such as optical fiber, routers, bridges, ATM equipment, and components of emerging wireless terminal technologies.²¹² Fujitsu and Toshiba have had success selling network and switching equipment in developing markets in Asia, Latin America, and Africa, where customers value the low prices and superior service of Japanese suppliers over the technologically advanced features of U.S. and EU equipment.²¹³ Some industry analysts view such sales as stepping stones toward acquiring greater competency in higher end products as well as a means to promote Japanese equipment standards globally.²¹⁴

Further, Japanese telecommunications equipment producers benefit from their global marketing experience with other types of products. NEC, Fujitsu, Toshiba, and Hitachi produce computer hardware in addition to telecommunications equipment, which provides them a long-term competitive advantage as these industries become increasingly integrated.²¹⁵ Toshiba and Matsushita will probably continue to benefit from their successful experience selling consumer

²¹¹ Japanese industry representatives and investment analysts, telephone interviews by USITC staff, Oct. 1996-Feb. 1997.

²¹² Ross, "Japan in the World Telecom Market," *Computing Japan*, Aug. 1997, p. 17.

²¹³ Japanese industry representatives and investment analysts, telephone interviews by USITC staff, Oct. 1996-Feb. 1997.

²¹⁴ Ross, interview by USITC staff.

²¹⁵ Ross, "Japan's Telecommunications Industry: Where It's Been and Where It's Going," p. 31. In comparison, none of the major U.S. telecommunications equipment manufacturers produce computers. However, certain U.S.-based companies such as Cisco Systems, IBM, and others do produce routers, modems, and components used by both industries.

electronics internationally as the markets for telecommunications equipment, computers, and consumer electronics converge.²¹⁶ Japanese producers also possess extensive experience in digitization and are likely to benefit as telecommunications equipment, such as cellular handsets and personal digital assistants (PDAs), move toward the next generation.²¹⁷ Finally, in the wake of deregulation, discussed below, NTT is expected to expand aggressively overseas, which will truly lead Japanese suppliers into the international market.²¹⁸

Foreign direct investment in telecommunications equipment production in Japan has been very limited. A notable exception is U.S.-based Lucent Technologies, which has a joint venture with Yazaki Cable to manufacture fiber optic cable.²¹⁹ To date, most foreign investment has been in research and development (R&D) facilities. Lucent has invested in telecommunications R&D laboratories in Japan, as have Canadian-based Nortel and Sweden-based Ericsson, and Motorola recently announced R&D investment plans.²²⁰ A few foreign firms have formed joint ventures with Japanese firms in certain areas to provide specialized technologies, such as U.S.-based Qualcomm's joint venture with NTT to provide code-division multiple-access (CDMA)²²¹ technology for cellular base stations and handsets.²²² U.S. Government sources report no known third country firms manufacturing telecommunications equipment in Japan.²²³

The lack of foreign manufacturing investment in Japan stems from a variety of reasons. U.S. Government sources report that, while many U.S. firms have successfully sold to NTT and its competitors, sales volumes are insufficient to justify investing in Japanese production facilities.²²⁴ For example, although U.S.-based Cisco Systems has sold significant quantities of wide area networking (WAN) equipment to NTT, and others, Cisco has not invested in manufacturing in Japan and instead relies on OEM relationships with local manufacturers for its Japanese sales.²²⁵ U.S. firms have reported that foreign sales are restricted in the Japanese market because of Japan/NTT-unique product standards and NTT's tendency to procure from its own family of suppliers.²²⁶

²¹⁶ U.S. and EU industry representatives and analysts, telephone interviews by USITC staff, Oct. 1996- Feb. 1997.

²¹⁷ Ross, E-mail correspondence with USITC staff, Aug. 14, 1998.

²¹⁸ Ibid.

²¹⁹ Foreign Commercial Service officer, U.S. Department of Commerce (USDOC), U.S. Embassy, Tokyo, E-mail correspondence with USITC staff, Oct. 20, 1997. Fiber optic cable is not included among the telecommunications equipment discussed elsewhere in this report although it is an integral component of the telecommunications network.

²²⁰ CIAJ representative, E-mail correspondence with USITC staff, Oct. 20, 1997, and "Motorola CIG Establishes 3G Wireless Research and Development Center in Japan," Motorola, press release, June 24, 1998.

²²¹ CDMA is a digital standard for mobile phone systems that provides up to 10 times the capacity of analog systems.

²²² Ross, E-mail correspondence with USITC staff, Oct. 17, 1997.

²²³ Foreign Commercial Service officer, USDOC, U.S. Embassy, Tokyo, E-mail correspondence with USITC staff, Oct. 20, 1997.

²²⁴ Ibid.

²²⁵ Cisco relies on OEM partnerships with prominent Japanese computer manufacturers such as NEC, Hitachi, and Fujitsu to produce its WAN equipment in Japan. Foreign Commercial Service officer, USDOC, U.S. Embassy, Tokyo, E-mail correspondence with USITC staff, Oct. 20, 1997.

²²⁶ These barriers are discussed in the "Trade Agreements and Nontariff Barriers" section of this chapter.

Further, many sales by foreign firms to NTT are one-time opportunities rather than long-term commitments.²²⁷

Trade²²⁸

Japan's telecommunications equipment imports rose at an average annual rate of 46 percent during 1993-96, to \$3.9 billion (table 5-1).²²⁹ However, imports were flat in 1997 in large part due to the depreciation of the yen that began in 1996 and the deepening of the Japanese recession. Wireline equipment accounted for approximately 75 percent, and wireless equipment for 25 percent, of Japan's 1997 sector imports. Wireless equipment imports grew at an average annual rate of 35 percent during 1993-97, reaching \$941 million. Wireless import growth was spurred by a revision in government regulations in April 1994 which allowed consumers to own cellular telephones that could previously only be rented.²³⁰ Japan's wireline equipment imports increased from \$970 million in 1993 to \$2.9 billion in 1997, or by 32 percent annually.

Imports of wireline parts and accessories grew by an average of 35 percent per year and accounted for the single greatest share, 29 percent, of Japan's telecommunications equipment imports total in 1997. The next largest category, transmission apparatus for wireless equipment, comprised 18 percent of all telecommunications equipment imports. Wireline switching and transmission equipment accounted for 17 percent and 12 percent, respectively, of Japan's 1997 telecommunications equipment imports.

In 1997, the United States was the largest source of Japan's telecommunications equipment imports, supplying almost half, while the next-largest sources were the EU, China, and Malaysia (figure 5-2). Japan's imports from the United States rose from \$695 million in 1993 to \$1.8 billion in 1997, an average annual increase of slightly more than 25 percent,²³¹ while the U.S. share of Japanese telecommunications equipment imports fell from 56 percent to 46 percent. Some U.S. imports were displaced by those from the EU, which rose from slightly more than 2 percent to approximately 19 percent of total imports, although this jump for the most part reflects the addition of Finland and Sweden to the EU on January 1, 1995.

²²⁷ Ross, interview by USITC staff.

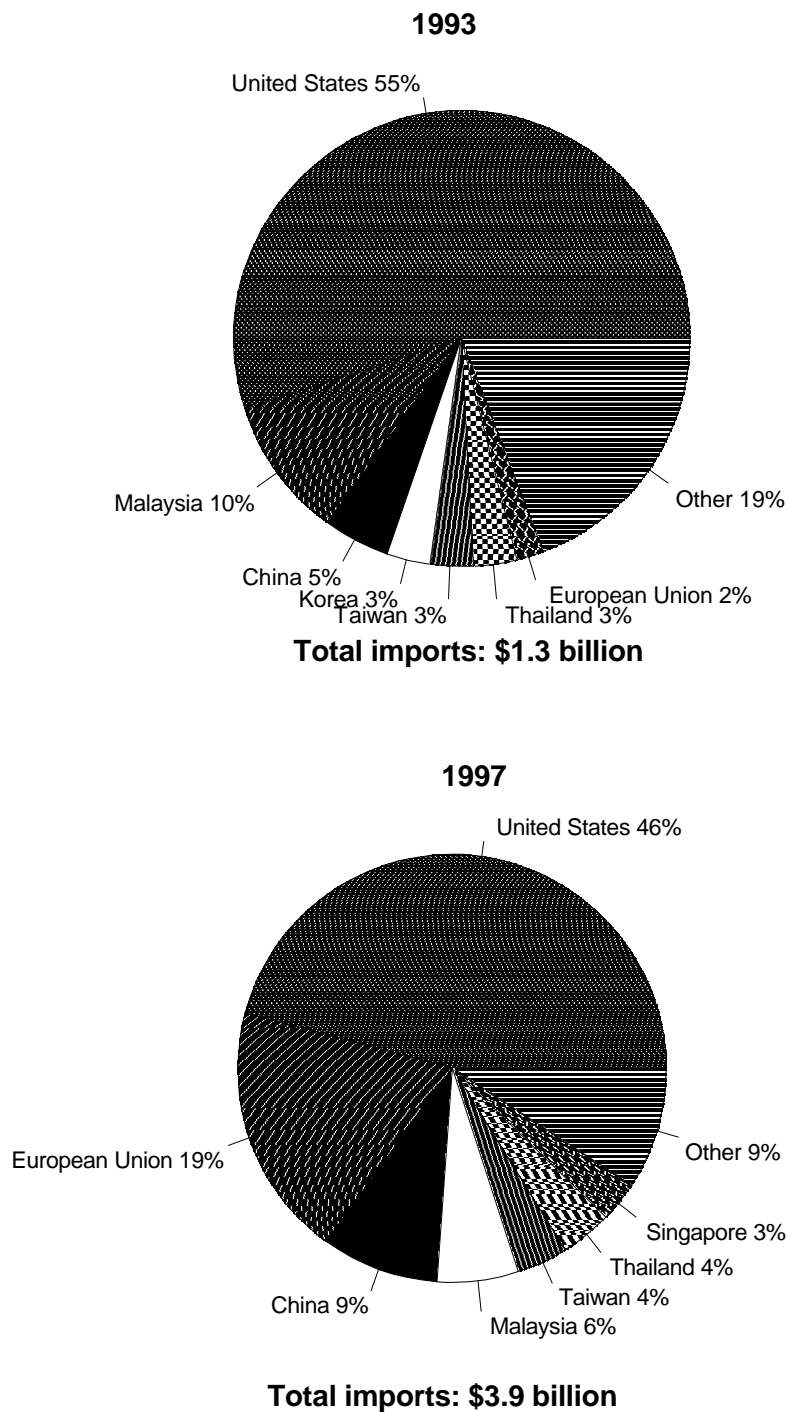
²²⁸ All trade data in this chapter are based on Ministry of Finance (MOF) statistics. These relatively detailed data provide for in-depth analysis of trends. Using MOF data also allows for consistent international comparison of Japan's trade with its various trading partners over the 5-year period. USDOC data on U.S. exports to and imports Japan that differ from MOF numbers are provided in footnotes.

²²⁹ MOF, *Japan Exports and Imports* (Tokyo: Japan Tariff Association, 1993,1994,1995,1996, and 1997).

²³⁰ *Japan Electronics Almanac 95/96* (Tokyo: Dempa Publications, Inc., 1995), p. 88. Japan agreed to institute this change under the 1994 U.S.-Japan agreement on cellular telephones.

²³¹ However, according to USDOC data, U.S. telecommunications equipment exports to Japan of the products covered in this report rose from \$604 million in 1993 to \$991 million in 1997, or at an average annual rate of 13 percent. Ministry of Finance statistics presented in current U.S. dollars would show Japan's imports from the United States rising from \$683 million in 1993 to \$1.6 billion in 1997, or at an average annual rate of 24 percent. The difference in MOF and USDOC data is most likely attributable to variations in product definitions as well as data collection methods.

Figure 5-2
Telecommunications equipment: Major Japanese import sources,¹ 1993 and 1997



¹ Figures presented in constant 1996 dollars (U.S. \$1= ¥ 109).

Source: Ministry of Finance, *Japan Exports and Imports*, various issues.

These two countries are home to globally competitive telecommunications equipment producers Nokia and Ericsson.²³² Japan's imports from other Asian countries²³³ increased at an average annual rate of 37 percent thereby expanding their total share from 25 to 29 percent during 1993-97.

The growth in imports from Asia was reportedly due in part to imports coming from Japanese firms that had relocated factories to Asia to escape rising production costs at home associated with the high yen.²³⁴ Japan's telecommunications equipment exports decreased from \$7.5 billion to \$5.3 billion between 1993 and 1996, then rose to \$6.5 billion in 1997 (table 5-1). These fluctuations can largely be attributed to changes in the exchange rate. The 1993-96 decrease coincided with the appreciation of the yen, which influenced some Japanese manufacturers to move production of lower end equipment overseas as mentioned above.²³⁵ Japanese industry sources attribute the increase in exports during 1997 to the depreciation of the yen against the dollar that began in the latter half of 1996, which made Japanese exports more competitive abroad.²³⁶

Nearly 80 percent of Japan's 1997 exports of telecommunications equipment were wireline products, while the remaining 20 percent were wireless products. Parts of wireline products comprised the largest single export sector (39 percent), followed by fax machines (19 percent). Wireless apparatus, which includes cellular telephones, comprised 14 percent of Japan's 1997 telecommunications equipment exports.

The United States is Japan's largest export market, accounting for 32 percent of Japan's 1997 exports, followed by the EU, China, and Hong Kong (figure 5-3). Although Japan's total exports to the United States fell at an average annual rate of close to 5 percent during 1993-97, exports of wireline equipment parts grew at an average annual rate of 11 percent, reaching nearly 45 percent of 1997 exports. Twenty-two percent of total exports to the United States were fax machines, which fell by nearly 16 percent annually, and 15 percent were wireless transmission apparatus, which fell by 2 percent.

Trade Agreements and Nontariff Barriers

Japan and the United States are signatories to various bilateral agreements affecting sales of U.S.-produced telecommunications equipment in the Japanese market. The primary U.S. objective of these agreements has been to maximize competitive opportunities within the Japanese market and to ensure procedures consistent with the 1979 GATT Agreement on Government Procurement, which Japan had not extended to NTT's procurement of telecommunications equipment.²³⁷ Thus, some of these agreements have sought to increase NTT's procurement of foreign-made telecommunications equipment as well as the equipment procurement by Japanese government and quasi-government entities other than NTT. Other bilateral agreements address Japan-specific

²³² In fact, Japan's imports from the EU increased nearly 25-fold from 1994 to 1995, the year these two countries joined the EU.

²³³ China, Hong Kong, Korea, Malaysia, Singapore, Taiwan, and Thailand.

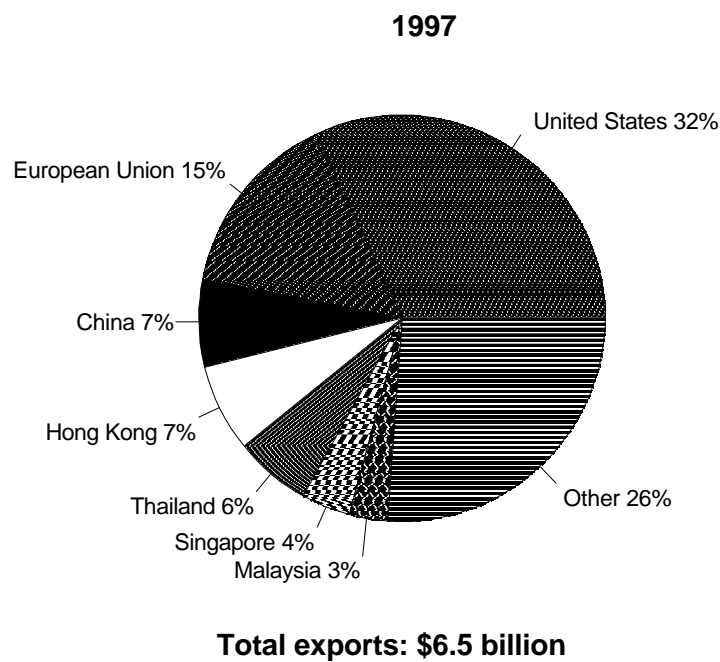
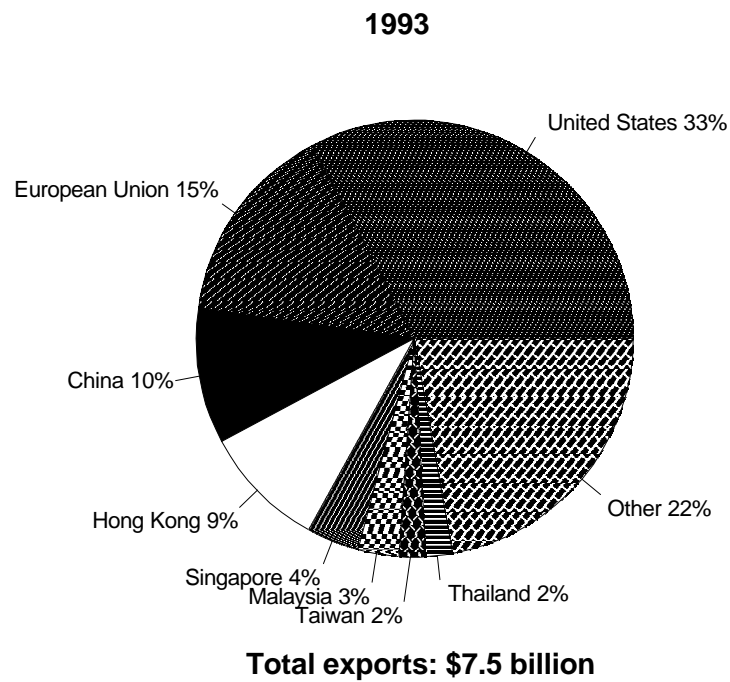
²³⁴ *Japan Electronics Almanac 95/96*, p. 88.

²³⁵ International Telecommunications Union (ITU), "Trade in Telecommunications Equipment," in *World Telecommunications Development Report*, (Geneva: ITU, 1997), p. 19.

²³⁶ CIAJ, "Telecommunications Equipment Statistics for the Fourth Quarter 1997," found at <http://www.ciaj.or.jp/ciaj/ci001078.html>, retrieved June 30, 1998.

²³⁷ USDOC official, Office of Japan Trade Policy, telephone interview by USITC staff, Nov. 20, 1997.

Figure 5-3
Telecommunications equipment: Major Japanese export markets,¹ 1993 and 1997



¹ Figures presented in constant 1996 dollars (U.S. \$1= ¥ 109).

Source: Ministry of Finance, *Japan Exports and Imports*, various issues.

standards and other barriers to U.S. suppliers' access to Japan's cellular telephone equipment market. U.S.-Japan bilateral telecommunications equipment agreements appear in table 5-3.

Although the U.S. Government has determined that Japan has implemented some of these agreements to its satisfaction, it actively monitors two agreements addressing Japan's government and quasi-government procurement of foreign telecommunications equipment (table 5-3). The NTT Procurement Agreement, which seeks to increase NTT's procurement of foreign equipment, has been of particular concern and has been revised and renewed every 3 years since it was first signed in 1980, most recently in 1997. As NTT is Japan's single largest purchaser of telecommunications equipment, U.S. industry remains concerned about equitable treatment in the NTT procurement process.

Table 5-3
Bilateral agreements on telecommunications equipment between the United States and Japan¹

Year	Agreement	Issue
1980	Nippon Telegraph and Telephone Corporation (NTT) Procurement Agreement	NTT's procurement of foreign equipment
1986	Report on the Market-Oriented, Sector-Selective (MOSS) Discussions--Telecommunications Sector	Telecommunications equipment standards
1989	Cellular and Third Party Radio Agreement	Market access for foreign cellular and trunked ² radio technologies
1990	Agreement on Network Channel Terminating Equipment (NCTE)	Liberalization of digital subscriber equipment
1994	Cellular Telephone Agreement	Implementation of 1989 agreement on cellular technologies
1994	Measures on Japanese Public Sector Procurement of Telecommunications Products and Services	Non-NTT public sector procurement of foreign equipment

¹ For details on these agreements, see the U.S. Department of Commerce Trade Compliance Center's trade agreements database at <http://www.mac.doc.gov/tcc/treaty.htm>.

² Trunked radio is the two-way transmission of voice and data that can be limited to a closed user group, commonly used for fleet management, emergency services, and taxi dispatch.

Note: The 1980 and 1994 procurement agreements continue to be actively monitored by the U.S. Government. The other agreements have been fully implemented and/or are no longer monitored.

Source: U.S. Department of Commerce.

Japan and the United States are also signatories to two plurilateral agreements affecting telecommunications equipment. In 1994, as part of the Uruguay Round, Japan and several other countries concluded a new WTO Government Procurement Agreement (GPA), which superseded the 1979 GATT Agreement on Government Procurement. Under the new GPA, Japan agreed to allow U.S. firms to bid on telecommunications equipment procurement contracts of central and

prefectural government entities, as well as certain municipal and other government-related entities.²³⁸ Japan is also a signatory to the 1997 Information Technology Agreement (ITA), under which participants will eliminate tariffs on most types of telecommunications equipment by January 1, 2000.²³⁹ However, Japan's tariffs on telecommunications equipment were zero prior to the ITA.

Despite the abovementioned agreements and the absence of tariffs on Japanese telecommunications equipment imports, U.S. companies allege that they face numerous nontariff barriers to selling telecommunications equipment in the Japanese market. U.S. industry representatives have reported that the Japanese public and quasi-public sector telecommunications equipment procurement process is non-transparent and discriminates against foreign suppliers, despite the bilateral U.S.-Japan agreements and the 1994 GPA.²⁴⁰ They further allege that NTT, which owns the majority of Japan's telecommunications infrastructure, has been the worst offender.²⁴¹ U.S. industry representatives assert that despite Japan's Ministry of Posts and Telecommunications' (MPT) partial privatization of NTT in 1985,²⁴² NTT continues to purchase almost exclusively from its family of Japanese equipment manufacturers.²⁴³ Further, U.S. companies allege that NTT tends to over-engineer and under-document standards which are often Japan- or NTT-specific, requiring U.S. firms to reengineer both their hardware and software to meet NTT specifications, thereby raising their production costs.²⁴⁴

Market

The Japanese telecommunications equipment market, valued at \$18.0 billion in 1993, rose at an average annual rate of nearly 19 percent to \$35.7 billion in 1997. Market growth can be largely attributed to further deregulation of the domestic telecommunications service industry as well as the changing nature of telecommunications traffic in Japan as demand moves from traditional wireline

²³⁸ Negotiations for this new GPA had been ongoing for several years, and the United States pursued its bilateral agreement with Japan on government procurement of telecommunications equipment independently. Both agreements were reached in 1994. Japan implemented the GPA on Jan. 1, 1996. Prior to the GPA, Japan's prefectures and other local governments were not subject to international procurement disciplines. USDOC official, Office of Japan Trade Policy, telephone interview by USITC staff, Nov. 20, 1997, and Office of the United States Trade Representative (USTR), *1997 National Trade Estimate on Foreign Trade Barriers (NTE)*, p. 194.

²³⁹ For a list of telecommunications equipment products covered by the ITA, see U.S. International Trade Commission (USITC), *Advice Concerning the Proposed Modification of Duties on Certain Information Technology Products and Distilled Spirits*, USITC publication 3031, Apr. 1997, Appendix D.

²⁴⁰ In 1996, in response to a complaint that Japan's National Police Agency (NPA) was discriminating against a U.S. supplier in a wireless telecommunications systems procurement, USTR determined that Japan was potentially in violation of both its WTO government procurement obligations and its obligations under the 1994 bilateral government procurement agreement. NPA agreed to revise the procurement and issued a Request for Proposals in August 1997. USTR, "Monitoring and Enforcing Trade Laws and Agreements Fact Sheet," Sept. 30, 1997, p. 6 and USTR, *1998 NTE*, pp. 215-217.

²⁴¹ USTR, *1998 NTE*, pp. 215-217.

²⁴² In 1985 NTT was incorporated as a private company, although 65.5 percent of NTT remains controlled by the Government of Japan.

²⁴³ USTR, *1998 NTE*, pp. 215-217.

²⁴⁴ *Ibid.*, and Foreign Commercial Service officer, USDOC, U.S. Embassy, Tokyo, E-mail correspondence with USITC staff, Oct. 20, 1997.

services to ISDN and cellular services.²⁴⁵ Overall growth in the market for wireless equipment has outpaced that for wireline equipment in the Japanese market, increasing at an average annual rate of 22 percent during the period, whereas the wireline market grew at approximately 8 percent per year. Demand for wireless equipment grew most noticeably from 1994 to 1995, due to the increased popularity of pagers among young people and the introduction in 1994 of regulations allowing consumers to own cellular terminal equipment for the first time.²⁴⁶ Growth in the wireline market was led greater demand for network equipment, whereas increased demand for cellular telephones led the expansion of the wireless market.²⁴⁷ Overall market growth slowed in the last years of the period, to 8 percent in 1996 and 4 percent in 1997. This slowdown is generally attributed to the completion of a number of major infrastructure construction projects by NTT and the New Common Carriers (NCCs).²⁴⁸

The vast majority of the Japanese market for telecommunications equipment is supplied by domestic Japanese production. Total import penetration remained relatively low during 1993-97, rising from approximately 7 percent to 11 percent (table 5-1), whereas import penetration in the United States in 1997 averaged 18 percent and the comparable figure in the EU was 19 percent. U.S. import penetration into Japan rose from 4 percent to 5 percent during the period (table 5-4). Japan has remained a very closed market for foreign telecommunications equipment producers, the primary factor being NTT's continued dominance of the Japanese telecommunications services market and its tendency to source from domestic producers. NTT is Japan's single largest purchaser of telecommunications equipment, accounting for more than one third of Japan's telecommunication equipment market.

Table 5-4
Telecommunications equipment: Japan's trade with the United States, 1993-97

Year	Imports from the United States	Exports to the United States	U.S. share of Japanese imports	U.S. import share of apparent consumption
	-----Million dollars-----		-----Percent-----	
1993	695	2,508	55.5	3.9
1994	854	2,326	49.1	4.5
1995	1,209	1,803	44.9	4.8
1996	1,660	1,737	42.4	4.9
1997	1,772	2,081	45.8	5.0

Source: Ministry of Finance, *Japan Exports and Imports*, various issues. Figures presented in constant 1996 U.S. dollars (U.S. \$1 = ¥ 109).

²⁴⁵ "Fujitsu and Telecommunications," Fujitsu Limited, Dec. 1996, found at <http://www.fujitsu.com>, retrieved Oct. 2, 1997, and U.S. Department of State telegram, "Overview of Japanese Telecommunications Market."

²⁴⁶ *Japan Electronics Almanac 95/96*, p. 86. The decision to allow the sale, in addition to rental, of cellular telephones was embodied in the 1994 U.S.-Japan exchange of letters regarding the 1989 bilateral agreement on cellular telephones and third party radio systems. This sales system was extended to personal handyphone systems (PHS) equipment when that technology was introduced in 1995.

²⁴⁷ CIAJ, "Telecommunications Equipment Statistics," *CIAJ Quarterly*, November 1997, found at <http://www.ciaj.or.jp/ciaj/ciaj-e/quarter/ci000980.html>, retrieved June 30, 1998.

²⁴⁸ The NCCs compete with NTT in the long-distant market. U.S. Department of State telegram, "Overview of Japanese Telecommunications Market."

A variety of developments have affected Japan's telecommunications equipment market and could provide increased opportunities for U.S. and other foreign telecommunications equipment producers. In particular, sources in Japan report that the wireless communications market is expanding quickly and the future for foreign suppliers is very promising.²⁴⁹ Past and present factors influencing market growth and opportunities include deregulatory measures, consumer demand, liberalization of Japan's telecommunications services industry, bilateral and multilateral trade agreements, government and private efforts to develop Japan's telecommunications infrastructure, and technological innovations.

The Japanese Government has undertaken some deregulatory measures in recent years affecting demand for telecommunications equipment. In 1994, per the U.S.-Japan Cellular Telephone Agreement, the government liberalized regulations on wireless communications terminals, such as cellular handsets and pagers, allowing Japanese customers to purchase these products for the first time, rather than lease them from carriers. Industry sources reported that this resulted in new competition, lower prices, and a tenfold increase in cellular telephone service by 1996, which, in turn, increased the number of service providers purchasing equipment.²⁵⁰ In addition, the Japanese Government introduced an "advanced notification regime" in 1996, allowing wireless carriers to set their own rates after first notifying MPT. This has led all wireless rates to fall even further and to a rapid implementation of new technologies.²⁵¹

Further, as rates for cellular phone service have fallen in the past 2 years, the advantages once associated with the lower cost, shorter range Personal Handyphone System (PHS)²⁵² have nearly disappeared. As a result, cellular phone subscriptions doubled in 1995 and 1996 and increased 47 percent in 1997, numbering over 33 million in May 1998.²⁵³ In addition, cellular service demand is beginning to compete with NTT's traditional wireline infrastructure. U.S. Government representatives report that as cellular phone rates have fallen, many younger, single Japanese consumers are choosing to eliminate home wireline telephones and instead solely use cellular telephones, in large part to avoid NTT's one-time wireline hook-up fee of ¥72,000 (approximately \$700).²⁵⁴

Further deregulation scheduled for 1999, when MPT plans to restructure NTT into two competing local-service companies and a long-distance company, has led to changes in Japan's telecommunications business environment.²⁵⁵ In anticipation of the restructuring, service providers are scrambling to position themselves for competition in the domestic market. Japan's top international carrier, Kokusai Denshin Denwa (KDD), is discussing alliances with smaller service providers to compete in the domestic market.²⁵⁶ For example, KDD and Teleway Japan Corp., a long-distance carrier, have agreed to merge in December 1998 to compete in next-generation cellular

²⁴⁹ USDOC, International Trade Administration, National Trade Data Bank, "Japan-- Wireless Communications," Stat-USA Database, Mar. 1, 1998, found at <http://www.stat-usa.gov>, retrieved June 2, 1998.

²⁵⁰ American Chamber of Commerce in Japan, *Making Trade Talks Work: Lessons from Recent History*, (Tokyo: ACCJ, 1997), p. 29.

²⁵¹ USDOC, "Japan-- Wireless Communications."

²⁵² PHS is the Japanese version of Personal Communications Services (PCS).

²⁵³ Demand for PHS peaked at approximately 7 million subscribers in September 1997. USDOC, "Japan--Wireless Communications," and USDOC official, Office of Telecommunications, fax to USITC staff, Aug. 7, 1998.

²⁵⁴ NTT has been financing the construction of its nationwide infrastructure in part with this fee since 1952. USDOC, "Japan-- Wireless Communications."

²⁵⁵ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, p. 209.

²⁵⁶ "Telecom Companies Seeking Allies," *The Nikkei Weekly*, Nov. 17, 1997, p. 1.

telephones and wireless telephone networks for business use, as well as promotion of Internet channels.²⁵⁷ Increased competition in the services market offers promise of opportunities for foreign equipment suppliers who have had difficulty selling to dominant NTT.

Japan's telecommunications services market has become more open to foreign service providers. A large step toward greater liberalization came as a result of the WTO's Agreement on Basic Telecommunications Services, implemented February 5, 1998. Japan abolished regulations on foreign companies' access to facility-based or Type-I telecommunications carrier licenses and now allows complete foreign equity ownership, including ownership of wireless communications service providers. The only exception is foreign ownership of NTT, either direct or indirect, which remains limited to 20 percent.²⁵⁸ As a result, the number of foreign firms providing telecommunications services in Japan is increasing, which should provide sales opportunities for foreign equipment suppliers.²⁵⁹ Finally, under the U.S.-Japan Enhanced Initiative on Deregulation and Competition Policy, agreed upon in June 1997, Japan consented to further deregulate its basic telecommunications services industry, including eliminating the foreign ownership restrictions on KDD, and reduce fees and simplify procedures for testing and certifying wireless equipment.²⁶⁰

Other U.S.-Japan bilateral trade agreements discussed above have had various degrees of success in raising the level of foreign telecommunications equipment sales in Japan. The NTT Procurement Agreement appears to have been moderately effective, resulting in U.S. and other foreign telecommunications equipment suppliers selling over \$1.5 billion of products to NTT in 1996, compared to almost no sales to NTT in 1980, when the agreement was first negotiated.²⁶¹ However, U.S. industry sources report that while NTT's procurement procedures have become more transparent, NTT's foreign equipment procurement remains low compared with patterns in other countries, and interpreting NTT's equipment standards remains a challenge.²⁶² U.S. industry has also stated that the 1994 agreement on non-NTT government and quasi-government procurement of telecommunications products and services has not resulted in foreign sales or market share increase.²⁶³ However, this market is relatively small compared with NTT.

Government and private investment in Japan's telecommunications infrastructure should also provide market opportunities for equipment suppliers. The Japanese Government's joint effort with NTT to connect all homes, offices, schools, and government entities to a nationwide fiber optic

²⁵⁷ "KDD, Teleway Finalize Deal for Merger Next December," *Japan Times*, July 25, 1998, found at <http://www.japantimes.co.jp/news/news7-98/newshtml>, retrieved July 29, 1998.

²⁵⁸ For more information, see USITC, *Recent Trends in Services Trade*, USITC publication No. 3105, May, 1998, p. 4-60. Under this agreement, Japan also had limited to 20 percent any foreign direct and indirect ownership of KDD. However, Japan's KDD law, passed in May 1998, abolished all foreign ownership restrictions on KDD.

²⁵⁹ Foreign companies that participated in wireless telephony in Japan as of winter 1998 were GTE, AirTouch International, Motorola, U.S. West, Time Warner, British Telecom, Cable & Wireless, Nextel Communications, Mannesmann Eurocom, and Bell Canada. USDOC, "Japan-- Wireless Communications."

²⁶⁰ USTR, *1998 NTE*, pp. 196-197.

²⁶¹ However, the product groupings under the agreement are broader than the list of products covered in this report. For example, the agreement includes some computer-related equipment. USTR, "U. S. and Japan Agree to Extend and Strengthen the NTT Procurement Procedures and Arrangements," press release, Oct. 1, 1997, and USDOC official, Office of Japan Trade Policy, telephone interview by USITC staff, Aug. 11, 1998.

²⁶² ACCJ, *Making Trade Talks Work: Lessons from Recent History*, pp. 22-24.

²⁶³ *Ibid.*, pp. 33-36.

network is expected to continue to drive demand for wireline equipment.²⁶⁴ In light of cost concerns, the plan has been modified recently to include broadband wireless access technologies such as wideband- CDMA (W-CDMA), discussed below, which should further drive demand in wireless equipment.²⁶⁵

New technologies also are influencing increased investment in Japan's telecommunications infrastructure. Growing use of the Internet is fueling Japanese demand for both wireline and wireless telecommunications equipment.²⁶⁶ According to MPT, the number of integrated services digital network (ISDN)²⁶⁷ service subscribers increased over 100 percent between March 1996 and March 1997. Japan's wireless market is growing so rapidly that current systems are expected to reach maximum capacity by the end of the 1990s. Japan's three major service providers, NTT DoCoMo,²⁶⁸ Daini Denden Inc. (DDI), and Nippon IDO Tsushin Co. (IDO), are working with foreign partners on new technologies to address this situation, including various versions of CDMA technology.²⁶⁹ Industry analysts believe there may be opportunities for foreign equipment firms to provide CDMA technology to the Japanese market.²⁷⁰ DDI and IDO have been developing a second generation digital cellular system, called "CDMA 95,"²⁷¹ based on a North American version of CDMA developed by U.S.-based Qualcomm.²⁷² DDI and IDO have installed \$3 billion of CDMA equipment supplied by Motorola, and Motorola's recently announced R&D investment in Japan will focus on third generation digital cellular technologies.²⁷³

While these developments may increase Japanese market opportunities for foreign telecommunications equipment suppliers, some factors may temper these potential opportunities. The International Telecommunication Union's (ITU) forthcoming decision on a third generation wireless systems standard,²⁷⁴ known as International Mobile Telecommunications 2000 (IMT-2000), may affect U.S. telecommunications equipment producers' competitive position vis-a-vis other foreign producers in the Japanese market. The EU and Japan have proposed that IMT-2000 be based on W-CDMA, a version of CDMA advocated by the European Telecommunications Standards Institute (ETSI) that is backwards compatible with GSM, the European second generation

²⁶⁴ U.S. Department of State telegram, "Overview of Japanese Telecommunications Market."

²⁶⁵ NTT is trying to cut costs in light of the increasing competition in the domestic market it anticipates after its breakup. "NTT Leaves Door Open for ADSL Domestic Access," *Communications International Reports*, June 3, 1998, found at <http://www.totaltele.com>, retrieved June 4, 1998.

²⁶⁶ "Fujitsu and Telecommunications," Fujitsu Limited, Dec. 1996, found at <http://www.fujitsu.com>, retrieved Oct. 2, 1997.

²⁶⁷ ISDN provides an end-to-end digital connecting, whereas regular telephone service relies on an analog connection. Digital signals allow much faster data transmission.

²⁶⁸ NTT's subsidiary that provides cellular services.

²⁶⁹ USDOC, "Japan-- Wireless Communications."

²⁷⁰ Ross, E-mail correspondence with USITC staff, Oct. 17, 1997.

²⁷¹ Also known as "cdmaOne."

²⁷² "Japan Competes to Set the Global Standard for Next-Generation Wireless Telecommunications," *Japanese High-Tech News*, Jan. 28, 1998, found at <http://www.ascii.co.jp/english/news/archive/98/01/28/>, retrieved July 1, 1998.

²⁷³ USDOC, *U.S. Industry and Trade Outlook 1998* (New York: McGraw-Hill, 1997), p. 31-19, USDOC official, Office of Telecommunications, fax to USITC staff, Aug. 7, 1998, and "Motorola CIG Establishes 3G Wireless Research and Development Center in Japan," Motorola, press release, June 24, 1998.

²⁷⁴ Analog cellular is considered the first generation, and digital cellular/personal communications services (PCS) is considered the second generation. The third generation standard is envisaged as having a single, universal air interface that will enable global roaming, high-speed data transfer capabilities, and new mobile multimedia transmission services.

cellular standard but is not compatible with the dominant U.S. standards, CDMA and TDMA. The United States has proposed CDMA 2000, which was developed in the United States and is backwards compatible with both second generation CDMA systems as well as GSM. Many U.S. industry representatives also advocate that IMT-2000 be a convergence of the W-CDMA and CDMA 2000 proposals.²⁷⁵ If the ITU adopts W-CDMA in its current form, and the standard is deployed in Japan, U.S. producers would be at a disadvantage in the Japanese market vis-a-vis European suppliers of GSM equipment, including Ericsson and Nokia. Both of these European producers as well as Lucent are currently working with NTT DoCoMo, Japan's largest cellular operator, to develop W-CDMA.²⁷⁶

Despite rapid growth in Japan's wireless infrastructure market and the potential deployment of an international standard, analysts believe that U.S. and other foreign companies will face substantial domestic competition in Japan's cellular equipment market. NEC dominates the Japanese market for cellular and PHS systems, despite U.S. firms' strong bids for such contracts.²⁷⁷ Several of Japan's large equipment suppliers produce cellular equipment including Matsushita, which produces cellular telephones and pagers; Oki, which makes cellular telephones; and NEC and Fujitsu, which produce cellular telephones, pagers, and wireless communications infrastructure products including base stations.²⁷⁸ These firms sell equipment to NTT DoCoMo, DDI, and IDO, as well as other digital carrier networks and PHS network providers. While U.S.-based Motorola has been successful in selling base stations to IDO and DDI, it has not been as successful in selling cellular telephones themselves.²⁷⁹

In addition, sources report that Japan's wireline market may remain for the most part fairly closed for foreign firms for the foreseeable future because of the continuing dominance of NTT.²⁸⁰ Despite privatization and liberalization, NTT continues to maintain its own R&D and software development laboratories and buy almost exclusively from its traditional Japanese suppliers.²⁸¹ In the wireline market, NTT still controls nearly 98 percent of local lines and switching equipment and maintains high access fees for competitors.²⁸² Although NTT has 130 NCC competitors in the long-distance market, the NCC's are very small in size and do not yet truly compete with NTT.²⁸³ Further, these competitors must either lease lines from NTT, or, because of NTT's monopolistic position, deploy

²⁷⁵ USDOC official, Office of Telecommunications, fax to USITC staff, Aug. 11, 1998.

²⁷⁶ "Japan Competes to Set the Global Standard for Next-Generation Wireless Telecommunications," *Japanese High-Tech News*, Jan. 28, 1998, found at <http://www.ascii.co.jp/english/news/archive/98/01/28/>, retrieved July 1, 1998, and USDOC, "Japan--Wireless Communications."

²⁷⁷ USDOC, *U.S. Industry and Trade Outlook 1998*, pp. 31-18.

²⁷⁸ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, pp. 183 and 185; "Qualcomm," Deutsche Morgan Grenfell Technology Group, U.S. Equity Research, Aug. 6, 1997, p. 1; "Panasonic-Product Categories," Matsushita Communication Industrial Co., Ltd, found at <http://www.panasonic.co.jp/mci/english/wmci/telecomm.html>, retrieved Oct. 6, 1997; and "Fujitsu and Telecommunications," Fujitsu Limited, Dec. 1996, found at <http://www.fujitsu.com>, retrieved Oct. 2, 1997.

²⁷⁹ Ross, interview by USITC staff.

²⁸⁰ Ross, "Japan's Telecommunications Industry: Where It's Been and Where It's Going," p. 31.

²⁸¹ Foreign Commercial Service officer, USDOC, U.S. Embassy, Tokyo, E-mail correspondence with USITC staff, Oct. 20, 1997.

²⁸² Ross, "Japan's Telecommunications Industry: Where It's Been and Where It's Going," p. 31.

²⁸³ Foreign Commercial Service officer, USDOC, U.S. Embassy, Tokyo, E-mail correspondence with USITC staff, Oct. 20, 1997.

networks compatible with NTT-specific network interface standards.²⁸⁴ Both options serve to keep the unique NTT standards in place and in effect keep foreign producers' sales in Japan relatively low.

Finally, the U.S. ability to monitor and enforce Japan's agreement to provide foreign equipment manufacturers more competitive opportunities to sell to NTT could be threatened by the restructuring of NTT in 1999. At the most recent renewal Japan refused to extend the NTT Agreement beyond NTT's restructuring, insisting on renegotiating it at that time.²⁸⁵ Nonetheless, failure to renew the agreement would not necessarily affect foreign manufacturers' sales to private entities in Japan, although these entities still comprise a relatively small share of the Japanese market.

²⁸⁴ Ibid., and Ross, E-mail correspondence with USITC staff, Oct. 17, 1997.

²⁸⁵ USTR, "U.S. and Japan Agree to Extend and Strengthen the NTT Procurement Procedures Arrangements."

CHAPTER 6

KOREA

Korea's telecommunications equipment market increased rapidly during 1993-97, from \$2.3 billion to \$5.8 billion, an average annual rate of 27 percent. Until the recent financial crisis, opportunities had been expected to grow over the next several years for U.S. sales of telecommunications equipment as economic restructuring and deregulation in the telecommunications services sector accelerated, the Korean government loosened its monopoly control over service providers and their equipment purchases,²⁸⁶ demand for new wireless services increased purchases of pagers and mobile telephones, and the government invested heavily in digital switching and networking infrastructure.²⁸⁷ However, the collapse of the Korean currency (the won) in late 1997 led to a slowdown in Korean procurement of telecommunications equipment during 1998 which is expected to continue.

Korea is one of the most difficult markets in Asia in terms of market access and foreign investment. Its trade policies remain structured primarily to encourage technology transfer, promote the import of inputs used in export industries, and discourage imports that compete with domestic products. Despite these restrictions, total imports of telecommunications equipment comprised 36 percent of apparent consumption in 1997, increasing from 28 percent in 1993. The United States was the largest source of these imports during 1993-97 and was also a leading recipient of Korean exports of these products. In terms of foreign investment, only a few of the world's leading telecommunications firms currently operate production facilities or joint ventures with domestic firms in Korea. Much of the government-to-government dialogue between the United States and South Korea has been aimed at removing trade and investment barriers in this industry.²⁸⁸

Industry Structure

Production of telecommunications equipment in Korea more than doubled to \$5.9 billion during 1993-97,²⁸⁹ an average annual increase of 20 percent (table 6-1). Parts and accessories, miscellaneous radio telecommunications equipment, mobile radio equipment (including cellular telephones), switching equipment, telephone sets, and facsimile machines were the major products manufactured by the Korean industry, accounting for 95 percent of Korean production during 1997 (figure 6-1).

²⁸⁶ U.S. Department of Commerce (USDOC), National Trade Data Bank (NTDB), Big Emerging Markets, "The Big Emerging Sectors in South Korea," Stat-USA Database, July 18, 1995, found at <http://www.stat-usa.gov/bems/bemssoko/sokobes.html>, retrieved Oct. 9, 1997.

²⁸⁷ USDOC, NTDB, Market Research Reports, "Korea - Wireless Mobile Telecom Equipment," Stat-USA Database, April 1, 1997, found at <http://www.stat-usa.gov/>, retrieved Sept. 21, 1998.

²⁸⁸ USDOC, NTDB, Big Emerging Markets, "South Korea - Market Access and Competition," Stat-USA Database, found at <http://www.stat-usa.gov/bems/bemssoko/sokomac.html>, retrieved Oct. 9, 1997.

²⁸⁹ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 4th and 5th ed. (Surrey: Reed Business Information, 1997), and Reed Electronics Research, *Yearbook of World Electronics Data 1998/99*, volume 3, (Surrey: Reed Business Information, 1998).

Table 6-1
Telecommunications equipment: Korea's production, imports, exports, and apparent consumption, 1993-97

Year	Production	Imports	Exports	Apparent consumption	Ratio of imports to consumption
-----Million dollars-----					Percent
1993	2,848	623	1,213	2,258	27.6
1994	3,534	981	1,484	3,031	32.4
1995	4,218	1,288	1,723	3,783	34.0
1996	4,833	1,627	1,769	4,691	34.7
1997	5,929	2,117	2,221	5,825	36.3

Sources: Estimated by USITC staff based on Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 5th ed., and Reed Electronics Research, *Yearbook of World Electronics Data* (various editions).

Parts and accessories, the largest sector of the Korean telecommunications equipment industry, grew by an average of 22 percent per year during this period, while mobile telephone equipment was the fastest growing segment, increasing by an average of 34 percent per year.²⁹⁰ Mobile telephone equipment production will likely continue to rise to meet increasing foreign demand for cellular handsets and greater domestic demand as new wireless services companies invest in infrastructure.²⁹¹ The Ministry of Information and Communications (MIC) forecasts that equipment purchases by the 27 companies selected to provide national or regional wireless services will reach almost \$6.5 billion by the year 2000.²⁹²

There are over 50 companies that manufacture telecommunications equipment in Korea.²⁹³ The largest include Samsung Electronics Corporation (Samsung), LG Information & Communications (LGIC), Daewoo Telecommunications (Daewoo), Hyundai Electronics Industries (HEI), Hanwha Corporation (Hanwha), Motorola, Nokia, and Philips Electronics (table 6-2). Of these, the Korean-headquartered companies accounted for almost \$4.5 billion in sales in 1996 with Samsung alone accounting for over half of this total.²⁹⁴ Samsung also ranked tenth in revenues in a listing of the world's top communications equipment firms in 1997, the only wholly-Korean manufacturer to place in the top 50.²⁹⁵

The Korean telecommunications equipment industry is dominated by a few large firms which are subsidiaries of larger industrial conglomerates with operations in a variety of different industries.

²⁹⁰ Ibid.

²⁹¹ USDOC, "Korea - Wireless Mobile Telecom Equipment".

²⁹² Ibid.

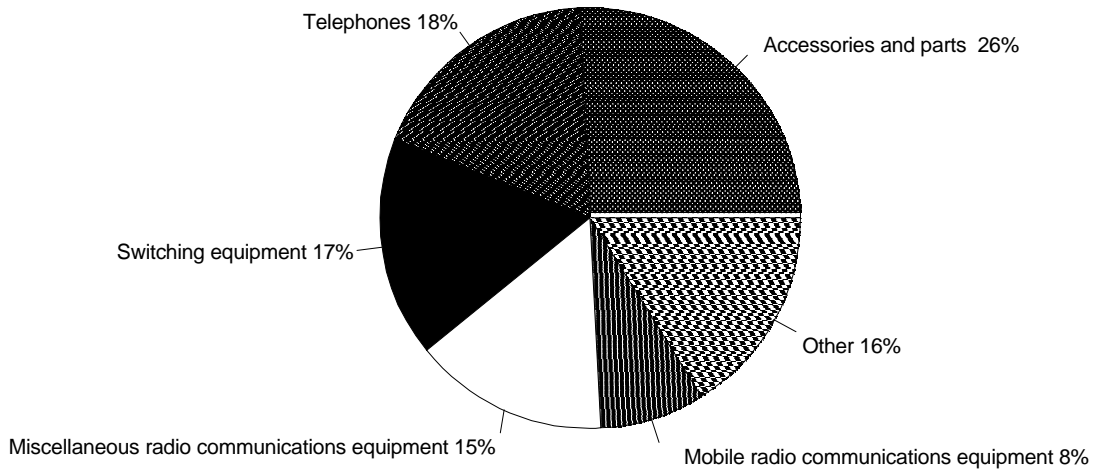
²⁹³ Compiled from company reports, information provided by the Electronics Industry Association of Korea, and the Electronics and Telecommunications Research Institute of the Korean Ministry of Information and Communication (ETRI).

²⁹⁴ USDOC, NTDB, Market Research Reports, "Korea: Telecom Giants Expand Investments," Stat-USA Database, found at <http://www.stat-usa.gov/>, retrieved Sept. 30, 1997.

²⁹⁵ "Top 50 Equipment Manufacturers, Ranked by Revenue," *Communications Week International*, Nov. 24, 1997, p. 31.

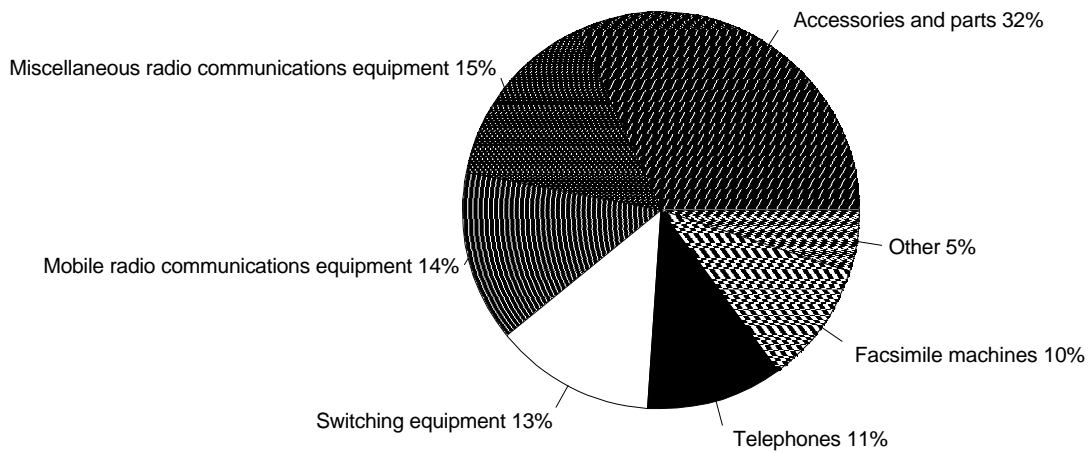
Figure 6-1
Telecommunications equipment: Korean production, 1993 and 1997

1993



Total production: \$2.8 billion

1997



Total production: \$5.9 billion

Source: Estimated by USITC staff based on Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 5th ed., and Reed Electronics Research, *Yearbook of World Electronics Data* (various editions).

Table 6-2
Telecommunications equipment: Major producers in Korea, selected products, and headquarter country

Company name	Selected products	Headquarter country
Motorola	Telephone components, pagers.	United States
DaewooTelecom	Wireline switching and transmission equipment.	Korea
Hanwha Corporation/Telecom	Wireless and wireline switching and transmission equipment.	Korea
Hyundai Electronics Industries Co.	Wireless and wireline infrastructure, wireless telephone handsets and pagers.	Korea
LG Information and Communications	Wireless and wireline switching and transmission equipment, and wireless telephone handsets.	Korea
Pantech Corporation	Wireless telephone handsets and pagers.	Korea
Samwoo Telecomm	Wireless and wireline transmission equipment.	Korea
Samsung Electronics	Wireless and wireline infrastructure equipment, wireless telephone handsets.	Korea
Tandy Nokia Mobile Telephone	Wireless telephone handsets.	Finland
Philips Electronics	Pagers, wireless telephone handsets, telephone parts.	Netherlands

Source: Compiled by USITC staff based on Dr. Byung-il Choi, Yong Ah Lee, Sakina Dhilawala, *Telecoms in South Korea: An Industry and Market Analysis*, (New York: Northern Business Information, 1997), ITU, Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, the Korean Ministry of Information and Communication, the Electronics Industry Association of Korea, various company annual reports, and company World Wide Web sites.

These Korean conglomerates, commonly referred to as chaebol, are similar to Japanese industry groups, often called keiretsu, in that they “consist of tightly-linked large and small firms that engage in a very broad range of production activities.”²⁹⁶ Like the Japanese keiretsu, Korean firms grew by aggressively exporting goods to open markets such as the United States.²⁹⁷ Although smaller companies do exist in the Korean telecommunications equipment industry, the Korean economy has traditionally been geared towards large-scale firms, favoring chaebol or chaebol subsidiaries, which restricts the long-term viability of small- and medium-sized enterprises.²⁹⁸ However, the Korean government has recognized the importance of supporting small- and medium-sized businesses in the sector and several smaller firms such as Pantech and Samwoo Telecomm have attracted government support.²⁹⁹

²⁹⁶ John Zysman and Eileen Doherty, “The Evolving Role of the State in Asian Industrialization,” Berkeley Roundtable on the International Economy (BRIE) Working Paper no. 84, Nov. 1995, pp. 5-6.

²⁹⁷ Ibid. However, Korean conglomerates are distinct from their Japanese counterparts as they are not centered on their own banks or financial institutions.

²⁹⁸ Zysman and Doherty, “The Evolving Role of the State in Asian Industrialization,” pp. 5-6, and World Technology Evaluation Center (WTEC), *WTEC Report on the Korean Electronics Industry, Executive Summary*, June 18, 1997, p. 2, found at <http://www.itri.loyola.edu/>, retrieved Sept. 1, 1998.

²⁹⁹ Sang-Mi Lee, ETRI, “Promising Small & Medium Sized Companies in Korean Information Technology Industry,” powerpoint presentation delivered during a symposium on foreign direct investment sponsored by the Ministry of Information of Communication, July 9, 1998.

Further, Korean firms in the telecommunications equipment and other industries are largely dependent on research, development, and product innovation that takes place in foreign markets such as the United States, Japan, and the EU.³⁰⁰ It is estimated that Korean firms paid royalties of almost \$1.9 billion during 1995 for foreign technology, with electric and electronics companies accounting for the largest share.³⁰¹ For instance, some Korean telecommunications equipment companies produce wireless telephones, base station facilities, and switching systems using Code Division Multiple Access (CDMA) technology but must pay royalties to the U.S. firm Qualcomm, the holder of the technology patent.³⁰²

Although Korea has removed most of its formal trade and investment barriers, both foreign investment and market access in the telecommunications equipment industry in Korea is generally limited as the Korean government tended to promote domestic companies in the sector.³⁰³ Korean firms have typically used joint venture arrangements with leading foreign manufacturers to facilitate the transfer of technology.³⁰⁴ Such arrangements have included joint ventures between: Alcatel and Samsung, AT&T and LGIC, Ericsson and Hanwha, and Nortel and Daewoo.³⁰⁵ Most of these arrangements have been dissolved.³⁰⁶

Notable exceptions to the dearth of foreign direct investment in the sector include Motorola, Nokia, and Philips Electronics. Motorola owns a facility in Paju that manufactures telecommunications products such as pagers and components, and also operates several research and development sites in Korea devoted to new telecommunications products.³⁰⁷ In addition, Motorola holds a 20 percent interest in Pantech, a Korean manufacturer of pagers and wireless telephone handsets.³⁰⁸ Pantech will reportedly supply CDMA telephones to Motorola on an original equipment manufacturer (OEM) basis as part of a strategic agreement concluded by the two companies.³⁰⁹ Nokia owns a manufacturing facility in Masan, a Free Export Zone, where it produces wireless telephone handsets for U.S. and Asian markets.³¹⁰

However, Korea has begun to take steps to bring more foreign investment into the economy.³¹¹ As of February 1997, requirements for investment applications were eliminated, and foreign investors currently need only notify the government of their intentions to invest. The government can reject a notification only if the activity appears in an explicit “negative list” or is related to national

³⁰⁰ Zysman and Doherty, “The Evolving Role of the State in Asian Industrialization,” pp. 5-6.

³⁰¹ WTEC, *WTEC Report on the Korean Electronics Industry, Executive Summary*, p. 6.

³⁰² USDOC, “Korea - Wireless Mobile Telecom Equipment.”

³⁰³ Office of the United States Trade Representative (USTR), *1998 National Trade Estimate on Foreign Trade Barriers (NTE)*, found at <http://www.ustr.gov/reports/nte/1998/contents.html>, retrieved July 31, 1998, p. 272.

³⁰⁴ WTEC, *WTEC Report on the Korean Electronics Industry, Executive Summary*, p. 6, and Youngsoo Kim, “Technological Capabilities and Samsung Electronics’ International Production Network in Asia,” Berkeley Roundtable on the International Economy (BRIE) Working Paper No. 106, Nov. 1997, p. 27.

³⁰⁵ Dr. Byung-il Choi, YongAh Lee, Sakina Dhilawala, *Telecoms in South Korea: An Industry and Market Analysis*, (New York: Northern Business Information, 1997), pp. 95-115.

³⁰⁶ Choi, Lee, and Dhilawala, *Telecoms in South Korea: An Industry and Market Analysis*, pp. 95-115.

³⁰⁷ Motorola, 10-K Report, March 20, 1998, and company press release.

³⁰⁸ “Motorola Buys 20% Stake in Pantech,” *Korea Inc.*, May 20, 1998, and company press release.

³⁰⁹ *Ibid.*

³¹⁰ Korea Trade & Investment Promotion Agency (KOTRA), “Telecom Investment gets a Boost,” *Korea Trade and Investment*, Sept.-Oct. 1997, found at <http://www.kotra.co.kr>, retrieved Sept. 3, 1998.

³¹¹ USTR, *1998 NTE*, pp. 253-272.

security, the maintenance of public order, the protection of public health, morality, or safety. Objections must be noted within 50 days or the investment is presumed to be legal. Despite these market opening measures, U.S. firms maintain that barriers remain.

In contrast to limited foreign investment in the Korean market, Korean telecommunications equipment companies have been active investors overseas. For instance, Daewoo has established joint ventures and subsidiaries in China, Uzbekistan, and the Ukraine to manufacture telecommunications equipment.³¹² LGIC has several subsidiaries in the United States, and joint ventures in Romania, Russia, China, Cambodia, India, and Vietnam.³¹³ HEI has joint venture operations for satellite telecommunications in Finland, India, Pakistan, and Thailand.³¹⁴ Generally, Korean firms established joint ventures or subsidiaries in overseas locations to engage in basic final assembly or low-end manufacturing at lower cost.³¹⁵ In particular, Korean telecommunications equipment manufacturers have invested in newly emerging economies in Europe and Asia where they assemble switching equipment and fax machines.³¹⁶ In more developed economies, Korean firms tend to manufacture consumer-oriented products, such as CDMA handsets produced by LGIC subsidiaries in the United States.³¹⁷ Further, LGIC has opened several research and development centers in the United States in an attempt to strengthen its ability to build or acquire new technologies.³¹⁸

Trade

Korean trade in telecommunications equipment has increased steadily during 1993-1997. Import growth averaged 36 percent annually while exports increased at a slower rate of 16 percent per year, as domestic market demand has outpaced increases in shipments abroad. Korean telecommunications equipment imports have more than tripled since 1993, reaching \$2.1 billion in 1997 (table 6-1). Since 1995, imports have accounted for more than one-third of total domestic consumption. Imports have grown largely as a result of rising demand for mobile transmission equipment and wireline infrastructure equipment.³¹⁹ From 1993-97, cellular telephones and miscellaneous telephonic apparatus grew from 32 percent to 59 percent of imports, while miscellaneous radio telecommunications equipment declined from 30 percent to 13 percent.³²⁰ Parts of telephonic apparatus were the third major import category in 1997.

The United States is a leading supplier of telecommunications equipment to Korea. Telecommunications equipment from the United States increased from \$334 million in 1993 to \$796 million in 1997 (table 6-3), growing at an annual rate of 24 percent. However, the U.S. share

³¹² Choi, Lee, and Dhilawala, *Telecoms in South Korea: An Industry and Market Analysis*, p. 101.

³¹³ *Ibid.*, pp. 96-97.

³¹⁴ *Ibid.*, pp. 108-109.

³¹⁵ Zysman and Doherty, "The Evolving Role of the State in Asian Industrialization," p. 9, and Kim, "Technological Capabilities and Samsung Electronics' International Production Network in Asia," p. 22.

³¹⁶ Choi, Lee, and Dhilawala, *Telecoms in South Korea: An Industry and Market Analysis*, pp. 96-102.

³¹⁷ *Ibid.*, pp. 96-97.

³¹⁸ *Ibid.*

³¹⁹ EIAK, "1996 Review and 1997 Outlook by Industrial Sector: Telecom Products," *Korean Electronics Overview*, found at <http://eiak.com/4.html>, retrieved Oct 16, 1997, and Choi, Lee, and Dhilawala, *Telecoms in South Korea: An Industry and Market Analysis*, pp. 85-93.

³²⁰ Korean Customs Administration, *Statistical Yearbook of Foreign Trade*, 1992 and 1996 editions.

Table 6-3
Telecommunications equipment: Korea's trade with the United States, 1993-97

Year	Imports from the United States	Exports to the United States	U.S. share of Korean imports	U.S. import share of apparent consumption
	-----Million dollars-----		-----Percent-----	
1993	334	236	53.6	14.8
1994	705	394	71.9	23.3
1995	619	469	48.1	16.4
1996	769	291	47.3	16.4
1997	796	471	37.6	13.7

Source: Estimated by the staff of the U.S. International Trade Commission based on official data of the U.S. Department of Commerce; Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 4th and 5th ed.; and Reed Electronics Research, *Yearbook of World Electronics Data 1998*. Figures presented in constant 1996 U.S. dollars (U.S. \$1 = 804 Korean won).

of Korea's telecommunications equipment imports decreased from 54 percent to 38 percent during the period. Of total sectoral imports from the United States, cellular telephones and cellular infrastructure equipment were the leading product categories, comprising 52 percent of the total in 1993 and 46 percent in 1997. Other leading categories were parts, the share of which fell from 27 percent in 1993 to 20 percent in 1997; and wireline transmission equipment, the share of which rose from 1 percent to 15 percent.³²¹

As a result of the Uruguay Round negotiations, Korea's bound import tariff rates on telecommunications equipment range from 6 percent to 13 percent ad valorem. U.S. firms report that the combination of tariffs and non-discriminatory value-added taxes for manufactured products has often been sufficient either to keep imports out of the Korean market or raise their prices such that competitiveness is significantly diminished.³²² However, tariffs are falling for some telecommunications products. In 1996, the Electronic Industries Association of Korea (EIAK) recommended that 44 items be designated "high tech," in addition to an existing 72 items and, thus, subject to tax reduction or exemption. Once designated, these items will be subject to a 5.6-percent tariff, rather than the 8 percent tariff that is currently applied.³²³ In addition, Korea is a signatory to the Information Technology Agreement which requires that import tariffs on virtually all telecommunications equipment be reduced to zero by the year 2000.

Korean exports of telecommunications equipment grew from \$1.2 billion in 1993 to \$2.2 billion in 1997.³²⁴ Major exports were telephone sets, cellular telephones, facsimile machines, and miscellaneous radio telecommunications equipment. Although the composition of Korea's exports has changed little since 1993, the level of concentration in these product categories was far greater in 1997. In 1993, these four categories comprised 64 percent of telecommunications equipment exports, whereas, they increased to 99 percent in 1996.³²⁵ Further, telephone sets as a share of the

³²¹ Estimated by USITC staff based on USDOC data.

³²² USTR, *1998 NTE*, pp. 253-272.

³²³ EIAK, "Major Activities and Achievements in 1996: Deregulation For Fair Competition," *Korean Electronics Overview*, found at <http://eiak.com/20.html>, retrieved Oct 16, 1997.

³²⁴ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 4th and 5th ed., and Reed Electronics Research, *Yearbook of World Electronics Data 1998*.

³²⁵ Korean Customs Administration, *Statistical Yearbook of Foreign Trade*, 1992 and 1996 editions.

total increased from 20 percent to 36 percent and cellular telephones increased from a 10 percent share to 29 percent during this period. Korean export growth slowed in 1996 mostly as a result of reduced exports of mobile phones that account for 40 percent of Korea's telecommunications equipment exports.³²⁶

Korea's major export markets for telecommunications equipment are the EU, the United States, Hong Kong, China, and Japan.³²⁷ The United States accounted for \$236 million, or 19 percent of Korea's telecommunications equipment exports in 1993, second only to the EU.³²⁸ Korea's sectoral exports to the United States increased steadily between 1993 and 1995, reaching \$469 million, 27 percent of total sectoral exports to the world. However, in 1996, exports to the United States dropped to \$291 million before rebounding to \$471 million, or 21 percent of all exports, in 1997.³²⁹ Samsung leads the Korean industry in telecommunications equipment exports although Daewoo and LGIC are also very export-oriented.³³⁰

Cellular telephones comprised the bulk of Korea's telecommunications exports to the United States, and trends within this product group dictated overall export patterns. In 1993, these telephones accounted for 39 percent of all Korean telecommunications equipment exports to the United States, increasing to 74 percent in 1995, declining to 50 percent in 1996, and growing again to 70 percent in 1997.³³¹ As discussed above, reduced exports of cellular telephones contributed to an overall drop in Korean telecom exports to the world in 1996. This included a 60 percent drop in exports of cellular telephones to the United States. This decline in Korean exports was caused by excess inventories and competitive pricing in the U.S. cellular handset market³³² as well as the rise in U.S. market share of Mexican producers as a result of the 1995 peso devaluation and the entry into force of the NAFTA. However, by 1997, telephone inventories had declined and digital wireless systems were being deployed, contributing to a rebound of 136 percent in Korean exports of cellular telephones to the United States, nearly matching 1995 export levels.³³³ Korea is in the forefront of developing state-of-the-art cellular products using the CDMA standard, and is expected to become a leading exporter of these and other telecommunications products. Prior to the Asian financial crisis, analysts predicted that Korea would export more than \$5 billion annually of telecommunications equipment by the year 2000. Such a scenario may yet occur as the depreciation of the Korean won in relation to the U.S. dollar may increase exports to the United States, although some analysts expect the Korean telecommunications industry to be one of the hardest hit as a result of the crisis.³³⁴

³²⁶ EIAK, "1996 Review and 1997 Outlook by Industrial Sector: Telecom Products."

³²⁷ Estimated by USITC staff based on Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*; Reed Electronics Research, *Yearbook of World Electronics Data* (various editions); and Korean Customs Administration, *Statistical Yearbook of Foreign Trade* (various editions).

³²⁸ Ibid.

³²⁹ Estimated by USITC staff based on USDOC data.

³³⁰ Ibid.

³³¹ Estimated by USITC staff based on USDOC data.

³³² Dennis Liebowitz, Eric Buck, Timothy Weller, and Eric S. Weinstein, *The Wireless Communications Industry* (New York: Donaldson, Lufkin, & Jenrette, Spring 1997), p. 47.

³³³ Estimated by USITC staff based on USDOC data.

³³⁴ USDOC, National Trade Data Bank, International Market Insight, "Korea - Implications for Economic Crisis," Stat-USA Database, Dec. 30, 1997, retrieved Sept. 22, 1998.

Trade Agreements and Nontariff Barriers

The United States and Korea have signed a number of agreements in recent years that directly address their bilateral trade in telecommunications equipment (table 6-4). During 1990-1991, the two countries developed several “Records of Understanding” intended to summarize the status of consultations on issues related to trade and investment in the telecommunications services and equipment industries. In 1992, the two countries reached an agreement covering value-added telecommunications services as well as telecommunications equipment standards, type approvals, procurement, and Korean tariff reductions.³³⁵

Table 6-4
Bilateral agreements on telecommunications equipment between the United States and Korea

Year	Agreement	Issue
1990 . . .	Record of Understanding on Telecommunications (1)	Standards, tariff reductions, government procurement.
	Record of Understanding on Telecommunications (2)	Standards, tariff reductions, government procurement.
1991 . . .	Record of Understanding on Telecommunications	Standards and government procurement.
1992 . . .	Understanding on Telecommunications Between the United States and Korea	Standards, procurement contracts, tariff reductions, type approval process and procedures.
1993 . . .	Exchange of Letters Relating to Korea Telecommunications Company’s Procurement of AT&T Switches	Procurement regulations, administration of regulations, Korea Telecom procurement contracts.
1995 . . .	Exchange of Letters on Telecommunications Issues Relating to Equipment Authorization and Korea Telecommunications Company’s Procurement	Korea Telecom procurement contracts, type approvals removals.
1996 . . .	Exchange of Letters on Implementation of the 1992 Telecommunications Agreement	Korea Telecom procurement contracts; protection of suppliers’ proprietary information, patents, trademarks, or other intellectual property; type approval regulations compliance.

Source: U.S. Department of Commerce, International Trade Administration, Market Access and Compliance Unit, Trade Compliance Center, *Trade Agreement Database*.

In 1993 and 1995, the United States and Korea exchanged letters regarding Korean implementation of the 1992 agreement, and in 1996 an understanding was reached on outstanding problems concerning the implementation of agreements recorded in 1990 and 1992.³³⁶ The 1996 agreement committed Korea to improve procurement procedures by government-owned Korea Telecom (KT) to ensure that U.S. suppliers receive equal treatment in procurement of advanced technologies, and provide effective protection of U.S. intellectual property rights in KT’s procurement process and the

³³⁵ USTR, *1997 Annual Report of the President of the United States on the Trade Agreements Program: Bilateral Agreements*, found at <http://www.ustr.gov/reports/tpa/1998/contents.html>, retrieved July 31, 1998.

³³⁶ Ibid.

government's type approval process.³³⁷ Finally, in 1997, the U.S. and Korean governments negotiated a Korean policy statement that addressed U.S. concerns, especially in the area of discriminatory procurement of telecommunications equipment, and in response, USTR revoked Korea's "priority foreign country" designation.³³⁸

As evidenced by bilateral agreements since 1992, the United States has repeatedly notified the Korean government of its concerns with discriminatory procurement of telecommunications equipment by both public and private entities. Reportedly, Korean government procurement needs are screened by the Ministry of Trade and Industry to determine if they can be met by local sources. This practice results in discrimination against foreign suppliers in cases where goods or services are available domestically.³³⁹ U.S. companies also contend that Korea Telecom continues to pursue a "buy local" requirement in its equipment procurement.³⁴⁰ Further, Korean telecommunications equipment makers have become significant shareholders in domestic telecommunications service providers, suggesting that they may influence procurement decisions.³⁴¹

Import restrictions as well as burdensome foreign investment requirements also continue to exist. Reportedly, Korea implements quantitative restrictions through its import licensing system whereby it routinely denies import licenses for products selected for "national promotion."³⁴² The list is revised on a quarterly basis at the request of Korean producers and usually includes about 80 high technology products, including information technology.³⁴³ Also, the foreign investment documentation requirement, described above, is still considered to be burdensome.³⁴⁴

Market

Korea's market for telecommunications equipment grew rapidly during 1993-1997. Apparent consumption rose from \$2.3 billion in 1993 to \$5.8 billion in 1997, increasing at an average annual rate of 27 percent (table 6-1). During this period, import penetration steadily rose from 28 percent to 36 percent, with imports from the United States accounting for 14 percent of total consumption in 1997.³⁴⁵ Overall expansion of the Korean telecommunications equipment market has been driven largely by massive infrastructure investment and growing demand for new wireless services.³⁴⁶ In 1996, the teledensity in Korea reached 43 telephones per 100 inhabitants, well above the world

³³⁷ Ibid.

³³⁸ The President, "Bilateral Negotiations," *The President's 1997 Annual Report on the Trade Agreements Program*, found at <http://www.ustr.gov/reports/tpa/1998/contents.html>, retrieved July 31, 1998. "Priority Foreign Countries" are those so-designated by the USTR because they deny mutually advantageous market opportunities to U.S. telecommunications exporters and their subsidiaries.

³³⁹ USTR, *1997 NTE*, found at <http://www.ustr.gov/reports/nte/1998/contents.html>, retrieved Sept. 24, 1997, pp. 233-252.

³⁴⁰ Ibid.

³⁴¹ "South Korea," ch. in *Asia: The Global Telecom Dynamo*, Sept. 1997, found at <http://www.telecoms-mag.com>, retrieved Sept. 2, 1998.

³⁴² USTR, *1998 NTE*, pp. 253-272.

³⁴³ Ibid.

³⁴⁴ Ibid.

³⁴⁵ Estimated by USITC staff based on USDOC data.

³⁴⁶ Choi, Lee, and Dhilawala, *Telecoms in South Korea: An Industry and Market Analysis*, pp. 85-93.

average of 13, but still significantly below the high-income-country average of 54.³⁴⁷ In both 1996 and 1997, Korean demand for telecommunications equipment grew by 24 percent, primarily as a result of the inauguration of digital cellular services, a sharp increase in subscriptions for paging services, and government investment in high-speed optical fiber networks.³⁴⁸ The fastest growing telecommunications products were personal communications (PCS) terminals, especially cellular phones.³⁴⁹

The primary customers for network infrastructure equipment in Korea are telecommunications services operators.³⁵⁰ Korea Telecom (KT) and a recently licensed Hanaro Telecom (a consortium led by DACOM and Korea Electric Power Corporation) provide local wireline services in Korea³⁵¹ whereas, domestic and international long distance wireline services are provided by KT, Dacom,³⁵² and ONSE Telecom.³⁵³ The leading wireless carriers in Korea are SK Telecom³⁵⁴ and Shinsegi Telecom.³⁵⁵ Further, the Korean government approved three additional wireless PCS, six TRS, eleven CT-2, three wireless data, one paging, and two leased line facility rental licenses in 1996.³⁵⁶ Many of these newly licensed providers began offering services in 1997.

All of the services operators described above, with the exception of KT, are privately-held firms with limited foreign investment. KT was a wholly government-owned provider of telecommunications services until 1993, when a limited portion of KT's equity shareholdings were sold to private investors. Although the Korean government currently holds the majority of shares in KT (71.2 percent), the remaining shares are held by Korean nationals and corporations.³⁵⁷

The future position of foreign equipment suppliers in the Korean market is uncertain. Despite the growth rate of the telecommunications equipment market, which has been much higher than that of any other industry in Korea,³⁵⁸ the recent collapse of the Korean won will likely lead to a decline in Korean procurement of such equipment and is likely to slow the growth of such imports. The

³⁴⁷ International Telecommunications Union (ITU), *World Telecommunications Development Report* (Geneva: ITU, 1997), p. A-6.

³⁴⁸ Kim Dong Gun, "Korea's Telecom Equipment Market Worth W5 Trillion In 1997," reported by Newsbytes News Network, Feb. 11, 1997, found at http://www.nb-pacifica.com/headline/koreastelecomequipmen_864.shtml, retrieved Dec. 15, 1997.

³⁴⁹ Ibid.

³⁵⁰ Choi, Lee, and Dhilawala, *Telecoms in South Korea: An Industry and Market Analysis*, p. 87.

³⁵¹ Ibid., p. 1.

³⁵² Dacom, originally the Korea Data Communication Corporation, was established in 1982 to hasten the development of data communications networks in Korea. The market for domestic long distance became a duopoly consisting of KT and Dacom in January 1996, and the market for data communication services was privatized in the early 1990s.

³⁵³ Choi, Lee, and Dhilawala, *Telecoms in South Korea: An Industry and Market Analysis*, pp. 1-2.

³⁵⁴ SK Telecom (formerly Korea Mobile Telecom, once a subsidiary of KT) is Korea's leading wireless communications service provider, established in 1984. While first providing only analog cellular service, the company launched digital cellular service in 1996, based on CDMA technology.

³⁵⁵ Choi, Lee, and Dhilawala, *Telecoms in South Korea: An Industry and Market Analysis*, pp. 1-2.

³⁵⁶ USDOC, "Korea - Wireless Mobile Telecom Equipment."

³⁵⁷ USDOC, NTDB, Market Research Reports, "Korea - Telecom's Shares for Sale," Stat-USA Database, July 7, 1998, found at <http://www.stat-usa.gov/>, retrieved Sept. 21, 1998.

³⁵⁸ *Business Korea*, Vol. 13, Iss. 12, Dec. 1996, pp. 32-35

exchange rate for the won declined from 902 to the dollar at the end of July 1997³⁵⁹ to 2,000 on Dec. 23, 1997.³⁶⁰

In addition, overseas telecommunications equipment makers fear that their market share in Korea will decline even as local Korean telecommunications service companies expand their operations and equipment purchases. The government has chosen communications equipment as the country's new strategic industry, to replace falling demand for steel and automobiles, and is likely to pressure the new service providers to select domestic equipment suppliers. Further, Korean telecommunications equipment makers have become significant shareholders in telecommunications services operators, and therefore have a major influence on procurement decisions.³⁶¹

However, recent openings in Korea's telecom services market will likely result in increased purchases of equipment, which could provide opportunities for foreign suppliers. In April 1998, the Korean Ministry of Information and Communications (MIC) revealed a plan to advance by 2 years the concession schedule Korea had submitted to the WTO for the liberalization of foreign equity investment in basic telecom services. Under this schedule, the MIC would eliminate the single foreign owner limit for basic telecom services, thus allowing any company to hold a majority share. It is hoped that this move would encourage the participation of large, foreign-owned companies with the necessary capital to upgrade the local telecommunications infrastructure. The plan is also expected to further open the Korean telecommunications market to competition and provide opportunities for U.S. service and equipment providers.³⁶² In particular, the MIC announced that it would completely privatize KT by the year 2001, allowing foreign investors to own 33 percent of KT by the end of 1998 and 49 percent in the first half of 1999.³⁶³ Foreign investment ceilings in privately-held telecommunications services firms also were raised to 33 percent in 1998 and will be raised further to 49 percent in 1999.³⁶⁴

Analysts believe that the wireless sector is the most promising for any near term growth in the Korean telecommunications equipment market.³⁶⁵ There are currently about 5 million Korean cellular phone subscribers,³⁶⁶ representing roughly 9 percent of the population. This low figure is partially due to the inability of SK Telecom to provide private subscriber connections and, as is the case with home telephones, significant unfilled demand remains.³⁶⁷ However, the number of wireless subscribers more than doubled in 1994, and has grown even more rapidly since a second provider of mobile service, Shinsegi Telecom, began operations in the first half of 1996.³⁶⁸ Foreign telecommunications equipment producers may have an opportunity to pursue this growing market.

³⁵⁹ International Monetary Fund (IMF), *International Financial Statistics*, Oct. 1997 (Washington, DC: IMF, 1997).

³⁶⁰ Currency Exchange, *Wall Street Journal*, Dec. 23, 1997, p. C17.

³⁶¹ "Asia: The Global Telecom Dynamo," *Telecommunications Magazine*, Sept. 1997, found at <http://www.telecoms-mag.com/marketing/articles/sep97/skorea.html>, retrieved Dec. 8, 1997.

³⁶² USDOC, NTDB, Market Research Reports, "Korea - Telecom Equity Invest Liberalized," Stat-USA Database, April 24, 1998, found at <http://www.stat-usa.gov>.

³⁶³ USDOC, "Korea - Telecom's Shares for Sale."

³⁶⁴ Ministry of Information and Communication, *Guide to Foreign Direct Investment in Korea's Telecommunications*, June 1998.

³⁶⁵ "Concern Over Economic Panic Mounts," *Korea Times*, Dec. 12, 1997, found at <http://www.koreatimes.co.kr/>, retrieved Dec. 12, 1997.

³⁶⁶ Choi, Lee, and Dhilawala, *Telecoms in South Korea: An Industry and Market Analysis*, pp. 2-3.

³⁶⁷ "Asia: The Global Telecom Dynamo," *Telecommunications Magazine*.

³⁶⁸ "National Information Infrastructure Initiatives in Korea: Vision and Policy Issues," found at <http://forum.nca.or.kr/info/g7pp/kii9601.htm#exist>, retrieved Dec. 19, 1997.

CHAPTER 7

MEXICO

Mexico's telecommunications equipment industry and market are relatively small on the global scale, although both are significant to and intricately linked with the United States. Mexico is the third largest market for U.S. exports of telecommunications equipment and, conversely, the U.S. market is the single largest destination for Mexican exports of such products. The implementation of the North American Free Trade Agreement (NAFTA) markedly increased U.S. telecommunications equipment trade with Mexico and, although the devaluation of the Mexican peso temporarily reduced Mexican demand for imports, it multiplied the beneficial effect of the NAFTA on exports. Government reforms and market liberalization as well as the privatization of Telefonos de Mexico (Telmex), the state-operated service provider and major equipment purchaser, also have influenced telecommunications equipment trade with Mexico.

Industry Structure

Mexico's telecommunications equipment industry is dominated by joint ventures, often between domestic companies and multinationals that are global leaders in the telecommunications equipment industry. Domestic manufacturing of telecommunications equipment is concentrated in low-technology products, such as telephone and telegraph equipment and, to an increasing extent, in cellular telephones and pagers, much of which is directly exported to the United States for distribution.³⁶⁹ Major multinational telecommunications producers in Mexico include Ericsson, Alcatel, Lucent Technologies (Lucent), Philips, Northern Telecom (Nortel), Nokia, and Motorola.

U.S.-based Lucent has manufacturing facilities in Guadalajara, Matamoros, and Reynosa, employing between 4,000 and 6,000 employees.³⁷⁰ The Matamoros plant assembles microelectronic components solely for the U.S. telecommunication equipment market, whereas the other two facilities are joint ventures with Netherlands-based Philips Consumer Communications that manufacture corded and cordless telephones as well as answering machines for both domestic and foreign markets.³⁷¹ Lucent's manufacturing complex in Guadalajara also includes a research and development facility.³⁷²

Canadian-based Nortel has a plant in Monterrey, employing 1,600 people, that manufactures digital telephone sets, advanced power systems, cable harnesses, and pay telephones. Domestic orders for

³⁶⁹ U.S. Department of Commerce (USDOC), International Trade Administration (ITA), Office of Telecommunications, *A Guide to Telecommunications Markets in Latin America and the Caribbean*, June 1996, p. 22.

³⁷⁰ Industry representatives, telephone interviews by USITC staff, Dec. 4 and Dec. 8, 1997. Marta Kindya, Northern Business Information, Dataquest, *Dossier: Latin American Telecom Service Markets: Mexican Telecom Market*, (Stamford, CT: Dataquest, Dec. 1997), p. 109.

³⁷¹ In 1997, Lucent merged its consumer communications products businesses with Philips Electronics N.V., a leading provider of corded and cordless phones as well as answering machines. Lucent has 40 percent ownership in this joint venture.

³⁷² Dan McCosh, "Lucent's Bell Labs Lead in Telephone R&D," *El Financiero International Edition*, Oct. 27- Nov.2, 1997, p. 14.

such products and goods have increased since the privatization of telecommunications services in Mexico.³⁷³ Nortel's Mexican operations purchase the vast majority of their components and parts from the United States and re-export approximately 90 percent of their production and assembly.³⁷⁴

European manufacturers also maintain significant production and sales operations in Mexico. For example, Finnish based Nokia produces mobile phone accessories and battery packs in Reynosa, Mexico which are shipped to Nokia's Dallas/Fort Worth facility for distribution.³⁷⁵ Swedish-based Ericsson has been involved in Mexico in one form or another longer than any other foreign telecommunications equipment manufacturer, and has a well established relationship with Telmex, providing the company with a high percentage of its switching systems.³⁷⁶ Ericsson is the largest local manufacturer of telecommunications equipment in Mexico with manufacturing facilities producing telephone sets and components for PBX systems in Tlalnepantla and a technology center in Saltillo.³⁷⁷ Alcatel, a French-based company, is another large supplier of telecom equipment to the Mexican market, with manufacturing facilities in Cuautitlan, Toluca, and Nogales.³⁷⁸

Many of these manufacturers have traditionally used Mexican assembly plants (maquiladoras) to minimize costs and improve worldwide competitiveness by combining state-of-the-art imported components and manufacturing equipment with low-cost Mexican labor. Mexican plants may import components and machinery free of duty for use in products destined for export under either the Maquiladora Program or under the Program of Temporary Imports to Produce Export Articles (PITEX). According to Mexico's Commerce and Industrial Development Secretariat (SECOFI) data, Mexican telecommunications equipment imports from the world for use in the maquiladora industry totaled about \$620 million (36 percent of total sector imports) in 1997, while maquiladora exports from the sector totaled about \$980 million (80 percent of total sector exports).³⁷⁹ Although, the elimination of tariffs under the NAFTA removes the incentive to use the maquiladora program for U.S. and Canadian manufacturers, the program continues to benefit other foreign manufacturers.

Trade

Both the implementation of NAFTA on January 1, 1994, and the devaluation of the Mexican peso by nearly 50 percent at the end of 1994 had a profound effect on Mexico's imports and exports of telecommunications products. As discussed above, NAFTA spurred trade between the United States and Mexico by reducing and/or eliminating tariffs, instituting rules of origin that favor North American-made products, and simplifying customs procedures. However, the peso devaluation mitigated the short-term positive effects of NAFTA on imports by significantly raising the price of foreign-produced goods in the Mexican market. The austerity plan which followed the devaluation

³⁷³ Nortel, "Welcome to Nortel in Mexico," found at <http://www.nortel.com/global/cala/mexico.html>, retrieved Sept. 25, 1997.

³⁷⁴ Nortel de Mexico officials, telephone interviews by USITC staff, Aug. 29, 1997.

³⁷⁵ Nokia employs nearly 1,100 workers in the Americas. Industry representative, telephone interviews by USITC staff, Dec. 3, 1997.

³⁷⁶ Ericsson became a major shareholder in Telmex when it was formed in 1947. Ericsson's stake in Telmex was later eliminated, although it continued to be a major supplier of such products as switches and transmission and power equipment.

³⁷⁷ USDOC official, E-mail reply to questions from USITC staff, Aug. 3, 1998.

³⁷⁸ Kindya, *Dossier: Latin American Telecom Service Markets: Mexican Telecom Market*, p. 109.

³⁷⁹ Based on SECOFI data as compiled by Global Trade Information Services, *World Trade Atlas: Mexico Edition, 1993-97* (Columbia, SC: Global Trade Information Services, 1998).

further reduced demand for U.S. products by calling for less government spending, higher taxes, and increased prices for consumer goods.³⁸⁰ Thus, imports from the United States rose by \$260 million (46 percent) in 1994, the first year after NAFTA's implementation, but fell by \$307 million the following year in large part because of the peso devaluation. The devaluation's impact was temporary, as Mexico's economy recovered and imports from the United States more than doubled during 1995-97, rising to \$1.1 billion. The devaluation reinforced the trade-enhancing effects of the NAFTA for Mexican exports because these products became less expensive in the U.S. market. Accordingly, Mexican exports of telecommunications equipment to the United States grew at a strong pace each year during 1993-97, to \$1.1 billion, an average annual increase of 41 percent (table 7-1).

Mexican imports of telecommunication equipment from NAFTA countries are mostly free of duty, as discussed earlier. The highest remaining duty is 4 percent, and is applied to certain types of cordless and corded phones as well as various transmission and reception apparatus. Mexican tariffs on most telecommunications equipment from the rest of the world, range from 10 to 20 percent, with only about four specific products being free of duty. The average rates of duty for the most significant Mexican imports are: carrier current line systems (15 percent); cellular phones and transceivers (15 percent); parts (10 percent); and corded and cordless telephone sets (20 percent).

Total Mexican imports of telecommunications products increased by \$606 million (54 percent) to \$1.7 billion in 1997, surpassing the \$1.3 billion recorded in 1994 before the peso devaluation (table 7-2). Mexico's principal imports from all sources were corded, cordless, and cellular telephones, parts for telecommunications equipment, and switching, transmission, and reception apparatus, which collectively comprised 78 percent of total imports in 1997. Mexican imports of cellular telephones have increased in the past two years in response to the continuing economic rebound that has provided Mexican consumers with increased discretionary income. The market for switching and transmission apparatus also expanded as the long distance market became more open to competition.³⁸¹

Table 7-1
Telecommunications equipment: Mexican trade with the United States, 1993-97

Year	Imports from the United States	Exports to the United States	U.S. share of Mexico's total imports	U.S. share of Mexico's total exports	U.S. imports share of apparent consumption
	----- <i>Million dollars</i> -----		----- <i>Percent</i> -----		
1993	561	262	59.1	63.9	38.4
1994	821	414	64.1	86.3	39.5
1995	514	555	63.5	86.7	32.7
1996	754	800	67.3	84.2	43.3
1997	1,071	1,047	62.1	85.3	45.1

Sources: Compiled from Official Statistics of the U.S. Department of Commerce.

³⁸⁰ Nonsubsistence items such as cordless and cellular telephones experienced a particularly notable decline.

³⁸¹ Kindya, *Dossier: Latin American Telecom Service Markets: Mexican Telecom Market*, p. 3.

Table 7-2
Telecommunications equipment: Mexico's production, imports, exports, and apparent consumption, 1993-97

Year	Production	Imports	Exports	Apparent consumption	Ratio of imports to consumption
----- <i>Million dollars</i> -----					<i>Percent</i>
1993	920	950	410	1,460	65.1
1994	1,280	1,280	480	2,080	61.5
1995	1,400	810	640	1,570	51.6
1996	1,570	1,120	950	1,740	64.4
1997	1,875	1,726	1,227	2,374	72.7

Sources: Estimated by USITC staff based on Reed Electronics Research, *Yearbook of World Electronics Data 1996*, and SECOFI as published in Global Trade Information Services, *World Trade Atlas: Mexico Edition, 1993-97*.

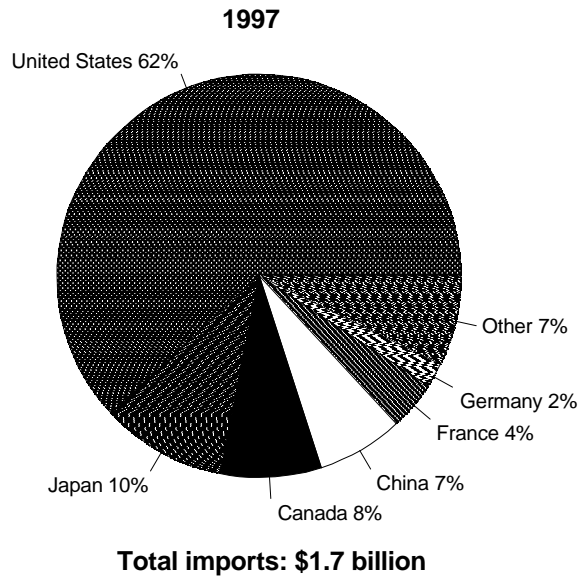
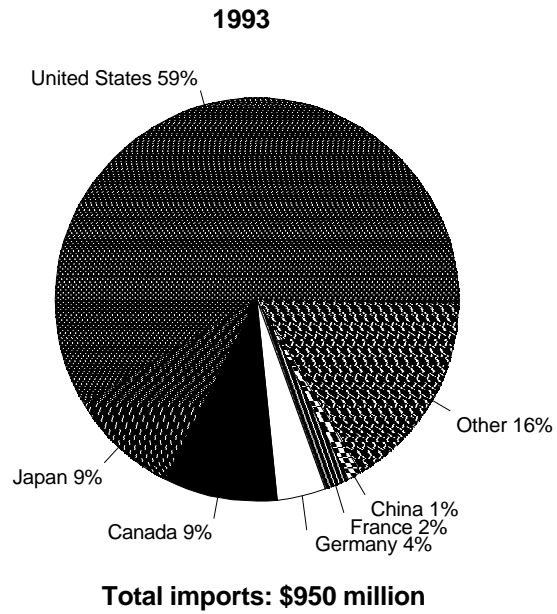
Imports from the United States continue to account for a large share of total Mexican imports, 62 percent in 1997. The major product sectors comprising telecommunications imports from the United States are parts;³⁸² radio communications equipment (other than cellular), including transmission apparatus; and cellular phones which combined accounted for 74 percent of the total in 1997. Proportionally, the import product mix has remained relatively steady since 1993, with the exception of parts and cellular telephones, both of which have experienced sharp increases over the period. Mexican imports of telecommunications equipment from the United States for use in maquiladoras comprised about 39 percent of U.S. sector exports, and were mainly telephone sets.

Because the United States accounted for over 62 percent of Mexico's telecommunications equipment imports in 1997, imports from other sources were relatively small in comparison (figure 7-1). Japan and Canada are Mexico's next largest suppliers of telecommunications products with 1997 imports totaling approximately \$100 million and \$80 million, respectively. Mexican imports from Japan and Canada followed the same pattern as those from the United States during 1993-97, showing a sharp decline in 1995 following the peso crisis and rebounding in 1996 and 1997, mainly due to the recovery of the Mexican economy and effects of NAFTA on trade with Canada. Other relatively important sources of Mexican imports of telecommunications products include China, France, and Germany.

Mexican exports of telecommunications products to the world nearly tripled during 1993-97, reaching \$1.2 billion (table 7-2). The largest annual increases occurred in the years immediately following the peso crisis. Exports from the Mexican maquiladora industry to all countries comprised 80 percent of total sector exports and consisted primarily of telephones and parts. The principal Mexican telecommunications products exported to the United States were, corded, cordless, and cellular telephones, modems, and pagers. These products collectively accounted for 77 percent of Mexican telecommunications exports to the United States in 1997. During 1993-97,

³⁸² Official U.S. data from the USDOC show that U.S. exports of parts to Mexico, were \$350 million in 1997, whereas SECOFI data show that Mexican imports of parts from the United States were \$152 million. This \$198 million discrepancy between the data sets may be due to a classification error since SECOFI data for Mexican imports of radio receivers, switching apparatus, carrier current line systems, and cordless telephones are higher than comparable USDOC data. Another explanation, provided by an industry representative, is that U.S.-based manufacturers exported large quantities of parts to Mexico for further assembly and re-export that were not included in the SECOFI data.

Figure 7-1
Telecommunications equipment: Mexican imports, by principal sources, 1993
and 1997



Source: Generated by SECOFI, and compiled by Global Trade Information Services, *World Trade Atlas: Mexico, Edition 1993-96, Preliminary, 1997*.

telephone sets (mainly cordless) cellular telephones, and pagers were the fastest growing Mexican exports to the United States.

Foreign companies have increasingly established or expanded production-sharing operations in Mexico in order to take advantage of the relatively low wages, proximity to the United States, and reduced tariff entry to the lucrative U.S. market. As a result, exports to the United States have steadily increased. For example, Lucent has diverted production from Thailand, Singapore, and Malaysia to Guadalajara and other Mexican locations.³⁸³ Mexican exports of telecommunications equipment to the United States continue to account for an increasing share of total exports, reaching 85 percent in 1997.

Canada is the only other significant market for Mexican exports of telecommunications equipment (figure 7-2). European companies with manufacturing facilities in Mexico likely sell the bulk of their production in North America, and supply the European market from plants located in Europe and Asia. The total share of Mexico's export market accounted for by Canada has remained steady at 4 percent during 1993-97 totaling approximately \$50 million in 1997.

Trade Agreements and Nontariff Barriers

The NAFTA is the only trade agreement between the United States and Mexico affecting trade in telecommunications equipment.³⁸⁴ The implementation of the NAFTA on January 1, 1994, significantly affected telecommunications equipment trade through the reduction and/or elimination of tariffs and nontariff barriers. Although most Mexican telecommunications equipment exports entered the United States free of duty prior to its implementation, NAFTA removed Mexican barriers to foreign investment and required enforcement of intellectual property rights and trademark protection. These measures encouraged the growth of its telecommunications equipment industry and expanded exports to the United States. U.S. exports to Mexico increased significantly because of the reduction or removal of tariffs that had previously been levied at 15-20 percent.³⁸⁵ Over 80 percent of such tariffs were immediately eliminated,³⁸⁶ while duties on most of the remaining products were to be phased out over five years.³⁸⁷

Other provisions in the NAFTA were designed to create a more open and transparent government procurement system and streamline customs procedures and regulations, while "Rules of Origin" procedures ensure that tariff benefits accrue only to Mexico, the United States, and Canada. The

³⁸³ Industry representatives, interviews by USITC staff, Monterrey, Mexico, June 19, 1997.

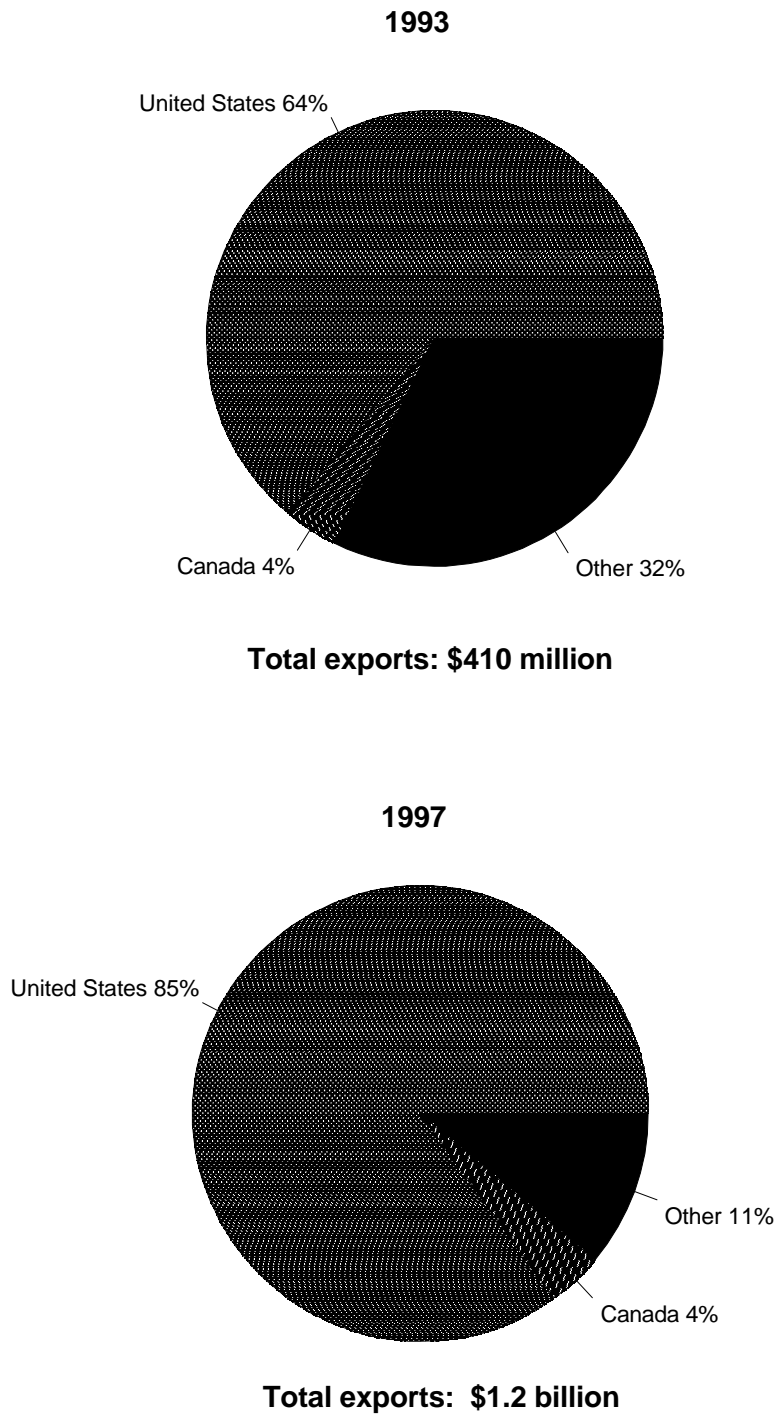
³⁸⁴ Mexico is not a signatory to the Information Technology Agreement (ITA).

³⁸⁵ USDOC, "Study on the Operation and Effects of the North American Free Trade Agreement," July 1997, found at <http://www.ita.doc.gov/industry/tai/telecom/naftatel.html>, retrieved Sept. 29, 1997.

³⁸⁶ Telecommunications equipment for which the Mexican duties on imports from the United States were immediately reduced to zero included private branch exchanges, cellular phones, telecommunications line equipment, and modems, as well as certain other equipment.

³⁸⁷ Duties on tone-paging alert devices, and certain coaxial cables and antennae, are to be phased out over ten years. MultiMedia Telecommunications Association (MMTA) Market Research Department, *1997 Multimedia Telecommunications Market Review and Forecast* (Arlington, VA: MMTA, 1997), p. 167.

Figure 7-2
Telecommunications equipment: Major Mexican export markets, 1993 and 1997



Source: Generated by SECOFI, and compiled by Global Trade Information Services, *World Trade Atlas: Mexico, Edition 1993-96, Preliminary, 1997*.

NAFTA also specifies that standards, technical regulations, and conformity assessment procedures may not be used as barriers to trade in telecommunications equipment, and requires a 60 day comment period for all draft standards. Equally important, a single laboratory is now able to certify a telecommunications product for sale in any NAFTA country.³⁸⁸ Further, the agreement mandates nondiscriminatory treatment for all North American investors³⁸⁹ and prohibits export performance requirements.³⁹⁰

The Office of the United States Trade Representative (USTR) cited Mexico during its Section 1377³⁹¹ review in 1996, for not fulfilling its NAFTA obligation to accept certain test data from other parties' laboratories or test facilities relating to product safety.³⁹² According to then-Ambassador Mickey Kantor, "Acceptance of such data will enable telecom equipment supplied to Mexico to be manufactured in the United States, protecting U.S. jobs in this important sector."³⁹³ Following extensive negotiations, an agreement that developed procedures to settle this issue was reached in April 1997.

However, U.S. companies have alleged that Mexico continues to apply onerous standards to U.S. exports of terminal equipment designed for attachment to the telecommunications network, often delaying entry of such exports.³⁹⁴ Although these mandatory interface standards apply equally to Mexican goods, they allegedly exceed NAFTA specifications and entail a time-consuming certification process and mandatory inspections.³⁹⁵

Market

Mexico accounts for less than five percent of the global market for telecommunications equipment;³⁹⁶ however, it is the third largest market for U.S. exports of such equipment. Apparent consumption in Mexico reached almost \$2.4 billion in 1997, with imports accounting for 73 percent of the total (table 7-2). Telmex has historically been the main purchaser of such equipment, although its share of market purchases has been declining as privatization and liberalization (ie.

³⁸⁸ USDOC, "Study on the Operation and Effects of the North American Free Trade Agreement."

³⁸⁹ North American investors now have the right to transfer profits, interest, dividends, capital, royalty payments, and other benefits from their investments.

³⁹⁰ These performance requirements specifically refer to the maquiladora industry, and state that restrictions on sales directly to the Mexican market will be reduced by 5 percent a year.

³⁹¹ Section 1377 of the Telecommunications Trade Act of 1988 requires that the USTR review the operation and effectiveness of each "trade agreement regarding telecommunications products or services that is in force with respect to the United States."

³⁹² Office of the United States Trade Representative (USTR), *Monitoring and Enforcing Trade Laws and Agreements Fact Sheet*, Sept. 30, 1997, p. 6.

³⁹³ USTR, "Annual Review of Telecommunications Trade Agreements Under Section 1377 of the 1988 Trade Act Completed," press release, Apr. 3, 1996, found at <http://www.gwjapa.org/ftp/pub/policy/ustr/1996/ustr9636.txt>, retrieved Sept. 25, 1997.

³⁹⁴ Stephen Glover and JoEllen Lotvedt, "The Mexican Telecommunications Market: The Interplay of Internal Reform and NAFTA," *NAFTA: Law and Business Review of the Americas*, Vol. III, No.1, Winter 1997, p. 24.

³⁹⁵ Mexican-produced and -distributed goods, on the other hand, undergo random inspections within the country. Glover and Lotvedt, "The Mexican Telecommunications Market: The Interplay of Internal Reform and NAFTA," p. 38.

³⁹⁶ Glover and Lotvedt, "The Mexican Telecommunications Market: The Interplay of Internal Reform and NAFTA," p. 23.

allowing new market entrants) have increased competition.³⁹⁷ With an estimated \$20 billion to be spent annually on Mexico's telecommunications infrastructure during 1997-2000, primarily by new operators, demand for telecommunications equipment will likely continue to rise.³⁹⁸

Until the 1990s, the equipment market in Mexico was dominated by Ericsson and Alcatel. Lucent successfully challenged this dominance in 1992 by winning contracts to install 60 percent of TELMEX's fiber optic long distance network.³⁹⁹ The implementation of NAFTA, the opening of the telecommunications services market to competition, and privatization of Telmex have encouraged other foreign investment in Mexico's telecommunications services and equipment markets. The relative lack of telecommunications infrastructure also presents a potential opportunity for foreign investors already in the market,⁴⁰⁰ especially for equipment vendors who, in some cases, have joined with cellular operators to install wireless network infrastructure to compete with wireline providers. Motorola, for example, has boosted its cellular equipment sales in this burgeoning market by investing in several Mexican cellular operators including Baja Cellular Mexicana, Cellular de Telefonía (CEDETEL), and Movitel de Noreste.⁴⁰¹ Recently, Lucent assisted Telmex by installing its equal access software which allows consumers to select their preferred long distance provider, thereby meeting government requirements that the long distance services market be open to competition by January 1, 1997. According to one company representative, "Mexico is among the top 15 global markets for Lucent, and is key to Lucent's global growth."⁴⁰²

Mexico is one of the leading markets in Latin America for cellular phones,⁴⁰³ reflecting, in part, the long waiting periods required to get regular, ground-line, phone service installed. This situation, however, has abated somewhat since the privatization of Telmex. Cellular service allows a customer to purchase a cellular phone and have it operational the same day, whereas wireline service entails an average wait of six months.⁴⁰⁴ Demand for pagers has increased for the same reason. Accordingly, companies such as Motorola have obtained contracts to replace the existing analog cellular network in Hermosillo, Sonora, Culiacan, and Sinaloa,⁴⁰⁵ and to provide paging infrastructure for Telmex and Video Grylm, to take advantage of these conditions. The largest cellular service providers in Mexico are CEDETEL, of which Motorola is majority owner, and Grupo IUSACELL, S.A., jointly owned by Grupo Industrias Unidas, S.A. and Bell Atlantic, and Radiomovil Dipsa (TELCEL), owned by TELMEX. Cellular telephones manufactured by Ericsson and Nokia are the most popular in Mexico.⁴⁰⁶

³⁹⁷ Kindya, *Dossier: Latin American Telecom Service Markets: Mexican Telecom Market*, p. 107.

³⁹⁸ USDOC, *U.S. Industry and Trade Outlook 1998*, (New York: McGraw Hill, 1997), pp. 31-37.

³⁹⁹ Kindya, *Dossier: Latin American Telecom Service Markets: Mexican Telecom Market*, p. 107.

⁴⁰⁰ David J. Drez III, "Direct Foreign Investment in Mexico's Telecommunications Market,"

NAFTA: Law and Business Review of the Americas, Winter 1997, p. 114.

⁴⁰¹ USDOC, *A Guide to Telecommunications Markets in Latin America and the Caribbean*, p. 14.

⁴⁰² Lucent representatives, telephone interviews by USITC staff, Dec. 4 and Dec. 8, 1997.

⁴⁰³ Northern Business Information, "Mexico," *Latin American Cellular Operators: 1997 Edition* (New York: Datapro, July 1997), p. 125.

⁴⁰⁴ Ericsson, *Mexican Model: Privatization Transforms Telecoms Structure*, found at <http://www.ericsson.com/Connexion/connexion1-94/market.html>, retrieved Nov. 18, 1997, and International Telecommunications Union (ITU), *World Telecommunications Development Report* (Geneva: ITU, 1998), p. A-14.

⁴⁰⁵ Motorola, Inc., "Motorola Cig Wins Contract to Replace Cellular Telephone Network in Mexico," press release, found at http://www.mot.com/CNSS/CIG/Press/press_archive_1997/1197070925.html, retrieved Nov. 11, 1997.

⁴⁰⁶ Northern Business Information, "Mexico," p. 142.

The Mexican market is dominated by joint ventures and other arrangements between domestic companies, often telecommunications service providers, and multinational equipment producers. Examples of such arrangements include: Lucent Technologies and Amaritel's⁴⁰⁷ deal to build a residential and business telecommunications network in Mexico City in which Lucent will install the network;⁴⁰⁸ Ericsson's contract with TELNOR in 1994 to modernize Baja California's telecommunication system by providing and installing switching systems, fiber optic systems for voice and data transport networks, and energy supply systems;⁴⁰⁹ and Nortel's agreement with Grupo IUSACELL to provide cellular services, and with Avantel to build a competitive, non-regulated fiber-optic network.⁴¹⁰

Since 1990, the Mexican government has introduced substantial reforms, ranging from the liberalization of foreign investment laws to the privatization of Telmex, the previously government-owned monopoly of telecommunications services.⁴¹¹ In May/June 1995, the Mexican legislature approved a statute establishing rules to attract foreign investment through greater competition to commence in August 1996. The law also addressed technological advances and NAFTA-required rules. In response, U.S. firms quickly established or expanded upon already-existing partnerships to manufacture digital switches and other infrastructure equipment.⁴¹² Mexico's long distance telecommunications market was fully deregulated in 1997 in accordance with the World Trade Organization's Basic Telecommunications Agreement, although it still retains a 49 percent limit on foreign ownership. As a result, switching equipment, fiber optic cable, and transmission equipment sales have increased as competition in the services market has driven demand.

⁴⁰⁷ A joint venture of the Aguirre Family and Grupo Radio Centro.

⁴⁰⁸ Lucent Technologies, "Amaritel Chooses Lucent Technologies to Build Its Telephone Network in Mexico," press release, found at http://bix.yahoo.com/bw/97/09/23/lu_x0007_1.html, retrieved September 26, 1997.

⁴⁰⁹ Ericsson, "Ericsson Signs Contract with TELNOR in Mexico," found at <http://www.ericsson.com/Eripress/Archive/1994/q194-part39.html>, retrieved Nov. 11, 1997.

⁴¹⁰ Nortel, "Welcome to Nortel in Mexico."

⁴¹¹ The privatization was initiated by Mexico's Secretariat for Communications and Transport in 1989 and completed by May 1994.

⁴¹² USDOC, ITA, "Overview," found at <http://www.ita.doc.gov/industry/tai/telecom/latelcom.txt>, retrieved Sept. 25, 1997.

CHAPTER 8

CHINA

China's determined efforts to develop its telecommunications infrastructure have resulted in the rapid expansion of its telecommunications equipment production, imports, and market during 1993-97. Production has grown at an average annual rate of 39 percent since 1993 and accounted for nearly 5 percent of the world total in 1997.⁴¹³ Trade increased by an average of 40 percent per year for exports and 34 percent for imports, while its market expanded at a rate exceeding 35 percent per year. The value of telecommunications equipment imports from the United States grew from \$306 million to \$380 million during 1993-97, while Chinese exports to the United States increased from \$484 million to \$1.3 billion. The majority of U.S.-manufactured goods shipped to China were cellular equipment, switching equipment, and related parts, while Chinese goods exported to the U.S. market were predominately low-end, commodity-type equipment such as corded, cordless, and cellular telephone handsets. The enormous population base, low labor costs, and expected investment in the telecommunications sector of \$8 billion to \$10 billion per year from 1996 to 2000 provide strong inducements to foreign multinationals to enter the Chinese market. However, China continues to arbitrarily impose various barriers on investment and trade in telecommunications equipment.

Industry Structure

The Chinese telecommunications equipment industry is composed of over 400 manufacturing facilities employing 94,000 workers.⁴¹⁴ In addition, China has more than 100 research institutions with over 600,000 technicians and specialists engaged in various types of research and development⁴¹⁵ related to the production of telecommunications equipment and other high technology goods. The largest companies in China, in terms of annual revenues, are joint venture operations established between domestic, usually state-run Chinese firms, and corporations headquartered in the United States, EU, Japan, and Canada (table 8-1). China has encouraged the creation of joint ventures in order to rapidly acquire technology and develop a domestic industry capable of meeting the country's demand for telecommunications equipment.⁴¹⁶ These joint ventures involve the participation of the world's leading companies in the sector including such firms as Alcatel, Ericsson, Lucent Technologies (Lucent), Motorola, NEC, Nokia, Nortel, and Siemens.

While China encourages joint ventures in order to develop the domestic industry, foreign telecommunications equipment manufacturers are attracted to China's enormous market potential

⁴¹³ All production, trade, and consumption data in this chapter are given in 1996 U.S. dollars (U.S. \$1 = 8.31 Yuan).

⁴¹⁴ "China Telecom Industry," Xinhua News Agency, Jan. 2, 1997, retrieved from NewEDGE/LAN, Feb. 1, 1997. However, employment figures may be overstated as they result in a value of production per employee of approximately \$46,500 in China compared with the U.S. industry, which generates about \$240,000 per employee.

⁴¹⁵ Sun Li, Jack Su, and Sakina Dhillawala, Northern Business Information, *Chinese Telecom Market* (New York: McGraw-Hill, Dec. 1997), p. 75.

⁴¹⁶ International Telecommunications Union (ITU), *World Telecommunication Development Report*, (Geneva: ITU, 1997), pp. 22-23.

Table 8-1**Telecommunications equipment: Major producers in China, selected products, and headquarter country**

Company name	Selected products	Headquarter country
Lucent Technologies	Switches, telephone handsets	United States
Motorola	Pagers, cellular telephones	United States
China Great Dragon Telecommunications Equipment Company	Switches, ISDN ¹ equipment, cordless telephones	China
Huawei Technologies	Switches, mobile network equipment	China
Ji Peng Electronic Information Machine (Golden Eagle)	Switches	China
Northern Telecom (Nortel)	Switches, SDH ² equipment	Canada
Nokia	Mobile telephones, optical fiber transmission equipment	Finland
Alcatel Alsthom	Switches, SDH transmission equipment	France
Siemens	Switches, PBXs, ³ corded and cordless telephones, GSM ⁴ network equipment, SDH transmission equipment	Germany
Fujitsu	PBXs, optical fiber transmission equipment	Japan
NEC	PBXs, mobile network equipment, mobile telephones	Japan
Ericsson	PBXs, switches, mobile network equipment	Sweden

¹ Integrated Services Digital Network.

² Synchronous Digital Hierarchy (SDH) is an optical interface standard used in the fiber optic transmission of digital signals. SDH has been widely used in Europe but it is very similar to the SONET standard used in North America. *Newton's Telecom Dictionary*, p. 600.

³ Private Branch Exchanges.

⁴ Global System for Mobile Communications.

Sources: Company reports; Milton Mueller and Zixiang Tan, *China in the Information Age: Telecommunications and the Dilemmas of Reform*, No. 169, The Washington Papers, The Center for Strategic and International Studies, Appendix D; Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 4th ed., pp. 216-222; and International Telecommunication Union, *World Telecommunication Development Report*, pp. 25-27.

industrialization, and ambitious economic development program. The Chinese partner in these joint ventures is typically a national, provincial, or local government agency. For instance, Shanghai Bell Telephone Equipment Manufacturing Company (Shanghai Bell), which has been producing central office switching equipment since 1983⁴¹⁷ is jointly owned by the French company Alcatel and China's Ministry of Posts and Telecommunications (MPT).⁴¹⁸ Table 8-2 lists representative examples of joint ventures in China.

⁴¹⁷ Milton Mueller and Zixiang Tan, *China in the Information Age: Telecommunications and the Dilemmas of Reform*, No. 169, The Washington Papers, The Center for Strategic and International Studies (CSIS) (Westport: Praeger, 1997), pp. 48-49.

⁴¹⁸ The Ministry of Posts and Telecommunication merged with the Ministry of Electronics Industry and parts of the Ministry of Radio, Film, and Television, China Aerospace Industry Corporation, and China Aviation Industry Corporation to form the Ministry of Information Industries, announced in March 1998. U.S. Department of State cable, "China/Telecom: New Ministry of Information Industries," message reference no. 6592, prepared by U.S. Embassy, Beijing, April 15, 1998.

Table 8-2

Telecommunications equipment: Representative examples of joint ventures in China, foreign partner/domestic partner, joint venture name, and selected products

Foreign partner/domestic partner	Joint venture name	Selected products
Alcatel/Posts and Telecommunications Industry Corporation	Shanghai Bell Telephone Equipment Manufacturing Company	Switches
Ericsson/Shanghai Simtek Industrial Company	Shanghai Ericsson Simtek Electronics Company	Electronic components for telephone modules
Motorola/Shanghai Radio Communication Equipment Manufacturing Company	Shanghai Motorola Paging Products Company	Pagers
NEC/Benxi Communications and Electrical Appliance Industry Corporation	Benxi NEC Communications Company	Private Branch Exchanges
Nokia/Posts and Telecommunications Industry Corporation	Beijing Nokia Mobile Telecommunications Company	GSM cellular infrastructure equipment
Nortel/China Tong Guang Electronics Corporation	Tong Guang Nortel Telecommunications Ltd.	Private Branch Exchanges
Siemens/Shanghai Posts and Telecommunications Authority	Siemens Shanghai Mobile Communications Company	GSM cellular radio base station equipment and handsets

Sources: Company reports; Milton Mueller and Zixiang Tan, *China in the Information Age: Telecommunications and the Dilemmas of Reform*, No. 169, The Washington Papers, The Center for Strategic and International Studies, pp. 48-49; John Wang, "Walking and Talking," *The China Business Review*, March-April 1996, pp. 14-17; and Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 4th ed., pp. 216-222.

Foreign companies are well positioned in the Chinese market as the leading suppliers of telecommunications products such as switches, transmission equipment, cellular equipment, and satellite equipment.⁴¹⁹ For example, Motorola, Ericsson, Lucent, Nokia, and Nortel are the major suppliers of cellular network equipment⁴²⁰ while Alcatel is the dominant supplier and local manufacturer of switching equipment in China through its joint venture manufacturing operation, Shanghai Bell.⁴²¹ However, some analysts fear that China's import restrictions and reliance on local manufacturers to develop its telecommunications infrastructure will increasingly hamper the competitiveness of foreign-owned firms in favor of wholly Chinese-owned operations.⁴²² Foreign manufacturers have reportedly encountered such government intervention in the PBX market.⁴²³ Further, the United States faces formidable competition in the Chinese market from European, Japanese, and Korean companies that have made significant investments in the country in order to supply China's market with high-end telecommunications equipment.

⁴¹⁹ John Henry and Nathaniel Caldwell, "China: Positioning for the Next Century," *Business America*, July 1997, p. 24.

⁴²⁰ USDOC, *U.S. Industry and Trade Outlook 1998*, p. 31-19, and John Adams, "Markets in Search of Technology," *Wireless Communications, Volume 5*, Wessels, Arnold & Henderson, L.L.C., Nov. 18, 1996, pp. 27, 29-30.

⁴²¹ Alexandra Rehak and John Wang, "On the Fast Track," *The China Business Review*, Mar.-Apr. 1996, p. 12.

⁴²² Mueller and Tan, *China in the Information Age: Telecommunications and the Dilemmas of Reform*, pp. 102-105.

⁴²³ Henry and Caldwell, "China: Positioning for the Next Century," p. 24. Also includes other information technology equipment, software, and services.

Direct investment by U.S. firms in the telecommunication equipment industry represents a major share of total U.S. investment in China, which reached \$2.9 billion in 1996.⁴²⁴ Motorola is the leading U.S. investor in the market for telecommunications equipment with joint venture operations that produce pagers and cellular telephones.⁴²⁵ During 1992-96, Motorola invested a total of \$1.2 billion in China,⁴²⁶ resulting in sales of approximately \$3.2 billion in 1996 and \$3.3 billion in 1997.⁴²⁷ Lucent had invested \$150 million in China by the end of 1996, making it the second largest U.S. investor in this sector.⁴²⁸

Wholly-owned local firms also successfully produce a number of products including switching equipment, pagers, and telephone sets. For instance, 120 switch manufacturers are currently producing in China, the largest of which are typically large, state-owned companies generally associated with the MPT or the Ministry of Electronics Industry (MEI).⁴²⁹ One of the largest wholly Chinese-owned companies is the China Great Dragon Telecommunications Equipment Company (Great Dragon), a merger of eight manufacturers of advanced digital network switches⁴³⁰ that was established by the MPT, MEI, and several other state-owned enterprises and research institutions.⁴³¹

In direct competition with Great Dragon is Ji Peng Electronic Information Machine Company, also known as Great Eagle, a telecommunications equipment producer composed of five switch manufacturers under the leadership of the MEI.⁴³² These wholly Chinese-owned manufacturers have been encouraged by the Chinese government to increase production capacity and compete with foreign suppliers. With government promotion and better technology, these producers are increasing their market share. The capacity of Chinese-made digital switches used in China's telecommunications network increased from 3 million to 5 million lines during 1996-97.⁴³³

During the 1990s, production of telecommunications equipment in China expanded rapidly, responding to increased domestic and foreign demand. Total production of telecommunications equipment in China has increased at an estimated average rate of 39 percent per year during 1993-97, reaching approximately \$5.7 billion (table 8-3).⁴³⁴ Increased domestic production has been fueled by the growing presence of joint venture firms affiliated with the world's leading

⁴²⁴ U.S. Department of Commerce (USDOC), Bureau of Economic Analysis, *Survey of Current Business*, Sept. 1997, table 17, p. 145.

⁴²⁵ Motorola Company Reports and "Top 10 US Firms in China," *Beijing Review*, vol. 40, no. 32, Aug. 11-17, 1997, found at <http://www.chinanews.org/bjreview>, retrieved Nov. 19, 1997.

⁴²⁶ Motorola Company Reports.

⁴²⁷ *Ibid.*, includes non-telecommunications equipment sales.

⁴²⁸ "Top 10 US Firms in China," *Beijing Review*.

⁴²⁹ The MPT and the MEI were recently folded into the Ministry of Information Industries.

⁴³⁰ Wei An, "China to Exert More Control Over Telecom Equipment," *IDG China News*, found at <http://www.idgchina.com>, retrieved Sept. 30, 1997.

⁴³¹ China Communications Industry Report, "An Intro to China Great Dragon Communications Equipment Co. Ltd.," May 1, 1997, found at <http://www.ccireport.com>, retrieved Oct. 1, 1997.

⁴³² USDOC, International Trade Administration (ITA), Office of Computers and Business Equipment, "Fifth Meeting of the U.S.-China Joint Commission on Commerce and Trade, Information Technologies Subgroup," June 3, 1997, updated Sept. 1997.

⁴³³ Alexandra Rehak and John Wang, "On the Fast Track," *The China Business Review*, Mar.-Apr. 1996, p. 13, and Pyramid Research, as cited in "Silicon Valley, PRC," *The Economist*, June 27, 1998, pp. 64-65.

⁴³⁴ Estimated by USITC staff based on Reed Electronics Research, *Yearbook of World Electronics Data 1994 and 1996* (Surrey: Reed Business Information, 1994 and 1996), and Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 5th ed. (Surrey: Reed Business Information, 1997).

Table 8-3**Telecommunications equipment: Chinese production, imports, exports, and apparent consumption, 1993-97**

Year	Production	Imports	Exports	Apparent consumption	Ratio of imports to consumption
	----- <i>Million dollars</i> -----				<i>Percent</i>
1993	1,532	1,655	560	2,627	63.0
1994	2,938	3,238	1,485	4,691	69.0
1995	3,601	3,651	1,583	5,669	64.4
1996	4,370	4,395	1,719	7,046	62.4
1997	5,681	5,274	2,148	8,807	59.9

Sources: Estimated by USITC staff based on Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 5th ed.; Reed Electronics Research, *Yearbooks of World Electronics Data*, 1996, 1995, 1994; and United Nations Trade Series D.

telecommunications companies, government targeting of telecommunications infrastructure development as a national priority, and by the high growth rate of the overall economy.⁴³⁵

Although the Chinese government maintains that the telecommunications equipment market has been fully open to investment by all suppliers⁴³⁶ since 1995, certain subsectors are more open than others. For example, the Chinese government restricts foreign investment in central office switches and PBX manufacturing operations while encouraging investment in others such as ATM switching equipment, certain digital cellular equipment, SDH optical equipment, network management equipment, and satellite telephone and data earth stations.⁴³⁷ These policies were revised in January 1998 as the Ministry of Foreign Trade and Economic Cooperation and China's State Policy Council considered new foreign investment rules for all sectors. Notably, foreign investment in CDMA cellular systems and multimedia communications equipment were added to the list of encouraged sectors.⁴³⁸ However, the manufacture of microwave telecommunications systems equipment was added to a "Restricted Category B" list, which means that investment in this area may be limited in terms of scope and activity but may be approved in certain circumstances.⁴³⁹ Essentially, the January revisions eliminated import and value-added taxes on capital goods destined for local manufacturing facilities.⁴⁴⁰

⁴³⁵ China's GDP grew by 10.2 percent in 1995 and 9.7 percent in 1996. U.S. Embassy Beijing, *China Country Commercial Guide, 1996-97*, and "China's Economy Grows 9.7% in 1996," *Beijing Review*, vol. 40, no. 3, Jan. 20-26, 1997.

⁴³⁶ Asia Pacific Economic Cooperation (APEC) Telecommunications Working Group, *State of Telecommunications Infrastructure and Regulatory Environment in APEC Economies* (Final text and 7/96 update), 1996.

⁴³⁷ Mueller and Tan, *China in the Information Age: Telecommunications and the Dilemmas of Reform*, Appendix C, p. 130.

⁴³⁸ U.S. Department of State, U.S. Embassy, Beijing, Economic Section, "China's New Foreign Investment Regs: Duty-free Import of Some Capital Investment Reinstated," Jan. 12, 1998.

⁴³⁹ *Ibid.*

⁴⁴⁰ *Ibid.*, and Xing Fan, Research Fellow, International Communications Studies, Center for Strategic and International Studies (CSIS), Washington, DC, E-mail correspondence with USITC staff, Nov. 13, 1997.

Trade

China's total imports of telecommunications equipment increased from \$1.7 billion in 1993 to approximately \$5.3 billion in 1997, an average annual rate of 34 percent (table 8-3). The U.S. share of this total declined steadily from over 18 percent in 1993 to 7 percent in 1997 largely because of increasing import competition from suppliers based in the EU, Japan, and Canada. China relies on imports for most high end telecommunications products such as switching, transmission, cellular, and satellite equipment for service providers and companies operating in China⁴⁴¹ although locally owned manufacturers appear to be increasing their share of the market.⁴⁴² Telecommunications products supplied by the United States are predominately cellular equipment, switching equipment, and related parts. Imports of telecommunications equipment from the United States grew from \$306 million to \$431 million during 1993-95 but decreased during the next 2 years, reaching \$380 million in 1997 (table 8-4). This decrease is partially the result of continued foreign direct investment from the United States, most notably from Motorola and Lucent which has replaced imports with domestic production.

Table 8-4
Telecommunications equipment: China's trade with the United States, 1993-97

Year	Imports from the United States	Exports to the United States	U.S. share of China imports	U.S. import share of apparent consumption
	----- <i>Million dollars</i> -----		----- <i>Percent</i> -----	
1993	306	476	18.5	11.6
1994	409	1,127	12.6	8.7
1995	431	1,173	11.8	7.6
1996	392	1,111	8.9	5.6
1997	380	1,305	7.2	4.3

Sources: Estimated by USITC staff based on Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*; Reed Electronic Research, Yearbooks of World Electronics Data, 1996, 1995, 1994; and United Nations Trade Series D.

A decline in imports of telephone switching equipment and related parts from the United States accounted for a major portion of the overall drop in U.S. telecommunications equipment supplied to China during 1996-1997. Reportedly, China has been restricting these types of imports to favor local suppliers.⁴⁴³ Intense price competition from local manufacturers also has contributed to this decline by lowering the unit value of these products.⁴⁴⁴ China's imports of cellular transmission equipment from the United States also fell during this period. Industry representatives have stated

⁴⁴¹ Henry and Caldwell, "China: Positioning for the Next Century," p. 24.

⁴⁴² "China Telecom Companies Begin to Challenge Multinationals," *Far Eastern Economic Review*, Sept. 3, 1998, p. 12.

⁴⁴³ U.S. Department of State cable, "China/Telecom: New Ministry of Information Industries," message reference no. 6592, prepared by U.S. Embassy, Beijing, April 15, 1998, and Henry and Caldwell, "China: Positioning for the Next Century," p. 24.

⁴⁴⁴ "Silicon Valley, PRC," *The Economist*, June 27, 1998, pp. 64-65.

that this decrease is a consequence of greater acceptance of European digital cellular standards in China at the expense of U.S. manufacturers.⁴⁴⁵

Although China depends on imports for a large share of its telecommunications equipment consumption, imports have been restricted by the imposition of significant tariffs designed to encourage domestic production. In 1997, China's MFN import duty rates on telecommunications equipment ranged from 9 percent to 50 percent ad valorem.⁴⁴⁶ Lower rates of duty are applied to imports of such products as cellular transmission and mobile communications equipment while the highest rate of duty is for telephone answering machines.

Although China produces only about 5 percent of the world's telecommunications equipment, it exports over a third of its total production. China's telecommunications equipment exports increased rapidly averaging 40 percent growth per year during 1993-97, reaching approximately \$2.1 billion (table 8-3). The United States market received 85 percent of China's exports from this sector in 1993 but this share decreased to 61 percent in 1997. Overall, China was the third largest supplier of telecommunications equipment to the United States during 1995-97, behind only Japan and Canada. Most of China's exports of telecommunications products to the United States are labor-intensive, commodity-type equipment such as corded and cordless telephone sets and cellular telephone handsets. Exports of these three products equaled approximately \$1.0 billion in 1997 and comprised 79 percent of all U.S. telecommunications equipment imports from China during that year, compared with \$429 million and 89 percent in 1993.⁴⁴⁷ Other major markets for Chinese telecommunications equipment exports include Japan and the EU.

Trade Agreements and Nontariff Barriers

The United States has two trade agreements with China that affect telecommunications equipment, a 1992 Memorandum of Understanding (MOU) on Market Access⁴⁴⁸ and a 1980 Bilateral Trade Agreement. The terms of the MOU required the Chinese government to eliminate market access barriers and reduce tariffs on U.S.-produced telecommunications equipment among other products by December 31, 1997.⁴⁴⁹ In addition, China agreed to abide by internationally accepted open tender and bidding procedures that would end discriminatory practices in the government procurement of digital switching systems. China also assented to apply uniform testing and certification standards

⁴⁴⁵ Most digital cellular equipment that is produced in the United States operates using one of two standards, Time Division Multiple Access (TDMA) or Code Division Multiple Access (CDMA). Digital cellular equipment in Europe operates on the Global System for Mobile Communications (GSM). See also Adams, "Markets in Search of Technology," p. 29, and The Economist Intelligence Unit, "China: Motorola as the Comeback Kid," *Business China*, May 27, 1998, found at <http://www.eiu.com>, retrieved July 8, 1998.

⁴⁴⁶ USDOC, ITA, Trade Information Center, facsimile response received July 10, 1998.

⁴⁴⁷ Estimated by USITC staff based on official statistics of the USDOC; Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 5th ed.; and Reed Electronics Research, *Yearbook of World Electronics Data 1994 and 1996*.

⁴⁴⁸ The full title of the agreement is "Memorandum of Understanding Between the Government of the United States and the Government of the People's Republic of China Concerning Market Access." The MOU on Market Access was signed on October 10, 1992.

⁴⁴⁹ The United States proposed increased import duties on a wide range of products from China, including cordless and cellular telephone handsets, in the absence of an acceptable agreement. For a complete list of China-produced goods on which the United States proposed import duties see 57 F.R. 38912. See also, Office of the United States Trade Representative (USTR), *1998 Trade Policy Agenda and 1997 Annual Report of the President of the United States on the Trade Agreements Program*, pp. 189-190.

to imported and domestic non-agricultural products throughout the country. Further, China committed to liberalize its trading system by increasing transparency via the publication of trade laws, regulations, and policies; refraining from import substitution measures and technology transfer or local investment conditions as prerequisites to obtaining import licenses; publicly releasing information on sales and marketing prospects; and establishing an administrative and judicial appeals process for import decisions.⁴⁵⁰ The United States reciprocated by liberalizing export controls on telecommunications equipment sent to China.⁴⁵¹

The Bilateral Trade Agreement between the United States and China was initially implemented on February 1, 1980, and affects trade in telecommunications equipment by imparting most-favored-nation (MFN) treatment to U.S. imports from China. Although the agreement is subject to renewal at 3-year intervals, section 402 of the Trade Act of 1974 requires that China's receipt of MFN treatment be reviewed on an annual basis.⁴⁵² President Clinton most recently renewed China's MFN status on June 3, 1998.⁴⁵³

China is not a member of the World Trade Organization and did not sign the Information Technology Agreement, which is intended to eliminate most import duties on telecommunications equipment as well as other information technology products by the year 2000.⁴⁵⁴ However, during a visit to the United States in the fall of 1997, Chinese President Jiang Zemin announced China's intention to sign the ITA in the immediate future.⁴⁵⁵ As yet, China has not formally signed the agreement.

U.S. exports of telecommunications equipment to China increased steadily from 1992, when the MOU was signed, until 1995. However, during the next two years, U.S. exports declined by a total of 12 percent despite the MOU's goal of eliminating Chinese market access barriers and tariffs on U.S.-produced equipment by the end of 1997. Although China has taken steps to eliminate market access barriers to telecommunications products and other goods, certain obstacles continue to restrict the presence of these goods in the Chinese market. For instance, import quotas have been used to restrict the importation of products whenever China's State Council and other agencies determine that sufficient capacity exists or saturation of a particular sector has been attained. Also, China has announced several regulations and directives that are basically *de facto* import and technology licensing requirements, such as guidelines for electronics equipment imports.⁴⁵⁶ Further, despite some progress in this area, the Office of the United States Trade Representative (USTR) remains concerned about the lack of transparency in China's trade regime.⁴⁵⁷ Finally, investment restrictions limit U.S. company opportunities in the Chinese market and compel companies to transfer

⁴⁵⁰ 57 F.R. 47889.

⁴⁵¹ U.S. International Trade Commission (USITC), *The Year in Trade: Operations of the Trade Agreements Program (OTAP), 1992*, USITC publication 2640, July 1993, pp. 68-69.

⁴⁵² 19 U.S.C. 2432. The President has authority to waive full compliance with the freedom-of-emigration requirements imposed on non-market economies, such as China, by section 402 of the Trade Act of 1974.

⁴⁵³ 63 F.R. 32705.

⁴⁵⁴ For a detailed discussion of the ITA see USITC, *Advice Concerning the Proposed Modification of Duties on Certain Information Technology Products and Distilled Spirits*, USITC publication 3031, April 1997.

⁴⁵⁵ The White House, "Press Conference by President Clinton and President Jiang Zemin," Oct. 29, 1997.

⁴⁵⁶ USTR, *1998 National Trade Estimate on Foreign Trade Barriers (NTE)*, pp. 47-48.

⁴⁵⁷ *Ibid.*, p. 48.

technology to domestic producers. While technology transfer is not formally required,⁴⁵⁸ China strongly “encourages” foreign companies to form joint ventures in the telecommunications equipment sector in order to localize production and acquire technology.⁴⁵⁹ In most instances, large sales in the Chinese market require foreign-based firms to enter into joint ventures with local companies.⁴⁶⁰ Despite improvements in China’s policies toward foreign investment, the USTR remains concerned about inconsistencies in China’s implementation of investment regulations and its general lack of transparency in the investment approval process.⁴⁶¹

Market

China’s market for telecommunications equipment is one of the fastest growing in the world. Apparent consumption increased at an estimated average annual rate of 35 percent during 1993-97 reaching approximately \$8.8 billion (table 8-3).⁴⁶² China already is the largest market in the world for new installations of switching equipment, averaging 15 million new lines per year.⁴⁶³ China’s subscriber base for wireless communications is one of the ten largest in the world and is one of the fastest growing.⁴⁶⁴ This growth is projected to continue since wireless communication is the only economically feasible option for rural and urban areas lacking adequate fixed line capacity.⁴⁶⁵

The major purchasers of telecommunications equipment are state-run enterprises which effectively control the telecommunications services market in China. Although China’s telecommunications equipment market is relatively open to foreign manufacturers, similar participation in the services market is prohibited. Foreign service providers are not allowed to directly own or operate telecommunications networks⁴⁶⁶ although several leading U.S. firms have managed to participate in wireless service projects as limited investors and/or advisors.⁴⁶⁷ Nonetheless, the state-run service providers buy infrastructure equipment from leading telecommunications companies worldwide. For instance, Ericsson has signed a \$369 million contract with Guangdong Mobile Communications

⁴⁵⁸ In the past, China directly tied any large procurement of foreign telecommunications equipment to requirements for technology transfer. Non-Chinese suppliers were typically required to provide Chinese producers with technological expertise, production methods, or actual lines of production.

⁴⁵⁹ Presentations by LinZhen Xie, Deputy Director General, Department of Telecommunication and System Equipment, Ministry of Electronics Industry, delivered at the Fifth Meeting of the U.S.-China Joint Commission on Commerce and Trade, Information Technologies Subgroup, New Orleans, LA, June 3, 1997.

⁴⁶⁰ Mueller and Tan, *China in the Information Age: Telecommunications and the Dilemmas of Reform*, pp. 102-105.

⁴⁶¹ USTR, *1998 NTE*, pp. 57-58.

⁴⁶² Estimated by USITC staff based on Reed Electronics Research, *Yearbook of World Electronics Data 1994 and 1996*, and Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 5th ed.

⁴⁶³ USDOC, *U.S. Industry and Trade Outlook 1998* (New York: McGraw-Hill, 1997), p. 31-6.

⁴⁶⁴ *Ibid.*, p. 31-19.

⁴⁶⁵ Adams, “Markets in Search of Technology,” p. 28.

⁴⁶⁶ Mueller and Tan, *China in the Information Age: Telecommunications and the Dilemmas of Reform*, p. 105, and Henry and Caldwell, “China: Positioning for the Next Century,” *Business America*, July 1997, p. 24.

⁴⁶⁷ Mueller and Tan, *China in the Information Age: Telecommunications and the Dilemmas of Reform*, p. 60; John Adams, “Markets in Search of Technology,” *Wireless Communications, Volume 5*, Wessels, Arnold & Henderson, L.L.C., Nov. 18, 1996, pp. 27, 29-30; and Henry and Caldwell, “China: Positioning for the Next Century,” p. 24.

Corporation to increase the service provider's digital wireless capacity in the province⁴⁶⁸ and Motorola recently won two contracts with a combined value of \$105 million to supply digital wireless infrastructure equipment to the Hunan Posts and Telecommunications Administration.⁴⁶⁹ The major purchasers of lower end equipment, such as cordless or corded telephones include government, business, and retail customers.

The Chinese government invested \$13 billion in telecommunications infrastructure in 1996,⁴⁷⁰ approximately \$15 billion in 1997,⁴⁷¹ and is expected to continue spending billions of dollars per year on telecommunications and other information technology infrastructure through the year 2000. China's State Council emphasized the strategic importance of creating a state-of-the-art communications infrastructure for national development in its Ninth Five-Year Plan (1996-2000) and intends to invest approximately \$40 billion to \$50 billion during the period for services and equipment.⁴⁷² This investment will be used to build China's capabilities in optical, satellite, digital microwave, and GSM wireless networks as well as technologies such as ISDN and cable telephony.⁴⁷³ A portion of this investment will likely be spread among several "Golden Projects," five of which are directly related to information technology products, including telecommunications and data communications equipment (in particular, such products as program-controlled switches and mobile communications equipment).⁴⁷⁴

China's plans to increase investment in telecommunications infrastructure, especially in state-of-the-art equipment, should provide opportunities for U.S. telecommunications equipment companies as these companies are industry leaders in the development of new technologies. Although U.S. companies face considerable competition from local and foreign competitors in the Chinese market, U.S. firms such as Motorola and Lucent Technologies are actively establishing local production facilities in order to capitalize on China's future growth in this sector.

⁴⁶⁸ Nokia Company Reports.

⁴⁶⁹ Motorola Company Reports.

⁴⁷⁰ Henry and Caldwell, "China: Positioning for the Next Century," p. 24.

⁴⁷¹ China Research Corporation, "97 China Posts and Telecommunications Market Development Review," *China Telecommunications Weekly*, Jan. 5, 1998. Also includes other information technology equipment, software, and services.

⁴⁷² USDOC, *U.S. Industry and Trade Outlook 1998*, p. 31-7, and USDOC, "Telecommunications Equipment FY98," section on China, Best Market Reports, Oct. 27, 1997.

⁴⁷³ China Communications Industry Report, "China Confirms Communications Development Focus," Mar. 14, 1997, found at <http://www.ccireport.com>, retrieved Oct. 1, 1997.

⁴⁷⁴ USDOC, ITA, Office of Computers and Business Equipment, "Information Technologies Market II," Apr. 5, 1996, and "Personal Computers and the Golden Projects," Mar. 1997. The five relevant programs are Golden Bridge, Golden Card, Golden Customs, Golden Taxes, and Golden Sea.

CHAPTER 9

TAIWAN

Taiwan produces only 1 percent of the global output of telecommunications equipment, yet it remains a major U.S. trading partner in this sector. Taiwan is heavily trade dependent in telecommunications equipment, importing over half of its domestic consumption and exporting over three-quarters of its production.⁴⁷⁵ The United States is both a leading supplier of telecommunications equipment imports to Taiwan and a leading recipient of exports from Taiwan. The U.S. share of total sector imports decreased from 44 percent to 23 percent during 1993-95 then increased over the next two years and returned to 44 percent in 1997. Most U.S. exports to Taiwan consist of parts for switching and other telephone equipment and wireless mobile telephones while most U.S. imports from Taiwan are telephone handsets and modems. The removal of restrictions limiting procurement of certain digital switching equipment in the middle of 1997 and the further liberalization of Taiwan's telecommunications services industry are likely to increase market demand in the next few years for network infrastructure equipment as well as mobile telephones, pagers, and data communications equipment. Global competition and rising labor and land costs have increasingly forced Taiwan's telecommunications equipment industry to meet this growing demand by subcontracting with companies in lower-cost areas, relocating manufacturing facilities to these areas, and moving into higher value-added segments of the industry.

Industry Structure

Taiwan's telecommunications equipment industry is composed of approximately 300 firms of various sizes, employing a total of 25,000 workers (table 9-1).⁴⁷⁶ Approximately two-thirds of these companies produce wireline or wireless customer premises equipment (CPE) and the remainder manufacture switching and transmission equipment. The industry is not heavily concentrated -- Taiwan's four largest telecommunications equipment firms accounted for approximately 16 percent of employment in this sector. The number of production workers, especially in low-end consumer equipment, is decreasing as some companies subcontract part of their production to foreign firms or move operations to China and Southeast Asia.⁴⁷⁷

Larger firms in the industry are predominantly joint ventures between the world's leading telecommunications equipment companies and domestic electronics firms (table 9-2). These types of companies generally manufacture higher-end products such as wireline and wireless network equipment. The largest domestic partner for joint ventures in Taiwan is also the dominant telecommunications service provider, Chunghwa Telecommunications Company Limited

⁴⁷⁵ All production, trade, and consumption data in this chapter are given in 1996 U.S. dollars (U.S. \$1 = NT \$27.5).

⁴⁷⁶ Frances Li, American Institute in Taipei, U.S. Department of Commerce (USDOC), National Trade Data Bank (NTDB), Industry Sector Analysis, "The Telecommunications Equipment Market in Taiwan," Sept. 1994, p. 6, and Taiwan Ministry of Economic Affairs, Industrial Development Bureau, "Industry Highlights -- Communications," found at <http://it.moeaidb.gov.tw/committee/english>, retrieved July 17, 1998.

⁴⁷⁷ China Economic News Service, "Industry Reports: Telephones," found at http://www.cens.com/i_electro.html#A1, retrieved Dec. 12, 1997.

Table 9-1
Telecommunications equipment: Representative producers in Taiwan, selected products, and headquarter country

Company name	Selected products	Headquarter country
Lucent Technologies Taiwan Telecommunications Company	Switching equipment	United States/Taiwan
Askey Computer Corporation	Data communications equipment	Taiwan
GVC Corporation	Data communications equipment	Taiwan
Kingtel	Telephone handsets	Taiwan
Kuan-Yu Electronic	Switching equipment	Taiwan
Wincomm	Switching equipment	Taiwan
Yoyang Electronics Company	Pagers	Taiwan
Zyxel Communications Corporation	Data communications equipment	Taiwan
Taiwan International Standard Electronics Ltd. (Taisel), also known as Alcatel Telecom Taiwan	Switching equipment	France/Taiwan
Siemens Telecommunications System Ltd. (formerly Taicom)	Switching equipment	Germany/Taiwan
Taiwan Taicom-Fujitsu Telecom Company Ltd.	Switching equipment	Japan/Taiwan
Taiwan Telecommunication Industry Company Ltd.	Switching equipment	Japan/Taiwan
SIS-Nortel	Fiber optic transmission equipment	Canada/Taiwan

Sources: Company reports; various issues of Asian Sources Magazine; various issues of China Economic News Service; and Frances Li, American Institute in Taipei, U.S. Department of Commerce, National Trade Data Bank, International Market Insight, "Taiwan to Open Switching Equipment Market," July 20, 1997, p. 2.

(Chunghwa), formed from part of the Directorate General of Telecommunications (DGT).⁴⁷⁸ Chunghwa inherited the DGT's shares in a number of joint ventures including Taiwan International Standard Electronics (Taisel), also known as Alcatel Telecom Taiwan, Lucent Technologies Taiwan Telecommunications Company, Siemens Telecommunications Systems, Ltd. (formerly Taicom), and Taiwan Taicom-Fujitsu Telecom Company, Ltd. Other local producers in this segment include Wincomm and Kuan-Yu Electronic.⁴⁷⁹

⁴⁷⁸ Chunghwa Telecom is a state-run company formed from the telecommunications equipment and services operations of the Directorate General of Telecommunications (DGT) in July of 1996 as a result of new telecommunications regulations that went into effect in February 1996. Prior to that time, the DGT operated Taiwan's telecommunications equipment and services operations and functioned as the government regulator. Currently, the DGT only functions as the regulatory body for Taiwan's telecommunications industry, similar to the U.S. Federal Communications Commission.

⁴⁷⁹ Frances Li, American Institute in Taipei, USDOC, NTDB, International Market Insight, "Taiwan to Open Switching Equipment Market," July 20, 1997, p. 2.

Table 9-2**Telecommunications equipment: Representative examples of joint ventures in Taiwan, foreign partner/domestic partner, joint venture name, and selected products**

Foreign partner/domestic partner	Joint venture name	Selected products
Alcatel/Chunghwa Telecom	Taiwan International Standard Electronics Ltd. (Taisel), also known as Alcatel Telecom Taiwan	Switches, transmission equipment, wireless network equipment, terminal equipment
Fujitsu/Siemens Telecommunications System Ltd. (See below)	Taiwan Taicom-Fujitsu Telecom Company Ltd.	Transmission equipment, ISDN terminal equipment
Lucent Technologies/Chunghwa Telecom, Bank of Communications, United Fiber Optic Communication, and Yao-hwa Glass Company	Lucent Technologies Taiwan Telecommunications Company	Switches and transmission equipment
NEC/Tatung Co.	Taiwan Telecommunication Industry Company Ltd.	ISDN phones/adapters, PBXs, facsimile machines
Nortel/Southern Information Systems	SIS-Nortel	Fiber optic transmission equipment
Siemens/Chunghwa Telecom, other local investors	Siemens Telecommunications System Ltd. (formerly Taicom)	Switches, transmission equipment, ISDN equipment, GSM mobile telephone switches

Sources: Company reports; Frances Li, American Institute in Taipei, U.S. Department of Commerce, National Trade Data Bank, International Market Insight, "Taiwan to Open Switching Equipment Market," July 20, 1997, p. 2.

Smaller firms in Taiwan's telecommunications equipment industry tend to focus on lower-end CPE. For instance, Kingtel Telecommunications Corporation, which generates under \$100 million per year in annual sales, specializes in full feature telephone sets.⁴⁸⁰ Kingtel is a good example of the difficulties a low-margin equipment manufacturer encounters in Taiwan. In order to remain profitable in a mature industry, Kingtel achieves economies of scale by exporting most of its production to the United States, the EU, and other countries in addition to supplying the domestic market. Further, in order to expand its production capacity, the firm has decided to forego Taiwan's high cost structure and establish a manufacturing facility in China's Guangdong province.⁴⁸¹ Other companies have either emulated Kingtel's movement of production outside of Taiwan, subcontracted production with companies in lower-cost areas, or have attempted to move into higher value-added segments of the industry.⁴⁸²

Prior to 1996, domestic manufacture of central office digital switches was limited to three joint venture sources each affiliated with the DGT in Taiwan's Ministry of Transportation and Communications (MOTC),⁴⁸³ and operated by leading foreign manufacturers Lucent (formerly AT&T), Alcatel, and Siemens.⁴⁸⁴ Taiwan agreed to lift restrictions on foreign investment in the

⁴⁸⁰ China Economic News Service, "Phone Firm is King of the Hill in Taiwan," July 1997, found at <http://www.cens.com>, retrieved Oct. 2, 1997.

⁴⁸¹ Ibid.

⁴⁸² Li, "The Telecommunications Equipment Market in Taiwan," pp. 6-7.

⁴⁸³ As discussed above, the Directorate General of Telecommunications has regulatory responsibility over Taiwan's telecommunications industry. A state-run company, Chunghwa Telecommunications Company Limited (Chunghwa), was formed to operate the business functions of the DGT in July 1996 as a result of new telecommunications regulations that went into effect in February 1996.

⁴⁸⁴ Li, "Taiwan to Open Switching Equipment Market."

manufacture of these systems in a bilateral discussion with the United States in July of 1996.⁴⁸⁵ Further, in July of 1997, the dominant carrier, Chunghwa, announced its willingness to procure digital switching equipment directly from foreign manufacturers.⁴⁸⁶

Taiwan's telecommunications industry accounted for between 1 and 2 percent of total world production of telecommunications equipment during 1993-97. Taiwan's production in this sector increased from approximately \$1.8 billion in 1993 to \$2.3 billion in 1997, an average annual increase of 6 percent (table 9-3).⁴⁸⁷ In terms of value, wireless communications and switching equipment comprised roughly half of all sectoral production in Taiwan. Telephone handsets, facsimile machines, and parts constituted most of the remainder. While the production of wireless communications equipment as a percentage of all telecommunications products remained relatively steady during the period, production of switching equipment declined from 34 percent to 20 percent, largely as a consequence of increased import competition. In addition the share of sector production composed of facsimile machines grew from 7 percent in 1993 to 10 percent in 1997 and the production share of telephone handsets declined from 17 percent to 8 percent, as a direct result of Taiwan's rising labor and land costs.⁴⁸⁸

Table 9-3
Telecommunications equipment: Taiwan's production, imports, exports, and apparent consumption, 1993-97

Year	Production	Imports	Exports	Apparent consumption	Ratio of imports to consumption
-----Million dollars-----					Percent
1993	1,785	504	1,333	956	52.7
1994	1,951	478	1,485	944	50.6
1995	2,062	630	1,739	953	66.1
1996	2,238	576	1,893	921	62.5
1997	2,308	604	1,982	930	64.9

Source: Estimated by USITC staff based on official statistics of the U.S. Department of Commerce; Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 5th ed.; Reed Electronics Research, *Yearbooks of World Electronics Data, 1994, 1995, 1996, and 1998*; and United Nations Trade Series D.

Trade

Taiwan's imports of telecommunications equipment have fluctuated in recent years, rising modestly from \$504 million in 1993 to approximately \$604 million in 1997 (table 9-3). Imports grew by 5 percent during 1996-97, as the digital switch market opened to competition in the middle of the year and the liberalization of the wireless telephone services market led to increased procurement

⁴⁸⁵ Office of the United States Trade Representative (USTR), *1997 National Trade Estimate of Foreign Trade Barriers (NTE)*, p. 358, and American Institute in Taipei, USDOC, NTDB, International Market Insight, "Foreign Investment Restrictions," Aug. 30, 1996, pp. 1-2.

⁴⁸⁶ Li, "Taiwan to Open Switching Equipment Market," p. 3.

⁴⁸⁷ Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 5th ed. (Surrey: Reed Business Information, 1997), p. 66.

⁴⁸⁸ Government Information Office, Republic of China, "The Economy," ch. in *The Republic of China Yearbook 199* companies generally manufacture higher-end products such as wireline and wireless network equipment. The largest domestic partner for joint ventures in Taiwan is also the dominant telecommunications service provider, Chunghwa Telecommunications 7, found at <http://www.gio.gov.tw>, retrieved Dec. 10, 1997.

of network infrastructure equipment and parts. Further DGT/Chunghwa, increased its purchases of telecommunications equipment in order to acquire new technologies and capacity to compete with foreign investors in the newly liberalized telecommunications services market.

The United States is the leading supplier of telecommunications equipment to Taiwan, accounting for approximately 44 percent of the island's total sectoral imports in 1997 (table 9-4). Since 1993, the U.S. share of Taiwan's imports has fluctuated between 23 percent and 44 percent depending largely on the procurement patterns of Taiwan's DGT/Chunghwa, the largest purchaser of telecommunications equipment in Taiwan.⁴⁸⁹ The majority of Taiwan's telecommunications imports from the United States during 1993-97 were wireless mobile telephones, parts for telephone switching equipment, and parts for other telephone equipment.⁴⁹⁰ Other leading suppliers of telecommunications equipment to Taiwan include Japan, the EU, Korea, and Singapore.

The telecommunications equipment industry in Taiwan is strongly export oriented, shipping most of its production to markets such as the United States, the EU, China, and Southeast Asia.⁴⁹¹ Taiwan exported approximately \$2.0 billion of telecommunications equipment to the world in 1997, compared with \$1.3 billion in 1993 (table 9-3). Among the top exports in the industry were modems, telephone sets, switching equipment, and facsimile machines.⁴⁹² The United States is a leading export destination for telecommunications equipment from Taiwan, accounting for 24 percent of the total in 1997. More than half of Taiwan's exports of telecommunications

Table 9-4
Telecommunications equipment: Taiwan's trade with the United States, 1993-97

Year	Imports from the United States	Exports to the United States	U.S. share of Taiwan imports	U.S. import share of apparent consumption
	-----Million dollars-----		-----Percent-----	
1993	220	299	43.7	23.0
1994	189	304	39.5	20.0
1995	145	263	23.0	15.2
1996	158	381	27.4	17.2
1997	265	468	43.9	28.5

Source: Estimated by USITC staff based on official statistics of the U.S. Department of Commerce; Reed Electronics Research, *Profile of the Worldwide Telecommunications Industry*, 5th ed.; Reed Electronics Research, *Yearbooks of World Electronics Data, 1994, 1995, 1996, and 1998*; and United Nations Trade Series D.

equipment to the United States were corded and cordless telephone sets and modems, which is comparable in composition to Taiwan's total sector exports. Telephone sets decreased as a share of telecommunications equipment exports to the United States from 35 percent in 1993 to 24 percent in 1997, indicative of the declining production trend for the goods discussed above. In comparison, the share of modem exports has increased from 26 percent in 1993 to 74 percent in 1997. This growth reflects Taiwan's successful production of computer-telephony products as an originalequipment manufacturer (OEM) or original design manufacturer (ODM) for the world's leading computer equipment firms.⁴⁹³

⁴⁸⁹ Li, "The Telecommunications Equipment Market in Taiwan," p. 4.

⁴⁹⁰ Estimated by USITC staff based on official statistics of the USDOC.

⁴⁹¹ "Telecommunication Products: Industry Growing Stronger," *Taiwan Products*, 1997, facsimile response from China External Trade Development Council (CETRA), Taiwan Trade Center, New York, received Dec. 18, 1997.

⁴⁹² Ibid.

⁴⁹³ Ibid.

Trade Agreements and Nontariff Barriers

Taiwan is not a member of the WTO but is a signatory to the Information Technology Agreement which will lower most import duties on telecommunications equipment by the year 2000. As an economy that has not yet acceded to the WTO, Taiwan's tariff rates remain unbound. As a result, Taiwan's tariff rates are not subject to WTO rules and may change with little or no notice. Further, Taiwan is not required to submit documentation to modify its tariff schedule in conformity with the Information Technology Agreement.⁴⁹⁴ However, Taiwan is expected to implement its commitments on an autonomous basis, with or without WTO accession, and to incorporate these commitments into its WTO market access schedule for goods when it becomes a WTO member.⁴⁹⁵ In 1997, most favored nation tariff rates on imports of telecommunication equipment into Taiwan ranged from 1 percent for certain parts to 15 percent for telephone answering machines.⁴⁹⁶

Market

Taiwan imports roughly half of its apparent domestic consumption and the United States supplies a major share of these imports. Taiwan's market for telecommunications equipment in 1997 reached \$930 million, maintaining a relatively stable level of activity since 1993 when it equaled \$956 million (table 9-3). Imports provided between 51 and 66 percent of total apparent consumption during this period, of which the United States supplied between 15 and 24 percent (table 9-4), mostly in mobile telephones and certain parts. With essentially one dominant telecommunications service provider during the period of study, market growth was greatly affected by the purchasing demands of the DGT and its successor, Chunghwa.⁴⁹⁷ The opening of the telecommunications equipment market to foreign manufacturers and new entrants in the telecommunications services market, makes it likely that consumption of related goods in Taiwan will increase significantly in the next few years.

Despite the flat demand for telecommunications equipment in Taiwan during 1993-97, the market is expected to increase in the next few years as a result of recent liberalization in the switching equipment, wireless services, and value added network services (VANS)⁴⁹⁸ markets as well as planned liberalization in satellite and basic telecommunications services. Expected government investment alone in the upgrading of wireline and wireless infrastructure equipment during 1997 to 2002 is estimated to reach \$18 billion.⁴⁹⁹

⁴⁹⁴ World Trade Organization (WTO), Note by the Secretariat, Revision, Committee of Participants on the Expansion of Trade in Information Technology Products, *Status of Implementation*, Doc. G/IT/Rev.2, Nov. 27, 1997.

⁴⁹⁵ WTO, *Ministerial Declaration on Trade in Information Technology Products*, Singapore, Dec. 13, 1996.

⁴⁹⁶ USDOC, International Trade Administration, Trade Information Center, facsimile response received July 10, 1998.

⁴⁹⁷ Li, "The Telecommunications Equipment Market in Taiwan," p. 4.

⁴⁹⁸ VANS provide data communications networks in which some sort of signal processing takes place or information is added by the network typically through an interactive computer with a database. VANS include electronic mail and dial-up stock market quoting services.

⁴⁹⁹ USDOC, *U.S. Industry and Trade Outlook 1998* (New York: McGraw Hill, 1997), p. 31-7.

Chunghwa is currently the dominant provider in mobile telephony and operates an existing island-wide mobile telephone network with 760,000 analog and 500,000 digital subscribers.⁵⁰⁰ Fifty-three operator licenses were issued by Taiwan to wireless service providers in 1996 from four major industry segments: mobile telephone, paging, mobile data, and trunking radio.⁵⁰¹ Eight mobile telephone licenses were awarded to private sector firms of which five were granted to firms that partnered with the U.S.-based service providers AT&T Wireless, GTE, Sprint Global One,⁵⁰² and Southwestern Bell (table 9-5). The three remaining licenses were won by firms affiliated with Hong Kong First Pacific and the German firm Deutsche Telekom.⁵⁰³

In total, Chunghwa must currently compete with new entrants in the wireless services market and an estimated 100 license holders in the VANS market. Also, many of these competitors have attracted investment from, or are wholly-owned by, foreign entities with global experience and considerable assets. Although Chunghwa is currently the dominant carrier, it will likely account for a decreasing share of the total telecommunications equipment market in Taiwan as new entrants build market share and further liberalization develops in the sector.

Table 9-5
Telecommunications equipment: Wireless network equipment suppliers, mobile telephone service providers, and geographic coverage in Taiwan

Equipment supplier	Service provider (foreign partner)	Coverage
Ericsson	Chunghwa Telecom Far Eastone (AT&T Wireless) TransAsia Telecom (SBC Corp.)	Island-wide (analog) ¹ Island-wide and Northern region Southern region
Lucent Technologies	KG Telecom (Bell Canada) Smart Link ² (First Pacific)	Northern region Central and Southern regions
Nokia	Mobitai (Deutsche Telekom)	Central region
Nortel	Chunghwa Telecom	Island-wide (digital)
Siemens	Pacific Communication Services (GTE)	Island-wide

¹ Motorola and Ericsson reportedly are bidding to supply equipment for the upgrade of this network.

² Also known as Tuntex Telecom.

Sources: Azra Moiz, Raymond Ho, Suzie Low, and Norman Miranda, *Asia Pacific Cellular Operators: 1997 Edition*, pp. 176-181; "Taiwan Further Liberalizes Telecom Market with Mobile Phone, Paging License Awards," *East Asian Executive Reports*, Dec. 15, 1996, pp. 8 and 17; Andrew Bailes and Andrew White, *Financial Times Media & Telecoms: Asia Pacific Telecoms Markets*, pp. 130-131; and company reports.

⁵⁰⁰ "Taiwan Further Liberalizes Telecom Market with Mobile Phone, Paging License Awards," *East Asian Executive Reports*, Dec. 15, 1996, p. 17.

⁵⁰¹ Lawrence S. Liu, Esq., "Telecommunications Market Liberalization in Taiwan: Political and Legal Issues," *East Asian Executive Reports*, Oct. 15, 1996, p. 19.

⁵⁰² Sprint Global One was soon replaced with Bell Canada. Azra Moiz, Raymond Ho, Suzie Low, and Norman Miranda, *Asia Pacific Cellular Operators: 1997 Edition* (New York: Northern Business Information, 1997), p. 176.

⁵⁰³ "Taiwan Further Liberalizes Telecom Market with Mobile Phone, Paging License Awards," *East Asian Executive Reports*, Dec. 15, 1996, pp. 8 and 17. See also Moiz, Ho, Low, and Miranda, *Asia Pacific Cellular Operators: 1997 Edition*, p. 176, and Andrew Bailes and Andrew White, *Financial Times Media & Telecoms: Asia Pacific Telecoms Markets* (London: Pearson Professional Ltd., 1997), pp. 130-131.

Several new governmental policies and regulations have recently been adopted with the intention of promoting the development of telecommunications services in Taiwan. For example, the Asia-Pacific Regional Operations Center Plan was intended to position the economy as a regional business center for international operations. The plan proposed liberalizing services in the telecommunications sector in stages with full liberalization of the market by the year 2000.⁵⁰⁴ Taiwan's 1996 telecommunications reforms adopted these proposals and formalized a timetable for full services liberalization by July 1, 2001. Although Chunghwa currently enjoys a monopoly on most Type One services,⁵⁰⁵ the market for wireless services was liberalized to a limited extent and the VANS market was fully opened to competition in 1996.

In 1996, the Government of Taiwan enacted three bills to reform and liberalize the telecommunications industry whereby the DGT -- Taiwan's telecommunications regulator, a major telecommunications equipment manufacturer, and the sole operator of basic telecommunications services before 1996 -- spun off its manufacturing and service operations to form Chunghwa.⁵⁰⁶ The DGT retains its role as the regulatory agency for Taiwan's telecommunications sector. These bills also divided telecommunications services into two classes: Type One, or basic telecommunications services, and Type Two, or VANS.⁵⁰⁷ A third result was to allow foreign ownership of telecommunications services firms; up to 20 percent of total equity for Type One services and 100 percent for Type Two services. More recently, in February of 1998, the United States and Taiwan reached an agreement on a bilateral understanding for Taiwan's accession to the WTO.⁵⁰⁸ Taiwan agreed to lower interconnection charges for wireless service providers by Chunghwa to base these charges on an international standard by the time Chunghwa is privatized in 2001. Additionally, Taiwan stated that it will permit foreign businesses to take a controlling interest in companies that provide Type One services in accordance with the terms of the Basic Telecommunications Agreement.⁵⁰⁹

As discussed above, prior to 1996, DGT/Chunghwa was the sole purchaser of central office switching equipment, which were sourced from three joint ventures in which DGT was affiliated. The three joint venture partners were Lucent, Alcatel, and Siemens. The removal of procurement restrictions will provide substantial market opportunities for a number of major global suppliers. These firms include leading foreign telecommunications equipment companies such as Nortel, Ericsson, and NEC.⁵¹⁰ The market potential for central office digital switching systems is estimated at \$800 million over the next 5 years.⁵¹¹ Further expenditures on central office switching equipment

⁵⁰⁴ Liu, "Telecommunications Market Liberalization in Taiwan: Political and Legal Issues," p. 19.

⁵⁰⁵ Value-added network service providers were allowed to establish very small aperture terminal (VSAT) networks for domestic data communications services as of April 1996. See Frances Li, American Institute in Taipei, USDOC, NTDB, International Market Insight, "Satellite Communication Liberalization," Oct. 20, 1997, p. 2.

⁵⁰⁶ Liu, "Telecommunications Market Liberalization in Taiwan: Political and Legal Issues," p. 19.

⁵⁰⁷ *Ibid.*, and Frances Li, American Institute in Taipei, USDOC, NTDB, Industry Sector Analysis, "Value-added Network Services," July 1, 1997, p. 3. Type One services are fixed network services which include local, long distance, international, leased line, broadband, and packet-switched services; mobile network services which include mobile/cellular telephony, paging, and mobile data services; and satellite network services both fixed and mobile. Type Two services are those that use Type One services and add value.

⁵⁰⁸ U.S. Department of State telegram, "Bilateral Agreement Reached on Taiwan's WTO Accession," message reference No. 034505, prepared by American Institute in Taipei, Feb. 25, 1998.

⁵⁰⁹ U.S. Department of State telegram, "Allowable Foreign Investment in Taiwan Telecom," message reference No. 002082, prepared by American Institute in Taipei, May 1998.

⁵¹⁰ *Ibid.*

⁵¹¹ Li, "Taiwan to Open Switching Equipment Market," p. 4.

should increase significantly after January 1, 2000 when the winners of fixed line basic telecommunications services bids will be announced for services commencing on July 1, 2001.

In the wireless mobile telephone market there is considerable demand for wireless network equipment and projected high demand for new subscriber handsets. Many of the world's leading equipment suppliers have agreed to build new wireless infrastructure in Taiwan (table 9-5). Ericsson supplied DGT/Chunghwa, with its existing analog cellular network⁵¹² and has signed contracts with two new entrants in the mobile telephone market for the supply of network equipment. These contracts have a total estimated value of \$260 million.⁵¹³ Lucent Technologies will reportedly supply network equipment to KG Telecom, a mobile telephone license holder for the Northern region, and Smart Link, a mobile license holder for the Central and Southern regions.⁵¹⁴ Siemens will supply an island-wide service provider, Pacific Communication Services, with mobile infrastructure valued at \$200 million,⁵¹⁵ Nokia will supply Mobitai, a regional GSM network operator, with SDH network equipment,⁵¹⁶ and Nortel won a contract worth \$150 million to expand Chunghwa's GSM network.⁵¹⁷ Nortel previously supplied DGT, now Chunghwa, with its existing digital GSM network.⁵¹⁸ The value of wireless telephone equipment needed to build these networks is estimated at \$600 million during the next few years.⁵¹⁹ These products will supply an estimated 3 to 4 million additional wireless telephone subscribers once new networks are in place.⁵²⁰

In the paging market, Taiwan's MOTC has projected that sales of infrastructure equipment and pagers will be worth a total of \$600 million in the next few years.⁵²¹ Motorola, NEC, and Ericsson have traditionally supplied paging network equipment to Taiwan's DGT, now Chunghwa.⁵²² Motorola will continue its presence in the paging network equipment market by supplying FITEL with its island-wide infrastructure.⁵²³

⁵¹² John Adams, "Markets in Search of Technology," *Wireless Communications, Volume 5*, Wessels, Arnold & Henderson, L.L.C., Nov. 18, 1996, p. 104, and Nortel, "Unprecedented Mobile Phone Demand in Taiwan Prompts Early Completion Target for Nortel GSM Network," Nov. 29, 1995, found at <http://www.nortel.com/home/press>, retrieved Dec. 9, 1997.

⁵¹³ Ericsson, "Ericsson Wins Two Major GSM Contracts in Taiwan," July 11, 1997, found at <http://www.ericsson.com/eripress/summ/>, retrieved Dec. 9, 1997.

⁵¹⁴ Lucent Technologies, "Lucent Technologies Installs Initial Phase of Taiwan's First Nationwide GSM 1800 Wireless Network," Oct. 29, 1997, found at <http://www.lucent.com/press>, retrieved Dec. 9, 1997.

⁵¹⁵ Siemens, "Large-scale Order from Taiwan," Jan. 20, 1997, found at <http://www.siemens.com.de>, retrieved Dec. 9, 1997.

⁵¹⁶ Nokia, "Mobitai Selects Nokia's SYNFO NET Solution for the First Live SDH Network in Taiwan," Nov. 27, 1997, found at <http://www.nokia.com/news>, retrieved Dec. 9, 1997.

⁵¹⁷ Nortel, "Nortel (Northern Telecom) to Provide \$US 150 Million Personal Communications Network for ChungHwa Telecom in Taiwan," July 31, 1997, found at <http://www.nortel.com/home/press>, retrieved Dec. 9, 1997.

⁵¹⁸ Adams, "Markets in Search of Technology," p. 104, and Nortel, "Unprecedented Mobile Phone Demand in Taiwan Prompts Early Completion Target for Nortel GSM Network," Nov. 29, 1995, found at <http://www.nortel.com/home/press>, retrieved Dec. 9, 1997.

⁵¹⁹ Frances Li and William Zarit, American Institute in Taipei, USDOC, NTDB, International Market Insight, "Taiwan Mobile Phone Licenses," Sept. 9, 1996, p. 2.

⁵²⁰ USDOC, *U.S. Industry and Trade Outlook 1998*, p. 31-19.

⁵²¹ Frances Li and William Zarit, American Institute in Taipei, USDOC, NTDB, International Market Insight, "Private Paging Licenses," Feb. 12, 1997, pp. 1-2.

⁵²² Adams, "Markets in Search of Technology," p. 104.

⁵²³ Motorola, "Motorola Infrastructure is Chosen to Support Islandwide Paging Network in Taiwan," June 24, 1997, found at <http://www.mot.com/MIMS/MSPG/Press>, retrieved Dec. 9, 1997.

The market for most other types of telecommunications equipment, such as corded handsets, in Taiwan is expected to grow at a slower pace than the market for wireless equipment in the next few years. However, Taiwan's market for data communications equipment is expected to increase as new entrants in the VANS market build backbone infrastructure for business clients to access the Internet,⁵²⁴ electronic commerce and Internet usage grows,⁵²⁵ and customers buy high speed modems and other wide area networking equipment for these new services. In comparison, the market for corded handsets is expected to increase at a less rapid pace in the next few years as the market is relatively mature and developed. For instance, Taiwan had a teledensity of 47 percent in 1996, only slightly below that of Japan (49 percent) and relatively close to the average teledensity of the world's high income countries as defined by the International Telecommunications Union.⁵²⁶ However, full liberalization of fixed line services in the year 2001 and incremental steps toward that goal may accelerate the demand for telephones above moderate levels.

Overall, U.S. companies face considerable opportunities in Taiwan's telecommunications equipment industry in the next few years. U.S. firms hold a leading share of Taiwan's imports, especially in high-value added products such as switches, network infrastructure equipment, and wireless equipment, which are all expected to increase significantly as a result of the liberalization of the telecommunications services market.

⁵²⁴ Mark LePendus, "Asian Internet Fever: Pent-up demand strains the region's infrastructure," *Byte*, Aug. 1996, found at <http://www.byte.com>, retrieved Dec. 19, 1997.

⁵²⁵ Jacy Huang, American Institute in Taipei, USDOC, NTDB, International Market Insight, "Electronic Commerce in Taiwan," April 1997, p. 1.

⁵²⁶ International Telecommunications Union (ITU), *World Telecommunications Development Report*, (Geneva: ITU, 1998), pp. A-8 and A-11.

APPENDIX A

GLOSSARY

Glossary⁵²⁷

Advanced Mobile Phone Service (AMPS):	Term used by AT&T's Bell Laboratories (prior to the 1984 divestiture) to refer to cellular telephone technology. The AMPS standard has become the foundation of the industry in the United States, although it has been slightly modified in recent years. "AMPS-compatible" means equipment designed to work with most standard U.S. analog cellular phones.
Analog:	Varying continuously (either in frequency or amplitude) without discrete values or steps. The human voice is analog, as is the traditional telephone network. While it is comparatively simple to transmit analog signals, they are very difficult to compress or filter for noise, which are the most important reasons digital technology is rapidly replacing analog.
Asynchronous Transfer Mode (ATM):	A broadband connection-oriented switching service that carries data, voice, and video information. ATM handles numerous services by combining the best of both circuit-switching technology (for constant-bit rate services such as voice and graphics) and packet-switching technology (for variable-bit rate services such as data and full-motion video).
Central Office Switch:	Telephone company facility where subscribers' lines are terminated and joined to other switching equipment, enabling local and long-distance connections.
Code Division Multiple Access (CDMA):	Spread-spectrum approach to digital cellular transmission. With CDMA, each conversation is digitized and then tagged and transmitted with a code. Mobile phones are then instructed to decipher only a particular code to select the correct conversation from the signal.

⁵²⁷ Sources: James Green, *The Irwin Handbook of Telecommunications* (Chicago: Irwin Professional Publishing, 1997); Harry Newton, *Newton's Telecom Dictionary* (New York: Flatiron Publishing, Inc., 1997); Gilbert Held, *Understanding Data Communications* (Indianapolis: Sams Publishing, 1996); MultiMedia Telecommunications Association (MMTA), *1998 MultiMedia Telecommunications Market Review and Forecast*, (Arlington, VA: MMTA, 1998); and Gemini Consulting, *C4 Lab Glossary of Terms, The Essential Guide to Convergence Terminology*, found at <http://digital.gemconsult.com/glossary/TEXTGLOS.HTM>, retrieved Sep. 10, 1998.

Computer-Telephony Integration (CTI)	The process of blending the functionality of computers and computer networks with the features and capabilities of advanced telephone systems via an intelligent link.
Customer Premises Equipment (CPE):	Telephone apparatus mounted on the user's premises and connected to the telephone network. Often includes telephones, key systems, PBXs, modems, fax machines, etc.
Digital:	A discrete or discontinuous signal, one whose various states are identified with discrete values. A mode of transmission in which binary (off/on) code is used to represent information.
Groupe Speciale Mobile (GSM):	Pan-European digital cellular system standard that is intended to allow European travelers use of a single digital cellular telephone in as many as twenty countries. Sometimes anglicized as Global System for Mobile Communications (GSM).
Integrated Services Digital Network (ISDN)	A system of end-to-end digital phone connectivity that provides much greater data carrying capacity than a standard (analog) connection.
Key Telephone System (KTS):	A method of allowing several central office lines to be accessed from multiple telephone sets. Although similar to a PBX, the KTS is not a switch and requires that the user make the selection of an available outside line.
Modem:	Contraction of Modulator/Demodulator. Modems are used to transmit or receive digital data over an analog channel, usually a telephone line. At the transmitting end, modems convert digital signals to analog. At the receiving end, modems convert analog signals to digital. Modems can be used to transmit data over a wireline or radio network.
Multiplexer:	A device which allows two or more signals to interleave or simultaneously pass over one communications circuit.
Network:	A set of communications points connected by channels. The switched telephone network consists of public telephone lines normally used for dialed telephone calls. A private network is a configuration of communications channels reserved for the use of a sole customer.
Original Equipment Manufacturer (OEM)	The manufacturer of equipment marketed by another vendor, usually under the name of the reseller.

Personal Communications Services (PCs):	FCC terminology describing intelligent, digital wireless, personal two-way communications systems. Based on "microcells" using frequencies in the 1.5- to 1.8-MHZ range with low-power transmitters to serve small areas such as buildings and neighborhoods.
Personal Handyphone System (PHS)	Japanese version of Personal Communications Services (see above).
Private Branch Exchange (PBX):	On-premises switch that operates as a private local exchange, typically providing reduced-digit dialing for internal calls. PBXs are dedicated to one customer and connected to the public switched network.
Switch:	Premises equipment which performs the functions of establishing and releasing connections on a per call basis between two or more circuits, services, or communications systems.
Synchronous Digital Hierarchy (SDH)	A set of fiber-optic-based serial standards planned for use with SONET and ATM in Europe.
Synchronous Optical Network (SONET)	An optical interface standard that allows internetworking of transmission products from multiple vendors.
Terminal Equipment:	Any device meant for direct operation over a telecommunications circuit by an end-user. Telephones or other equipment at the end of telephone lines. Wireless terminal equipment includes telephone handsets and pagers.
Time Division Multiple Access (TDMA):	Method of digital wireless communications transmission allowing a large number of users to access (in sequence) a single radio frequency channel without interference by allocating unique time slots to each user within each channel.
Value Added Network Services (VANS)	VANS provide data communications networks in which some sort of signal processing takes place or information is added by the network typically through an interactive computer with a database. VANS include electronic mail and dial-up stock market quoting services.

Wideband:	Any channel wider than a single voice-grade channel (3 KHz) but not as wide as a broadband channel (20 KHz).
Wireless:	Term used to describe radio-based systems allowing transmission of telephone and/or data signals through the air without a physical connection such as a metal wire or fiber-optic cable. A phone system that operates locally without wires.
Wireline:	A phone system that operates over cables (copper, coaxial, fiber optic, etc.), rather than radio.