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Southwest Economy

Empty Spaces: Are Texas Office Markets on the Road to Recovery?

Office markets are cyclical by nature, but in Texas the booms tend to be larger and the busts seem to last longer. In the past, Texas' office construction was sometimes driven by external factors—such as oil prices and tax law changes—in addition to economic fundamentals. However, beginning in the 1990s, Texas real estate was driven more by supply and demand.

Economic prosperity in the 1990s, partly thanks to the high-tech boom, breathed life into Texas office markets that had been stagnant since the mid-1980s bust. Demand for office space rose strongly, rents increased at double-digit rates and construction cranes dotted the Texas skyline.

The national recession that began in March 2001, along with the high-tech bust and catastrophic events of 9/11, took a toll on the Texas economy, however. The downturn hit harder and lasted longer in Texas than elsewhere in the country. As firms downsized, office vacancies in Texas markets climbed quickly and rents began falling.

(Continued on page 2)

Supply Chain Management: The Science of Better, Faster, Cheaper

Over the past 20 years, real GDP growth in the United States has become strikingly less volatile. Extreme movements in output occur far less often today, and there have been only two relatively mild recessions since 1982. In addition, about 10 years ago productivity growth began to accelerate. The average annual productivity growth rate since 1995 is about double that experienced from 1973 to 1995.

Improved economic stability and accelerating productivity growth have important policy implications. Specifically, accelerating productivity ultimately leads to higher living standards and fewer and milder periods of declining output. This makes the economy more resilient and flexible. Together, rising

(Continued on page 7)

INSIDE:
Domestic Policy No Match for Trade Stance of Central American Countries

Supply Chain Management: The Science of Better, Faster, Cheaper

(Continued from front page)

productivity growth and a more stable economic environment give monetary policymakers more room to maneuver by allowing faster economic growth with less inflationary pressure.

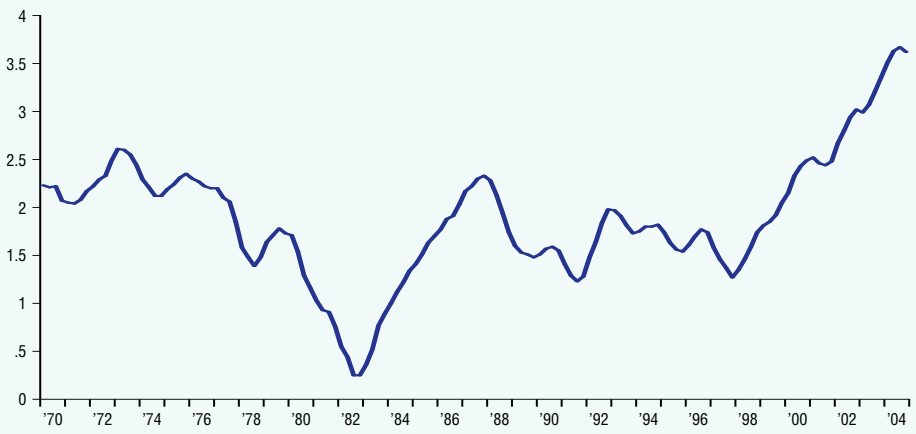
The economy's increased stability and stronger productivity growth in recent years have intrigued economists and policymakers (*Charts 1 and 2*). Several competing explanations—which are not mutually exclusive and are likely complementary—have been put forth. Among the leading hypotheses are that monetary policy has been better in the Volcker and Greenspan eras;[1] that there have been fewer shocks—or better luck—in recent years; that globalization, trade and deregulation have become more commonplace around the world; and that businesses have radically improved their supply chain management through the widespread adoption of new information technologies.[2]

This article focuses on one of these explanations—improved supply chain management. I discuss important changes and emerging trends in management practices and then present some of the evidence that has led analysts to believe that better supply chain management has contributed to the nation's improved macroeconomic performance.

Chart 2

Productivity Growth Has Surged

(Output per hour, nonfarm business sector)



*Four-quarter growth rate.

SOURCE: Bureau of Labor Statistics.

What Is Supply Chain Management?

Supply chain management is getting the right things to the right places at the right times for maximum profit. Many important strategic decisions impact the supply chain: how to coordinate the production of goods and services, including which suppliers to buy materials from; how and where to store inventory; how to distribute products in the most cost-effective, timely manner; and how and when to make payments.

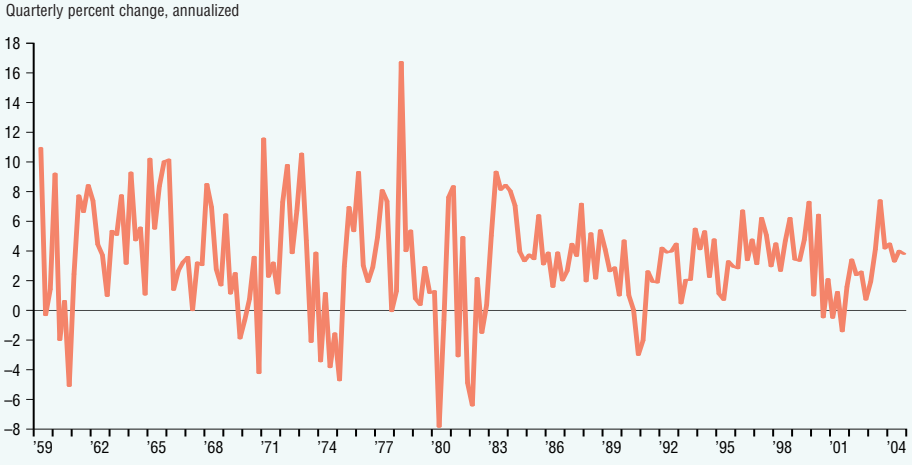
A typical supply chain is made up of many interrelated firms. As shown in Chart 3, component and subassembly suppliers are upstream from the manufacturer. Further up the chain are the supplier's suppliers, who provide raw materials. Downstream from the producing firm are the warehousing and distribution channels, then the retail channels and finally the consumer. Thus, the supply chain encompasses the flow and transformation of goods, services and information from the raw materials stage to the customer.

While supply chain management is as old as trade itself, new information and communications technologies have made today's supply chains better, faster and cheaper. Information engineering that combines new information technologies with improved production, inventory, distribution and payments methods has revolutionized supply chain operations.

For example, one way to buy a computer is to get on Dell's web site and

Chart 1

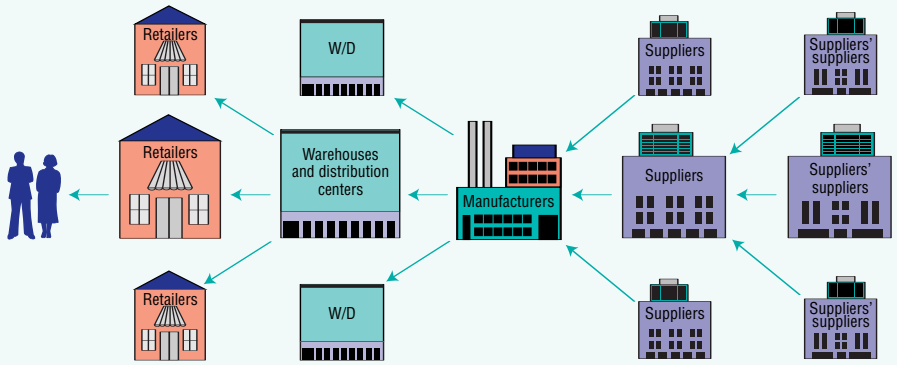
Real U.S. GDP Growth Is More Stable



SOURCE: Bureau of Economic Analysis.

Chart 3

The Supply Chain



configure and price a system exactly as you want it. As soon as you submit the online order, all of Dell's global suppliers—those providing chips, monitors and so on—are immediately notified of the sale and go to work so that you receive your computer typically within a week.

Contrast this direct sales model with yesterday's supply chain. The old model required the customer to go to a store in search of a product that the manufacturer thinks you want to buy.

But now, in some cases, the middlemen between you and the manufacturer can be eliminated. Moreover, in the direct sales model, the upstream suppliers play a key real-time role in keeping production and distribution flowing smoothly.

Better supply chain models help not only manufacturers of goods, but also some service businesses, including those requiring creativity, imagination and specialized knowledge. For example, using a virtual reality system and ultrasound data sent through the Internet, a medical specialist in Dallas can give an opinion to a patient in New York…or London… or Bombay. A virtual reality system worn around the hand and arm allows a physician to feel pressure sensations from computer images and make an informed diagnosis in real time halfway around the globe.

Today's most efficient supply chains use the Internet and associated technologies to move information in real time to those who need it. These bits of data—digital strings of zeroes and ones—can be shipped anywhere in the world in seconds at virtually no cost. And with digital products there are no time-to-manufacture delays, inventory shortages or delivery problems.

Supply Chain Management Eras

Throughout history, new ideas and technologies have revolutionized supply chains and changed the way we work. Two hundred years ago, giant machines replaced manual labor to complete tasks in large factories. Railroads, electricity and new communications media expanded markets and made supply chains better, faster and cheaper.

Mass Production Era. In the early 1900s, Henry Ford created the first moving assembly line. This reduced the time required to build a Model T from 728 hours to 1.5 hours and ushered in the mass production era. Over the next 60 years, American manufacturers became adept at mass production and streamlined supply chains with the help of scientific management methods and operations research techniques.

Lean Manufacturing Era. But in the 1970s, U.S. manufacturing's superiority was challenged. Foreign firms in many industries made higher quality products at lower costs. Global competition forced U.S. manufacturers to concentrate on improving quality by reducing defects in their supply chains.

Starting in the early 1970s, Japanese manufacturers like Toyota changed the rules of production from mass to lean. Lean manufacturing focuses on flexibility and quality more than on efficiency and quantity. Significant lean manufacturing ideas include six-sigma quality control, just-in-time inventory and total quality management. (See the box titled "Lean Manufacturing Lingo.")

Mass Customization Era. Beginning around 1995 and coinciding with the commercial application of the Internet, manufacturers started to mass-produce customized products. Henry Ford's famous statement "You can have any color Model T as long as it's black" no longer applies. While Dell may be the most famous mass customizer, the elimination of middlemen (such as travel agents, warehousers and salespeople) and the sharing of critical information in real time with key partners make this era significantly different. Perhaps a more accurate term would be the "information engineering" or "information management" era.

Firms are effectively using new information technologies to improve service and delivery processes. Through secure intranet systems and business-to-business (B2B) e-commerce platforms, firms focus on improving information

Lean Manufacturing Lingo

Six-sigma: This quality control idea was pioneered by Motorola as a way to improve processes that are already under control. The outputs of such processes typically have a normal distribution, and the process capability is expected to be within plus or minus three standard deviations of the mean. Each standard deviation is one sigma, so the total process capability covers six sigma.

Just-in-time: This inventory management idea was pioneered by Toyota to ensure that inventory in production systems would arrive in good condition exactly when needed: not too early and not too late.

Total quality management: This idea emphasizes multifunctional teams to solve quality-related problems. Such teams are trained to understand basic statistical tools and then collect and analyze data to resolve quality problems.

Kaizen: This is a team approach toward incremental improvement to tear down and rebuild a process layout to function more efficiently.

Kanban: This inventory management technique uses containers, cards and electronic signals to help production systems plan more efficiently.

management by integrating internal systems with external partners. For example, through its web site, Amazon.com gives customers the ability to track the delivery status of their purchases. And Wal-Mart routinely shares all sales data in real time with its upstream suppliers and manufacturers.

Components of the Supply Chain

The supply chain has four basic components:

- Production. Businesses focus on how much to produce, where to produce it and which suppliers to use.
- Inventory. Businesses decide where to store their products and how much to store.
- Distribution. Businesses address questions about how their products should be moved and stored.
- Payments. Businesses look for the best ways to pay suppliers and get paid by customers.

The efficiency and effectiveness of a supply chain is contingent on firms' ability to gather and analyze important information through these components.

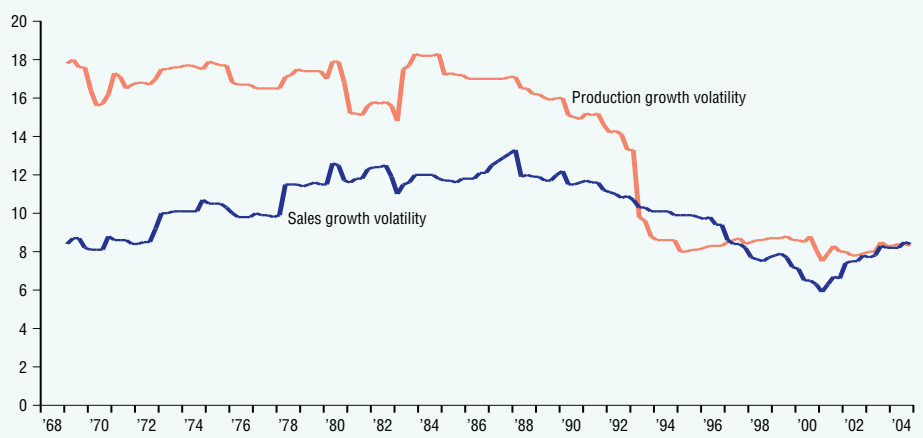
Information Distortions and the Bullwhip Effect

Distorted information, or the lack of information, is the main cause of the "bullwhip effect"—the phenomenon whereby demand uncertainties and variability are magnified as orders are placed at each step up the supply chain from the customer to the raw materials suppliers. The bullwhip effect takes its name from the way the amplitude of a whip increases down its length. This effect has been observed in many industries and is the main cause of supply chain inefficiencies.[3]

Proctor and Gamble (P&G) executives coined the term after studying the demand for disposable diapers. As expected, babies use diapers at a fairly steady and predictable rate, and as a result, retail sales are reasonably uniform. But P&G found that each retailer based its orders on its own slightly exaggerated forecast, thereby distorting information about true demand. Wholesalers' orders to the P&G diaper factory fluctuated more, and P&G's orders to 3M and other materials suppliers oscillated even more.

Chart 4

Reduced Bullwhip Effect for Durables



*10-year moving standard deviation of one-quarter annualized growth.

SOURCE: Bureau of Economic Analysis.

Production. One way to see the bullwhip effect in production is to compare sales growth volatility at the customer end of the supply chain with production growth volatility at the opposite end. Supply chains that use real-time information effectively should have an information distortion bullwhip that is shallower and less volatile.

Chart 4 shows that for durable goods, production growth volatility is now much closer to sales growth volatility. Both have declined since the mid-1980s. Sales growth volatility has declined from a 10-year moving standard deviation of 13 percentage points in 1987 to about 8 percentage points today; production growth volatility has dropped from around 18 percentage points in 1983 to 8 percentage points today.

Several explanations are possible. Deeper and more flexible capital markets, better monetary policies or just plain luck could have all helped to reduce the volatility of final sales, which may have driven production volatility lower. Nevertheless, while these and other explanations may have contributed to supply chain improvements, better supply chain practices that use new information technologies also seem plausible. Certainly, the dramatic reduction in production growth volatility occurred as superior manufacturing and quality control processes combined with new information technologies to bring significant efficiencies to supply chain operations.[4]

To reduce production growth volatility at JCPenney, the company has implemented a revolutionary computer system that directly captures sales data for each of its products at the cash-register level. Rather than making forecasts on what corporate managers think they will sell, forecasts are now based on real-time point-of-sale data.

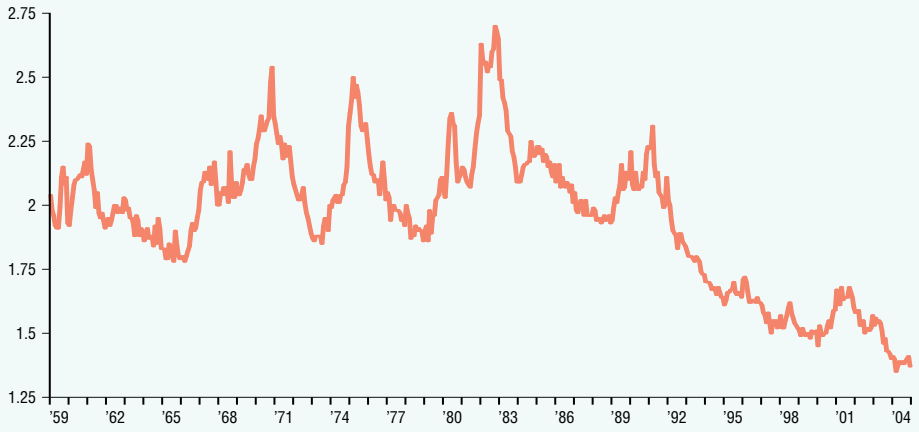
For certain men's dress shirts, JCPenney has gone a step further and outsourced the sales forecasting and inventory management functions to the shirtmaker in Hong Kong. So now a supplier thousands of miles away decides how many shirts to make and in what styles, colors and sizes and then sends the shirts directly to each JCPenney store—bypassing the company's corporate decisionmakers and warehouses.[5]

Inventory. Information distortions and the bullwhip effect also unnecessarily increase inventory at all points along the supply chain. In many respects, inventory is simply insurance against supply chain uncertainties. Unused and unsold inventory carries burdensome costs, including those for holding, warehouse and production-line storage, insurance, obsolescence and spoilage. At the same time, however, sufficient inventory must be maintained to meet demand and keep production flowing smoothly.

Chart 5

Inventory Management Continues to Improve

Durable goods inventory/shipments ratio



SOURCE: Census Bureau.

As shown in Chart 5, producers have streamlined their supply chain operations to hold less inventory relative to sales. The inventory-to-shipments ratio dropped markedly during the 1990s and is now near its all-time low. In essence, new technologies have allowed firms to replace inventory with information and then use that information more productively.[6]

Indeed, Dell has turned traditional manufacturing thinking on its head by saying that it will not make anything until it receives an order. In 1996, Dell held 31 days of inventory. It now holds four days of inventory.

Distribution. Just about everything we consume is taken from the earth, processed and transported, often requiring many stages before reaching consumers. Today's transportation and distribution of goods often involve longer distances and better coordination than in the past.

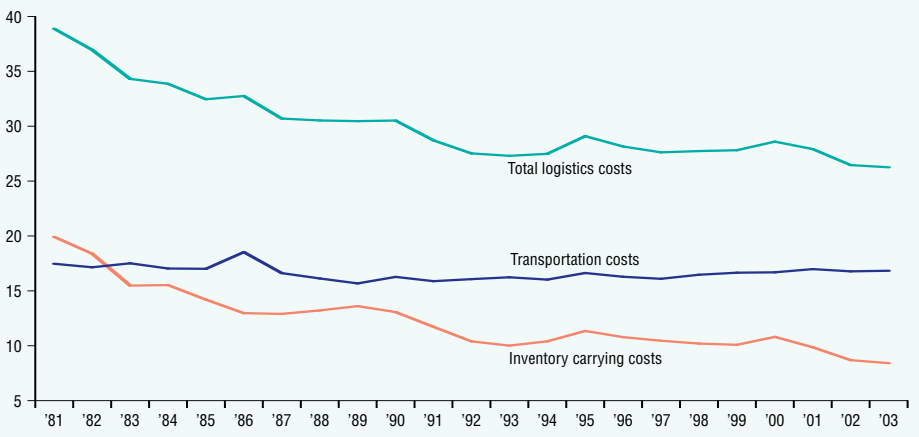
Yet, as Chart 6 shows, logistics costs trended downward from about 39 percent of the goods component of GDP in 1981 to around 26 percent in 2003. Transportation costs declined nearly 4 percent, whereas inventory carrying costs dropped about 58 percent. While inventory carrying costs have been driven down partly by lower interest rates, evidence shows that inventories are managed more efficiently, which also contributes to lower costs. Warehousing expenses have gone down as firms implement automated systems, and risks have been minimized as third-party logistics providers increasingly furnish specialized and customized solutions that increase efficiency. For example, firms such as FedEx and UPS now take on the entire logistics planning and fulfillment tasks for businesses of all sizes.

Chart 6

Logistics Costs

(As a percentage of the goods component of GDP)

Percent



NOTE: For years 2001–03, manufacturing sector income data are grouped by the North American Industry Classification System; previous years use the Standard Industrial Classification.

SOURCES: Bureau of Economic Analysis; "15th Annual State of Logistics Report," by Rosalyn Wilson, Council of Logistics Management, June 2004.

Perhaps the biggest distribution challenge is managing demand in a dynamic and uncertain environment. Demand-based management that optimizes sales prices and shortens lead times from design to delivery will likely become the next major area of strategic competitiveness in managing supply chains. For example, by using real-time sales data, Zara, a Spanish clothing company, streamlined its supply chain to introduce new products in stores within three weeks of design.

Payments. As technology costs have fallen and electronic connections between companies have increased, more firms are adopting digital technologies and eliminating paper transactions and human contact. Automatic order placement, billing and payment can all be triggered and performed by a computer without human intervention and paperwork. And more and more companies have implemented business-to-business e-commerce systems to streamline payments and enhance communications with suppliers. Such systems also guarantee faster collections and result in fewer losses. Progressive Insurance, for example, can use satellites, camera phones and the Internet to issue final settlement checks within minutes of being called.

Better, Faster, Cheaper. All these improvements—reduced production volatility, lower inventory levels, less expensive logistics and streamlined payments systems—have a common denominator: more efficient information management through better methodologies and tech-

Chart 7

U.S. Business Cycle Expansions and Contractions

Black = months in contraction

SOURCE: National Bureau of Economic Research.

nologies. Successful businesses are reorganizing to take advantage of information technology and rethink the way work is done.[7] The result, of course, is that consumers benefit from higher quality products, a greater selection of goods and lower prices.

Macroeconomic Performance Across Supply Chain Management Eras

Chart 7 may look like an ordinary bar code, but a closer scan reveals that it's actually a record of U.S. business cycle expansions and contractions. Each black bar represents a recession: The fatter the bar, the longer the recession. The timeline starts in 1855, the earliest year for such records.[8] The large spaces on the right side of the chart indicate that the U.S. economy is in recession far less often today.

Chart 8 indicates that GDP growth has been less volatile recently. The three pie charts correspond to the three supply chain eras discussed earlier: mass production, lean manufacturing and mass customization. The percentage of time that annual GDP growth is negative, which roughly corresponds to recessionary periods, is far less in the mass customization era than in the prior eras. And the percentage of time the economy experienced real GDP growth above 3.5 percent annually is greater in the mass customization era.

Productivity growth tells a similar story: It has become less volatile and has trended upward for several years. As shown in Chart 9, during the mass customization era, productivity growth exceeds 2.5 percent far more often, and negative productivity growth occurs far less often than in the prior eras. As new technologies help companies streamline supply chain operations, it makes sense that productivity, measured as output per hour, will improve.[9]

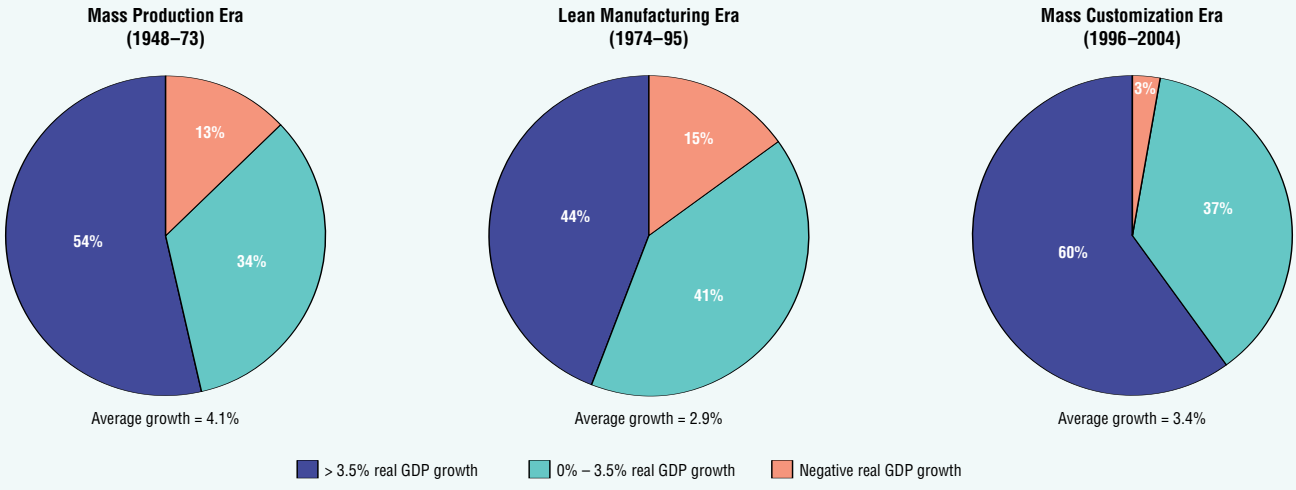
We live far better than did earlier generations because of the power of productivity. Our ability to innovate—to improve production processes, implement new technologies, better manage product and information flows, engage in more specialization and trade, and further upgrade our skills—allows us to get more for less.

The Power of Productivity

Further improvements are on the horizon. Other new information technologies, like the global positioning system (GPS) and radio frequency identifi-

Chart 8

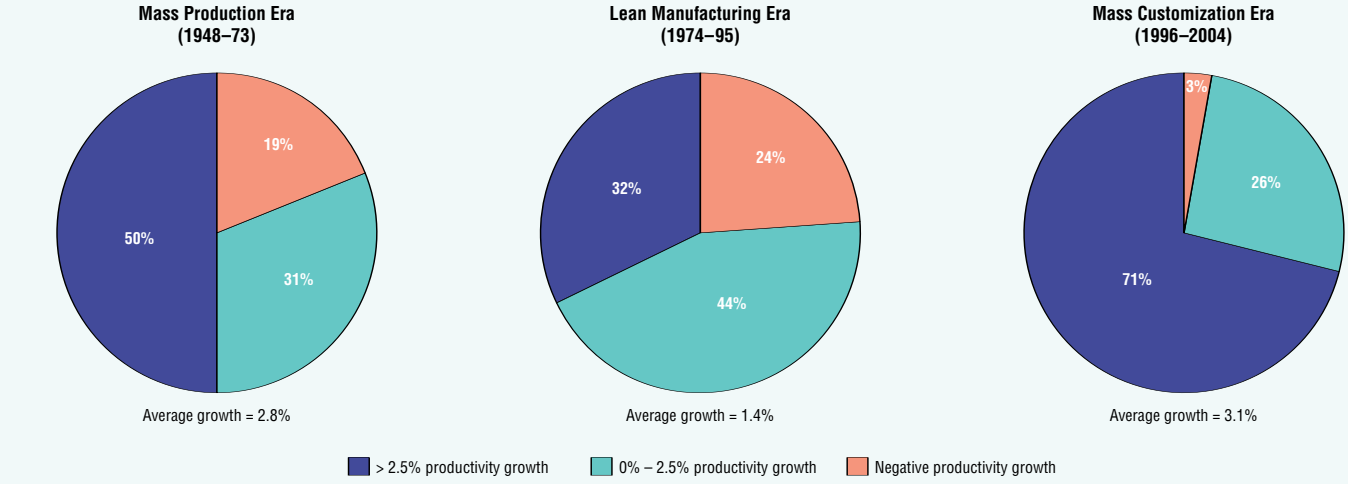
Real GDP Growth Is Less Volatile Today



SOURCE: Bureau of Economic Analysis.

Chart 9

Productivity Growth Getting Stronger



SOURCE: Bureau of Labor Statistics.

cation (RFID), will continue to improve supply chains. This is true not only in manufacturing, but also in retail, insurance, health care and other industries. We are just beginning to see the power of productivity as firms effectively implement these new technologies.

For example, an RFID tag embedded into a product allows it to be tracked and to transmit predetermined information without physical scanning. The productivity gains from RFIDs could be substantial. Imagine wheeling a full grocery cart through checkout and receiving an instant total without scanning individual items.

In our increasingly interconnected and interdependent global economy, the processes involved in delivering supplies and finished goods—including information and other business services—from one place to another are mind-boggling. But through information engineering, supply chain improvements have resulted in a reduced bullwhip effect, lower inventory levels, reduced logistics costs and streamlined payments. These improvements have led to macroeconomic benefits such as more stable economic output and stronger productivity growth.

—Thomas F. Siems

Siems is a senior economist and policy advisor in the Research Department of the Federal Reserve Bank of Dallas.

Notes

I am grateful to Mike Cox, Evan Koenig, Anil Kumar and Mark Wynne for valuable comments that improved this article. Dan Lamendola provided excellent research assistance.

1 Paul A. Volcker was chairman of the Board of Governors of the Federal Reserve System from 1979 to 1987. Alan Greenspan has been chairman since 1987.

2 For more on these explanations, see "Recent U.S. Macroeconomic Stability: Good Policies, Good Practices, or Good Luck?" by Shaghil Ahmed, Andrew Levin and Beth Anne Wilson, *The Review of Economics and Statistics*, vol. 86, August 2004, pp. 824–32; "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory," by Richard Clarida, Jordi Gali and Mark Gertler, *Quarterly Journal of Economics*, vol. 115, February 2000, pp. 147–80; "The Long and Large Decline in U.S. Output Volatility," by Olivier Blanchard and John Simon, *Brookings Papers on Economic Activity*, no.1, 2001, pp. 135–64; and "On the Causes of the Increased Stability of the U.S. Economy," by James A. Kahn, Margaret M. McConnell and Gabriel Perez-Quiros, Federal Reserve Bank of New York *Economic Policy Review*, vol. 8, May 2002, pp. 183–202.

3 "Information Distortion in a Supply Chain: The Bullwhip Effect," by Hau Lee, V. Padmanabhan and Seungjin Whang, *Management Science*, vol. 43, April 1997, pp. 546–58.

4 Kahn, McConnell and Perez-Quiros (2002) find that changes in inventory behavior stemming from improvements in information technology have played a direct role in reducing real output volatility.

5 "Made to Measure: Invisible Supplier Has Penney's Shirts All Buttoned Up," by Gabriel Kahn, *The Wall Street Journal*, Sept. 11, 2003, p. A1.

6 Kahn, McConnell and Perez-Quiros (2002) examine the inventory-to-sales ratio for durable goods against a target ratio extracted from a smooth trend of the data and find evidence that firms are making smaller mistakes now than before the mid-1980s. They argue that this improvement could plausibly be linked to advancements in information technology.

7 "Where IT's @: Technology and the Economy," by Thomas F. Siems and Mine K. Yücel, Federal Reserve Bank of Dallas *Southwest Economy*, January/February 2005, pp. 13–16.

8 The observation that post-World War II expansions are twice as long as prewar expansions has been questioned and investigated in "Business-Cycle Durations and Postwar Stabilization of the U.S. Economy," by Mark W. Watson, *American Economic Review*, vol. 84, March 1994, pp. 24–46. The most likely explanation is that the National Bureau of Economic Research used different ways to choose prewar and postwar business-cycle reference dates. Thus, the recession record shown here uses data that may exaggerate economic volatility prior to World War II.

9 Again, there are several explanations for the higher trend rate of productivity growth and the economy's increased stability. And while it seems plausible that improved supply chain management combined with the effective implementation of new information technologies has contributed to the economy's improved performance, there are difficulties in disentangling the impact of supply chain management. Even so, the anecdotal and factual evidence presented here suggests that the technology-led New Economy paradigm that emerged in the mid-1990s may be alive and well.