productivity growth & the "new economy"

*by Cathy E. Minehan, Lynn E. Browne and Lee McIntyre**

By almost any measure these have been good economic times. In 1999, U.S. economic growth averaged more than 4 percent for the third consecutive year. The unemployment rate fell to a 30-year low. Inflation averaged just over 2 percent. And real incomes increased. Even those at the bottom of the income distribution seem to be making gains, after years of stagnation. For some time, "it doesn't get much better than this" has been on everyone's lips. Is this rosy picture just an unusually long upswing in the business cycle? Or is a "New Economy" truly emerging?

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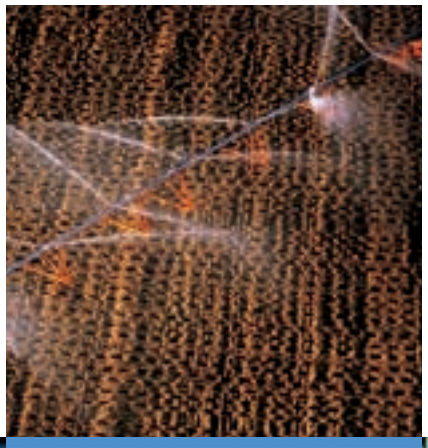
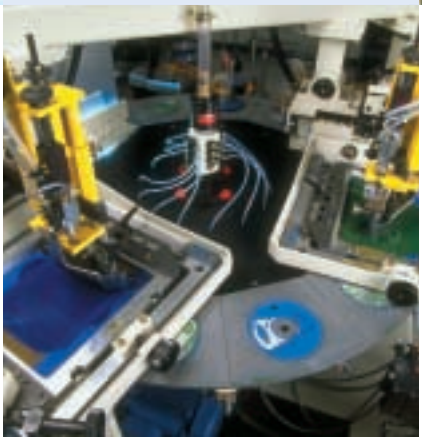


INCREASING

PRODUCTIVITY



Not very long ago, conventional economic wisdom held that the U.S. economy should not be able to sustain growth in excess of 2.5 percent with unemployment rates below 5.5 percent without experiencing an upturn in inflation. But for the past three years, growth averaged more than 4 percent and the unemployment rate fell to just above 4 percent. Yet inflation remained low. Why?

Higher productivity growth has been an important reason for our recent good fortune. Higher rates of productivity growth allowed the economy to grow rapidly without causing the unemployment rate to fall even further. Higher rates of productivity growth also helped firms absorb some of the cost pressures associated with low unemployment rates.

Throughout the 1980s, and even during the early years of this expansion, productivity growth averaged about 1.5 percent per year. But beginning in 1996, productivity growth just about doubled. Moreover, in 1999, the nation's productivity grew by 3.6 percent.

Why is productivity so important? First, productivity growth is as close as we can come to an unqualified economic benefit. It has the potential to make everyone better off. In contrast to the gains that one may make by taking a larger slice of the economic pie, productivity increases the size of the pie for everyone. As a result, productivity growth is the most important determinant of the country's standard of living. If the economy's output can increase, using the same amount of effort, everyone can benefit. And, like the magic of compound interest, small differences in productivity growth can yield large cumulative results over time. After twenty years, the difference between the 1.4 percent annual rate of productivity growth in the 1980s, and the 2.6 rate of the last half of the 1990s, will produce a 35 percent higher level of real national income. Put another way, this higher rate of growth means that the nation's standard of living will double in approximately half the time.

Second, the rate of productivity growth plays a key role in shaping monetary and fiscal policy, by influencing assumptions about the economy's sustainable rate of growth. If increasing productivity allows the nation to grow at a faster rate without generating inflationary pressure, this, in turn, may affect judgments about interest rates, projections about governmental surpluses or deficits, and other policy issues as well. Clearly, what is best for the economy is long-term growth. But, knowing how much growth can be sustained without increasing inflation depends critically on the economy's rate of productivity growth. Likewise, long-term fiscal balance depends on future tax revenues, which, in turn, depend on the economy's rate of growth, which, in turn, depends on productivity growth. Thus, understanding the role of productivity helps policy-makers keep the nation's economic house in order.

Measuring Productivity

For all of the agreement about the importance of productivity, it is a difficult concept to measure, especially for the economy as a whole. The most basic measure — the one that is most familiar — is labor productivity, typically measured as output per hour. This measure shows how output fluctuates in relation to the critical input of total hours worked. Increases in the amount and quality of capital available for each worker and technological advances will be reflected in greater labor efficiency — either more output for the same labor input or the same output for less labor input. The classic illustration of increasing labor productivity can be seen in what happened to farming over the last one hundred years. At the turn of the century, over a third of the labor force was devoted to agriculture; today it is just over two percent. Since fewer people (hours) were needed to produce the same output, something must have changed: the nation's agricultural productivity increased.

Measuring productivity poses problems, however. Even something as conceptually straightforward as hours worked is not as simple to measure as it might seem. The primary information source is the survey of establishments conducted by the Bureau of Labor Statistics. This provides information on the weekly paid hours of nonsupervisory workers. This is then supplemented from various sources to capture the hours of supervisors and managers, the self-employed and unpaid family workers. But what happens when time is spent completing tasks beyond the standard workweek for which workers or managers are compensated? What happens when time for which workers are paid is spent not working? And even if hours are accurately reported, there is no way to control for effort — how hard people are actually working.

Output poses greater challenges. The output data used to measure business sector productivity are derived from GDP but exclude government and several other components. The starting place is the value of expenditures on the various goods and services that make up final demand. Values are observable; data can be collected on firms' sales. Additionally, using values

allows one to aggregate such diverse products as locomotives, haircuts and legal services. The output of each activity is weighted by its price. And if prices never changed, any change in value would represent a change in output. However, because prices do change, it is necessary to break the change in value into a price and a quantity change. Most commonly, this is done by estimating the price change and then "deflating" the change in value to determine the "real" change in output.

Much effort has gone in to improving our measures of price changes in recent years. However, problems remain. Some of the most vexing arise from difficulties in defining the basic unit of output for which the price change is to be estimated. What is the unit of output for legal or social services? What is the basic unit of output for computers? It is certainly not the physical unit. In the case of computers and some other products, the statistical agencies have determined that the unit is a set of key attributes, such as speed and memory. Statistical techniques are then used to estimate prices for these attributes and from changes in these prices, changes in output are estimated.

Before the recent pickup in productivity growth, many business people had difficulty reconciling the official estimates of productivity growth with their own experience, which suggested that larger gains were taking place. Trying to improve productivity in individual firms is the natural focus of individual businesses and managers, since a more productive operation can result in a better bottom line. At this micro level, productivity gains often reflect the combination of increased use of technology and worker skill and they are relatively easy to see and measure. Here at the Federal Reserve Bank of Boston, and in industries around New England, the need to be more and more productive to control costs, to offer better products and services, and to survive in an ever more competitive environment has been the primary management theme of the '80s and '90s. Anecdotes abounded for years about major increases in productivity at individual firms (see side bars), but until the last four years or so, these increases were not reflected in the national productivity figures.

Part of the explanation may be measurement difficulties. But part of the explanation may also be that productivity gains at the micro level do not necessarily imply gains in the aggregate. Productivity gains at one firm may be offset by increased inefficiencies at another. While everyone may be trying to improve productivity, mistakes can be made; investments in new equipment and changes in business practices may not yield the expected payoff — particularly in the short run. Additionally, if productivity gains at individual firms result in worker displacement, the productivity gains for the economy as a whole depend upon those workers' re-employment opportunities. If workers are moving into industries and occupations in which output per hour is lower than in their former employment, this shift from higher productivity activities to lower productivity ones will damp productivity growth at the aggregate level.

Because productivity growth is so important, much effort has been devoted to determining its causes. But this, too, poses difficulties. Many argue that in one way or another all productivity growth can be linked to improvements in either the quantity or the quality of investments in the means of production. The amount of capital per worker might be increased. For instance, providing more workers with access to computers may cause labor productivity to rise. Similarly, if workers are provided with better computers and other capital — perhaps reflecting the latest technological improvements — their productivity should go up as well. Third, productivity might be enhanced by improving the quality of the workforce itself, for example, through better education or improved job-specific skills.

There are, however, certain residual efficiencies that are left over even after one has accounted for all such improvements in the traditional inputs to production. This is where some have turned to the concept of "multi-factor" or "total factor" productivity. The standard measures of multi-factor productivity calculate output relative to capital as well as labor inputs with each factor weighted by its returns. Multi-factor productivity embodies the possibility that at least some effi-

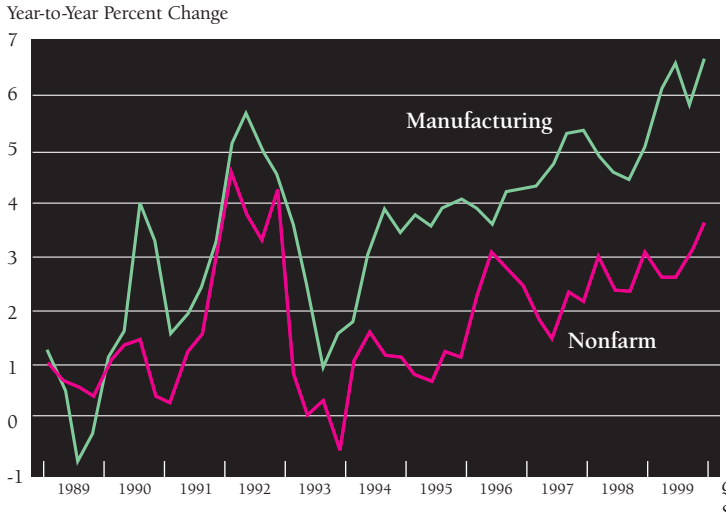
ciencies arise from harder to measure "synergies" of production. The idea is that, in addition to the benefits that may accrue directly from better inputs, there may be potential gains that result from the way that the inputs are put together as well.

One such example is known as "spillover," where firms that produce similar products may benefit from being in close proximity to one another. Consider the clustering of high-tech firms along Route 128, or in Silicon Valley. Sharing ideas and exposure to different ways of doing things is potentially beneficial to all who participate. As a result of such interactions, the whole may be greater than the sum of its parts.

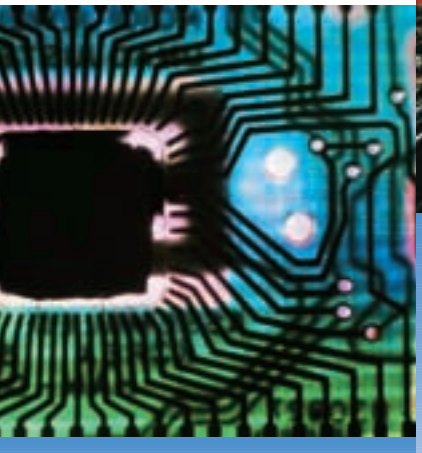
Despite all of the complexities in defining and measuring productivity, however, the nation's recent productivity numbers represent real gains in economic well-being. All of the anecdotal evidence of productivity increases in the 1980s and 1990s is being reflected in the aggregate data. If this increase in productivity growth is to prove long-lasting, the key lies in investment in the means of production, such as technology and education.

U.S. labor productivity has surged since 1996

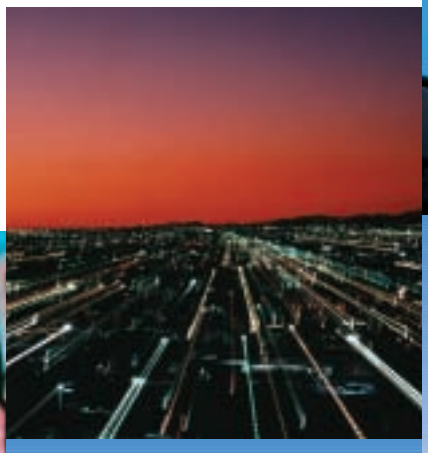
Output per Hour



Quarterly Data
Source: Bureau of Labor Statistics



New Technology Introduced



Reaching a Critical Mass

Effect on Commerce

THE ROLE OF TECHNOLOGY

At the start of the 21st century, it is easy to marvel at the fast pace of technological change. The blossoming of the Information Age has created a sense of both enormity and uncertainty about the potential that today's inventions may have for the economy, and for future standards of living. It is important to remember, however, that this is not the first time that this nation has faced such rapid technological progress. Early in the 20th century, the invention of the automobile, the telephone, and the spread of electrification, all were beginning to transform the American economy, leading to a period of rapid productivity growth during the 1920s. With the benefit of hindsight, it is easy to appreciate such a link. Scholars have noted, however, the curious reluctance with which breakthrough innovations were first embraced. The radio was initially regarded as useful only for ship-to-ship, or ship-to-shore communications. The telephone was thought merely to be a slight improvement over telegraphy. The automobile was dismissed as a plaything for the rich. Even the computer was initially perceived as having no direct business applications.

Over time, of course, things changed. Further technical refinements were made, prices came down, and new applications were developed. At times, the very process by which a product was manufactured — such as the mass production techniques employed by Henry Ford — was copied with great success in other industries. Eventually, each of the technological innovations mentioned above led to new efficiencies in business interaction, or improvements in manufacturing, and ultimately led to an increase in productivity. Even though it is sometimes difficult to appreciate at the time, it now seems obvious that with each new invention come unanticipated benefits to commerce.

Today, some have argued that the engine behind our current economic boom is the novel efficiencies that have resulted from what is called the Information Revolution. In just a few short years, the growth of computers and the Internet have changed much about the way that business is done. Earlier methods of data gathering and communication have been replaced by transactions that occur in "internet time," and many are just beginning to discover the economic benefit of this quickened pace. Consequently, some speculate that the computer and the Internet have restructured the economy, and shifted its sustainable rate of growth, through a period of accelerating productivity, much like that characterizing the "Second Industrial Revolution" in the early 20th Century.

Beyond the problems of measurement noted earlier, why were the gains in productivity growth so slow throughout the 1980s, when the computer was invented in the 1940s, and large businesses first started to use them as early as the late 1950s? Recent work by Paul David, an economic historian, makes the argument that the computer, like electrification, takes time to have an effect. The real economic benefit of technology comes only as a product of the synergy that results when it has diffused to a critical mass of people. Although the incandescent light bulb was invented by Edison in 1879, at the turn of the century only 3% of all residences had electric lighting. It took another twenty years to reach 50%. Critical mass was not reached, David contends, until widespread factory electrification in the early 1920s. Though it would ultimately have a marked effect on our economy, the economic benefits of electrification did not show up until fairly late. By the same token, David speculates that the computer has only recently diffused to the point where we would begin to expect it to have an effect on our economy.

The most recent productivity numbers bring encouraging news for this prediction. A recent study by Stephen Oliner and Daniel Sichel, of the Board of Governors of the Federal Reserve System, provides evidence that computers are having an effect on American productivity, by their estimate accounting for close to two-thirds of our recent acceleration in productivity growth. Notably, in contrast to other studies that linked the entirety of the computer's contribution to production of computer hardware, Oliner and Sichel attribute a significant share of the pickup to computer use. Thus, by the late 1990s, the economy apparently had moved beyond the situation in 1987, when Nobel Laureate Robert Solow remarked that "we can see the computer age everywhere except in the productivity numbers." While no one knows whether such gains will survive an economic downturn, the prospects seem brighter than they once did that computers are having a measurable effect on productivity. And perhaps, as with electrification, we are only beginning to enjoy the full fruits of the computer revolution, with even larger gains still to come.

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Fifteen years ago, the jewelry manufacturing industry in the greater Providence, Rhode Island, area numbered 25 firms and was in a steep decline. Today, only a handful of these firms remain in business. Increasingly, wholesale jewelry buyers were looking to Europe, mainly Italy, to satisfy their demand for quick delivery of high quality products at lower prices. Local jewelry manufacturing companies had difficulty competing with their international counterparts. Excel Manufacturing Company, a company of 160 employees founded in 1919, was a typical, small jewelry manufacturer sharing in these competitive difficulties. However, unlike many of these firms, Excel took a long hard look at its future prospects and decided that it would not survive if it continued to do business in the traditional way. It became clear to Excel's CEO, Howard Kilguss, that the old formula of increased production to meet customer demand, that is, hiring more people and buying more machines, would simply not work. Survival meant taking a whole new approach to business and productivity.

Company management took a strategic look at the industry and decided to learn more about it. Specifically, they realized that Excel needed to develop ways to be far more productive and maintain lower manufacturing costs to successfully compete in an increasingly global marketplace. Their search for the right formula took them to Italy, where they saw first-hand the capabilities of technology and a corporate culture of continuous technological advancement. These were some of the tools that were giving Italian firms the competitive edge. Excel adopted these new tools and values. The end result of research, decision-making, and implementation was the transformation of a declining company into a successful, growing, high-tech jewelry manufacturing firm.

Today, Excel has approximately the same number of employees it had fifteen years ago, half the number of machines, and four times the level of production. The company's success is a result of continuing investment in the latest state-of-the-art equipment, staying ahead of the industry technologically, hiring educated and skilled technicians, and retraining lower skilled workers. Also, management created a company culture that readily embraces technology and anticipates further technological changes to increase productivity. While the old machines produced 80 gold chain links per minute, the new machines are producing 300-350 links per minute and require far less labor input. Future machines will produce even more. Unmanned laser-manufacturing equipment now produces jewelry 7 days a week, 24 hours a day. Moreover, the time needed to complete other related tasks has diminished and these tasks require far less labor. For instance, X-raying material to determine gold composition previously took hours; through technological advances it now takes minutes.

The road to success took time and tremendous effort. The mix of employees shifted from mostly low skilled to mostly technical and highly skilled. Innovation, quality standards and increased productivity became goals as the company built its future. Supply lead times were cut in half because investment in capital allowed the company to produce its own wire, the staple in jewelry making. Purchasing practices were streamlined to eliminate unnecessary wait time for materials, which, in turn, drastically reduced attendant production slowdowns. In-house retraining allowed many workers to learn the skills needed for the new technical positions that replaced lower-skilled, labor-intensive jobs.

The future for Excel means more innovation. The jewelry manufacturing industry competes in a rapidly changing global market. Excel management knows that it must stay keenly aware of the competition and continually invest in technology that will increase high quality production, reduce cost, and improve delivery times. Increased use of lasers in manufacturing jewelry will further transform the industry, and will produce additional productivity gains. New employees will need to be even more well-educated, possess more technical skills and be open to change when the technology changes.

Gains in productivity allowed Excel to become a strong competitor in the global jewelry manufacturing market. Its management is keenly aware that further increases in productivity are the keys to ongoing success and survival.

Boston Fed Productivity Snapshots

Long before it is measured in economy-wide statistics, increasing productivity is created by the many decisions, small and large, of individual companies who have committed themselves to a process of continual improvement in the way they do business. Here at the Federal Reserve Bank of Boston, productivity improvements have been the focus of management attention for many years. Three snapshots follow.

"Paperless" Payments

In the last four years, the Bank has revolutionized its method of paying vendors, so as to enjoy the efficiency of paperless transactions. In 1995, the Bank paid only two vendors a total of 39 payments electronically through the Automated Clearing House (ACH). The remaining vendors were paid with paper checks — 9,738 of them. By 1999, a sea-change had occurred, with 92 percent of all payments made through ACH. The resulting efficiencies have been significant, both for the Bank and for its vendors.

Internally, the entire volume of out-going checks can now be handled by one person. In addition, manual and mechanical printing processes have been eliminated, the Bank's mailing costs have dropped, and check reconcilement — a once arduous task with 10,000 checks — is now trivial. The Bank's vendors have benefited from quicker access to payments, elimination of lost checks, and the possibility of nearly instantaneous reconcilement of payments through invoice matching.

Traveling Smarter

Prior to the fall of 1997, employees traveling on Bank business and needing travel advances followed a long and winding road to the cash. The traveler completed a paper request, sought an official approval signature, delivered the paper to accounts payable, waited a day or two, picked up the check, went to a Bank teller between 10:00 a.m and 2:00 p.m., and cashed the check.

Corporate travel cards straightened and shortened the road. Travelers were issued corporate credit cards to charge travel-related expenses as well as obtain cash advances from any ATM in the country. There was no longer a need for paper, before-the-fact permission, or the Bank teller; any advances taken are documented and settled after the trip.

The productivity gains are both direct and indirect. The traveler's time to obtain a cash advance was greatly reduced, the Bank saved the cost of a teller's position, and the documentation process was greatly improved.

Turning a "Cycle" into a Trend

In 1999, the Bank's check collection department experienced a sudden upsurge in volume. Volume increased by nearly 10 percent, but hours worked only grew by a bit over 5 percent. Productivity surged. Some of this productivity improvement was attributed to short-term economies of scale; staff worked harder and faster for a short period to absorb the growth. However, to sustain higher volumes over a long period, something more permanent had to be done.

The check operation focused on improving process flows and internal quality. A reorganization and review of processes was undertaken. This review moved two experienced supervisory staff from the day shift to cover the high volume night shift. Staff work schedules were changed to better meet deadlines and cover peak times, and staff was cross-trained in multiple functions. In the process, overtime decreased 39 percent from 1998 to 1999, and quality improved, as reflected in a 20 percent drop in the internal error rate. More importantly, these changes created the ability for the check operation to sustain its hard-won productivity gains.

The Role of Education and Training

Investments in technology are important. But just as important are investments in human capital. In recent studies of U.S. productivity growth, economist Dale Jorgenson attributes a good share of the increase in productivity over the period of 1948-98 to improvements in the quality of human capital. Increasing educational attainment is a major component in this increased quality. Education, innovation, creativity, even sheer effort: all of these are tied to the quality of the workforce. This quality must continue to improve, if continued improvements in productivity are to be seen.

There are, of course, tradeoffs. As productivity increases, some people will be left behind. Think here of the farmers who were compelled to find other occupations as a direct result of the increased productivity of modern farming methods. With increases in productivity sometimes come sharp disruptions in living styles, either within a profession or across an entire society. Though, on the whole, increasing productivity is a good thing for everyone, it can produce short-run setbacks for some.

With economic change, displaced workers are a fact of life. There may well be jobs for them, but will they have the skills to fill these new positions? Two factors are important: first, the quality of initial education experiences, and second, the need for continual training and retraining. Increasingly, a good education must prepare a worker not just with the skills needed for a first job, but for a lifetime of continuing change. Beyond that, industries must focus resources on training and retraining incumbent workers. Particularly now, with levels of unemployment at a 30-year low, and a dearth of available labor in technical areas, the interest of business and labor coincide in this regard, with investments in training an increasing necessity from a business as well as worker perspective.

Investments in Human and Physical Capital

Increased Productivity Growth

Cyclical or New Trend?

Cycle Versus Trend

We now return to the question of whether a "New Economy" exists. Is there any evidence that the investments in human and physical capital are paying off, not only with higher rates of productivity growth for the moment, but with sustained higher rates? Has the information revolution brought about a structural change in the economy, such that the old assumptions about how fast the economy can grow no longer apply, because of higher and possibly even accelerating productivity?

The critical question is whether the productivity gains now being enjoyed are the result of the strength of the current cyclical expansion or reflect a new trend. While there is now some evidence that a large share of the economy's recent productivity growth is due to the impact of computers, some question whether this involves a permanent change in the rate of productivity growth. Whatever its cause, some argue that the nation's recent increase in productivity growth rate does not, in and of itself, provide evidence that a new trend exists. The recent rate of productivity growth, while impressive, they argue, is what one would expect given the nation's strong overall growth rate. Measured productivity growth could have increased simply because the recent strength of demand required a short-term spurt in production. Normally, such short-term bursts cannot be sustained, either because demand falls or supply constraints start to bite, increasing costs and inflation.

Of course, this raises the question of what caused the rate of GDP growth to be so high in the first place. Is productivity growth itself feeding back in such a way as to influence GDP, or are both GDP growth and productivity growth collateral effects of some common cause? Improvements in productivity brought about by technological change, or changes in education or skill levels, could well make consumers and businesses more confident about the future. This increase in confidence could lead to more near-term growth in consumption and investment, which in turn would raise measured productivity. But could this process reverse itself as well? If businesses and consumers become more pessimistic about the future, perhaps because investments in new technologies do not deliver the returns expected, could a collective reevaluation occur and bring into question the permanence of recent increases in productivity? There is no way to tell. All we can say is that while our best evidence cannot prove that we are in a "New Economy," neither can it rule it out. Just as in the examples of technological innovations at the turn of the century, it is only over time that the impact of today's technological innovations will be fully realized.

International Comparisons

Although the recent pickup in overall U.S. productivity growth has not been matched in the rest of industrial world, a number of countries achieved growth in manufacturing productivity in the 1990s comparable to that in this country. Sweden and Germany also saw a notable acceleration in manufacturing productivity growth from the 1980s to the 1990s. An interesting question, then, is not just whether the United States is experiencing a new trend, but whether the world (at least the developed world) may be on the verge of doing so as well.

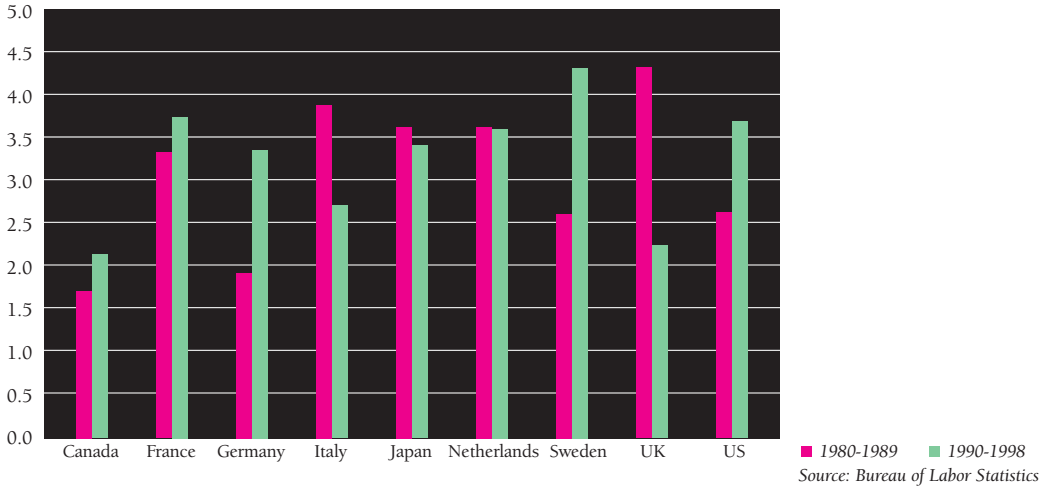
That high rates of growth in manufacturing productivity in other countries are generally not reflected in high rates of productivity growth overall could reflect the relatively slow rates of expansion and excess capacity in some of these countries. As noted earlier, increases in labor efficiency at the micro level translate more readily into productivity gains at the aggregate level when excess workers can be redeployed — and redeployed into activities at least as productive as those they left.

It is also possible that Paul David's theory applies to the rest of the world, as well as to the United States. As the United States leads other countries in investment in information technology equipment and its dispersion throughout the economy, the fruits of a technology-induced productivity gain might appear here earlier than in other countries. However, if history is any indication, the other industrial countries will follow the U.S. lead. Through much of the post World War II era, productivity levels in the industrial world showed a strong tendency to converge, as countries with comparatively low output per hour narrowed the gap with the productivity leaders, especially the United States. Even now, other industrial countries are active investors in and users of the new technologies. Indeed, in the number of mobile phones per capita the United States is actually well down in the pack.

Unfortunately, the convergence process has not yet extended to many developing countries. In this regard, a very encouraging feature of many of the new technologies, like personal computers and mobile phones, is that they can be widely dispersed without the costly infrastructure improvements required by many of the major technological innovations of previous eras. It seems at least possible that the new technologies could eventually allow more of the developing countries to join the group where convergence — rather than divergence — prevails.

Manufacturing Productivity

Average of Year-to-Year Percent Change



Source: Bureau of Labor Statistics

Increasing productivity, for all of our uncertainties in defining and measuring it, is the most important reason for the nation's current economic prosperity. Arguably, it is what has brought the nation from the uncertainty and collective angst of the 1970s to confidence in its position as one of the most competitive economies in the world with one of the highest standards of living. The gains in productivity that we have seen in the last few years deserve to be celebrated. But, they must not be taken for granted; there is no way to know how long these gains will last nor how far they will reach.

One thing does seem clear, however. The combination of macroeconomic policies in the 1980s and 1990s, policies focused on price stability and on reducing budget deficits, created an environment in which the investments in technology and in human capital so necessary to productivity improvement were both possible and logical. With low inflation, economic distortions are minimized and productive investment is rewarded. Declining budget deficits, more recently budget surpluses, in combination with low inflation, reduce long-term interest rates and make a wider variety of investments feasible. If investments in technology and human capital are the proximate cause for the country's recent gains in productivity, then these prudent macroeconomic policies have made such investment possible.

The potential for complacency must be regarded as the worst enemy. Business cycles will come and go; economic fortunes will wax and wane. But policymakers and the public alike must remain focused on the fundamental necessities for continued productivity growth. Low inflation, conservative national budgets, combined with public and private investments in new technologies and human capital must be the highest priority. That is the only way that this country's current success in increasing productivity, and ultimately in improving the lives of its citizens, can be maintained.

Papers referred to in this essay:

Paul David, "The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox," The American Economic Review, Vol. 80, #2 (May 1990), pp. 355-361.

Jeffrey Fuhrer and Jane Sneddon Little (eds.), "Technology and Growth: Conference Proceedings," Conference Series No. 40, Federal Reserve Bank of Boston (June 1996).

Mun Ho and Dale Jorgenson, "The Quality of the U.S. Work Force, 1948-1995," Program on Technology and Economic Policy, Kennedy School of Government, Harvard University (forthcoming).

Dale Jorgenson and Kevin Stiroh, "Raising the Speed Limit: U.S. Economic Growth in the Information Age," Brookings Papers on Economic Activity, 2000, No. 2 (forthcoming).

Stephen Oliner and Daniel Sichel, "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?," Finance and Discussion Series No. 2000-20, Federal Reserve Board (March 2000).

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