Thinking about a "New Economy"

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THE Industrial Revolution that began about 200 years ago lives in the collective memory as a cavalcade of inventors and machines James Watt and the steam engine, Eli Whitney and the cotton gin, Cyrus McCormick and the reaper, Charles Goodyear and vulcanized rubber, and many more But the Industrial Revolution brought a remarkable change in the human condition that went beyond any particular invention It instilled a belief that the standard of living did not have to be forever stagnant

Looking back from today's privileged vantage point, after two centuries of economic growth, it may be impossible to feel in our bones what it meant to live in a world without economic progress. Consider, for example, the note of genuine wonder in the voice of Karl Marx, writing of the new realities in the *Communist Manifesto* in 1848

> The bourgeoisie during its rule of scarce one hundred years has created more massive and more colossal productive forces than have all preceding generations together Subjection of nature's

> forces to man, machinery, application of chemistry to industry and agriculture, steam-navigation, railways, electric telegraphs, clearing of whole continents for cultivation, canalization of rivers, whole populations conjured out of the ground—what earlier century had even a presentiment that such productive forces slumbered in the lap of social labour?

Modern economists, with their highly developed talent for reducing the drama of human production and consumption to dry statistics describe the Industrial Revolution more simply. It was the era when economic growth in countries like the United States rose from essentially nothing to 2 percent per year. This 2 percent growth rate should not be understood as a physical constant like the boiling point of water but rather as a rough guideline to the average experience of the most highly developed economies over the last two centuries.

A 2 percent growth rate may sound small to those who have not doodled with a calculator and the magic of compound growth rates. But, at a humble 2 percent per capita annual rate of growth, the average standard of living doubles in 36 years, quadruples in 72 years, and will rise roughly 50-fold over two centuries. The change from almost no increase in the average standard of living over several millennia, until 1800, to a 50-fold increase in the next two centuries is what the Industrial Revolution has meant to those who live in developed countries.

In recent years, there has been considerable discussion of whether the development and application of information and communications technology have changed the U.S. economy in a fundamental way, promising a golden future of rapid growth, low unemployment and inflation, perpetual economic expansion, and a booming stock market. The change is sometimes called the "Information Revolution", more commonly, it is called the "New Economy." While there is sound evidence that the U.S. economy has experienced a revival in productivity growth since the mid 1990s, the argument that it has undergone either a fundamental shift in its patterns or a change on the scale of the Industrial Revolution appears overblown.

What's in a name?

There are three distinct senses in which the development

and dispersion of information and communications technology could qualify as a "revolution." One would be that just as the Industrial Revolution increased the annual per capita rate of growth by two percentage points a year, from zero to 2 percent, the Information Revolution should raise the per capita growth rate by an additional two percentage points, from 2 percent to 4 percent. Such a change would represent a phenomenal shift in the human condition. Again doodling with a calculator, an annual per capita growth rate of 4 percent per year sustained over two centuries, would mean a staggering 2,500-fold increase in the standard of living.

A less exacting standard for the Information Revolution would be that a new set of inventions will carry the economy forward at its 2 percent annual growth rate. After all, the key generators of the 2 percent rate of growth have varied over time. Economic historians often count two or three distinct Industrial Revolutions over the last several centuries. The twentieth century alone has seen the commercialization and dispersion of inventions like electricity, the internal combustion engine, and the chemical industry. It has seen a shift in the emphasis of the economy from farming to manufacturing to services. Each of these shifts can be labeled as "revolutions." This interpretation of the Information Revolution may seem bland, pedestrian, and emotionally unsatisfying—but that doesn't make it wrong.

The third possible meaning of the Information Revolution looks at gains or changes not reflected in the numbers. The argument that economic statistics are inadequate is always true, and it is eternally popular among those who are having trouble proving their point. But the claim that social gains are not captured by economic statistics is not a free pass to assert any and all conclusions. After all, economic statistics do capture a number of salient factors, like corporate profits, wages, and the size of gross domestic product (GDP). Thus, the Information Revolution means in this case that we will all *feel* that the new technologies have changed our world even though we see no special change in such tangible measures as wages and GDP growth.

Before trying to unravel how information technology may change the economy in measured, unmeasured, and even

unmeasurable ways, it is useful to begin by exploring what the productivity statistics say

Productivity growth in the 1990s

U S productivity growth in the last 50 years is typically divided into three periods In the first period, running from 1950 to 1973, productivity (as measured by growth of output per labor hour in the business sector) rose at 3 0 percent per year This period of relatively rapid growth has been attributed to many factors the application of new technologies, especially those that had been developed during World War II, a burst of pent-up economic energy after the dark economic times of the 1930s, and growth of global trade

Then productivity slowed down From 1973 to 1995, productivity growth averaged just 1 4 percent per year The years from 1973 to 1982 were worst of all Over that time, productivity grew at only 0 9 percent per year From 1982 to 1995, productivity grew a bit more briskly at 1.7 percent per year Various events of the 1970s might explain the slower productivity higher oil prices, higher inflation, a slowdown in government research and development spending after the Apollo moon landing, the growth of environmental legislation, and so on But no single factor, nor any combination of factors, has proven sufficient to explain the depth and length of the productivity slowdown

The default explanation for the slowdown was that the 1950s and 1960s had been an extraordinary time, following in the aftermath of world wars and depression, and that perhaps more modest growth rates were all a highly developed economy like the United States could expect But then productivity bounced back, growing at an annual rate of 2 9 percent per year from 1995 to mid 2000 A lusty academic dispute in recent years has sought to explain the reasons for the turnaround The standard methodology for these "growth-accounting" studies is to try to explain the overall rise in productivity by tracing it to gains in different sectors of the economy Interestingly studies done by both believers in, and skeptics of, the Information Revolution reach many of the same conclusions

For example, they agree that business investment in computers and related equipment, which quadrupled from 1995 to

1999, is one main reason for the recent surge in productivity. The average worker is now working with more powerful technology than a few years ago. This involves more than faster personal computers, it also means better computer-aided design and manufacturing and better information systems for tying together inventories, purchasing, and accounting.

Moreover, it is broadly agreed that faster productivity growth in the production of computers themselves—especially in the underlying semiconductor chips—explains part of the productivity increase. The price of computing power had been falling about 15 percent per year in the late 1980s and first half of the 1990s, but beginning in the mid 1990s, it started to fall by 30 percent per year.

Yet another area of broad agreement is that commerce over the Internet—whether of the business-to-consumer or business-to-business variety—has nothing to do with the surge in productivity since 1995. By the end of 2000, only about half of Americans had a home connection to the Internet, and most of those connections were over painfully slow telephone modems. Business-to-consumer e-commerce was about $30 billion in 2000, or 1 percent of retail sales. In mid 2000, only about one-third of American manufacturing firms had even started using the Internet for buying inputs or for sales. Business-to-business e-commerce was about $140 billion in 2000, about 1 percent of business-to-business sales. One can sketch plausible scenarios in which e-commerce offers dramatic productivity gains in the next few years. But it hasn't been large enough over the last five years to have been driving economy-wide productivity trends.

Probably the main area of disagreement in these growth-accounting studies is whether the majority of the productivity increase in the past five years should be viewed as an increase in the long-term trend or as a short-term blip. At a conceptual level, productivity is economic output divided by inputs. When GDP growth is red-hot, as it was during much of the late 1990s, it boosts the productivity statistics by driving up the ratio of outputs to inputs. For example, real GDP, projected at an annual rate, grew at a rate of 5.7 percent in the third quarter of 1999 and a whopping 8.3 percent in the fourth quarter. But when the pace of economic growth settles some-

what—not necessarily because of a recession but simply because of a more moderate pace of growth—then productivity growth will also be slower

Those economists who are most sanguine about the Information Revolution give it the lion's share of credit for boosting productivity by about 1 percent per year The pessimists, who fear that a substantial share of the productivity resurgence is partly due to unsustainably fast short-term growth give information technology credit for only about 0 6 percent of the annual increase in productivity growth

Those who don't conduct growth-accounting studies might be forgiven for focusing on the implicit level of agreement here, rather than the remaining disagreement In 2000, the U S GDP will be roughly $10 trillion Before the productivity surge of the mid 1990s, it was plausible to project that GDP would grow at a real rate of 2 7 percent per year—a growth rate including the 1 7 percent productivity growth of the 1980s and early 1990s and 1 percent per year growth in labor hours worked At this growth rate, the economy would reach $17 trillion after 20 years However, productivity gains of 0 8 percent per year due to the Information Revolution (splitting the difference between optimists and pessimists) could cause the economy to grow at 3 5 percent annually, counting 2 5 percent productivity growth and 1 percent per year growth in hours worked After 20 years of this higher growth rate, GDP would reach nearly $20 trillion

In short, the additional GDP from the Information Revolution could within two decades be a direct cause of $3 trillion per year in output, which at that point would represent about one-seventh of the entire economy The power of increasing growth rates by even small percentages, if sustained over decades, is phenomenal

The wonders of e-commerce

Technology enthusiasts often assert that the New Economy is already upon us But, for the sake of clarity, it is important to keep one's verb tenses straight Although the U S economy has experienced a strong surge of investment in ever-faster computers over the last five years, the bow wave of the e-commerce revolution is just beginning to rock the economy

This is good news, because it opens up the exciting possibility that the Information Revolution will have staying power. The future prospects of e-commerce are especially important because the underlying sources of increased productivity growth over the last five years won't last forever.

For some years now, semiconductor-industry insiders have been pointing out that the process of etching ever-smaller computer chips will, at some point, run into physical limits. Current chip technology involves working at a scale of nanometers—billionths of a meter. At this scale, electrons sometimes hop unpredictably across very small distances. The tendency of certain molecules to clump together, which doesn't matter at a larger scale, poses a production problem. To overcome these sorts of problems, even a continuation of the brilliant engineering advances of the last few decades won't be enough. It seems plausible that the rate of increase in chip technology could slow substantially.

The surge in information-technology investment in the last five years will be increasingly difficult to duplicate in the future as well. Certainly, investment in computers will continue rising, but it will be difficult to repeat the quadrupling of such investment that occurred over the last five years in the next five years—and it would be even harder to quadruple yet again in the five years after that. It's always easier to quadruple from a smaller base than from a larger one.

Thus if the Information Revolution is to last for the medium run, it cannot rely only on improvements in computer chips and increases in technology investment. The underlying drivers of productivity growth will have to shift. In the medium term, it is e-commerce that can potentially maintain the Information Revolution and productivity growth.

As the economy absorbs any new technology, what typically happens first is that existing economic activities are performed at lower cost. E-commerce is no exception. A professor of mine used to say, more than half-seriously, that the typical job in the U.S. economy involved picking up a piece of paper, looking at it, and then taking some action. Indeed, about 40 percent of all U.S. workers are in what the Bureau of Labor Statistics classifies as "sales occupations," "administrative support," or "executive, administrative, and managerial jobs." The

new information and communications technologies seem likely to transform these kinds of jobs, which often involve tasks like finding out what supplies a factory needs and what it has in inventory, checking availability and price with competing suppliers, placing an order, determining a delivery schedule, confirming receipt of order being billed, paying the bill, and including the transaction in company records and accounting statements With an e-commerce system, a supplier can learn automatically of a shortage of supplies at one company The placement of the order, confirmation, updates about delivery schedules, billing, payment, receipts, and accounting are all built into the system The costs of the transaction fall dramatically that is, fewer phone calls, hand-scrawled and typed reports, double-checking by departments, and lost or mismatched records Only a few firms have gone through the deep organizational changes needed to become web-based organizations, but those that have done so have achieved remarkable results, like cutting administrative costs by 75 percent

In addition, because of tighter, faster links between suppliers and buyers, there is less need to have inventories sitting in warehouses Since the U S economy holds about $1 1 trillion in inventories, gains in this area will mean a few hundred billion dollars worth of stuff not sitting around gathering dust Thus, although the first stage of the Information Revolution over the last five years has been characterized by high investment in more powerful computers, the second stage, over the next decade, seems likely to be characterized by a dramatic change in how transactions are carried out and processed

Welcome to "web world"

The economic gains from reducing transaction costs and holding down inventories are potentially enormous—but again, they are also self-limiting While the costs of transactions and the levels of inventories can be cut in the nature of things those costs will never fall below zero Market forces will encourage firms to seek out the juiciest cost-cutting targets first, but once the low-hanging apples are picked, it will become harder and harder to squeeze out further cost savings If the Information Revolution is to last beyond the next decade, and if it is to rival society-transforming inventions like the internal

combustion engine, it will have to do more than reduce paperwork and empty out some inventory warehouses It will need to change how people live in fundamental ways

When thinking about the possibilities of this stage of the Information Revolution, one leaves behind hard data and enters the realm of plausible speculation It's useful to begin by visualizing the technology as it someday may be The Internet, as we presently know it, is a technological marvel but also clunky, buggy, and slow Now imagine web pages that appear as quickly as a television set changes channels, with television-style clarity, movement, and sound Think about calling up these web pages with voice commands, or some form of channel clicker or mouse, not with laboriously typed web addresses The great increase in speed will make these web pages interactive Ask a question, get an immediate answer Now combine all this with hand-held, wireless access to the Internet, with communications anywhere in the world at costs lower than today's long-distance telephone rates Just for fun, or perhaps for terror, mix in the capability of the global positioning system to know exactly where you are in relation to everything else and databases that have complete records of your past purchases and viewing habits In a decade or two, I suspect that we will look back on the current state of the Internet the way we reminisce about black-and-white photographs or old radio programs

A technological change of this magnitude clearly has the potential to alter patterns of work, consumption, business production, education, health care entertainment, recreation—perhaps even what is meant by friendship Perhaps the most intriguing possibility of all is that a "web-based world" will produce a more powerful synergy of ideas, as widely distributed groups of people work separately and yet in close touch with each other The ultimate constraint, which no computer will change, is that each person has only 168 hours per week But the Information Revolution could eventually lead to dramatic changes in how we spend those hours

Social changes and economic gains

True believers in the New Economy often argue that focusing on economic statistics misses the point of what the Infor-

mation Revolution means to people's experience, rather like attempting to summarize the running of an Olympic marathon by quoting finishing times. Certainly, the faithful have a point. For example, an online book-shopper has a broader range of titles at his disposal than what's available in a conventional bookstore. To be sure, it's harder for the online shopper to take a book off the shelf and skim a few paragraphs to see if it looks interesting, although improved technology will eventually overcome that problem. But in GDP statistics, it doesn't matter whether you have many choices or few, all that matters is the amount of money spent. As another example, imagine that the new information leads to a dramatic shift in how people spend their leisure time. Instead of the typical adult watching an average of 1,500 hours of television per year, he might spend that time playing interactive games on the Internet. Instead of going shopping at the mall and carrying everything home in bags, people will go to the mall to see and hold the products they wish to buy, and then order them from their homes via the Internet. But again, GDP statistics will measure sales only.

Economic statistics are not especially good at measuring the value of new products, either. The ability to watch a videotaped movie at home, on demand, is measured in GDP statistics as the rental price of the movie, not as an expansion of entertainment possibilities. The ability to check a bank balance and get cash 24 hours a day at an automated teller machine is measured in GDP statistics as the cost of banking services, not as an expansion of convenience. The ability to make a wireless phone call is measured in GDP as the cost of the call, not as improved ease of communication.

All of these reservations about the extent to which measured economic output captures social changes from technology are perfectly reasonable. But the complaints aren't new. The economists who invented GDP statistics in the 1940s and 1950s were quick to point out that gross domestic product measures only what is bought and sold in the economy, not the amount of human satisfaction received. And clearly, the social impact of great inventions of the past were captured only in part by economic statistics as well.

For example, the full social effects of the internal combus-

tion engine include the growth of suburbs, the relocation of businesses out of cities, the appearance of the driving vacation, and an increase in the mobility of the average person. But GDP statistics measure only cars, gasoline, and houses, not the change in living patterns. A listing of the effects of the electrical dynamo would include the relocation of factories away from water power, the construction of skyscrapers, time-saving appliances like washing machines in the home, which arguably facilitated feminism's rise, and air-conditioning, making possible the great growth of southern cities. GDP hardly captures all or even most of these changes in how we live.

These historical examples should also make clear that the social changes of the first five years of the Information Revolution have not come anywhere close to the sort of seismic changes in location, family patterns, and human possibilities that occurred throughout the twentieth century. To be sure, a future stage of the Information Revolution may eventually bring such changes. The social implications of technologies like electricity and the internal combustion engine took decades to become apparent. But unless or until such changes occur within the next decade or two, the argument that the Information Revolution "changes everything," and in a way missed by economic statistics, is overblown rhetoric.

Sources of economic growth

The most optimistic claims for the Information Revolution go beyond productivity growth, whether measured or unmeasured, and include promises that the good economic news of recent years—low unemployment, low inflation, no recession, rising stock prices—will be sustained into the future. But although the U.S. economic performance in these areas in the last five years has indeed been spectacular, productivity growth is only one part of the overall story—and probably not the most important part.

Since 1997, the U.S. unemployment rate has been below 5 percent and the inflation rate has been below 3 percent. The last time these rates were this low for this long was back in the mid 1960s—not coincidentally, a time when productivity growth was also quite high. In the 1980s and early 1990s, it was common to hear economists argue that unemployment

could not be reduced below 6 percent for a sustained period without leading to an overheated economy and inflationary pressures. Such predictions are clearly outdated

There are a variety of possible reasons why unemployment dropped so low in the late 1990s Sustained economic growth helped, of course In addition, as the Baby Boomers have aged, a higher proportion of the workforce is in its prime working years, and thus more likely to cling to jobs or, if necessary, to find another job quickly The rise of temporary agencies has made it easier to work while looking for work The Internet may also be helping to reduce unemployment by streamlining the job-search process· Prospective employers and workers can more easily and quickly find one another

The rise in productivity growth has also played a role in lower unemployment rates When productivity is higher than expected, as occurred in the late 1990s, businesses perceive that they are getting an especially good value from hiring, and so become more eager to take on additional workers This process operated in reverse in the 1970s and helped contribute to higher unemployment at that time Because of the productivity slowdown of the 1970s, businesses saw themselves as receiving less than they had expected from hiring workers. As a result, their willingness to hire declined and unemployment stayed high

Low inflation in recent years is also a result of several causes The Federal Reserve has shown a willingness to raise interest rates when inflation threatens, taking a preemptive strike against inflation by raising interest rates back in 1995, and pursuing a series of increases late in 1999 and into 2000 When the central bank is clearly committed to keeping prices stable, it is difficult for an inflationary mindset or momentum to become established In addition, lower oil prices in 1997 and 1998 helped hold down inflation at that time, although oil prices have since bounced up again.

The rise in productivity growth also held down inflation Inflation results from an imbalance between the total demand in an economy and the total supply If demand happens to race ahead of supply, then there are too many dollars chasing too few goods, and inflation rises. However, a surge in productivity means that the quantity of goods has risen more

rapidly than expected, given the levels of inputs involved, and so inflationary pressures are muted. Again, in the 1970s, this process operated in reverse, helping demand to stay ahead of supply and inflation to stay high.

The links from higher productivity to lower unemployment and inflation are real, but they guarantee nothing about the future. Over the medium term, the amount paid to workers catches up to their productivity, and so the effect of an unexpected productivity boost on unemployment diminishes. There is some evidence in the wage data of the last two years that such a catch-up is occurring. The main determinant of inflation over time is the vigilance of the Federal Reserve and how it manages the supply of money and credit, and thus the power of demand in the economy. Unlucky events or poor public policies—or both together—can easily bring on another bout of unemployment or inflation. After all, several decades of rapid productivity growth in the 1950s and 1960s didn't prevent the stagflation of the 1970s and early 1980s.

The current economic expansion, which started in March 1991, is probably the longest in U.S. history, although economic statistics before about 1870 are unreliable. While the surge of productivity growth has contributed to the length of the expansion, it is, again, only part of the story. The second-longest economic expansion in U.S. history ran from February 1961 to December 1969, and the third-longest ran from November 1982 to July 1990. Thus the interesting question is not why the current expansion has been so long but why economic expansions in general seem to have lengthened in the last four decades. A variety of plausible answers have been proposed. Deposit-insurance legislation passed in the 1930s has made the banking system less fragile and prone to runs, which used to be a common source of economic instability. The federal government's expanded role in the economy—especially its willingness after the Second World War to run large budget deficits in times of recession—has had a stabilizing effect too. The Federal Reserve, which used to overreact to economic events, is now steering the economy more cautiously and capably.

Taken individually, these arguments have their strengths and weaknesses. But taken together, they are a far better

explanation for the length of the present economic expansion than a surge in computer productivity circa 1995. Recessions have deep wellsprings in the dynamics of irrational exuberance and equally irrational doom and gloom that arise in a market-oriented, investment-driven economy. The Information Revolution will not cure economic mood swings.

Irrational exuberance?

The rapid rise in the stock market in the 1990s powerfully reinforced the belief that an Information Revolution had arrived. Despite the dismal performance of the stock market in 2000, the Dow Jones Industrial Average still more than doubled from 4,500 in 1995 to above 10,000 by the end of 2000. The NASDAQ stock index, which is made up disproportionately of technology-oriented firms, has risen even faster, from 1,000 in 1995 to nearly 3,000 by the end of 2000. But the Information Economy offers no guarantee that stocks will remain at their present levels, much less that they will keep rising.

At a basic statistical level, higher stock prices are not counted at all in measures of economic output. After all, every time one party buys a share of stock, another party must be selling it. The transaction involves a change of ownership, but nothing is produced. For similar reasons, GDP statistics include the sales of new homes, where something new is produced that year, but not the sales of existing homes, which are a transfer of ownership. The growth of GDP and productivity in the last five years has literally no direct connection to the stock market.

But some indirect connections have been suggested. For example, the claim is sometimes made that America's economic growth of the late 1990s was a virtuous circle where the economy boosted stock prices, higher stock prices encouraged higher consumption, consumption boosted the economy further, and so on. But each of these connections is partial, at best.

Although the strong economy has surely helped to boost stock prices, stock prices have risen much further than the economy alone would seem to justify. One benchmark for valuing stocks is the price-earnings (P/E) ratio, which is the price per share of a stock divided by the earnings per share of the stock. Historically, the P/E ratio for the market has been

about 14, a little higher in good times, a little lower in bad times. Back in 1994 and 1995, for example, the P/E ratio was in the range of 16 to 17, well in line with historical experience for a period of economic expansion. But by early in 2000, the P/E ratio for the stock market as a whole—not just for a few high-flying technology stocks—was above 30. The price of stocks had far outstripped the rise in earnings, so that the state of the economy over the last five years is not nearly enough to account for the remarkable surge in stock market prices.

It also seems unlikely that the rising stock market has spurred vastly greater consumption. About half of all stock (including stock owned through pension funds) is owned by the top 1 percent of shareholders, about three-quarters of all stock is owned by the top 5 percent of shareholders. Thus there is little reason for most households, which have benefited a relatively small amount from the rise in stocks, to alter their consumption patterns as a result. Moreover, many people who own stock have it in retirement or pension accounts. They don't run out and buy a new car every time the stock market goes up. Yes, the rise in the stock market led to increased sales of Porsches and Jaguars in Silicon Valley. But, for the overall economy, mainstream estimates are that the rise in the stock market might account for one-tenth of the rise in consumption over the last five years.

The connection between the Information Revolution and the rise in the stock market is real, but loose. After all, when the NASDAQ stock index fell 50 percent in value between March and December 2000, it certainly didn't mean that the Information Revolution had suddenly ended or switched off. Financial markets do reflect the real economy, but in a funhouse mirror, susceptible to sudden distortions.

Looking ahead, there are two plausible scenarios for the stock market. One is that stock prices had climbed too high, perhaps driven in part by inexperienced day-traders using web-based technology to buy overpriced shares in overhyped technology companies. In this scenario, stock prices will stagnate or decline in the next few years. The alternative is that, for a variety of reasons, the old historical benchmarks like a P/E ratio of 14 no longer apply. It is possible that changes in

patterns of corporate finance and accounting are making "earnings" appear smaller, and thus P/E ratios appear larger. Moreover, a broader group of investors has apparently become willing to risk putting money in the stock market in the last 15 years. With broader entry into the stock market and changes in finance patterns in mind, one can construct a plausible case that stock prices will hold their own or increase slowly over the next few years.

My own view is that a well-diversified stock portfolio remains the most sensible investment for those with long time horizons. But the stock market's glory days of the late 1990s are done. It seems extremely unlikely—whatever the course of the Information Revolution—that stock prices will double or triple in the next five years, as they have in the last five.

The not-so-new New Economy

In the mid 1990s, the U.S. economy experienced a substantial rise in productivity growth, based on a wave of investment in faster computer technology. The economy now appears to be entering a second stage of productivity growth, which will be based on using information technology to revolutionize the way transactions are done. Recognizing these facts, even mainstream economic forecasters, like the Congressional Budget Office and the Office of Management and Budget, have built a rise of about 1 percentage point per year in productivity growth into their medium-term predictions. If this higher productivity can be sustained over a decade or two, the change will be a momentous one, representing literally trillions of dollars of additional output each year.

But momentous is not the same as unprecedented. From a macroeconomic perspective, the New Economy isn't really new. After all, productivity growth rates averaged about 3.0 percent per year in the 1950s and 1960s. The 1960s also saw low unemployment, low inflation, a booming stock market, and what was then the longest economic expansion in U.S. history. But the stagflation of the 1970s—resulting from a combination of unlucky economic events and ill-conceived public policy—arrived nonetheless.

The claim that the Information Revolution has shifted the fundamental patterns of the economy is based on the all-too-

human failing of myopic hindsight In this case, it manifests itself as a cocksure belief—often implicit rather than explicit—that no previous generation has seen a degree of technological change that can match the computer and the Internet But consider the lives of my grandmothers, who were born around 1900 and lived into the 1990s When they were born, the United States already had the highest standard of living of any country But they grew up in Midwestern homes that, as was typical of the time, had no electricity or plumbing In their lifetimes, they saw indoor plumbing and electric lighting, machines for washing clothes and dishes, cars and the creation of highways and suburbs, telephones, antibiotics and the birth of modern medicine, commercial air travel, home entertainment options from radio to recorded music to movies to television, and even the Apollo moon landing

I was born in 1960 Certainly, I will see technological marvels in my lifetime that would be unimaginable to my grandmothers But based on a comparison of the first 40 years of our lives—what they saw between 1900 and 1940 and what I have lived through since 1960—it is far from obvious that I will see in my lifetime a larger degree of technological, social or economic change than they saw in theirs

The Information Revolution is by no means *sui generis* It is best viewed as a new chapter in the book that opened with the original Industrial Revolution, two centuries ago Like previous chapters involving steam power, the reaper, the telegraph, chemicals, railroads, electricity, telephones, automobiles, and antibiotics, the Information Revolution will generate substantial economic growth and social change over a period of decades Like the previous chapters, the Information Revolution will be distinctive in its details But from a broader perspective, the levels of productivity growth, unemployment, and inflation, along with the likelihood of recessions and stock-market crashes, will remain within the range of experience of the last half-century The Information Revolution is more evolution than revolution.