Innovation, Growth, and Economic Policy in an Environment of Change

What is the source of economic prosperity? This is the question that motivates all economic study—and it is more than just academic inquiry. Economics, ultimately, is about advocating policy. Whether we are atop the world stage or around the kitchen table, each of us is a policymaker trying to maximize our well-being using our limited means. The search for greater prosperity—what economist and historian Joel Mokyr aptly calls "the lever of riches"—is ubiquitous.

The idea of economic prosperity has a particular urgency here in the Fourth Federal Reserve District, where manufacturing jobs are giving way to the unrelenting pressures of an expanding service sector, foreign competition, and their own spectacular productivity growth. Indeed, our region has a ringside seat for the competitive struggle that will determine our nation's potential: the importance of innovation in spurring and sustaining growth, and the government's role in promoting the most conducive environment for that growth.

In this report, we explore innovation as the engine of economic prosperity and argue that the greatest strength we possess is our ability to induce and embrace change, from the integration of new technologies to new peoples and cultures. Indeed, if we hope to remain an ongoing, vital player in the global economy, flexibility is likely to be our most valuable asset.

"If you're not competing, you're dead."

Arnold Palmer

The Economics of Us and Them

Competition for precious resources is always and everywhere. It is the struggle that defines all life: Limited resources meet unlimited desires. And so we compete with one another, person with person, business with business, and nation with nation. At first glance, the marketplace appears destructive—that is, the elevation of one cannot be accomplished without a proportionate cost borne by another. This is the economics of *us versus them*, and it is this view that each of us sees from our individual vantage point. This perspective is limited, though, and tends to breed misunderstanding about competition and social welfare. Unfortunately, it is also the perspective that has motivated an array of economic "remedies" that, more often than not, have inhibited economic progress.

The predominant economic theory of the eighteenth century, mercantilism, was based on such a view. The mercantilists held that a nation's wealth lies in its stockpiles of precious metals. One road to economic prosperity is god given—some nations are simply endowed with a richer store of precious metals that need only be dug from the ground. But a nation might also create its own prosperity by accumulating precious metals through trade. At the heart of mercantilist economic policy are commercial controls aimed at promoting exports and suppressing imports.

In 1776, Adam Smith challenged the mercantilists' us-versus-them view in his monumental work, *An Inquiry into the Nature and Causes of the Wealth of Nations*. The mercantilist prescription of promoting exports and discouraging imports elevated the interests of the producer at the expense of the consumer, Smith argued, yet "consumption is the sole end and purpose of all production." No nation can hope to raise the prosperity of its citizens by encouraging them to produce what they could buy more cheaply elsewhere. But how can an environment as seemingly destructive as the marketplace be the basis for prosperity? The answer, said Smith, is specialization and trade:

> *If [they] can supply us with a commodity cheaper than we ourselves can make it, better buy it of them with some part of the produce of our own industry, employed in a way in which we have some advantage.*

Two important ideas here deserve emphasis. First, we gain from the marketplace by allocating our efforts to areas where we get the most bang for our buck. In other words, we want to produce those things that require the smallest sacrifice compared to others. When we each focus our abilities on our "comparative advantage," and then trade with those offering something different, both parties advance their welfare beyond what they could have attained in isolation.[1] The logic that both parties are made better off by trade is obvious: If each enters into the trade voluntarily, it is because what they offer is less valuable to them than what they receive in return.

The second key insight—a point the mercantilists missed—is that trade is symbiotic. If we wish to buy, we must also sell. We simply cannot do one without the other. This truth holds for nations just as it does for each of us individually, though it is often lost on us. It is hard to look beyond the "us versus them" of competition. When we see the production of a particular

1 David Ricardo (1817) is generally credited with the formal development of the idea of comparative advantage.

product moving to another location, perhaps even another nation, we are tempted to extrapolate that trend in isolation and wonder: What will become of us if all the jobs go away? But employment opportunities don't go away—they reappear in another form. We cannot buy if we do not sell *"from the produce of our own."* In the marketplace, the prosperity of each trading partner is inextricably linked. This is the economics of us *and* them, and it is the mechanism by which competition elevates overall prosperity.

Not everyone among "us," however, will share equally in the gains of competitive trade with "them." There will be casualties along the way. Those who carry the heaviest burdens—workers whose skills are at odds with economic reorganization—will find little comfort in the knowledge they are paying its inevitable and necessary costs. What is certain, though, is that the benefits flowing to the gainers will more than offset the losses of the ravaged. How we choose to compensate those who are in direct conflict with the changes brought by competitive forces and how we reengage them in the marketplace is a great and thorny challenge for economic policymakers.

Economists today accept almost without debate that specialization and trade define the benefits of a market economy. Still, more than two centuries after Smith described the process, it remains one of the most mistrusted—if not vilified—economic notions among noneconomists. Consider the recent controversy when N. Gregory Mankiw, chairman of the president's Council of Economic Advisers, repeated this widely held view among economists: "Outsourcing of professional services is a prominent example of a new type of trade....When a good or service is produced at lower cost in another country, it makes sense to import it rather than to produce it domestically. This allows the United States to devote its resources to more productive purposes."

The mathematician Stanislaw Ulam once challenged Nobel laureate Paul Samuelson to name "one proposition in all of the social sciences that is both true and non-trivial." Several years later, Samuelson thought of the correct response: *comparative advantage.* "That it is logically true need not be argued before a mathematician; that it is not trivial is attested by the thousands of important and intelligent men who have never been able to grasp the doctrine for themselves or to believe it after it was explained to them."[2]

The Arithmetic of the Dismal Scientists: Early Growth Theory

Adam Smith gave us a crucial analytical framework, a model of the marketplace based on individual self-interest which, intentionally or not, promoted economic prosperity. The lever of riches was not, as the mercantilists had claimed, to be found in the accumulation of money, but in our ability to lower the costs of production and create new trade relationships. But Smith's was the era of the first great industrial revolution. Jethro Tull had invented his planting drill, Samuel Crompton his spinning "mule," and James Watt the steam engine, while in America, Eli Whitney would soon develop the cotton gin. New gadgetry was rearranging the nature of work, altering trade patterns, and ushering in an era of prosperity that had been unimaginable.

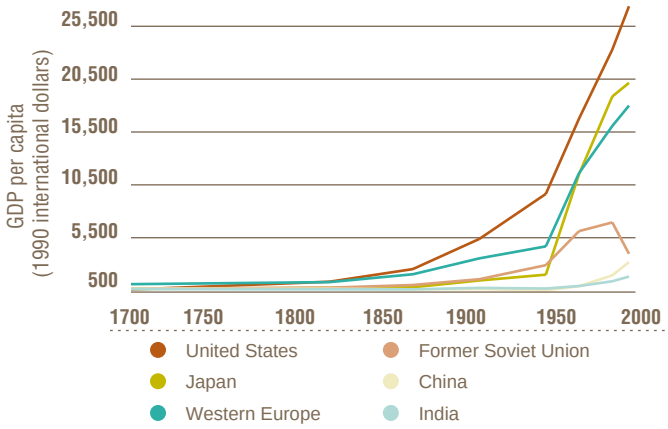
But if Adam Smith's vision for the world was hopeful, it would soon be dashed by the first generation of economists to follow him, notably the Reverend Thomas Robert Malthus. These early-nineteenth-century economists investigated the dynamics of Smith's model and found in it one inescapable conclusion: While prosperity may originate in specialization and trade, it would eventually be brought to a crashing end by unchecked

2 Samuelson (1969).

population growth. The undoing of prosperity is found in Malthus's "law" of diminishing returns, which he applied to land, but it could just as easily be applied to any economic resource. As more land is cultivated, Malthus argued, the productive capacity of each additional plot is necessarily less than the previous plot and, eventually, the expanding number of ravenous mouths will overtake food production. In this view, widespread poverty, misery, and suffering are inescapable.

Indeed, too much of the world continues to languish at or near the level of starvation the classical economists predicted would be the inevitable long-run state of the human race. But in the nineteenth century, a small number of nations were dramatically distancing themselves from that dismal fate in what economists now call the "great divergence." Something was propelling these nations, including the United States, forward at an undreamed-of pace.

Figure 1: The Great Divergence



In the nineteenth century, the United States joined Western Europe in distancing itself economically from the rest of the world. This prosperity gap accelerated during the Industrial Revolution, and today, these advanced economies enjoy per capita incomes six to 10 times that of other nations.

Source: Maddison (2001).

Charles Darwin, Cleveland Public Library/Photograph Collection;
Thomas Robert Malthus, Private Collection/Roger-Viollet, Paris/Bridgeman Art Library

Innovation, Extinction, and Growth: Evolution Meets the Dismal Science

Charles Darwin's inspiration for his theory of evolution may have come from the social sciences rather than biology. In 1838, four years after Thomas Malthus's death, Darwin, pursuing a "systematic inquiry" into the factors driving the origin of new species, read the works of Malthus, noting:

> *…the Struggle for Existence amongst all organic beings throughout the world, which inevitably follows from the high geometrical ratio of their increase, will be considered. This is the doctrine of Malthus, applied to the whole animal and vegetable kingdoms. As many more individuals of each species are born than can possibly survive; and as, consequently, there is a frequently recurring struggle for existence, it follows that any being, if it vary however slightly in any manner profitable to itself, under the complex and sometimes varying conditions of life, will have a better chance of surviving, and thus be "naturally selected." From the strong principle of inheritance, any selected variety will tend to propagate its new and modified form.*
>
> *—Origin of the Species*

The idea is that systems evolve as a result of innovation—which, if it is advantageous, supplants the obsolescent technology. The competition for limited resources favors the better technology and, as it flourishes, the economic "species" improves.

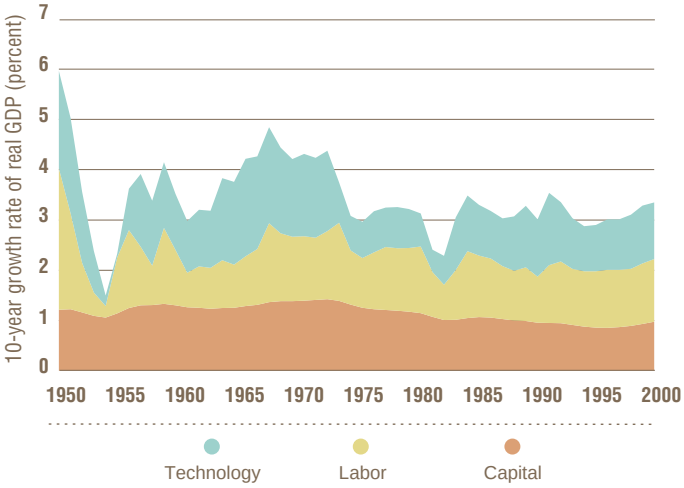
The Process of Growth: Innovation and Creative Destruction

During the first half of the twentieth century, the question of how economies grow over time, known as *growth theory*, was pushed to the back burner of economic inquiry, subjugated by the exigencies of the world's economic depression. *Stabilization theory* became the rallying cry of most economists, and it was exemplified by British economist John Maynard Keynes's scornful denigration of the long-run perspective of growth theorists when he said that "in the long run, we are all dead." To Keynes, the important questions did not concern the long march of economic progress, but the unnerving fluctuations that characterize that march—fluctuations he believed demonstrate the inherent instability of market economies and threaten to mire our economies in chronic underemployment, if not bring them down altogether.

While Keynes was refocusing economists' attention away from growth theory and toward stabilization theory, the Austrian-born Harvard economist Joseph Schumpeter argued that the two theories are inextricably connected. In Schumpeter's view, the ebb and flow of economic activity and national joblessness that Keynes had aimed to control are an integral—indeed, necessary—part of growth. Growth, he argued, is about *innovation*, or "putting productive resources to uses hitherto untried in practice, and withdrawing them from the uses they have served so far."[3] Schumpeter included in his set of growth-driving innovations the introduction of new products, new methods of production, new trade relationships, the discovery of raw materials, and the reorganization of business and economy activity. Each innovation, he believed, would be accompanied by temporary periods of joblessness and business stress as it "reconstruct[s] each time the economic system on a more efficient plan."[4] He called this process *creative destruction*.

Growth theory made another great leap forward in the 1950s with the publication of two influential papers by economist Robert Solow, who would go on to win a Nobel Prize. In his 1956 paper, Solow demonstrated that an economy's long-run growth is unaffected by its rate of saving and investment. The idea was similar to that posited by the classical economists and came to be known as the "neoclassical growth model." In a 1957 paper, Solow went on to show that nearly 90 percent of the rise in U.S. prosperity during the first half of the twentieth century came from technological growth, and not, as most economists had assumed, from the mere accumulation of machinery.[5]

Figure 2: Accounting for Growth



In the typical growth accounting exercise, economic growth is separated into three sources: labor, capital, and a hard-to-measure factor that connects workers to their machinery—technology. By this measure, technology has accounted for one-third of U.S. growth over the past 10 years.

Sources: Federal Reserve Bank of Cleveland; for standard parameter assumptions, see Edward C. Prescott, "Theory Ahead of Business Cycle Measurement," Federal Reserve Bank of Minneapolis, *Quarterly Review*, Fall 1986, 9–22.

Using Solow's framework and the accumulated evidence of several centuries, growth theorists now suspect that technological development is not the result of random inspiration, but instead arises from the same competitive, seemingly destructive, forces that produce all goods. The roots of this idea can also be traced back to Schumpeter:

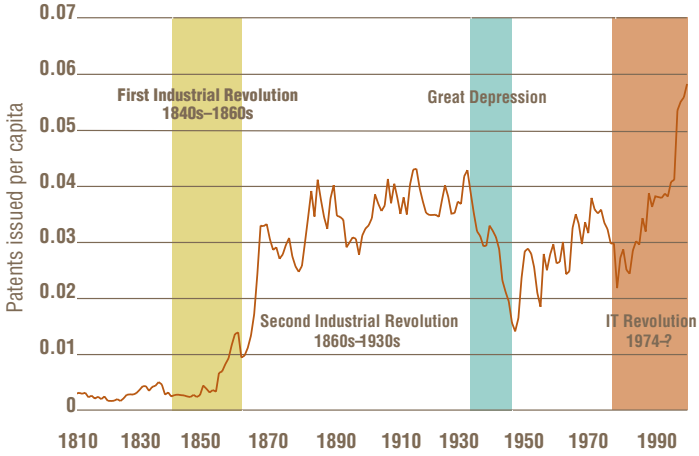
3 Schumpeter (1928).
4 Schumpeter (1934).

5 Subsequent "growth accounting" exercises, like the influential work of Edward F. Denison (1974) in the 1960s through the 1980s, have lowered that estimate, but the fact remains that technology—the introduction of innovations—is an essential component of long-run growth.

> *It is quite wrong…to say, as so many economists do, that capitalist enterprise was one, and technological progress a second, distinct factor in the observed development of output; they were essentially one and the same thing or, as we may also put it, the former was the propelling force of the latter.*[6]

The theory that technology responds to market incentives—that an economy manufactures technology as it does other goods—is called *endogenous growth*. Innovation begets growth, which begets yet more innovation. But what is the nature of the process that spawns innovation, and is there anything that economic policymakers can do to promote it? These questions are being addressed by today's growth theorists in the hope that we might yet understand the lever of riches.[7]

Figure 3: Patents and Technological Revolution



Charles H. Duell, commissioner of the U.S. Patent Office in 1899, is often credited with the statement that "Everything that can be invented has been invented." Although it seems doubtful the commissioner actually made this remark, it is easy to underestimate the pace of innovation. Since the early 1970s, the number of patents per capita has accelerated to a new record, roughly doubling the pace of the 1960s and 1970s.

Sources: U.S. Department of Commerce, Patent and Trademark Office; and Greenwood (1999).

Innovation, Diffusion, and Economic Stress

History has revealed that major economic innovations take many years to fully diffuse throughout an economy, and the course is hardly steady. At first, new technology is slow to take hold. Businesses are heavily invested in the older technology, and the applications of the new technology—seen through the eyes of entrepreneurs, who tend to view production through the lens of the old technology—appear limited. Moreover, the new technology may require a critical level of diffusion before it is truly effective; for instance, a telephone isn't a particularly useful tool until a sufficiently large number of people own phones. And of course, the initial innovation is just the beginning, as supporting technologies are developed and diffused. Technological revolution "constitute[s] a social process that involves more than the sum of our individual struggles with inanimate nature. People are adjusting not only to changes in technology, but to changes that others are making to technology."[8]

The process of growth through innovation, erratic and uneven, produces some unpleasant side effects. At the inception of the new technology, productivity gains are difficult to come by, and productivity may actually decline for some time because of the awkward process of learning and assimilation. Here again we find the insights of Schumpeter: Some of the economy's existing capital will be made obsolete nearly overnight, and skills that once were valuable will no longer be needed. From livery workers to milkmen, elevator operators to wireless operators, railroad conductors to cobblers, gas station attendants to blacksmiths, our economic history is littered with jobs that are now largely obsolete. Workers will need to be retrained and production processes overhauled, and, for a time, unemployment will rise.

The process of creative destruction is also likely to create a temporary gap in the distribution of prosperity.[9]

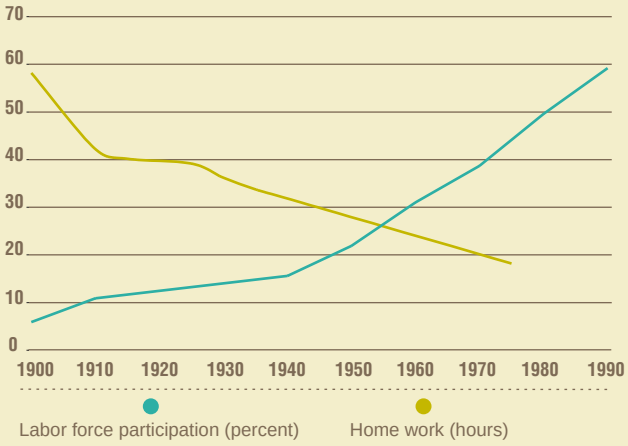
6 Schumpeter (1942).
7 Notably, economist Paul Romer (1990, 1994, 1996) of Stanford University.
8 Howitt (1994).
9 See Galor and Tsiddon (1997) and Greenwood (1999).

Innovation and Social Organization: Has Technology Liberated Women?

In 1900, about 5 percent of married women worked outside the home. By 1960, that figure had risen to about 30 percent, and in 1990, nearly 60 percent of all married women participated in the labor market. What accounts for this major social change? It seems to be the result of a confluence of events: the breakdown of social stereotypes, social legislation, the narrowing wage gap between the sexes, and—perhaps most underappreciated—women's liberation from home work as a result of innovation in home technology. This is one example of the social reorganization that often accompanies major technological breakthroughs.

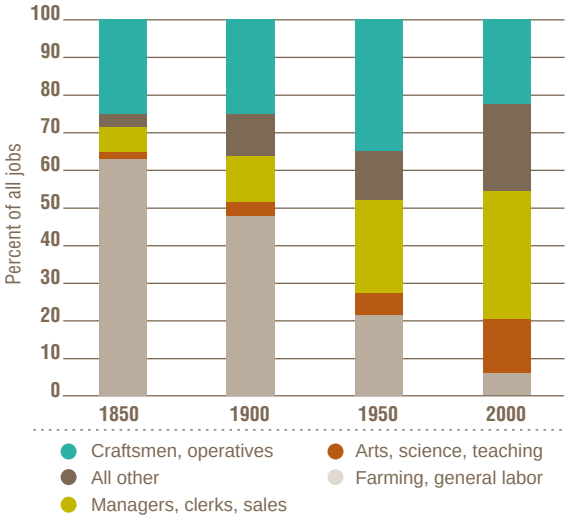
Economists Jeremy Greenwood, Ananth Seshadri, and Mehmet Yorukoglu (2003) argue that a variety of labor-saving devices—from home electronics in the 1920s and 1930s to the introduction of microwave ovens more recently—have dramatically lowered the time required for household chores, allowing women greater freedom to choose paid employment.

Home and Market Work of Married Women



Sources: Labor force participation rates are from Matthew Sobek, "A Century of Work: Gender, Labor Force Participation, and Occupational Attainment in the United States, 1880–1990," PhD diss., University of Minnesota, 1997; hours of home work is from Stanley Lebergott, *Pursuing Happiness, American Consumers in the Twentieth Century* (Princeton, NJ: Princeton University Press, 1993), table 8.1.

Figure 4: The Changing Character of American Jobs



The nature of American work has undergone dramatic change over time. While some jobs have remained relatively constant, many have fallen into economic obscurity, such as railroad conductors, porters, ushers, charwomen, elevator operators, postmasters, and midwives. In the last 50 years, the share of craftsmen and operatives has declined, replaced by occupations in the arts and sciences (including teachers), and managers, clerks, and salespeople.

Source: Steven Ruggles and Matthew Sobek, et al., *Integrated Public Use Microdata Series: Version 3.0* (Minneapolis, MN: Historical Census Projects, University of Minnesota, 2003).

Some will be so heavily invested in the old technology that the new process will seem like more of a threat than a benefit. The same will be true for the workforce. Collectively, then, there will be many people who have little interest in or ability to embrace the new tools and techniques. But over time, those who readily adapt to successful innovations will find their incomes growing faster than those who cling to obsolete technologies and business practices. Eventually, the superiority of the new technology will become so great that its widespread adoption is imperative. The next generation masters the skills associated with the newer methods, and income inequality falls as the technology is diffused across industries and occupations.

The economy is now being transformed by another great innovation, the microprocessor. This, and the vast number of innovations the microprocessor has spawned—called the *information technology revolution*—is dramatically lowering the cost of information. The cost

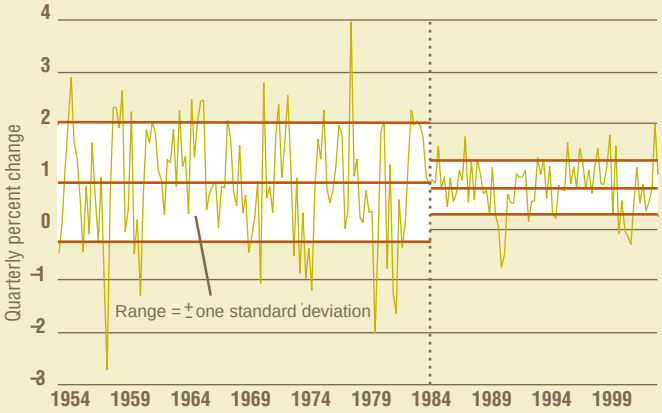
Smarter, Luckier, or Better Technology? What Accounts for the Improvement in U.S. Economic Stability?

One of the most remarkable developments of the last quarter-century has been the U.S. economy's increased stability: The variability of U.S. output has been cut in half during the last 20 years or so.

The puzzle of our recent economic stability has prompted three explanations—improved management of the economy by policymakers, good luck, and structural changes, including improved technology. All three probably deserve some measure of the credit, and each has its proponents.[10]

Economists Margaret McConnell and Gabriel Perez-Quiros (2000) say that, beginning in 1984, increased economic stability was associated with lower volatility in the durable goods sector of the economy, which, in turn, roughly coincided with a reduction in durable goods inventories. One reason for the improvement in inventory management may have been the widespread adoption of new technologies that have allowed firms to better manage their stock of goods relative to their sales.

U.S. Economic Stability since 1984



Source: U.S. Department of Commerce, Bureau of Economic Analysis.

per computation has declined so rapidly over the past few decades that mechanical devices have replaced human action in innumerable daily tasks.

Technology may be the reason for the surging U.S. productivity of the 1990s, and it may sustain us for quite some time. We may yet see a second wave of high productivity growth, brought about by still more innovation in IT software and services, greater diffusion of information technology in lagging sectors of the economy, and further cost advantages from the global production of technologies.[11] Sharply lower communications costs have accelerated the exchange of ideas in a way not seen since the invention of the telegraph. It is no exaggeration to say that information technology has expanded the marketplace to every location on the globe. Markets that had been isolated since before World War II are now opening, and we stand before a great opportunity that would have seemed impossible only a decade ago.

How this transformation will unfold is unknown, but we have learned from earlier periods in world history that, although the potential gains to our economic well-being are considerable, they are likely to be uneven. Several studies contend that technology has produced greater inequality in earnings in the United States, as the demand for workers who can adopt the technology rises relative to those who are less able to do so.[12] In some places, the transformation will put great stress on the existing economic order. The more dramatically the new technology promises to raise our *future* standard of living, the more disrupting it will be to *current* businesses and employees.

From the scribe guilds of the fifteenth century that resisted the introduction of Gutenberg's printing press, to the attempts by canal operators to block the expansion of the railroads, in every century, in every nation, in every industry, those who have a stake in the old ways

10 See Bernanke (2004).

11 Mann (2003) is one who predicts a second wave of IT-induced productivity growth. Oliner and Sichel (2000) document IT-related productivity growth during the 1990s. Baily (2001) provides a comprehensive overview of the issue.

12 See, for example, Autor, Katz, and Krueger (1998).

impede the new, either by direct assault, or indirectly in the name of preserving a particular way of life.[13]

Many social systems are resistant to change, making them infertile ground for breeding and adopting new ideas. Certainly, some thoughtful resistance to innovation makes sense. Like Darwin's genetic mutations, not every innovation is necessarily life enhancing, and it should prove itself in the competitive struggle with the existing regime. But "[u]nlike natural selection, however, in cultural evolution there is a feedback effect; a high level of resistance will not only obstruct the adoption of new ideas but also discourage their emergence altogether, thus throttling the supply of the raw material of which change is made."[14]

The usual justifications for resisting new technologies are diverse and predictable. New practices are frequently characterized as too risky, a corruption of social values or environmental harmony, destructive to human creativity, indeed, a threat to humanity itself. Historically, the political order controls the speed and direction of change by using controls on wages and prices, trade restrictions and protectionist measures, regulatory constraints on business expansions and contractions, and other strategies to preserve the status quo.

But the colossal failure of state-managed economic systems in the second half of the twentieth century is not just a warning about the dangers of replacing the values of the marketplace with the values of the state. It is also a warning about the fate of societies that cannot adjust to the shifting preferences and technologies that guide precious resources to their most beneficial use. For this reason, state-directed industrial policies, no matter how well intended or initially successful, tend to have a detrimental effect on growth. Once in place, they are hard to remove, and this creates inflexibility in the distribution of resources. We handcuff our futures to an economic structure that must, in time, become obsolete.

Luddite Rioters, Private Collection/Bridgeman Art Library

Resistance to Technology: The Luddites

New technology cannot help but make older technology obsolete—and the old technology will undoubtedly have a constituency with a vested interest in preserving it. In the first century, the emperor Tiberius, who had an interest in Roman glass manufacturing, is said to have ordered the inventor of "unbreakable" glass to be strangled. Fourteenth-century tailors in Cologne were prohibited from using machines that pressed pin heads. And the ribbon loom, originally invented in Germany in the late sixteenth century, was killed by political pressure—only to be reinvented 25 years later in the Netherlands.[15]

The Luddite movement was a notorious uprising that protested technological change. The Luddites began in 1811 as a band of artisans in the wool and cotton industries in Nottingham, England. Distraught over wage reductions, the use of unapprenticed workmen, and the emerging use of machines, the artisans vandalized mills across the English countryside. Operating under its mythical leader and namesake, Ned Ludd, the group sought to defend its livelihood by targeting the symbols of industrial change—the machinery and factories of England's early industrialists.

The Luddites gained widespread support throughout Nottingham and other shires. Their brutal and violent response to the new industrialists was met with the same, as the British government set troops against the rioters. Although the Luddites were ultimately overcome, antitechnology sentiment grew stronger in Victorian Britain, and the torch of technological leadership was passed to the American continent, where there was considerably less resistance to new technology.

13 For a detailed historical account of resistance to innovation, see Mokyr (1992). Parente and Prescott (1994) provide a theoretical treatment of barriers to technology adoption.
14 Mokyr (1992).
15 Examples are from Mokyr (1990, 1992).

"It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change."

Charles Darwin

The Wealth of Nations: What Accounts for the Success of the American Economy?

Classical economists believed the unusually strong growth experienced in America during the early nineteenth century was a function of our great expanse of land relative to our small population. In time, as the population expanded and the law of diminishing returns took hold, it seemed likely that America's growth rate would fall back to match that of the European continent. But it did not. So if we are to believe modern growth theorists—that innovation is the origin of long-term growth—why has the United States been a more fertile environment for innovation than elsewhere? Some have suggested that much of America's economic success lies in what it did *not* do. During the industrial revolution of the late nineteenth and early twentieth centuries, America resisted many of the antitechnology forces that prevented other nations from realizing the full advantage of new technology.[16]

And so the nation was transformed from a rural giant to an industrial giant, but to say it was a difficult transition would be a gross understatement. Factories absorbed a rapidly increasing share of our nation's resources, and rural workers migrated to the industrializing urban centers in huge numbers. It was an era of great upheaval that changed many of our social institutions, including our system of public education. Industrial capitalism placed a premium on workers who could read, compute, and interact with complex production processes, putting pressure on our educational institutions to turn out employees who could contribute more than brute force to the new economic order. Mass education became imperative, and the nation responded.

The same constellation of factors may be propelling the nation today as we rapidly assimilate information technologies into the economy. The successful adoption of new technology in America is often attributed to the nation's relatively unencumbered regulatory environment, more flexible labor markets, and, again, our educational system. In the United States, our emphasis on post–high school education has been general, not vocational, allowing greater flexibility for workers who face a changing work environment. We teach *how* to learn rather than *what* to learn. One estimate suggests the difference in education strategy between the United States and Europe may account for as much as three-quarters of the growth differential between the two over the past decade, with the remainder attributable to regulatory and labor "rigidities."[17]

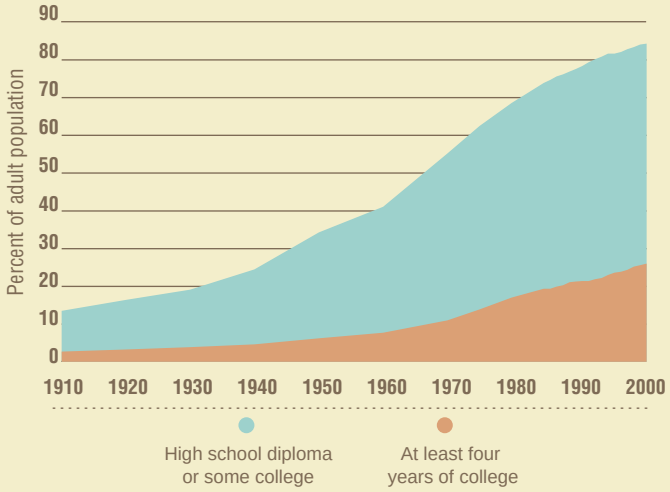
16 Mokyr (1992).

17 See Krueger and Kumar (2003). The role of general versus technical education is discussed in Bertocchi and Spagat (2001).

The Founding Fathers on Manufacturing and Public Education

To America's founding fathers, the public promotion of education was a matter of good government. For a democracy to be successful, its citizenry needed to be intellectually up to the challenge—and it would be from these enlightened citizens that our elected leaders would be drawn. Yet it may have been economic necessity that ultimately provided the motivation for our public education system. The study of practical subjects prepared the ground for the emergence of manufacturing, and it was an important—and perhaps underappreciated—force in our nation's industrialization. By the mid-nineteenth century, the United States had the highest rate of school enrollment of any nation, and its curriculum and egalitarianism became a model that other nations would follow.

U.S. Educational Achievement since 1910

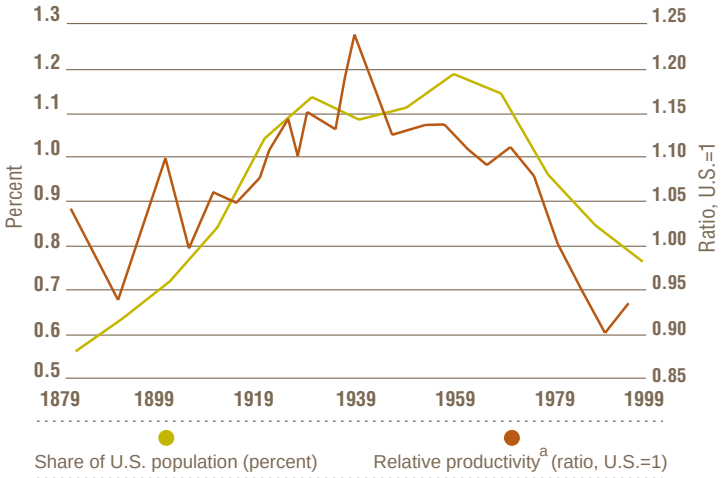


Source: U.S. Department of Education, National Center for Education Statistics, *Digest of Education Statistics,* 2002.

The Rise and Fall and Rise of Regional Economies

Can modern growth theory help us to understand our own region? Of course. Our natural infrastructure includes easy access to the lakes, rivers, and canals that moved products east, and, for a time, the greatest network of rail lines connecting resources to the rest of the nation. Our geography, combined with a frontier spirit, worked to the region's advantage at a time when new technologies enabled industrial mass production and transportation. Although these advantages initially started the ball rolling, they have not proved to be a continual source of economic prosperity. While our region's relative share of the national population peaked in the early 1960s, its relative productivity growth peaked some 30 years earlier, and the seeds of that gradual decline may have been sowed in the 1920s, when our region's network of innovators became "industrycentric," focusing on technologies that served a particular industrial need rather than general technology that would spawn new businesses.[18]

Figure 5: Population and Productivity in Northeast Ohio



Northeast Ohio, traditionally known for durable goods manufacturing, peaked as a share of the national population in the early 1960s. But the seeds of that decline may have begun considerably earlier: According to one estimate, the region's relative productivity may have peaked just before World War II.

a. Value added per production worker, relative to U.S. average.
Source: Fogarty, Garofalo, and Hammack (2002).

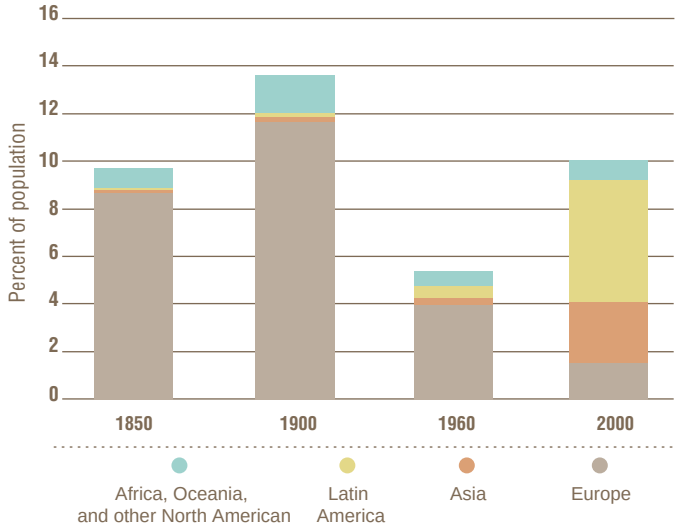
18 See Forgarty, Garofalo, and Hammack (2002).

The key to maintaining a region's economic vibrancy, like that of a nation, is to be found in its ability to sustain a community of innovators. Although there is no foolproof cookbook to follow, modern growth theory nevertheless suggests some appealing recipes. Some of the qualities that may help an economy to nurture innovation are a commitment to the rule of law, stable government and economic institutions, openness to trade, and a willingness to integrate our economy with an expanding international marketplace. To these we add the following ingredients.

Diversity

We must think about the elements that make the ground fertile for new ideas—or perhaps more accurately, for new *idea makers*. Many economists believe communities of innovators are attracted as much as they are bred. The process goes something like this: A major technological breakthrough creates a wage premium for high-ability individuals—those with the capacity to apply the technology most effectively. These workers migrate to sectors of the economy that offer the greatest potential for advancing the technology, and the growing concentration of workers creates an environment of continuous innovation—that is, the intellectual synergy necessary for even more growth-sustaining innovation.[19] The American melting pot, our great social and ethnic diversity, is not only about adding more mouths to a fixed stock of resources, as it has been portrayed since Thomas Malthus, but may itself contribute to our fertile ground for innovation. With such diversity in people and cultures, we cannot help but see old problems in new ways.

Figure 6: Immigrants in America



America has seen a resurgence of immigrants in the workforce, especially during the 1990s, when foreign-born workers made up nearly half of the net increase in the U.S. labor force. In 2000, just over 10 percent of the U.S. population was foreign born, almost twice its 1960 level. Moreover, the geographic origins of immigrants have shifted considerably, with Asian and Latin America immigrants replacing people of European origin as the predominant share of our foreign-born population.

Source: Mosisa (2002).

In a similar spirit, Richard Florida (2002) of Carnegie Mellon University suggests that communities need to create an environment that is attractive to what he calls the "creative class," which may include scientists and artists, lawyers and musicians, teachers and poets—any group of people whose product is ideas. Certainly, lifestyle amenities are important to attracting a community of innovators. But perhaps even more important is a community's openness to new ideas and different perspectives. Whereas in the current language of regional economic development, the term "brain drain" refers to the migration of younger, highly educated residents to other communities, "innovation drain" characterizes the loss of creative people whose ideas are the engine of economic growth.

Ending the Manufacturing versus Services Debate

What Adam Smith tried to teach us in *The Wealth of Nations* is that economic strength does not lie in *what* a nation produces, but *how effectively* it's produced. Our present attachment to the industrial economy, from which many presume our national wealth flows, closely parallels our attachment to farming during the first half

19 These "agglomeration effects" can be traced to the work of Cambridge economist Alfred Marshall (1920).

of the last century. In that world, as we may have forgotten, most presumed wealth came from the ground. Manufacturers, the proponents of agriculture claimed, were merely the benefactors of agricultural wealth, not the creators of it. Without farming and mining and forestry, there would be nothing to manufacture! This idea was powerfully expressed during the last industrial revolution by the great Populist orator, William Jennings Bryan. Speaking at the Democratic Convention of 1896, Bryan thundered:

> *[T]he great cities rest upon our broad and fertile prairies. Burn down your cities and leave our farms, and your cities will spring up again as if by magic; but destroy our farms and the grass will grow in the streets of every city in the country.*

This idea is simple and intuitive—and we now know it is wrong. Seventy years ago, 26 percent of our nation worked on farms—about 10 percentage points higher than the number currently working in U.S. manufacturing. Within 30 years, that share had fallen to just below 7 percent of all jobs, and 30 years after that, agricultural workers represented only about $2\,^1/_2$ percent of all jobs. Indeed, the rise of U.S. manufacturing was driven, in part, by the continual, unrelenting pressure of the marketplace to make our food better and cheaper.

Today, we hear the same story turned on its head: Manufacturing, some say, is the origin of wealth. The service economy, for all its fanfare, is little more than one hand scratching the other, and wouldn't be possible without the wealth generated by industry. Of course, the importance of manufacturing employment is waning—that has been a persistent and defining characteristic of the manufacturing economy since 1960. But manufacturing and service output have been expanding, with each sector depending on the other in ways that are changing over time. It is not one *versus* the other, but one *and* the other that leads to greater prosperity.

Education, Government, and Institutions

Are there any policies that can help to facilitate innovation? At the top of virtually every economist's list is education. During the last century—what Claudia Goldin (2002) calls the "human capital century"—the United States led the world in raising the educational level of its citizens. The virtues of the U.S. mass educational system, that "it was publicly funded, managed by numerous small, fiscally independent districts, open and forgiving, academic yet practical in its curriculum, secular in control, and gender-neutral in its admission… increased social mobility and enhanced economic growth."[20] The success of a country's educational system is still a critical determinant of how quickly and effectively workers can assimilate new, growth-enhancing technologies.[21]

But education by itself may not be enough if a nation inhibits its citizens' incentives to gain from their educational capital. In 1999, economists Robert Hall and Charles Jones investigated why some nations create prosperity so much more successfully than others. The authors concluded that it is a consequence of "social infrastructure," the incentives that a nation's institutions and government policies provide, which take the form of the protection of property rights, the embrace of trade, and capital and labor flexibility.

In other words, having a comparative advantage in ideas requires a highly educated workforce—but knowing this is not a sufficient condition for achieving it. Policymakers must carefully evaluate the *public* returns to a variety of competing investments that may include roads, sports complexes, industrial site development, business location incentives, and education. Sound public policy justifies reallocating funds to high-return activities, as well as experimenting with different ways of delivering services if traditional organizational structures do not

20 Goldin (2002).
21 Benhabib and Spiegel (1994) model and estimate these effects across countries.

yield the desired outcomes. States spend resources to attract businesses from "them" to "us," an activity that, overall, does little good for society. What if more of these resources were devoted to building human capital?

Nobel laureate James Heckman (2003) argues that education generally delivers the greatest returns to public investment, and that social returns to early childhood development yield the highest returns of all. But money alone is not always the answer: Public funds for K–12 education have increased considerably during the past several decades, but educational outcomes have hardly changed.[22] Innovation and the willingness to try new methods might yield better results.

The Long Run May Be Closer than We Think

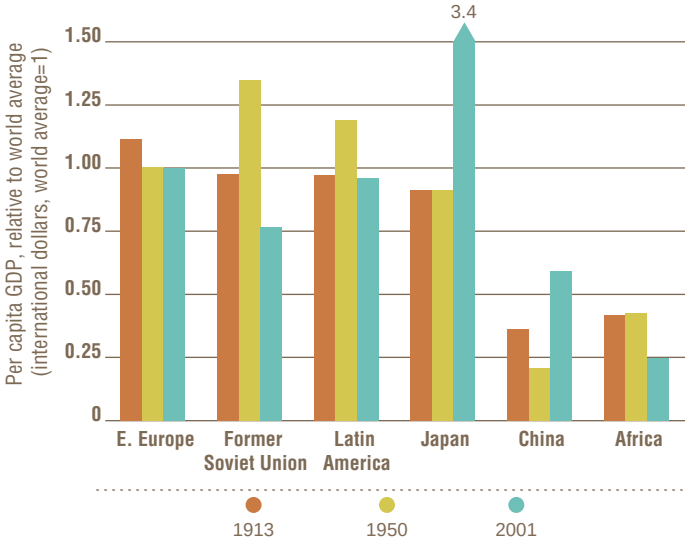
Productivity in the United States has increased generation after generation, creating ever-rising standards of living. Our knowledge-based skills in a business environment…have enabled our workforce to create ever-greater value added—irrespective of what goods and services we have chosen to produce at home and what and how much we have chosen to import.
—Alan Greenspan, Federal Reserve Chairman, 2004

At the turn of the nineteenth century, the United States was one of a select group of nations that were able to distance themselves from the subsistence threshold that characterized many of the world's economies. Membership in that elite group has not been exclusive, as some nations that were slow to prosper are now finally doing so. And of course, membership among the world's most economically elite nations is not necessarily permanent—some nations that were once prosperous are no longer so.[23]

One of the most important policy implications of the new theory of endogenous growth is that we must think more holistically about our economic environment. That is, we must think not in terms of specific industries or projects, but in terms of whether the economic climate is conducive to innovation and change. To do so requires that we lengthen the horizon over which we hope to effect change. Nations, regions, and cities can live for quite some time off their past successes, addressing what they perceive to be their immediate needs. They can protect their established industries, they can discourage newcomers, and they can squabble over how to divide what assets they still have. In the meantime, innovation will migrate to a more accepting environment and take root—disruptions and all.

Change comes hard, and change takes time, but cumulative change raises living standards in the only way it can, step by step. It is easy for citizens to resist change, but harder for their children and grandchildren to live with the consequences. Policies put in place today, even if they raise living standards by only $^{1}/_{2}$ percentage point each year, will raise prosperity by 25 percent within 44 years, roughly the working life of the average person. Small gains can offer such great long-run rewards.

Figure 7: Relative Economic Prosperity



While some of the world's economies have advanced far beyond the average, membership in this group is not exclusive or permanent. Former Soviet countries and Latin America enjoyed a relatively high standard of living in the middle half of the last century, but have since seen that advantage decline. Japan, on the other hand, has greatly elevated itself relative to the average in the latter half of the century, while China has recently begun to improve its economic standing.

Source: Maddison (2003).

22 See Hanushek (2002).
23 See Dowrick and DeLong (2003).

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