CHAPTER 10

FOSTERING PRODUCTIVITY GROWTH THROUGH INNOVATION AND TRADE

Americans have always believed in building a better future. Each generation has strived to pass on higher standards of living to their children than they themselves experienced. And for most of American history, this goal has been realized. Per capita income has risen strongly for most of the past two centuries.

Such economic growth stems from a number of factors. Investment in skills and education, or human capital, is a key determinant. The United States has a long history of investing in people, and this has enabled American workers to be among the most productive in the world. Investment in physical capital is also important. The tremendous accumulation of machines, buildings, and infrastructure has been a source of America's prosperity, and times of particularly great investment, such as the 1950s and 1960s, have been times of particularly rapid advances in standards of living.

Because investing in people and capital is important to the maintenance and growth of standards of living, the President has fashioned an ambitious agenda of improvements in education, incentives for investment, and financial regulatory reform to ensure that we have the financial system needed to support such investment. These initiatives have been described in detail in earlier chapters.

But as important as investments in labor and capital have been and will continue to be, they are not the only sources of growth. A third, more amorphous factor has also played a central role in American economic growth: advances in the overall productivity of that labor and capital. One need only think of a few of the technological changes of the past century—the airplane, antibiotics, computers, fiber-optic cables, and the Internet—to see that technological discovery and innovation are central to improved standards of living. Such innovations not only make us richer as a country, they have the potential to fundamentally alter the very way we live our lives and interact with one another.

As discussed throughout this *Report,* in the past decade American economic growth has slowed in important ways. American families saw their median income actually fall from 2000 to 2006. An important part of restoring growth and increases in standards of living is spurring innovation and increases in productivity. American firms and universities will naturally play the leading role in this endeavor. But that does not mean government has no role to play. Indeed, overwhelming evidence shows that innovation creates positive "externalities"—benefits for others beyond the individuals or firms who originally produce new ideas. Since inventors do not reap the full rewards, on its own the market will produce less innovation than is optimal. Public policy therefore has a powerful role to play in fostering pursuit of the myriad possibilities for scientific, technical, and analytical advances.

At its best, trade between regions of the country and across borders can also be an engine of growth. Trade has the potential to allow the U.S. economy to expand output in areas where it is more productive and to enable higher-productivity firms to expand. Access to a world market encourages American firms to invest in the research needed to become technological leaders. Through these routes, a free and fair trade regime can play an important part in lifting living standards in the long run.

Based on an understanding that progress springs from achieving the proper balance between generous rewards for the creation of new ideas and encouraging the best of those ideas to spread widely, the Administration has formulated a comprehensive "innovation agenda" that reaches far beyond the traditional scope of science and technology policy. This agenda touches everything from improvements in the Patent and Trademark Office, to increased government investments in research and development (R&D), to engaging the world economy in ways that ensure that the United States achieves the maximum benefits from trade's productivity-enhancing potential. This chapter discusses the key components of the agenda in detail.

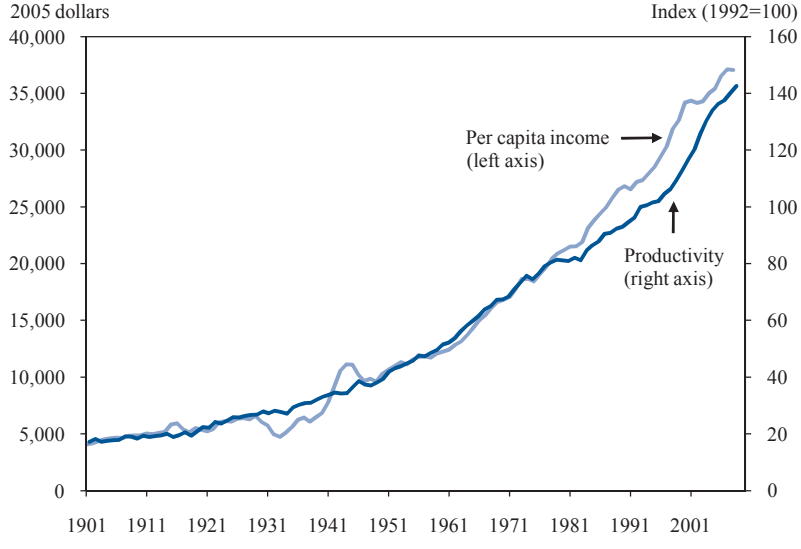
All advances in productivity, whether from scientific breakthroughs, changes in the organization of firms, or increased international trade, involve losers as well as winners. Because productivity growth is the critical source of improved standards of living, the most effective way to address the painful impacts for those harmed by progress is not to stifle new ideas or trade. Rather, it is to build a robust system of support that can help ease the transition from employment in declining firms and industries to jobs in new, higher-paying, higher-productivity areas. Even more important are broad-based policies that ensure that the gains from rising productivity are widely shared: progressive taxation, a health care system that provides security and stability, a strong educational system, and a secure social safety net.

For too many years, our Nation has ignored necessary reforms in these broad-based policies and underinvested in areas such as health care and education, which are essential to ensuring that middle-class families will benefit from productivity advances. That is why the Obama Administration has set as a central economic priority rebuilding our economy on a firmer foundation. The Administration's innovation agenda must go hand in hand with progress in those areas as well.

The Role of Productivity Growth in Driving Living Standards

In the long run, the critical determinant of living standards is labor productivity—the amount of goods and services produced by an average worker in a fixed period of time, such as an hour or a 40-hour week. Figure 10-1 provides striking visual confirmation of this hypothesis. It shows that over U.S. history since the early 20th century, sustained increases in labor productivity have translated nearly one-for-one into increases in income per person.

Figure 10-1
Non-Farm Labor Productivity and Per Capita Income



Note: Productivity represents total output per unit of labor, 1901-1946, and non-farm business sector only, 1947-2008.
Sources: Department of Commerce (1973); Department of Commerce (Bureau of Economic Analysis), National Income and Product Accounts Table 7.1; Department of Labor (Bureau of Labor Statistics), Productivity and Costs Table A.

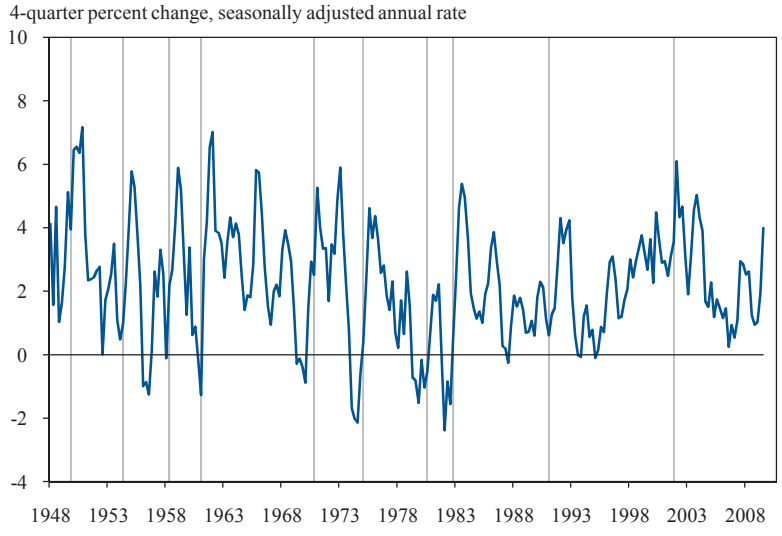
The importance of labor productivity to living standards may seem obvious, or even tautological, but it is not. In principle, increases in income per person could come not from more output per unit of labor input, but from more labor input per person—that is, from increases in the fraction of the population that is working or increases in each worker's hours. But both the historical evidence from the United States and the evidence from across a wide range of countries show that differences in labor input per person account for at most a small fraction of income differences.

Recent Trends in Productivity in the United States

Since labor productivity is the key driver of standards of living in the long run, it is important to discern the underlying trends in productivity. This task is complicated by the fact that in the short run, productivity depends on more than those underlying trends. It is powerfully influenced by the state of the business cycle, as well as by other factors (including simple measurement error) that leave no lasting mark on productivity.

Figure 10-2 shows the growth rate of labor productivity from four quarters earlier over the last 62 years. One immediate message is that although the overall pattern of productivity is strongly upward (as shown clearly by Figure 10-1), there is enormous short-run variation in productivity growth.

Figure 10-2
Labor Productivity Growth since 1947



Note: Grey lines represent NBER business cycle troughs.
Source: Department of Labor (Bureau of Labor Statistics), Productivity and Costs Table A.

A more subtle message is that the average or trend rate of productivity growth is not constant but changes substantially over extended periods. It is conventional to divide the era from the beginning of the sample until about 1995 into two periods: the "immediate postwar" period from 1947 through 1972, and the "productivity growth slowdown" period from 1973 through 1995. In the immediate postwar period, the average rate of productivity growth was 2.8 percent per year. During the productivity growth slowdown, it was only 1.4 percent.

This division into different periods lets one see the cumulative importance of even seemingly modest changes in productivity growth. For example, if the high productivity growth of the immediate postwar period had continued through 1995 instead of slowing, the level of productivity in 1995—and hence standards of living—would have been more than one-third higher than they actually were.

The pattern of productivity growth since 1995 is somewhat complicated. From 1996:Q1 to the last available observation (2009:Q3), it averaged 2.7 percent per year, almost equal to its rate over the immediate postwar period. But that rapid growth was concentrated in the first part of the period. In the first eight years (1996:Q1 to 2003:Q4), productivity growth averaged 3.3 percent; in the four years before the business cycle peak (2004:Q1 to 2007:Q4), it averaged only 1.7 percent. A four-year period is too short to confidently determine underlying trends. But productivity growth in the years leading up to the recession was not strong enough to generate robust increases in standards of living.

A final pattern revealed by Figure 10-2 is a relationship between productivity growth and the business cycle. Productivity growth tends to fall during recessions and surge near their ends (marked by the vertical lines in Figure 10-2). This pattern has been operating strongly in the current recession. Productivity growth averaged less than 1 percent at an annual rate over the first five quarters of the recession, but then surged in 2009:Q2 and 2009:Q3, and appears to have remained high in 2009:Q4.

This recent experience highlights the importance of distinguishing between cyclical movements in productivity and longer-term movements: the pattern in productivity growth in 2009 largely reflects the fact that employment moves more slowly than production over the business cycle. The sluggishness of employment growth has meant that even as output reached its low point and began to recover, employment continued to decline. This cyclical improvement in productivity is obviously of a different character than the secular improvements that are the source of long-run increases in standards of living. Over the course of 2009, standards of living clearly did not follow productivity closely. But once the cyclical dynamics

play themselves out, the usual long-term role of productivity growth in driving income growth is bound to reassert itself. An important goal of policy is to make the long-term path of productivity as favorable as possible.

Sources of Productivity Growth

Productivity growth is the overwhelming determinant of the progress of economic well-being over extended periods. It is therefore imperative to understand what determines productivity growth. Three sources have been identified as key.

The first source is the accumulation of physical capital—the machines, tools, computers, factories, infrastructure, and so on that workers use to produce output. Each year, some of our Nation's economic output takes the form of these capital goods. When workers have more or better capital to work with, they are more productive.

The second source is the accumulation of human capital—workers' education, skills, and training. The accumulation of human capital is just as much an investment as the accumulation of physical capital is. When some of the economy's output takes the form of physical capital goods rather than consumption, we are forgoing some consumption today in exchange for the ability to produce more in the future. Likewise, when students and teachers are in a classroom, or when an experienced worker is taking time to train a new hire, resources that could be used to produce goods for current consumption are being used instead for activities that increase future productive capacity. And just as a worker with better equipment is more productive, so too is a worker with more skills.

The third source of productivity growth is increases in the amount that can be produced from given amounts of physical and human capital. This factor goes by various names, such as "total factor productivity growth" or "the Solow residual." It encompasses all the forces that cause changes in how much an economy produces from its stocks of physical and human capital. Most obviously, it encompasses advances in knowledge and technology. These advances in knowledge and technology allow factory workers to build better automobiles and electronics from the same raw materials; they allow doctors to provide more accurate diagnoses and prescribe better treatments in the same office visit; and much more.

But total factor productivity growth includes more than advances in knowledge and technology. For example, if an economy faces an increase in crime, individuals may devote more of their skills and physical capital to protecting the goods they have rather than producing more goods, and so total factor productivity growth may be low or even negative. If a country switches from central planning to a market-based economy, then

workers and capital are likely to be allocated more effectively, and so output given the economy's stocks of physical and human capital may increase greatly. Changes in these types of "organizational capital" (or "institutional" or "social" capital) are potentially critical determinants of total factor productivity growth.

Research has not just identified changes in these three factors (physical capital, human capital, and total factor productivity) as critical determinants of productivity growth; it has also come to a fairly clear view about their relative importance. Perhaps surprisingly, the ranking of the three factors appears to be the same whether one is trying to understand the enormous growth in productivity over extended periods in the United States (for example, Jones 2002), or the vast differences in the level of productivity across countries (for example, Hall and Jones 1999).[1]

The factor that is most obvious and easiest to quantify—physical capital accumulation—turns out to be only moderately important. Differences in the fraction of output devoted to physical capital investment account for some portion of both long-run productivity growth and cross-country productivity differences, and increases in investment can have a significant impact on productivity growth, and hence on standards of living. At the same time, the evidence suggests that the other factors are even more important.[2]

One of those more important factors is human capital accumulation. Increases in the education and skills of the workforce play a substantial role in the long-term growth of labor productivity, and cross-country differences in human capital per worker are important to cross-country differences in labor productivity. Thus, increases in human capital investment through a stronger educational system and greater educational attainment at all levels, together with lifetime learning, provide another powerful route to raising productivity growth and standards of living.

The most important determinant is not physical or human capital accumulation, but changes in how much can be produced with them—that is, total factor productivity growth. Again, this finding applies to both long-term growth and cross-country differences. At an intuitive level, this result is not surprising. It seems very plausible that the most important reason we are so much more productive than our forebears is that, for reasons ranging

[1] See also Klenow and Rodríguez-Clare 1997; Hendricks 2002; Caselli 2005; and Hsieh and Klenow 2007.

[2] There is a subtlety here. When total factor productivity or human capital improves, the result is higher output, which then leads to more physical capital investment if the fraction of the economy's output that is invested does not change. The decompositions that find a moderate role for physical capital assign these indirect effects of total factor productivity and human capital investment to those factors, and not to physical capital. If those effects are instead assigned to physical capital, its importance increases greatly.

from advances in basic scientific knowledge to improved ways of organizing the workplace, we have found vastly better ways of producing output from a given set of inputs. Likewise, it is likely that a key reason the United States outperformed the Soviet Union economically in the postwar period was not that the United States was better at channeling its productive capacity into producing capital goods and its children into education (both of which the Soviet Union did on a very large scale), but that the United States' free-market institutions led it to produce more from its inputs, and led to myriad innovations that widened the productivity gap over time.

This discussion implies that in order to foster improvements in standards of living, policy should foster investment in physical capital, investment in human capital, and crucially, improvements in total factor productivity. Physical and human capital investment are discussed in earlier chapters—most notably Chapter 4 (as well as Chapters 5 and 6) in the case of physical capital investment, and Chapter 8 in the case of human capital. The remainder of this chapter turns to measures to improve total factor productivity. Such improvements in total factor productivity can be described broadly as "innovations."

Fostering Productivity Growth Through Innovation

Because total factor productivity reflects all determinants of labor productivity other than physical and human capital, it has a wide range of elements. As a result, there are many avenues along which well-designed policies can work to improve total factor productivity. It is for this reason that the Administration has proposed a comprehensive innovation agenda (Box 10-1).

Box 10-1: Overview of the Administration's Innovation Agenda

On a September 21 visit to New York's Hudson Valley Community College, President Obama presented the first comprehensive description of the Administration's Innovation Agenda, the conceptual framework underpinning the wide range of initiatives that the Administration has undertaken that share a common aim of fostering innovation.

The Agenda has three elements. The first is a commitment to invest in the building blocks of innovation, including basic scientific research and infrastructure, as articulated in detail in the body of this chapter.

Continued on next page

Box 10-1, continued

The second is a recognition of the vital role that competitive markets and a healthy environment for entrepreneurial risk-taking play in spurring innovation; reform of the Patent Office, improving the accessibility and usefulness of government statistics, and increasing the predictability and transparency of government policy are all parts of this effort. The final part of the agenda is a particular focus on innovation targeted toward specific national priorities, including the development of alternative energy sources, reducing costs and improving medical care through the use of health information technology, the creation of a "smart grid" that will allow more efficient use of existing energy generation capacity, and initiatives aimed at inventing cleaner and more fuel-efficient transportation technologies.

The Agenda builds on over $100 billion of funds appropriated in the American Recovery and Reinvestment Act of 2009 for the support of innovation, education, and technological and scientific infrastructure. It also encompasses directives to regulatory and executive branch agencies designed to help them refocus their missions to support the Agenda in whatever ways are most appropriate to their usual activities. A final key tool is the commitment to science-based, data-driven policymaking that brings to bear all the intellectual, statistical, informational, and analytical resources necessary to make sure that government policies achieve their stated aims as efficiently and effectively as possible.

The Importance of Basic Research

One uncontroversial conclusion of work on the determinants of productivity growth is that the payoff to investment in basic scientific and technological research has been vast, at least in some fields and over the long run. Breakthroughs on fundamental questions of physics, chemistry, biology, and other sciences have powered the transformations of economic production that underlie much of the productivity growth measured (however imperfectly) in economic statistics (Nordhaus 1997; Nelson and Romer 1996).

The Administration has taken that lesson to heart in its support for basic research in science and technology, especially in two areas where the need for progress is pressing: energy and biomedical research. The Department of Energy has created a new Advanced Research Projects Agency-Energy (ARPA-E), with the objective of pursuing breakthroughs

that could fundamentally change the way we use and produce energy. In the medical and biological sciences, the Administration has ended restrictions on Federal funding for embryonic stem cell research, and in September 2009 it announced $5 billion in grants under the American Recovery and Reinvestment Act to fund cutting-edge medical research.

Across all areas, the Recovery Act included $18.3 billion for research funding. Because the Administration's commitment to evidence-based policymaking will require substantial improvements in the ability to reliably measure economic outcomes, the Act committed $1 billion to the 2010 Census as a first step in a longer-term effort to revamp the Nation's statistical infrastructure—a process that will not only improve policymaking but will also help private businesses make better decisions (for example, about where to locate new production or sales facilities).

In addition, the fiscal year 2011 budget enhances research funding in numerous ways. First, it continues to work to fulfill the President's pledge to double the budgets of three key science agencies (the National Science Foundation, the Department of Energy's Office of Science, and the Department of Commerce's National Institute of Standards and Technology). Second, it boosts funding for biomedical research at the National Institutes of Health by $1 billion to $32.1 billion. Third, it reinvigorates climate change research through increased investments in earth observations and climate science in agencies such as the U.S. Geological Survey and the National Oceanic and Atmospheric Administration. Fourth, it funds potentially groundbreaking discoveries with a boost to Department of Defense basic research and $300 million for the Department of Energy's ARPA-E program. Finally, it supports world-class agricultural research for national needs such as food safety and bioenergy with $429 million for the competitive research grants program in the Department of Agriculture's new National Institute of Food and Agriculture.

As part of the innovation agenda, and to ensure that the increased research funds are spent well, the Administration has also instructed agencies to work on constructing a set of systematic tools to track the long-term results of federally sponsored research, such as journal articles published and cited, patents obtained, medical advances achieved, or other measurable consequences (particularly in areas of national importance such as health or energy). Although the fruits of this effort will not be available for a number of years, the project is one of the most promising in the Administration's efforts at turning the evaluation of scientific research into a "science of science."

Private Research and Experimentation

Scientific breakthroughs are only the first step in producing improvements in total factor productivity and hence living standards. Benjamin Franklin's discovery that lightning was a form of electricity did not produce an immediate reduction in damage from electrical storms; much further research and development was necessary to turn that discovery into the lightning rod (though by late in his life Franklin was able to observe a flourishing industry that had been built upon his insight).

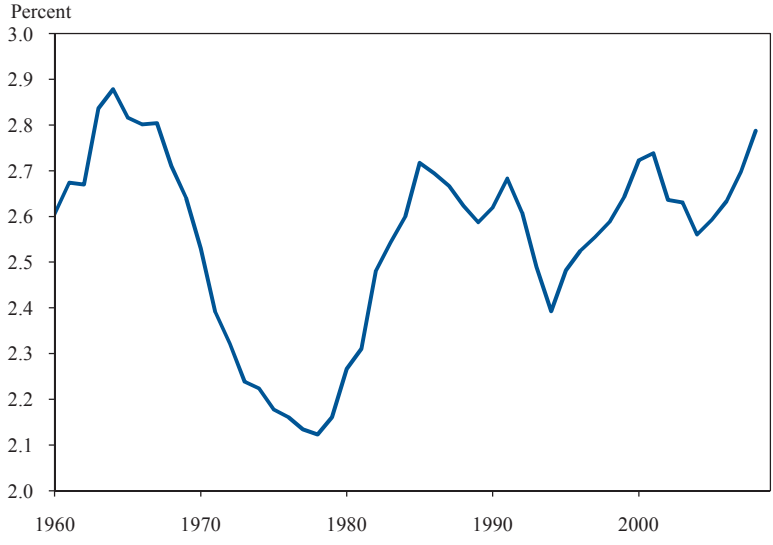
Measuring the returns to the economy as a whole from private research and experimentation is almost as formidable a challenge as measuring the returns to basic research. But most studies find that aggregate returns to such spending are much higher than the returns to ordinary investments in physical capital. Some work estimates the aggregate returns at 50 percent or higher (Hall, Mairesse, and Mohnen 2009).

These returns are mostly not received by the firms or individuals who pay for the work, because the ideas ultimately benefit others in many ways whose value is not captured through markets. Economic theory provides a clear prescription for policy toward activities that have measurable positive externalities: the activities should be subsidized.

This is the logic behind the research and experimentation (R&E) tax credit that has been an off-and-on part of the tax code for many years. But the credit's effectiveness has been hampered by chronic uncertainty about how long it will remain in force. Partly for budgetary accounting reasons, the R&E tax credit has been treated for many years as a temporary provision that was scheduled to expire at some point in the near future. Yet each year (except for 1995), Congress and the President have agreed (sometimes at the last minute) to extend the credit. The effect has been to substantially increase the uncertainty that firms face about the costs that they will end up paying for their research and experimentation projects; this uncertainty can have a serious negative effect on research, which is already a highly uncertain investment. The problem is particularly acute for the kinds of projects that might be expected to have the highest returns: long-term projects that require continuing expenditures over many years. For such projects, uncertainty about whether the R&E tax credit will be in place through the duration of the project can make the difference between pursuing or abandoning the research. The Administration therefore supports efforts in Congress to make the R&E tax credit permanent, so that the highest-return long-run projects can be confidently started without uncertainty about whether the credit will be there for the duration.

The importance of both public and private R&D spending for innovation and improvements in standards of living forms the basis for a key Administration goal. In a speech in May 2009 to the National Academy of Sciences, the President articulated the ambition of boosting total national investment in research and development to 3 percent of gross domestic product. As can be seen from Figure 10-3, this is a rate that would exceed even the peak rates reached in the 1960s. As described earlier, the American Recovery and Reinvestment Act began the Federal contribution with a historic increase in direct funding for scientific and technological research, as well as major investments in technological and scientific infrastructure detailed below. But reaching the President's goal will require not just an increase in the Federal Government's role; equally important is the need for a resurgence of entrepreneurial and corporate investment in research. The Administration's consequent focus on creating the best possible environment for private sector innovation is one of the many novel aspects of its innovation agenda.

Figure 10-3
R&D Spending as a Percent of GDP



Note: Data for 2008 are preliminary.
Sources: National Science Foundation, Science and Engineering Indicators 2010 Tables 4-1 and 4-7.

Protection of Intellectual Property Rights

A subsidy like the R&E credit is one way to address underinvestment caused by the fact that the inventor of a new technology does not reap all the benefits of that invention. An older approach is embodied in the American

system of patents and copyrights that had its origins in the Constitution (and before that, in the English legal system).

One leading scholar (Jones 2001) has argued that the invention of ways to protect intellectual property may have been a trigger for the industrial revolution that led to the modern era of economic growth. In this interpretation of history, the creation of a legal system that could protect intellectual property may have been one of the most important "technological" developments in human history. Though this interpretation can be debated, the practical implication is surely correct: achieving the proper balance between the private and the societal rewards from innovation is a critical element in creating and sustaining long-run economic growth.

The existing U.S. patent system developed over many years in response to the needs of an industrial economy. That system has been under considerable strain in the past couple of decades as the United States and the world have moved increasingly toward a "knowledge-based" economy. The Patent and Trademark Office (PTO) has been required to answer many questions that could not have been imagined in 1952 when the current patent statute was written, such as how and whether to grant patents for human genes or for Internet advertising tools. Further, the sheer volume of information necessary to evaluate a patent application, which might now arrive from any country in the world and might rely on ideas that even an expert might be unfamiliar with, has made the PTO's job increasingly daunting. As a result of these challenges, the agency currently faces a backlog of over 700,000 unexamined applications. Waiting times on a patent application can extend to four years or more. The costs that such waiting times impose on firms are substantial; and delays impose a particularly large burden on startup firms that rely on patents to attract venture capital funding—precisely the kind of firms that the Administration's innovation agenda is particularly designed to help.

While the PTO has made progress in responding to these problems, most notably by developing a "peer review" system modeled on academic publishing, observers agree that the patent system is in need of an overhaul. The Administration has endorsed the aims of bills pending in Congress that would address many of these problems, particularly by giving the PTO authority to set fees that cover the cost of application processing, and also by barring diversion of fees to projects unrelated to PTO activities. The PTO is also in the process of creating an Office of the Chief Economist, which will provide a mechanism for better integration into patent policy of economic research on how to properly reward innovation without stifling the widespread use of good ideas.

In recognition of the role of innovation and intellectual property in advancing continued U.S. leadership in the global economy, in 2008

Congress created the Office of the United States Intellectual Property Enforcement Coordinator. This office is charged with creating and implementing a strategy to coordinate and enhance enforcement of intellectual property rights in the United States and overseas. By ensuring that the Administration has a coordinated strategy, this office will work to ensure that the effort of American workers and businesses to produce creative and innovative products and services is valued fairly around the world.

Spurring Progress in National Priority Areas

Much of the Administration's innovation agenda is aimed at creating a general economic environment that encourages innovation across the board. But the Administration has also focused special attention on certain areas where particular national needs are urgent. These include investments in building a "smart grid" to enhance the reliability, flexibility, and efficiency of the electricity transmission grid; research on renewable energy technologies like wind, solar, and biofuels; and support for research into advanced vehicle technologies. These investments are motivated not only by the perception that technological breakthroughs are possible and would be highly valuable, but also by the enormous potential benefits that such breakthroughs could have in terms of enhancing national security, mitigating pollution, and stemming climate change. These are also investments that have a direct impact on creating high-paying, durable jobs—something that is particularly valuable at a time of high unemployment. Thus, as noted in Chapter 9, investments in the clean energy transformation involve two layers of externalities: innovators fail to receive the full economic benefits of their breakthroughs as measured by market valuation, and the market valuation itself understates the true social benefits of the breakthroughs.

Another priority, given the looming threat that health care spending poses to the Federal budget, is developing technologies for measuring and monitoring health more efficiently. Through the Recovery Act, the Administration has allocated substantial funds to development of a 21st-century system of medical recordkeeping that should jump-start work in this area.

Increasing Openness and Transparency

To noneconomists, the idea that the legal system or the Patent Office is a form of technology seems a bit of a stretch. Even more challenging is the idea that a society's overall degree of openness and transparency may be a key determinant of economic progress. Yet a substantial body of economic research has found that measures of openness and transparency

in governmental policymaking processes have a strong association with growth outcomes.

There are several reasons why this may be so. One fairly simple one is that openness and transparency make it more difficult for special interests to achieve their aims at the expense of the public. Another view, which is not in conflict with the first, is that the process of requiring policies to be explained and encouraging wide discussion about them yields new ideas and improvements of existing ideas that might not otherwise have occurred even to the cleverest and most well-motivated public servant.

A more speculative proposition is that a commitment to openness and transparency on the part of the government is a form of investment in the kind of "organizational capital" described earlier. Economic research has found a strong correlation between measures of governmental transparency or openness and private sector productivity. Interpretations of this relationship are a matter of debate; some scholars argue that higher levels of productivity and income cause citizens to demand better government; others argue that both governmental openness and private productivity are a reflection of deeper unmeasured forces; and some advocate the straightforward view that open and transparent government has a direct effect in producing greater private sector efficiency.

The Administration's commitment in this area has been on full display in the unprecedented openness and transparency surrounding implementation of the Recovery Act. The most obvious manifestation of this transparency is the creation of the independent Recovery Accountability and Transparency Board charged with monitoring and reporting on the government spending under the Act. Likewise, the requirement that recipients report on job creation and retention each quarter provides a new source of information on the employment impact of the Act. The knowledge generated by the data collection and measurement under the Recovery Act will be valuable in assessing economic policymaking for years to come.

The principles of openness, accountability, and public input are far broader than just the Recovery Act, however. The Administration's "open government" initiative aims to harness the power of the Internet to bring the same commitment to transparency and accountability to every part of the Federal Government. New tools for this purpose are being developed not only by government agencies but by the private sector, by open source software programmers, and by citizens around the country. It seems plausible that eventually the new kinds of openness and transparency made possible by new forms of technology will have the same kinds of positive effects on growth that openness and transparency seem to have had across countries in the past.

Trade as an Engine of Productivity Growth and Higher Living Standards

Specialization has long been understood to be an important source of productivity growth. In his *Wealth of Nations,* Adam Smith (1776) extolled the virtues of specialization in the pin factory where many different specialized laborers were involved in producing a simple pin. Perhaps the most important form of specialization is a transition from a subsistence society, where people produce all their consumption goods themselves, to a market economy, where people focus on particular skills and occupations and depend on purchases for their daily needs. Another significant transition, though, is one from a country that must produce everything its inhabitants want to consume toward one that specializes in particular goods and services and sells them on global markets for other goods and services.

Increases in trade and increases in GDP tend to go hand in hand, but untangling whether economic growth is generating more trade or whether trade is lifting growth is a difficult task. Creative research, however, has been able to demonstrate the causal role trade plays in increasing the amount a society can produce. One study demonstrated that countries that were geographically better suited for trade (because of their proximity to trading partners, access to ports, and the like) have higher levels of GDP (Frankel and Romer 1999). Another demonstrated that the same relationship can be seen across time (Feyrer 2009).[3]

Initially, trade was about introducing products (such as spices) from one market to another, providing consumers with choices they previously did not have. Still today, trade can offer consumers different goods and different varieties of products already available to them and bring new technology from other countries. By allowing countries to specialize based on skills or endowments, trade can also allow countries to improve their standards of living. Trade can also help a country increase its overall output by allowing firms or industries to take advantage of economies of scale or by encouraging the growth of more productive firms. Thus, trade has the potential to increase the overall quantity of goods and services that a given economy can produce with its resources—and hence increase the overall standard of living—making global commerce a cooperative, not a competitive venture. A clear rules-based system with enforcement of those rules can help ensure that trade is mutually beneficial.

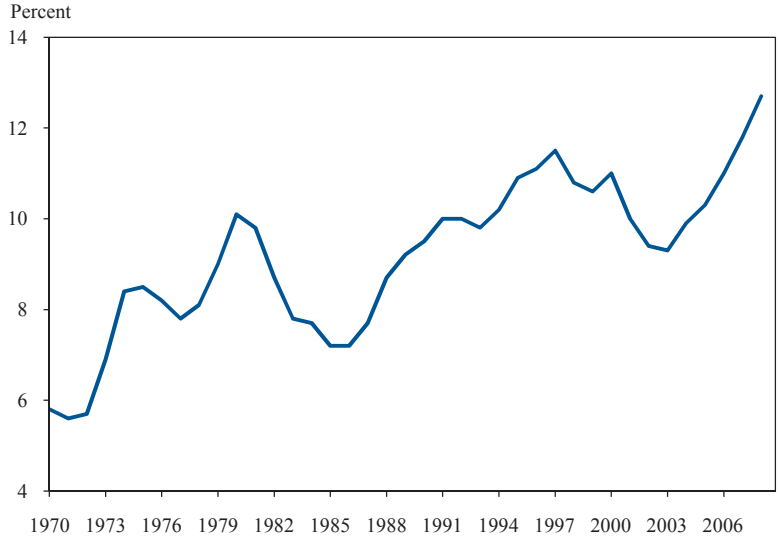
[3] The transition from sea to air traffic for much of the world's trade has meant more of a collapsing of distance for some nations than others. Because some sea-based trading routes are inconvenient, a shift to air transport has increased trade more for some nations than others. Controlling for other features, countries whose trade has increased due to this transition have grown faster than other countries.

While the act of specializing should lift living standards over time, it requires shifting resources from one sector to another, and so can generate short-run dislocations. As a result, it is essential to strengthen both targeted and more general policies that seek to ensure all can benefit from increases in trade. For this reason, after this section describes the productivity-enhancing benefits trade can generate for the U.S. economy, the following section discusses how progressive taxation and a strong social safety net are crucial counterparts to productivity change of all types.

The United States and International Trade

Because of its massive size, the United States can engage in a considerable amount of specialization and trade within its own economy. Historically, foreign trade as a share of GDP has been smaller in the United States than in most other countries. In 1970, exports as a share of GDP for the average member of the Organisation for Economic Co-operation and Development (OECD) was 25 percent, while in the United States, the share was just 6 percent. By 2008, exports had increased to 13 percent of the U.S. economy (see Figure 10-4). Although that share is still relatively small, the increase in trade over the past four decades has meant that even in a large country like the United States, global commerce is an important part of the economy and—as discussed below—can be an important source of productivity growth.

Figure 10-4
Exports as a Share of GDP



Source: Department of Commerce (Bureau of Economic Analysis), National Income and Product Accounts Table 1.1.10.

Millions of American workers contribute to the production of goods and services that are exported to foreign markets, and their jobs, on average, pay higher wages than a typical job. The Commerce Department estimates that in 2008 U.S. exports represented the work of roughly 10 million American workers. The majority of these export-supported jobs were related to the export of goods; millions more were related to services exports and nearly a million were related to agricultural exports. The manufacturing sector is particularly connected to exports; 20 to 30 percent of manufacturing employment in the United States in 2008 was supported by exports. These estimates represent the number of job-equivalents based on total hours needed to produce the volume of exports. Because few workers produce exclusively exports or inputs for exports, the number of workers who are involved with exports is likely much larger than 10 million.

Currently, the U.S. economy is far from full employment, and any increased production could generate an increase in jobs. Chapter 4 discusses how an increase in exports may be an important part of GDP growth in the medium term. In the long run, though, the principal contribution of an increase in the trade share will be the increase in productivity and living standards it can generate. Thus, the rise in the export share of the economy from 6 percent in 1970 to 13 percent today represents specialization, as some workers who produced goods for domestic use have moved into export sectors. The following sections describe the ways in which trade can increase productivity.

Sources of Productivity Growth from International Trade

Productivity growth can come from a number of channels. Trade can allow increased specialization; it can allow increased scale of production; and it can allow more productive firms to grow rapidly, increasing their share of the economy.

Specialization. In the United States, a primary source of trade-related productivity growth is specialization. The concept of Ricardian comparative advantage—that nations specialize in producing the goods that they can produce cheaply relative to other goods—can be seen in a number of aspects of U.S. trade. America makes far more aircraft, grain, plastics, and equipment (optical, photographic, and medical) than it consumes. In these product areas, the United States has a substantial trade surplus, totaling over $100 billion in 2008. Conversely, the United States produces less electrical equipment, clothing, furniture, and toys than it consumes, and therefore imports more of these goods than it exports. If America cut its production of aircraft, where it has a comparative advantage, by the $50 billion it

currently exports on net and instead tried to produce more of the goods we currently import, productivity would likely be lower.

Specialization also takes place within industries. For example, within the broad category of "electrical machinery and equipment," America imports telephones (including cell phones) and computer monitors, but exports electronic integrated circuits. Specialization can even take place within more narrow product classifications (for example, computer memory). Advanced countries with higher wages tend to produce and export more high-quality products even as they import lower-cost, lower-quality products from abroad in the same product type. Economists refer to this within-product differentiation as the "quality ladder," and extensive research in recent years has noted this pattern of specialization within products (Schott 2004). Over time, high-skill countries climb the quality ladder, making higher-quality products and increasingly importing low-skill products.

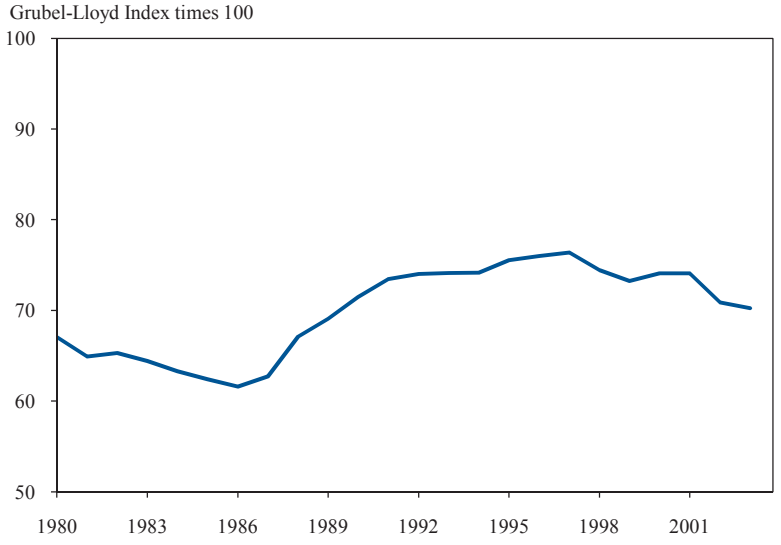
For example, consider the category "electrically erasable programmable read-only memory." The United States both imports and exports billions of dollars worth of products in this category every year, but the average unit price of the exports is roughly three times the average unit price of the imports. The U.S. products may have bigger memories with more complex production processes or be of higher quality than the cheaper imports. In any event, the imports and exports do not appear to be overlapping. Again, such a division of labor allows for higher standards of living across the world.

Intra-Industry Trade. Beyond specialization, trade can generate productivity advances in a number of ways. One important channel is that trade can allow companies to achieve a scale of production that they could not attain by selling just to the local market, thus increasing their productivity. Within any given economy, there is a limit to the quantity of a specific good that the domestic market will want to consume. The ability to manufacture more of a product than domestic consumption supports and exchange it for other products—even ones that are extremely similar to the exported good—can be quite beneficial. It results in economies of scale that can be internal to a firm, where one company grows quite large and productive at making one good, or to a region, where a particular good tends to be made in a given physical location as a substantial amount of expertise builds up there.

Trade in which different quality or simply different brand products are traded in both directions, known as intra-industry trade, represents between 40 and 50 percent of trade in the world economy. For the manufacturing industry of the United States, that figure is even higher. As Figure 10-5 shows, intra-industry foreign trade moved from roughly 65 percent of U.S.

manufacturing trade in the 1980s to roughly 75 percent in 2001. Frequently, this means two very similar countries engaging in trade with each other. Five of the seven largest U.S. trading partners are advanced economies; in fact, despite some observers' focus on low-wage country imports, roughly 50 percent of U.S. imports come from other advanced economies. These countries often have similar endowments of labor and are generally able to use the same technology, but narrow specialization within product classes, different brands, or differences in resource allocations allows for productive exchange.

Figure 10-5
Intra-Industry Trade, U.S. Manufacturing



Source: Organisation for Economic Co-operation and Development, Structural Analysis (STAN) database.

Firm Productivity. Trade can also allow productive firms to grow relative to less productive firms as they increase their scale. A new literature on "heterogeneous firms" has focused less on differences in endowments or comparative advantage across countries and more on how firms within an economy respond to trade. A crucial insight in this literature is that most firms do not engage in trade, but those that do are on average more productive and pay higher wages. This literature shows that when a country opens to trade, more productive firms grow relative to less productive firms, thus shifting labor and other resources to the better organized firms and increasing overall productivity. Even if workers do not switch industries, they move from firms that are either poorly managed or that

use less advanced technology and production processes toward the more productive firms. Thus, firm-level evidence demonstrates that trade allows not only economy-wide advances through resource allocation, but also allows within-industry productivity advances through reallocation of resources across firms. This shift has clear welfare-enhancing impacts; see Bernard et al. (2007) for a general overview of this literature.

Vertical Specialization. Thus far, the discussion regarding sources of productivity growth in international trade has assumed that finished goods are being bought and sold across borders. The world of trade, though, has changed substantially. Today, multinational corporations (U.S. or foreign-based) are involved in 64 percent of U.S. goods trade (imports and exports), and fully 19 percent of U.S. goods exports are sales from a U.S. multinational firm to its affiliates abroad. An increase in international vertical specialization, where firms have production in multiple countries and break up the production of a particular good into stages across different countries, has contributed significantly to growth in world trade. The process can be within a large firm or intermediate inputs can be bought and sold on the market. Decreased trade costs have made it easier to break up the value chain of production as various parts of production can be done in different places and an in-process good can be shipped many times before final assembly. One study estimates that roughly one-third of the growth in world trade from 1970 to 1990 was attributable to the growth in vertical-specialization exports (Hummels, Ishii, and Yi 2001). Calculations about the extent of vertical specialization vary from estimates that 30 percent of OECD exports contain imported inputs to estimates that intermediate inputs account for up to 60 percent of world trade.[4]

A trade system in which the same firms are both importers and exporters complicates considerations of the impacts of trade on different groups, as comparative advantage may not matter as much for a particular good as for a particular task or piece of the production process. Specialization by process should allow the United States to focus on jobs oriented toward the processes that match the human capital, physical capital, and technology in the United States, again increasing productivity. But it has also raised fears that the process of adjustment could be disruptive, as a broader range of jobs could be exposed to international competition. The crucial policy goal is to harness the benefits of trade and ensure that its benefits are shared broadly by all Americans.

[4] The 30 percent figure refers specifically to the share of exports that is made from imported inputs—sometimes called the vertical specialization of exports. The larger figure includes the volume of trade that is imports of intermediate goods used in the production of goods for either exports or the home market.

Encouraging Trade and Enforcing Trade Agreements

All of these aspects of trade highlight its potential to contribute to the long-run expansion of productivity in the United States. Many of the advantages of increased trade come from opening foreign markets to the products of U.S. workers. The best way to guarantee reliable access is through negotiated trade agreements and consistent enforcement of existing trade rules. As noted in Chapter 3, one positive development in the recent crisis is that, for the most part, countries did not resort to protectionism; that is, they did not close their markets to imports. Had they done so, the dislocation in U.S. employment would likely have been much worse. As it was, U.S. imports of goods and services fell 34 percent and exports dropped 26 percent from July 2008 to April 2009. From their peak in the third quarter of 2008 until the trough in the second quarter of 2009, the nominal value of exports of goods and services fell more than $400 billion at an annual rate, a drop of almost 3 percent of GDP. Imports also dropped substantially. In the long run, such a decline in world trade would be harmful for the U.S. economy. If trade had stayed at that depressed level, with lower trade surpluses in the United States' main export goods and smaller trade deficits in our import goods, the long-run dislocations from the crisis would have been worse than now expected. But U.S. exports are rebounding, opening the possibility that many workers who lost jobs in the crisis may find employment in the same productive industries where they were before the crisis.

Several explanations have been offered for this avoidance of protectionism during the crisis. One is the availability of macroeconomic policy tools such as fiscal and monetary policy (Eichengreen and Irwin 2009); another is the public commitments made by leaders at the Group of Twenty summits to avoid protectionist strategies. But the clear and concrete rules-based trade system was helpful as well. That rules-based system, embodied by the World Trade Organization (WTO) and by other trade commitments, allows the United States to take steps to ensure that other countries will abide by their obligations. It is also designed to give U.S. workers and firms confidence about the economic environment they will be facing and confidence that commitments made when trade agreements are negotiated will be kept. In addition, creating predictable and enforceable markets for innovative and creative works grounded in intellectual property rights is essential to spurring and protecting U.S. investments in technology and innovation.

The Administration recognizes that simply negotiating trade frameworks is not enough; robust enforcement of trade rules is an important part of our engagement in the world economy. The Administration has taken many trade enforcement actions recently. For example, the

Administration has continued pressing a WTO case that challenged China's treatment of U.S. auto parts exports. The ruling in this case resulted in China having to change its policies and increase its openness to U.S. exports. The United States (joined by Mexico and the European Union) has also initiated an action challenging China's use of subsidies and taxes to keep input costs low for firms in China, which lowers the cost of final goods from China relative to the world. Further, the Administration takes very seriously the "Special 301" process under which it monitors the protection and enforcement of intellectual property rights. In 2009, it added Canada to the priority watch list because Canada has not implemented key proposals to improve enforcement and protection of intellectual property rights. Actions like these represent the Administration's intent (made explicit, for example, in United States Trade Representative Ronald Kirk's speeches[5]) to enforce trade rules and aggressively pursue actions to open markets to U.S. exports.

As noted in Chapter 4, the Administration is currently pursuing these and other options to expand American exports, recognizing that increasing exports will be a key part of the U.S. growth model. Increases in our exports in the short run can help to return the economy to full employment. Over the longer run, increases in trade provide avenues for the United States to increase productivity through specialization, scale, and firm effects, and in turn, increase standards of living for American families.

Currently, a number of other trade expansion opportunities exist for the United States. The Administration supports a strong market-opening agreement for both goods and services in the WTO Doha Round negotiations and is continuing to work with U.S. trade partners on potential free trade agreements. Because the United States is a relatively open economy, negotiated trade deals often involve substantial improvements in access for U.S. exports to other countries relative to the market opening made by the United States.

It is also important that these trade frameworks protect productivity-enhancing innovation through adequate provisions for intellectual property rights and that they reflect our values regarding workers and the environment. An example of the Administration's actions to improve the world's trading regime is seen in the way the Administration is working to engage our trading partners across the Pacific region in a new regional agreement (the Trans-Pacific Partnership). It will be a high-standards agreement that expands trade in a way that is beneficial to the economy, workers, small businesses, and farmers, and is consistent with the values of the United States.

In addition to benefits to the United States, trade benefits our trade partners. This is of direct benefit to Americans in the sense that as these

[5] See for example his speech at Mon Valley Works—Edgar Thomson Plant on July 16, 2009.

economies grow, they can grow as a destination for U.S. exports. Trade can also have large benefits for the poorest countries. In particular, multilateral agreements that open trade flows between developing countries can have substantial impacts on poorer countries, and trade relations with the United States can be a crucial part of the path to development for the poorest countries. For example, the African Growth and Opportunity Act seeks to increase two-way trade with poor nations in sub-Saharan Africa, help integrate these countries into the global economy, and do so in a way that improves their institutions and reduces poverty. As development in the poorest nations of the world is in our national interest strategically, economically, and morally, trade presents win-win opportunities to advance development.

Ensuring the Gains from Productivity Growth Are Widely Shared

Any productivity advance—be it from technological change, trade, or other factors—will have different impacts across the economy. As discussed earlier, productivity advances are crucial to an increase in living standards. Still, those firms that do not make a specific advance will likely contract or fail, and some workers in the affected industry may face losses. Likewise, international trade can have disparate effects across industries, firms, and workers. In both cases, society on average will be better off because the economy is able to generate a higher standard of living. But the recent stagnation in median real wages despite positive productivity growth (discussed in Chapter 8) highlights the challenge of ensuring that the gains from productivity growth are widely spread.

The potential for productivity advances to generate disparities in outcomes suggests the need for strong social policy to support those who do not immediately benefit and to ensure that gains from trade and productivity advances are shared by all. Because identifying directly impacted individuals is difficult, the logical response to productivity advances is a strong social safety net that ensures that all benefit from the rise in living standards. Trade theory suggests that trade liberalization can generate gains that are large enough that they can be shared in a way that every member of society is made better off. In the past, however, the gains from our trade policies have not been shared sufficiently, and technological change and globalization have left many behind.

Trade adjustment assistance, worker retraining, and temporary relief programs are ways the Federal Government can and does support those

who do not benefit from these advances. The Administration has supported trade adjustment assistance, which provides additional unemployment funds, retraining, and health coverage assistance, and has made trade adjustment assistance available to a wider set of employees through the Trade and Globalization Adjustment Assistance Act of 2009.

These specific institutions, though, are not enough. More broad-based policy must ensure that as the economy grows in the long run, it enhances living standards for all citizens. Progressive taxation—which can be justified in many ways—is supported by the uneven outcomes from productivity advances and globalization. Those whose incomes rise can pay a larger share of total taxes and still be better off than before the gains. By doing so, they support lower taxes for others whose incomes may have declined. This process makes everyone better off and thus supports innovation and open borders by minimizing the number of people who feel threatened by productivity advances and therefore oppose them.

For example, the ability to sell books across borders certainly enhanced the income J.K. Rowling was able to collect from writing the famous Harry Potter books. Had she been able to sell her books only in the United Kingdom, her audience and income would have been much smaller. In addition, millions of American readers benefited from the increased consumer choice and the ability to purchase her books. Similarly, more Americans can work as well-paid aircraft engineers or manufacturing employees for Boeing or as technology specialists for Apple because those firms are able to sell on a world market. At the same time, it is distinctly possible that some American authors who would have captured a larger share of the "magic-oriented book" market had there been no trade in literature were crowded out by Rowling's success, or that some handheld music device engineer in the United Kingdom has had to find another career because of Apple's success.

A progressive tax rate combined with trade allows those who realize substantial income gains from globalization to still prosper a great deal relative to the state where there is no trade and incomes are taxed at a flat rate. And it does so while making sure that those who face lower incomes from globalization also obtain benefits—not just through the lower prices and expanded choices associated with trade, but also through lower taxation.

Beyond a progressive tax rate, a strong social safety net can cushion the disruption generated by a dynamic economy. Unemployment insurance can provide temporary income. A robust health care system can ensure that temporary dislocations do not generate drastic consequences. And a vibrant education system can prepare workers for changing economic needs.

Conclusion

Advances in productivity are crucial to increasing the living standards of all Americans—to building a better future. Innovation initiatives, such as increased research and development, targeted investments, stronger intellectual property rights, and harnessing trade's productivity-enhancing potential, are all essential parts of lifting living standards in the long run. But to ensure living standards are rising for all, a dynamic open economy depends on a robust social infrastructure. Education improvements described in Chapter 8 are crucial to creating a well-trained labor force able to thrive in a flexible economy where innovation and trade may reshape industries over time. A sound health care system is needed to provide the certainty that changing jobs will not mean a loss of health services. And a productive, well-regulated financial system is essential to allocate capital to growing sectors. Thus, the initiatives being taken today as part of the Administration's rescue-and-rebuild programs are not meant only to correct the problems of today, but to set the stage for strong growth over decades to come.

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