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THE RACE TO THE TOP

Global economic growth depends on technological innovation catalyzed by appropriate national policies. But these are being neglected by the United States and other affluent nations—risking not only their own economies but global well-being.

Since 1990, nations of the Group of Seven, comprising the world's largest industrialized economies, have all shown declining rates of economic growth. Over the same period, growth in many developing countries has been extremely fast, especially among a group of rapidly industrializing countries (the so-called I6) that includes China, India, Indonesia, Poland, South Korea, and Thailand. One consequence of these two trends is that the G7's share of the world's gross domestic product—the total value of goods and services produced—has fallen from two-thirds in 1990 to half today.

Neoclassical economists, who since the 1960s have dominated economic policy debates in the G7 countries, make no connection between these two sets of figures, describing the slowing growth of the G7 countries as a "productivity puzzle." It is difficult, however, if one understands how market economies work, not to make a connection between the decline of the G7's rate of economic growth and the rise of the I6 countries, and not see that the decline involved a loss of competitive advantage by the G7 countries in the face of the rapid rate of innovation of the I6 countries.

For the United States, one element of this loss of competitive advantage is reflected in the balance of trade of advanced technology goods, which has been in decline for decades and turned negative in 2002. Another element is change in the labor market. On the one hand, since 1990, prior to COVID-19 the United

States had seen a net increase of 27.3 million jobs. But almost all these new jobs (26.7 million) were created in the low-value-added service, or nontradeable, sector, including 6.3 million jobs in health care and 4.1 million jobs in government service. Meanwhile, aggregate employment growth in the manufacturing and high-value-added service, or tradeable, sectors was essentially flat, as some industries grew and others declined.

The different employment growth rates of the tradeable and nontradeable sectors are especially significant because the value-added per person in the two sectors is very different. The value-added per person of a firm is the selling price of the products produced per person less the total material purchases used. It is an important measure of the performance of a firm because the value-added per capita of a firm is the money that is available to pay the wages and salaries of employees and the dividends of shareholders.

In 1990, the per capita value-added in the tradeable sector was almost $80,000—roughly $10,000, or nearly 15%, above the service sector. By 2008, the value-added per capita in the tradeable sector had risen to over 50% above that of the nontradeable sector. In other words, the value-added per capita in the United States over this period was held back because firms in the economy created many low-value-added jobs while creating only a few more high-value-added ones.

The United Kingdom's economy over the period 1999–2015 shows a very similar picture, with manufacturing gradually becoming a smaller part of the economy and low-value-added services becoming a larger part. And because in 2016 the value-added of manufacturing was £49 (roughly $66) per hour and that of low-value-added services was £23 (roughly $33) per hour, the impact of this shift on the UK's economic rate of growth was very considerable.

Why isn't this obvious?

Why is it that neoclassical economists have failed to see the impact that foreign competition has had on the economic growth of the United States and the United Kingdom? I think the answer is that at the center of neoclassical economic growth theory is still the assumption that the market economy is one of perfect competition, in which every firm is selling the same product—whether a computer, or an hour of legal services—at the same price as its competitors. This is a completely unrealistic view of the world, as can be seen by a quick trip to any shopping center or car showroom. In the real world, firms compete by trying to gain a competitive advantage over their rivals, as this enables them to grow and increase their value-added per capita.

The essential question then that economic growth theory raises is how do firms gain a competitive advantage over their rivals? There are two major ways. They can reduce the cost of their product or service through innovations in their production methods, or use innovation to make their products more attractive to their customers by better meeting their needs through enhanced performance, more functionality, or improved design.

Henry Ford's development of the production line is an example of using innovation to increase production efficiency, and Steve Jobs's development of the Apple iPhone is an example of using innovation to create competitive advantage. Innovation is the engine of economic growth.

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The ability of firms to innovate in turn depends on their capability to take advantage of market opportunities created by new technologies, new customer demands, or both. This will vary between sectors, which is why understanding the growth performance of a country requires looking at what is happening in its different sectors. The reason it varies between sectors is not difficult to explain, and depends on the ease with which competitive advantage can be created and appropriated, and production efficiency increased, in different sectors. In manufacturing, there have historically been many windows of opportunity that enabled firms to use their technological and organizational capabilities to create and appropriate competitive advantages.

This has not been the case in agriculture. And only a few service areas, such as financial and professional services and information technology, have experienced windows of opportunity that have enabled firms to create competitive advantages through use of high-level skills and the spillover of knowledge in clusters.

It is also important to understand that in the world economy there is a ladder of economic development,

whose rungs represent products that require increasing amounts of organizational and technological capability, and which produce increasing amounts of value-added per capita due to fewer companies being able to produce them. It is a ladder that developing countries have to climb by increasing their organizational and technological capabilities. No country tries to start growing by creating a pharmaceutical industry, and no country has ever achieved a high GDP per capita by having a cheap garment industry, although that is often a good early step on the ladder.

With a narrow view of national competitive advantage involving only input costs and economies of scale, it is very easy for policy debates to degenerate into an "us versus them" conflict. However, it is clear that a broader set of forces is at work, and if developed countries can rapidly innovate, create new high-value-added products and services, while ceding lower-value-added products and services to developing countries, allowing them to move up the ladder of economic development, then all countries can increase their national standards of living. If the pie is bigger everyone can have a larger slice, and the "race to the top" enables a country to climb out of a zero-sum confrontation with other countries at a similar stage of development.

It is therefore important that countries avoid thinking that the best way to compete is by reducing the wages of their labor force or engineering a favorable exchange rate to achieve competitiveness, but instead understand that the way to achieve economic growth is by developing products and services that command premium prices in international markets and can, therefore, support high wages.

Among leaders of G7 nations, American politicians seem especially susceptible to arguments by neoclassical economists that even if the cause of a nation's slow rate of economic growth is a loss of competitive advantage, there is nothing that governments can do about it. But history shows that governments can play a constructive role if they understand that their job is to help firms develop their capabilities, rather than to direct their strategies. And if we analyze the institutional failures that have led American firms to lose competitive advantage in world markets, we can see plenty of opportunities for the government to help firms improve their capabilities and grow faster.

Loss of competitive advantage

As in the United Kingdom, American firms have seen their ability to innovate and gain competitive advantage in world markets eroded by three major institutional failures: in its education and training system, in its national system of innovation, and in the financing and corporate governance system of its firms. These are failures that the government for political and ideological reasons has not been able to correct.

Looking first at the education and training system, US skill levels are being equaled or exceeded by other countries. At all levels, the educational system appears to be performing badly. The school system is outdated, having remained largely unchanged from its origins in an agricultural economy. A vestige of the former agricultural society is the length of the school year, with American students in primary and secondary education averaging 180 days, compared with 190–210 in Europe and 240 days in Japan.

Performance is also poor compared with other countries. The International Student Assessment program ranks the United States 24th out of 29 industrial nations in math literacy and problem-solving. In fact, the study shows that a large number of US high school students can barely do math at all.

Turning to the university sector, in one generation the United States fell from first to ninth in terms of the proportion of its young people with graduate degrees, and now ranks 12th among all nations. The United States also ranks just 27th among developed nations in terms of the proportion of college students receiving undergraduate degrees in science or engineering.

By comparison, in the United Kingdom the number of students who, as a percentage of their cohort, get a science degree is reasonably high measured against other countries. However, a lower percentage of students than is desirable from a competitiveness point of view take an engineering degree and go into industry.

Throughout the Cold War, the United States was able to make up for its shortage of science and engineering degrees by attracting students from Europe and Asia. Today, however, globalization and the associated technological convergence is reducing the nation's ability to supply the manpower needs of its high-tech industry in this way. National Science Foundation data show both lower enrollment by foreign students in US universities, and higher repatriation rates after students complete their education. The rise in the number of research universities in other countries is substantially reducing the number of foreign students coming to the United States to study, while degrees awarded to US citizens are certainly not taking up the slack.

Looking now at the funding of research and development, US levels still appear enviable, accounting for slightly less than one-third of the world's R&D total of $1 trillion. However, if one looks at R&D intensity (the ratio of R&D to GDP), a different picture emerges. R&D intensity is important because the current output of goods and services is driven by past R&D, and therefore current

R&D spending relative to the size of the economy is a driver of future economic growth.

Examining the R&D intensity of the US economy over recent decades, a clear pattern emerges. Following President Kennedy's famous 1961 speech calling for greater investment in science and technology in response to the Russian launch of Sputnik in 1957, and the flight of the first human in space in 1961, R&D intensity reached a peak of 2.83% during 1963–67. However, this increased emphasis on science and technology petered out in the 1970s, and national R&D intensity declined steadily to an average of 2.15% for the period 1975–79.

The 1980s brought a more pervasive and market-oriented threat from Japan in the form of electronics, optoelectronics, advance materials (ceramics), and advanced manufacturing (robotics). This second shock led to sustained higher growth rates in R&D spending by industry, and raised national R&D intensity close to its 1960's peak. Today, however, highly innovative countries such as Israel, Sweden, and Finland have higher ratios than the United States.

Not so exceptional

Two other aspects of US investment in R&D should be noted. First, as a result of the rising technological capabilities of other economies, a steadily increasing amount of US firms' R&D has been offshored. R&D spending by majority-owned foreign affiliates of US multinational companies grew 50% faster (9.98% average annual rate) than that of their US parents (6.3%).

There are two reasons for investing in R&D overseas. The first is to support local market strategies, and the second is to acquire technical knowledge. These two strategies have been described as "market seeking" and "asset seeking," and there is evidence it is the second strategy that has motivated American firms.

This should be of great concern to US policy-makers, as it suggests that the country's firms are faced by an increasingly attractive environment for conducting research abroad, as well as difficulty in recruiting qualified staff. Also, if American companies outsource not only manufacturing but also R&D to foreign countries, it seems very likely that new world-beating products will in future be designed in those countries.

The second important aspect to note is the government's declining R&D support of major programs for generic technologies. A generic technology is one that has the potential to be applied to a variety of applications across many industries (such as jet engines), and its importance stems from the fact that it acts as the bridge between basic science and the considerable private-sector investment in technology development necessary to spawn innovative products. Underinvestment in generic technology is also a major barrier to the emergence of radical new technologies because of the high risk faced by the private sector in this phase of the R&D cycle.

Evidence of the importance of government investment in generic technology is in your pocket. When the economist Mariana Mazzucato analyzed 12 key technologies that enable the iPhone to work, she found that the development of every one of them had been supported in significant ways by governments, often the American government.

As further evidence, the US government during the 1950s, 1960s, and 1970s funded major programs of generic R&D by the Defense Advanced Research Projects Agency that were instrumental in advancing computer technology, including the internet, and by the National Institutes of Health in the 1970s to develop generic technologies that resulted in the creation of the biotechnology industry. But in recent years the government has not supported generic technologies as strongly—and this is believed to have had an impact on the competitiveness of US firms in global markets. Yet US policy-makers have developed an allergy to supporting generic technologies, focusing increased R&D investments in recent years mostly on basic research at the National Institutes of Health and the National Science Foundations.

The third institutional failure leading to an erosion of the ability of US firms to innovate and move into new higher-valued technological sectors is the increasingly short-term horizons of the nation's financial institutions. This has forced firms to concentrate on short-term profits and financial engineering. As a result, profits have gone disproportionately into dividend payments and share buybacks, rather than into investment. In the case of manufacturers, the ratio of dividends paid to the amount invested in capital equipment increased from 20% in the late 1970s and early 1980s to 40% to 50% in the early 1990s and about 60% in the 2000s.

The increase in share buybacks has also been enormous. The economist William Lazonick has shown that of the companies in the S&P 500 Index that were publicly listed from 2003 through 2012, 449 of them used 54% of their earnings (a total of $2.4 trillion) to buy back their own stock. Dividends absorbed an additional 37% of their earnings, leaving very little to invest in research, advanced equipment, training, or other contributors to innovative capability.

But instead of focusing on these three institutional failures, the US government, believing that all that was necessary for economic growth was market efficiency, placed excessive reliance on business cycle management (monetary and fiscal stimulus) and on removing trade barriers. But even if demand is stimulated and all trade barriers are removed, an economy still has to develop

competitive products and services to grow incomes over time.

As a result of these institutional failures, the United States has seen an erosion of its competitive advantages in world markets, and it is this erosion that lies behind its slow economic growth rate.

The United States continues to lead the world in many strategic areas of innovation, notably software, biosciences, social media, and most computer chip technology. In some others, such as aerospace and satellites, the nation now shares the lead with Europe and Asia. In many other areas, however, including robotics, flat-panel displays, lithium-ion batteries, nuclear power, high-speed trains, and memory chips, the United States has given up the chase. The United Kingdom today leads in very few areas of manufacturing.

Wasted energy

The lessons of America's failure to focus government investment on generic technologies are especially apparent in the clean energy sector, and policy-makers should take note. Clean energy was probably the country's best chance of getting a slice of the biggest twenty-first century, high-tech manufacturing growth area.

In the mid-1990s, the United States accounted for the bulk of global solar panel production, as well as for most of the world demand, principally from California. But the nation threw away a huge first-mover advantage by not providing industry, as other countries did as part of their climate change policies, with subsidies up to the point where economies of scale and innovation enable clean energy technologies to compete commercially with other sources of energy. As one consequence, the US share of both global photovoltaic production and capacity has plummeted to below 10%. The United States has gone from being the big fish in a small pond to a small fish in a growing lake. The Silicon Valley-style clusters of the future are instead emerging in places such as "Electricity Valley" in Baoding, China, and around Seoul as part of South Korea's "Green New Deal," rather than in California.

Neoclassical economists in the United States condemn government efforts to catalyze innovation through government policies as so-called industrial policies that "pick winners and losers," and claim such efforts have repeatedly failed. But it is important to distinguish between the Soviet-style attempts of economic planning that have universally failed, and strategic efforts by many countries—including the United States—to intervene appropriately in support of innovation. Indeed, economists of innovation, though often ignored by the larger, neoclassical arm of the discipline, have shown repeatedly that such interventions, when well-designed, are essential contributors to productivity enhancement and economic growth. It should also be pointed out that it makes no sense for the United States to argue that all government support for industry fails, and then to say that the Chinese government's support for industry must be stopped as it gives their industry an unfair advantage.

The key challenge is, of course, to define precisely what sort of role the government should play. In making this choice, it is useful to think in terms of the continuum proposed by Robert D. Atkinson and Stephen J. Ezell in their book, *Innovation Economics*. The continuum runs from the political right to the political left, in the form of (starting on the right): leave it principally to the market; support necessary inputs, such as science and skills; support key broad industries and technologies; and pick specific firms, technologies, and products. Only this last category is equivalent to what neoclassical economists describe as industrial strategy.

Instead of focusing on institutional failures, the US government placed excessive reliance on business cycle management (monetary and fiscal stimulus) and on removing trade barriers.

No country that has gone from poverty to wealth has done it through market forces alone. At the other end of the spectrum, most economists who have studied national economic growth policies would agree that countries that have depended on picking specific firms, technologies, or products have not been successful. Picking products that are likely to be commercially successful, or picking companies that are going to be profitable, requires deep insights into market dynamics, competitive conditions, and customer needs. These are capabilities that even the best civil servants do not have. And once such decisions are in the hands of government, they become subject to the distortions of the political process, including pressures from special interest groups and political constituencies.

When, however, governments have supported the necessary inputs for innovation as well as key broad industries and technologies, they have generally been successful. For those who doubt this point, a brief survey of the work of innovation economists such as Richard Nelson, Nathan Rosenberg, and Vernon Ruttan will convince

them that most of the technologies at the heart of modern economies got there with strong support from government policies.

We live in a world of opportunity and danger. Many windows of opportunity are being opened up by advances in science and technology, and this means countries with firms that have the capabilities to take advantage of them will be able to innovate, raise their level of competitive advantage, and increase their rates of growth.

Coming to you soon ...

There are some economists who believe that the slowing of economic growth in the G7 countries is due to a lack of opportunities to innovate. This is clearly wrong. The world of work is going to be transformed by artificial intelligence and robotics. In transport, we have electric and autonomous vehicles and drones. In energy, we have solar and wind power, and potentially in the long-term, fusion. In agriculture, we have a huge revolution starting to take place with genetically modified crops. In health, regenerative medicine and treatments modified to take account of individual genomes will have an impact, and there is a real possibility that the growing understanding of neuroscience will bring about major changes in the treatment of psychiatric disorders. And major advances in new materials will have an impact on many industries.

We should also remember that many past advances came as complete surprises. The existence of cars, spaceships, and robots were widely predicted, but few people foresaw the arrival of genetic modification, nanotechnology, lasers, superconductors, nuclear energy, or solid-state electronics. Nor did anyone foresee how smartphones would rapidly transform entire swaths of national economies. No one knows what the transistor or smartphone of the future will be, but if the United States, the United Kingdom, and other already affluent nations base their strategies for the future on our limited imaginations, others will not be so foolish.

Policy-makers in the G7 countries must understand that innovation is the engine of economic growth, and that governments can play a key role in fueling and tuning that engine. If they fail to do so, they face the very real possibility that, as a result of the growing competition from countries such as China, India, South Korea, and Taiwan, they will see their nations' standards of living fall, bringing with it anger, despair, and a continued expansion of populism. But if nations are prepared to teach their citizens new skills, speed up their rate of innovation, and produce new high-value-added products and services for world markets, they have a chance to continue to raise their standards of living, and with it, ensure a stable foundation for a democratic society and an increasingly affluent world.

In looking at the economic growth performance of countries, we should always remember that it is the performance of firms that delivers economic growth. However, neoclassical economics does not provide the necessary guidance for policy-makers seeking to catalyze such growth. In the United States and the United Kingdom, as well as in the other G7 countries, governments need to do a better job of providing the R&D resources, the skilled labor, and the necessary industrial infrastructure if they are to grow their economies in a fiercely competitive global economy.

Equally, policy-makers in these countries have to find a way of remunerating the managers of their firms so that they are incentivized to compete over the long haul. If they are rewarded only for short-term movements in the share prices of their companies, it should not be surprising if they spend time manipulating those share prices with share buybacks, rather than making long-term investments in research and innovation.

In today's world of rapid technological advance, the global race for innovation advantage is one that all nations can potentially win, with higher per capita incomes, better products and services, and a major reduction in world poverty. Today's potentially catastrophic problems of hunger, disease, and environmental degradation can also be effectively tackled. But to succeed, we need to be clear about the choices we face, because they are vitally important ones, and the quality of life enjoyed by our children and future generations will depend on the decisions we make.

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Recommended reading

Robert D. Atkinson and Stephen J. Ezell, *Innovation Economics: The Race for Global Advantage* (New Haven, CT: Yale University Press, 2012).

William Lazonick, "Profits Without Prosperity," *Harvard Business Review* (Sept. 2014).

Mariana Mazzucato, *The Entrepreneurial State* (London, UK: Anthem Press, 2013).

Michael Spence and Sandile Hlatshwayo, "The Evolving Structure of the American Economy and the Employment Challenge," Working Paper, Council on Foreign Relations (Mar. 2011).