

## Review Essay

# How to Boost the Payoff from Innovation While Shrinking its Destructive Side Effects

The Power of Creative Destruction: Economic Upheaval and the Wealth of Nations. *By Philippe Aghion, Céline Antonin, and Simon Bunel.* Translated by Jodie Cohen-Tanugi. Cambridge, MA: Harvard University Press, 2021. 400 pp. Illustrations, tables, notes, index. Hardcover, \$35.00. ISBN: 978-0-674-97116-5.

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Reviewed by Robert J. Gordon

Gather a group of economists together and ask what most concerns them, and a wide variety of topics would soon emerge: slowing economic growth in the rich nations, the inability of many poor nations to converge toward the rich, rising income and wealth inequality, the increasing dominance of superstar firms, growing profit margins and the decline in labor's income share, globalization and the human costs of outsourcing, deaths of despair, and the threat of climate change. Decade after decade, numerous books have been written about each of these issues. But here we have in one compact package a blockbuster book that deals with *all of them*.

The central concept of creative destruction, the glue that links the topics together, was originally developed by the famous Austrian economist Joseph Schumpeter in his classic 1942 book, *Capitalism, Socialism, and Democracy*. For him the driving engine of economic growth is the creative innovation of new products and methods of production, but as each new innovation emerges from its predecessors it causes the destruction of the previous cohort of firms and the unemployment of their workers. Rather than viewing this as a fruitful process that would inexorably improve living standards, Schumpeter pessimistically predicted that large monopolistic conglomerates determined to protect profits from their own previous inventions would push aside new entrepreneurs and strangle the growth process in a web of bureaucracy and special interests, leading to the demise of capitalism.

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But the engine of innovation did not grind to a halt, as the triumphs of Apple, Amazon, Google, Microsoft, and the rest remind us every day. Indeed, what is striking is the historical continuity of the dualism between innovation and creative destruction, dating back to the Luddites of early nineteenth-century England, who destroyed textile machinery in protest at the threat to their jobs as manual weavers. As innovations emerged, makers of kerosene and whale oil lamps were put out of business by Edison's electric light, stable owners and blacksmiths by Henry Ford's Model T, milk deliverymen by refrigerators, elevator and telephone operators by automation, typewriter makers by the personal computer, and more recently Blockbuster by Netflix, the Blackberry by Apple's iPhone, and book encyclopedias by Wikipedia.

As interpreted by Philippe Aghion, Céline Antonin, and Simon Bunel in this pathbreaking book, the dualism of innovation and creative destruction emerges from the limitations of Robert Solow's seminal theory of economic growth.<sup>1</sup> Solow showed that a model of capital accumulation could not by itself generate sustained growth. Without technical change that steadily improves the quality and productivity of machines, capital accumulation would simply amount to—in the words of Evsey Domar, another growth pioneer—"wooden ploughs piled up on the top of existing wooden ploughs."<sup>2</sup>

For this reason Solow recognized that steady technical change was essential to the growth process and indeed in a sequel article credited technical change instead of investment as responsible for 88 percent of U.S. output per hour growth in the first half of the twentieth century.<sup>3</sup> But Solow's model did not explain technical change; rather, it was like "manna from heaven," freely available to all including the richest and the poorest countries. If technical change is there for the taking, Solow's model predicted steady convergence of the poorest countries to the level of the richest. Indeed, the only handicap holding back poor countries was that for some reason they were late to the process of accumulating capital. The Solow model fails to explain not only nonconvergence of poor countries but also why there was stagnation in the advanced countries in the millennium before 1800, followed by a post-1800 growth takeoff that in the two subsequent centuries propelled the standard of living to soar by a large multiple.

<sup>1</sup> Robert M. Solow, "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics* 70, no. 1 (1956): 65–94.

<sup>2</sup> Evsey D. Domar, "On the Measurement of Technological Change," *Economic Journal* 71, no. 284 (1961): P. 712.

<sup>3</sup> Robert M. Solow, "Technical Change and the Aggregate Production Function," *Review of Economics and Statistics* 39, no. 3 (1957): 312–20.

Clearly it was unsatisfactory to treat technical change as an exogenous unexplained process, and so a generation of growth economists including Nobel winners William Nordhaus and Robert Lucas built models that made technical change endogenous. It was Paul Romer, another Nobel winner and a student of Lucas, who in a classic article made the creation of ideas the centerpiece of growth theory.<sup>4</sup> For Romer, innovations are the result of purposeful activity by inventors who respond to economic incentives. One of his key contributions is that ideas are nonrival—that is, once developed, ideas can be used and developed by many people at once, leading to the conclusion that the growth process depends on the total stock of ideas rather than the number of ideas per capita. Growth is characterized by increasing returns and depends on the stock of workers engaged in creating ideas, i.e., research and development (R&D). The private economy tends to underprovide new ideas owing to the monopoly power acquired by innovators, requiring countervailing government intervention to break up monopolies. The “nonrivalness” of ideas also means that private firms underprovide new ideas because of the externality that they cannot capture all the benefits created by those ideas, suggesting the need for government subsidies of idea creation.

*The Power of Creative Destruction* shares with Romer the central ideas that growth depends on research input and that for inventors to engage in the process of innovation, they must be attracted by the lure of rewards, which the authors call “innovation rents.” For these rents to be a credible incentive, the state must protect intellectual property rights and maintain strong pro-growth institutions to prevent the underprovision of new ideas. The paradigm of creative destruction, in which the steady arrival of new innovations replaces old innovations, leads to a central dilemma of how to prevent incumbent firms from using their rents to stifle the creation of new innovations by entering entrepreneurs. While Schumpeter predicted that the incumbents would obstruct new entry, Aghion, Antonin, and Bunel rely on the tools of government intervention to avoid this outcome, including antitrust regulation, innovation subsidies, and social insurance policies to mitigate the adverse effects of creative destruction. For instance, faced with the intransigent resistance and lobbying by firms producing fossil fuels to block the entry of innovative wind and power entrants, the government should tax carbon, subsidize renewable energy, and provide unemployment benefits and job training for workers displaced from the fossil fuel industry.

<sup>4</sup> Paul M. Romer, “Endogenous Technological Change,” *Journal of Political Economy* 98, no. 5, pt. 2 (1990): S71–S102.

The book weaves a rich tapestry of empirical evidence and in part can be viewed as a handy and concise guide to the enormous output of research by Aghion and his many coauthors over the last two decades. They document a Darwinian struggle for survival of newly entering young firms, which create jobs at a higher rate than established firms but are more likely to fail while still young. The surviving young firms account for a substantial share of innovation and, if they survive, grow at a faster rate than incumbents. But the authors warn that it is misleading to attribute all innovation to new firms. Indeed, they criticize the original Schumpeterian paradigm, which assumed unrealistically that all innovation is created by new firms that, by competing with one another, drive down the rents from innovation, thus stifling the process of innovation. Instead, the authors here present evidence that competition stimulates innovation and raises productivity growth.

The authors reconcile this conflict about the effect of competition on innovation by introducing a more nuanced interpretation of the growth process of incumbent firms, which are composed of two types, “leading” and “laggard.” Leading firms are near the technological frontier and make substantial profits, while laggards have lower productivity and slim, if any, profits. If competition is initially weak, new innovative entrants drive leading firms to invest more in innovation to maintain their profits and stay ahead, while laggards are discouraged and fall further behind. If competition is initially intense, however, more entry will drive down profits even for the leading firms and reduce their incentive to innovate.

The authors conclude that there is an inverted-U-shaped relationship between competition and innovation, with either too little or too much competition leading to less innovation than a moderate middle ground. They cite evidence that rising U.S. profit margins in the last decade do not provide evidence of diminishing competition but result from a composition effect in the form of a rising market share of firms (like Apple and Google) that already are making high profits. This framework leaves the reader somewhat puzzled about the continued survival of laggard firms. Could it be that the laggards are misclassified as being in the same industry group as the leaders, whereas they actually reside in different industry subgroups, such as the one-owner corner convenience store coexisting with large nationwide retail chains like Walmart?

What are the policy implications of this subtle interpretation of the interplay between competition and innovation? The authors consider the case of intellectual property (IP) protection, like patents, and criticize the view that it conflicts with competition. Their paradigm of leading incumbent firms struggling to stay ahead of competitors implies that both the “carrot” of IP protection and the “stick” of competition spur

innovation. A successful economy combines rent-raising IP protection with regulations such as active antitrust policy to prevent innovation rents from stifling competition. And that antitrust policy should be reoriented from a focus on market shares to, as an alternative criterion, weighing the effects of mergers on the entry of small firms and their ability to innovate.

Aghion, Antonin, and Bunel cite evidence that the formation of the European single market increased competition across national borders and raised innovation more in countries that already had strong IP protection. But they could have gone further by providing more of a comparison of the relationship between innovation and competition in Europe, in light of the near disappearance of European firms from the international league table of market capitalization. In this context they do not remark on the puzzle that productivity growth in Europe continued to slow during the period from 1995 to 2005, when the United States enjoyed a doubling of productivity growth usually attributed to information technology (IT) investment. Their discussion of innovation in Europe is limited to the inability of French firms to grow beyond a certain size as a result of labor market regulations and a lack of finance.

The authors are right to move beyond the Schumpeterian paradigm that all innovation is done by newly entering firms and to emphasize competition among incumbent firms. The Ford Motor Company is still the same corporate entity that developed Henry Ford's first Model T in 1908 and his Highland Park assembly line in 1913. For more than a century it has competed with General Motors, and its ever-evolving machines incorporate a steady stream of innovations that over the decades, through creative destruction, have led to the replacement of thousands of workers. At the forefront of modern technology the Apple and Microsoft corporations are forty-five and forty-six years old, respectively—hardly new entrants. Indeed, Peter Klenow and Huiyu Li have shown that 60 percent of innovation takes the form of incumbent firms improving existing products (like Ford's vehicles), 27 percent the form of incumbents introducing new varieties (like the Apple Watch), and only 13 percent from creative destruction.<sup>5</sup>

Innovation by new entrants does not happen without a source of finance. The authors trace out a chain of finance as it works in the United States, starting with venture capital, which is an important source of funding for young innovative firms. Venture capitalists take an equity interest in the firms and have veto power over decisions in order to reduce the risks inherent in the early stages of development.

<sup>5</sup> Peter J. Klenow and Huiyu Li, "Innovative Growth Accounting," *NBER Macroeconomics Annual* 35 (2020): 245–95.

As firms grow they sell shares to the public, most of which are purchased by institutional investors. The state has a role both in funding basic research in universities and in subsidizing R&D funding in private firms, but it is important that R&D support be based on the intensity of the research effort, measured by the ratio of R&D expenses to sales, rather than to favor large firms.

Notably missing in this account is the role of bank loans in the innovation process and their greater importance in Europe than in the United States. In fact, most of the discussion of innovation and competition relies on empirical evidence from the United States, and there is little analysis by these French authors of what has gone wrong with the innovation machine in Europe. The authors note the near absence of venture capital in France and the small role of institutional pension funds as investors in private firms, with U.S. pension fund assets of 145 percent of gross domestic product (GDP) versus 10 percent in France. But the reader looks in vain for an explanation of why the market capitalization of the four top U.S. technology firms (about \$8 trillion) is greater than the entire market capitalization (\$7.5 trillion) of the Euro-wide Euronext stock market. Is the increase in markups and profit margins in the United States matched in Europe, or is the United States an international outlier? The exposition could have been strengthened by transatlantic comparisons of individual firms in the same industry, such as Carrefour versus Walmart or Ford versus BMW.

The broad horizons of the authors' topic coverage extend well beyond innovation at the level of the individual firm, as they turn to two perennial questions about the economic growth of nations. First, what accounted for the growth takeoff initiated by the first Industrial Revolution of the late eighteenth century after more than a millennium of economic stagnation? Second, what accounts for the failure of so many poor nations to converge to the per capita income level of the rich countries?

The authors document the absence of growth prior to 1800, which Thomas Malthus diagnosed as the result of what they call the "Malthusian trap." Because land was a fixed factor, any increase in the population would cause output per person to decline to subsistence level. Whenever positive technical change did occur through inventions or an increase in trade, the population would increase through some combination of increased fertility and decreased mortality. The combination of these two factors—the stimulus of technical change to population growth and the effect of that population growth in reducing per capita income back to subsistence level—prevented any durable increase in per capita income. In a marvelous collection of charts the authors show that before 1800, intervals of economic growth were always followed by

periods of economic decline, leaving the standard of living in 1800 little higher than it had been one thousand years earlier. The late eighteenth century brought the first Industrial Revolution, as a result of which capital began to accumulate and technological change began to increase the quality of capital, allowing production of both food and other commodities to escape from the Malthusian trap. But generations of authors have disagreed about why the Industrial Revolution happened when and where it did.

Aghion, Antonin, and Bunel favor Joel Mokyr's explanation, which blends a subtle mix of historical and institutional factors that explain how practical and theoretical knowledge came together to make sustained and cumulative innovation possible.<sup>6</sup> These include the increasing diffusion of knowledge made possible in part by the falling cost of printing and the emergence of regular postal service; competition among European nations to innovate despite the effects of creative destruction that might otherwise have caused a stifling of innovation by vested interests; and, crucially, the protection of property rights that rewarded technological pioneers with innovation rents. That the United Kingdom took the lead over France is attributed to its earlier evolution of property rights and patents and its unique supply of artisans and engineers as masters trained apprentices, while China's continued stagnation in the nineteenth century after an earlier phase of pre-1700 invention is ascribed to the ongoing economic and political power of incumbents that stifled innovation (as happened even earlier in Venice).

From today's perspective, the first growth puzzle of the origins of the first Industrial Revolution pales in importance compared with the second puzzle: the reasons for differences in growth rates across countries and the failure of poor countries to converge to the output per capita level of rich countries. The continuing gigantic gap in living standards between rich and poor nations has been called the most important topic in economics. Robert Lucas once famously wrote that "the consequences for human welfare of questions like these are simply staggering: once one starts thinking about them, it is hard to think about anything else."<sup>7</sup>

The most compact illustration of the basic facts is the "convergence diagram," which in Aghion, Antonin, and Bunel's version plots each nation's 1960 level of per capita income on the horizontal axis (indexed to the U.S. as 100) and the nation's per capita growth rate from 1961 to 2017 on the vertical axis. Because per capita income in

<sup>6</sup> Joel Mokyr, *The Culture of Growth: The Origins of the Modern Economy* (Princeton, 2016).

<sup>7</sup> Robert E. Lucas Jr., "On the Mechanics of Economic Development," *Journal of Monetary Economics* 22, no. 1 (1988): P. 5.

the United States grew at 2 percent over that interval, a nation that was poor in 1960 and grew at a rate higher than 2 percent is plotted in the northwest corner of the diagram and has experienced convergence toward the U.S. level, whereas those plotted in the southwest corner have experienced divergence in which their per capita income level fell further behind that of the United States. Thus, what must be explained is not a uniform experience of convergence or divergence but why roughly half the nations converged, including all nations in Asia, whereas the other half diverged, including most in Africa and the Middle East and some in Latin America. In fact, five nations, all in Africa, actually experienced negative growth in per capita income between 1960 and 2017.

As we have seen, the Solow model with its diminishing returns to capital accumulation predicts that the rate of return to capital should be higher in poor countries and thus capital should flow from rich to poor. Instead, it flows from poor to rich, a fact sometimes called the “Lucas paradox.” This is no puzzle for Aghion, Antonin, and Bunel, who place innovation at the heart of the growth process and ask what prevents the poor nations from sharing the same level of technology as the rich nations. They ponder the reasons why poor nations cannot simply imitate the advanced rich-nation technologies, which would imply that the poorest nations the furthest from the technological frontier would have the greatest opportunity for rapid growth. Consistent with their Schumpeterian theory, they argue that copying innovation is costly and requires the reward of innovation rents, which must be protected by property rights. Thus, nations that remain poor are those with corruption and weak property rights protection, a list of handicaps that for some nations includes dictatorship and civil war.

Further policies needed for successful growth by imitation are the encouragement of technological transfers, the reallocation of resources, and the development of management skills. A central ingredient in China’s rapid catch-up growth has been its encouragement of foreign investment, where Chinese authorities have uniquely forced foreign firms upon arrival to share cutting-edge technology. While in recent decades India has begun to grow rapidly, its growth achievement remains well behind China’s, with GDP per capita growth of 3.6 percent between 1980 and 1999 and 5.6 percent between 2000 and 2019, far short of China’s growth path of 8.5 percent for both of these two-decade intervals.<sup>8</sup> India suffers from too many small firms that are controlled by family members instead of by professional managers,

<sup>8</sup> Conference Board Total Economy Database. <https://www.conference-board.org/data/economydatabase/total-economy-database-productivity>.

which are lacking in part because of inadequate educational attainment. An early investment in education helps to explain successful growth in Asian countries like Japan, South Korea, and China, and the authors point to the contrast between China, where in 2018 79 percent of adults had completed secondary education, and India, where the percentage was only 51 percent. This comparison may understate the educational advantage of China and other Asian countries like South Korea, with their education arms race and frenetic competition among teenagers to pass national qualifying exams with the help of a private tutoring industry.

Special attention is given to the South Korean growth miracle, where 7 percent growth was achieved between 1960 and 1998. The government favored the chaebol financial-industrial conglomerates with import protection, a weak currency, and both credit and export subsidies. Competition from new entrants was prevented by high entry barriers and limitations on investment by foreign firms. Why, then, did Korea not suffer from the Schumpeterian disease in which complacent incumbents stifled innovation? A blessing in disguise was the 1998 Asian financial crisis, during which some chaebols failed and others were weakened while the IMF imposed reforms that opened up the economy to foreign investment and competition. As a result, rapid growth resumed and innovation shifted from imitation to frontier advances; in 2012, South Korea filed 60 percent more patent applications per capita than Germany.

Probing further, the authors note that all of the high-convergence Asian nations made export-oriented manufacturing the heart of their growth strategy, leading them to ask whether industrialization is a necessary ingredient in catch-up growth. They point to the “Kuznets facts” that growing economies transition out of agriculture, first into manufacturing and then into services. This is explained by Engel’s law, that the income elasticity of food is less than that of nonfood goods and services, together with Baumol’s law that services have steadily rising relative prices relative to the falling relative prices of agricultural and manufactured goods because services are relatively labor intensive. Industrialization brings benefits to the entire economy through what the authors call the “technological externalities between industry and other branches of a nation’s economy” (p. 168). Exports also bring income from the outside that raises domestic rents and leads to further innovation, as well as fostering infrastructure investment and the development of financial institutions.

India and Ghana are cited as exceptions, having achieved growth through innovation in the services while bypassing export-oriented manufacturing. But both are poor examples. India’s elitist education system

has left one-fifth of males and one-third of females illiterate. India spends one-third as much of its GDP as China on medical care.<sup>9</sup> China's successful approach to technology transfer contrasts with India's resistance to foreign investment. It is as if India missed out on the whole chunk of GDP that in China is contributed by manufacturing exports, not to mention much less investment in infrastructure. Partially as a result, India's per capita GDP in 2019 was a mere \$7,300 compared to China's \$17,700; throughout history up to 1992, India's per capita GDP was actually greater than that of China.<sup>10</sup> And Ghana, where per capita GDP grew at 6.7 percent per year between 2010 and 2019, is a poor example for the rest of Africa because of its reliance on exports of oil and gold, of which it now exports more than South Africa.

For all of the book's attention to successful growth convergence in Asia, its lack of parallel attention to growth divergence in Africa is a disappointment. The African development failure, with almost all countries falling back in per capita income relative to the United States from 1960 to 2017, is only partly explained by the authors' overall emphasis on the benefits of property rights and the evils of corruption. Is there something special about Africa that inhibits growth? David Bloom and Jeffrey Sachs cite barriers to growth created by both geography and demography.<sup>11</sup> The hot, humid climate lacks a monsoon to provide irrigation and breeds tropical diseases, which deter foreign settlement and investment. Africa lacks deep harbors and many nations are landlocked with relatively few navigable rivers. Transportation costs are high and isolation inhibits innovation. Demography is also an issue because a combination of high fertility rates with improved public health practices have led to rapid population growth and a high ratio of dependent youths, limiting saving and investment. These geographical and demographic factors must be weighed together with deficiencies that are at least in principle amenable to policy changes, such as lack of infrastructure and electricity and, perhaps most important, the combination of dictatorship, civil wars, and fear of expropriation that limits the protection of property rights and deters foreign investment. All these elements must be considered together to explain the failure of most African nations to develop low-wage manufacturing exports as in the Asian model.

Beyond two chapters on the worldwide convergence puzzle, most of the book concerns creation and destruction in the developed countries, where productivity growth has slowed down nearly everywhere. In western Europe, growth of output per hour slowed steadily from

<sup>9</sup> Amartya Sen, "Why India Trails China," *New York Times*, 19 June 2013.

<sup>10</sup> See footnote 8.

<sup>11</sup> David E. Bloom and Jeffrey D. Sachs, "Geography, Demography, and Economic Growth in Africa," *Brookings Papers on Economic Activity*, no. 2 (1998).

nearly 5 percent per year from 1945 to 1975 (a period sometimes called *les trente glorieuses*) to only 0.5 percent per year from 2010 to 2019. The U.S. growth achievement of 2.9 percent productivity growth over the half-century from 1920 to 1970 was followed by three phases: slow growth of 1.5 percent between 1970 and 1995 and 1.1 percent between 2005 and 2019, interrupted by a growth spurt from 1995 to 2005 of 3.0 percent that is usually attributed to the arrival of the Internet and a wave of IT investment. The authors focus on the sources of the post-2005 slowdown in the United States and do not discuss why Europe failed to duplicate the American IT-led productivity revival of 1995 to 2005.

The authors' interpretation of the U.S. slowdown contrasts the optimistic view of Mokyr with the more pessimistic interpretation that I have espoused. Mokyr stresses that the digital revolution has improved the technology of finding new ideas, and that genomics and biological research are achieving breakthroughs like the COVID-19 vaccines, while globalization has increased the rewards of innovation. His optimism is supported by the growth rate of U.S. patents, which has doubled in the last two decades compared with the previous two. My opposing view interprets the innovation process as experiencing diminishing returns. The fifty-year surge of productivity growth ending in 1970 was driven by electricity, the internal combustion engine, and other "great inventions," while the computer revolution created a corresponding boost to productivity growth for only a single decade, from 1995 to 2005. The diminishing returns interpretation is supported in an article by Nicholas Bloom and coauthors that contrasts steady or falling total productivity growth in computer chip, agricultural, and pharmaceutical production despite massive increases in the number of research workers engaged in research and development.<sup>12</sup>

Aghion, Antonin, and Bunel develop a complementary explanation of the productivity slowdown based on their emphasis, introduced above, on leading and laggard firms. In the short run, the productivity revival of the late 1990s can be explained by the role of the IT revolution in reallocating economic activities to more efficient "superstar" producers. However, as time went on these superstar firms discouraged innovation by the laggards, which were forced to reduce prices and thus their innovation rents. This increasingly discouraged the laggards, which represent the vast majority of firms, from innovating.

This is how the authors explain why the IT revolution reduced innovation and growth in the economy after 2005, but I am skeptical. Thomas

<sup>12</sup> Nicholas Bloom, Charles I. Jones, John Van Reenen, and Michael Webb, "Are Ideas Getting Harder to Find?," *American Economic Review* 110, no. 4 (2020): 1104–44.

Philippon has shown that productivity growth slowed for his “star” firms as much as for the nonstars.<sup>13</sup> My current ongoing research shows that U. S. productivity growth from 2010 to 2019 was virtually zero throughout manufacturing, in durable and nondurable industries alike, including many that have no superstar firms. Likewise, superstar firms are lacking in many of the service industries that experienced the slowdown. The authors’ treatment provides no hint about why the U.S. slowdown has been so heterogeneous across industries; if we measure the U.S. productivity growth slowdown from 1996–2004 to 2010–2019 and rank industries by the magnitude of the slowdown, the top quarter of industries experienced a slowdown of -5.1 percent, the next quarter -2.5 percent, the third quartile -1.0 percent, and the bottom quartile experienced an net increase of +0.5 percent. And the absence of any productivity growth in manufacturing between 2010 and 2019 raises a puzzle in light of a doubling of robots over that decade: Why didn’t all those robots displace enough workers to create significantly positive productivity growth?

Even if most innovation is created by incumbents without necessarily involving new entry or the bankruptcy of firms, the process of creative destruction still proceeds in other directions. Much of the richness of *The Power of Creative Destruction* lies in its analysis of the many spillovers of the destruction process that accompanies innovation, particularly rising income inequality, job loss, job insecurity, community decay, and health deterioration. The authors provide a nuanced interpretation of the effects of innovation on income inequality. While innovation raises the income shares of the top cohorts, it also has been shown to increase social mobility between generations. Innovative firms serve as social ladders for unskilled workers to ascend to higher income cohorts than those of their parents. The most innovative U.S. states have been shown to have the greatest top income shares but also the most social mobility, leaving as ambiguous the effect on overall measures of inequality like the Gini coefficient. The effect of innovation is contrasted with that of lobbying, which raises top income shares while reducing social mobility.

The authors ask, “Who are the innovators?” (p. 18). They exhibit a strong J-shaped relationship in which there is little innovation by children of low- and medium-income parents while children of high-income parents have a strong record of innovation as measured by patents. They lament that “we lose potential Einsteins” but in doing so appear to contradict their previous finding that innovation promotes

<sup>13</sup> Germán Gutiérrez and Thomas Philippon, “Fading Stars,” *AEA Papers and Proceedings* 109, no. 5 (2019): 312–16.

social mobility (p. 202). They contrast basic research that is mainly conducted in universities, where researchers trade academic freedom (and often tenure) for lower salaries, with applied research that is mainly carried out in private firms, where research is task driven but salaries are higher. They also find that innovations within these private firms often reward the entrepreneurs who run the firms more than the individuals who create the inventions.

An important source of innovators is immigration of well-educated individuals who have already begun to develop ideas in their native countries. The authors cite evidence for the United States that immigrants have contributed more patents than native-born workers relative to their share of the population, although it takes about a decade after arrival for immigrants to contribute significantly to innovation. This record leads the authors to espouse a substantial loosening of U.S. restrictions on high-skilled immigration (they do not mention that skill-based immigration quotas are already in place in Australia, Canada, and elsewhere).

Innovation does not lead to a net loss of jobs in the long run, at least in the United States, where the unemployment rate was roughly the same in 1948, 1968, 2000, and 2019. Yet, however many jobs are created by the new products, varieties, and industries created by innovation, there is no doubt that job loss in the short run is an inevitable by-product of creative destruction. Job loss has particularly severe consequences in small to medium-sized cities where the closing of a single large plant can have a multiplier effect by causing job termination not only for those previously employed in the plant but also for those working in surrounding service industries. The smaller the city, the less likely there will be alternative available jobs with skill requirements that match the skill sets of the job losers, and the accompanying decline in house prices limits the financial resources available for job losers to move to other, more prosperous cities.

Jobs can disappear not only as a sudden shock when a plant closes but in the form of a steady leakage of jobs when firms replace workers with automation, whether that is more machines of a given type or new types of machines created by innovation. Likewise, jobs have been lost to globalization and outsourcing, to which the authors pay particular attention in the form of the decimation of U.S. manufacturing jobs caused by Chinese imports, particularly during the interval from 2001 to 2007. The authors show that the flood of Chinese imports squeezed domestic profit margins and, by reducing innovation rents, led to a decline in patents granted to U.S. firms during the same (2001 to 2007) period. But as we are taught by the standard theory of free trade, globalization creates both winners and losers, and its role in

opening up export markets increases innovation rents for firms with products that can compete on the world stage.

Just as innovation leads to both job creation and destruction, so it is both good and bad for overall health. Medical and drug innovations have spurred a worldwide convergence of life expectancy that is more rapid than the convergence of per capita incomes. But job destruction can also have negative health consequences, most obviously (at least in the United States) in the loss of employer-financed health insurance. Anne Case and Angus Deaton have highlighted the severe consequences for the “working class aristocracy” that has forfeited not just high-wage employment with health insurance benefits but also status, leading to “deaths of despair” from overdoses of drugs and alcohol, as well as an increased incidence of suicide.<sup>14</sup>

This rise in mortality among American white males with less than a high school education has since 2015 been sufficiently serious to interrupt the historical increase in overall U.S. life expectancy. The authors show that increased mortality did not occur in France and Germany, and they strongly recommend adoption of the Danish “flexicurity” system that encourages firms to adjust their work force flexibly while sheltering job losers by providing generous unemployment compensation and job training assistance.

Throughout the book a fundamental role of the state is to provide property rights to protect the incentives of innovation rents. Beyond that the authors provide a broad range of policy recommendations that they frame as a dualism combining the “investor” role of the state, to stimulate and maintain a high level of innovation, with the state’s “insurer” role, to mitigate and offset the harmful side effects of creative destruction. Their broad view of the investor role encompasses not only R&D subsidies but also government support for public education. They are particular admirers of the U.S. government’s Defense Advanced Research Projects Agency (DARPA)—which is widely credited with the foundational research that created the Internet and satellite navigation through GPS—as a model of public support of innovation.

Assessing the insurer role of the state, the book traces the postwar history of Europe’s welfare state but argues that it is insufficient to offset the harmful effects on workers displaced by creative destruction. The older the victims the less likely they are to reinvent themselves and find a comparable replacement occupation. Also, the welfare state has not been able to prevent a high level of unemployment of young people in several European countries. The authors seem sympathetic

<sup>14</sup> Anne Case and Angus Deaton, *Deaths of Despair and the Future of Capitalism* (Princeton, 2020).

to proposals for a universal basic income to address the side effects of creative destruction, but they do not discuss the fiscal implications of a scheme that is generous enough to make a difference. They place more emphasis on countercyclical macroeconomic policies and, in particular, monetary and fiscal policies to provide funding for firms that face liquidity constraints in recessions that would otherwise force them to cut back on innovation activity.

The investor and insurer roles of the state provide one side of a “golden triangle,” supplemented on the other two sides by the contributions of the free market and civil society. The incentives and reward of innovation are provided by markets, while civil society supervises and influences the power of the state. A democratic constitution is an incomplete contract that requires an independent judiciary to counteract abuses of power by the executive, avoid corruption, and protect innovation rents. Civil society in different countries and regions can influence the effect of government policies and edicts, as in the example of the COVID-19 pandemic where South Korea has experienced only about 2.5 percent of the per capita death rate of the United States and where southern U.S. states with widespread vaccine resistance have suffered from substantially higher death rates than those in the Northeast.<sup>15</sup> Likewise, social pressure can influence how rapidly consumers transition to electric vehicles in the face of their higher prices and anxiety about their limited driving range. The authors’ nuanced vision of the golden triangle of democracy leaves open the enormous achievement of authoritarian China in its sustained four-decade record of 8.5 percent per capita income growth; the book contains too little about China and its challenge to the book’s vision of democratic capitalism.

In their conclusion the authors sound an urgent alarm that increasing inequality, stalled growth, the looming threat of climate change, and the COVID-19 pandemic have “laid bare the deficiencies of our social and economic systems” (p. 312). They search for a middle way between the excesses of laissez-faire capitalism and stifling of the market under state-controlled socialism. They juxtapose the “cutthroat capitalism” of the United States, which combines innovation creativity with high inequality and poverty, against the “cuddly capitalism” of the German and Scandinavian welfare states, where innovation is much lower (p. 314). As throughout the book, they focus on the need for a rapid pace of innovation and the need to prevent “yesterday’s innovators from pulling up the ladder behind themselves” (p. 313). Equally

<sup>15</sup> Comparison of South Korea and U.S. from Johns Hopkins Coronavirus website: <https://coronavirus.jhu.edu/data/mortality>. Comparison of U.S. states from Center for Disease Control website: [https://covid.cdc.gov/covid-data-tracker/#cases\\_deathsper100k](https://covid.cdc.gov/covid-data-tracker/#cases_deathsper100k).

important is the need to mitigate the consequences of creative destruction on displaced workers through enlightened unemployment compensation and job training programs. The book ends with a clarion call for a carefully nuanced set of regulations to avoid the harmful effects of creative destruction on individuals, firms, and the environment while maintaining the pace of innovation. “Capitalism is a spirited horse: it takes off readily, escaping control. But if we hold its reins firmly, it goes where we wish” (p. 318).

Which regulations do the authors endorse? They are clear that climate change requires a carbon tax. But they warn that too excessive a carbon tax rate would impose an excessive share of the green transition on current generations, and they cite the “yellow vest” protest movement in France as an example of political opposition to high fuel taxes. The carbon tax should be combined with subsidies and penalties to redirect innovation toward green technologies. To prevent economic growth in emerging economies from overwhelming the atmosphere with new sources of carbon emissions, they endorse a combination of generous transfers of green technologies from developed to emerging economies, together with “carbon tariffs” on goods imported from nations that fail to control their emissions. They are more ambiguous about globalization and the effects of imports in squeezing the innovation rents of domestic competitors. They point out that tariffs on Chinese imports will push production to countries like Vietnam instead of back to the United States, and they worry that protecting domestic rents with import tariffs will blunt the forces of competition. Better, they say, to subsidize R&D in import-competing industries, but this is hardly a solution given the low-tech nature of many imports, where emerging nations have a massive cost advantage. You cannot beat back imports of patio furniture with R&D subsidies for domestic makers of patio furniture.

Despite its labeling of U.S.-style capitalism as “cutthroat,” the book has too little to say about redistribution in the face of rising income and wealth inequality (p. 314). The main example provided is that of the Swedish tax reforms of the early 1990s, which drastically reduced tax rates on top incomes and on corporations, leading to a surge of innovation. The reader looks in vain for recommendations regarding income and wealth taxes in nations like the United States that are characterized by much more income and wealth inequality than Sweden. Likewise, the authors’ enthusiasm for the Danish flexicurity remedy to the job losses from creative destruction does not recognize that the homogeneity and geographical compactness of Denmark make the reemployment of displaced workers an easier task than for those confronting the skill and locational mismatch of the U.S. job market. It is hard to imagine a set of welfare state reforms that would convert the U.S. consequences of

creative destruction into the benign consequences faced by the average Danish worker.

The book's focus on innovation leads to a remarkably narrow interpretation that attributes rising income inequality at the top in the United States to innovation rents, barriers to entry, and lobbying. Another component of top income inequality rests on the economics of superstars—not just successful innovators but the highly paid victors of the winner-take-all competition in the worlds of sports and entertainment. Since 1980 the pay of corporate CEOs has jumped from thirty times to three hundred times the average worker pay, and this has been fueled partly by a transition to an ethos of maximizing shareholder value that has rewarded executives with a cornucopia of stock options. The income share of the top 1 percent rises and falls with the stock market and has ballooned as the Dow Jones Industrial Average has soared from 1,000 in 1982 to 36,000 today. The book says almost nothing about the role of the U.S. stock market in creating income and wealth inequality and the causes of its long upswing, which include a steady decline in the real long-term interest rate and several rounds of cuts in the corporate income tax.

While top incomes have flourished, the median wage has stagnated over the past four decades, reflecting in part the decline in the real minimum wage, the diminished role of labor unions, and monopsony power of firms that impose restrictions like non-compete clauses on worker flexibility. In short, innovation rents and lobbying explain only a small slice of the overall trajectory of U.S. inequality. This helps to explain a puzzle raised but not answered by the authors: why inequality has continued to increase in the United States since 2005 despite the declining impact of innovation on productivity growth.

Finally, in this book by three distinguished French economists, there is too little discussion of what is wrong with the innovation machine in Europe as a whole. The authors show that between 2010 and 2017 the United States accounted for 72 percent of the top 5 percent of the most-cited patents, while virtually none were contributed by Europe (presumably the rest were in Asia, particularly China and South Korea). The United States and, increasingly, China account for seventy-six of the world's one hundred most valuable firms. The tally for Europe has declined from forty-one in 1990 to a mere fifteen today. The *Economist* created an index of "business activity" based on market capitalization, public-offering proceeds, and venture-capital funding, with the result that the United States accounts for 48 percent, China for 20 percent, and the rest of the world for the remainder.<sup>16</sup> The creation

<sup>16</sup> *Economist*, "Geopolitics and Business," June 5, 2021, P. 11.

of the euro in 1999 was supposed to reduce the isolation of individual European economies and create a more competitive and innovative marketplace. What happened?

These limitations are minor in the context of a magisterial book with something new and imaginative to say on such a wide and important range of topics. The pages sparkle with charts, many pulled from a plethora of important journal articles written by Aghion and his transatlantic set of research coauthors. Textbook-like topic boxes provide background and suggest that the book will find widespread use as supplementary reading in both graduate and undergraduate economics courses. And the book is highly readable, without a single equation, and much praise is due Jodie Cohen-Tanugi for the lively and expert translation.

Robert J. Gordon is the Stanley G. Harris Professor in the Social Sciences at Northwestern University. He is an expert in the causes and consequences of unemployment, inflation, and both the cyclical and long-run behavior of productivity growth. While specializing in U.S. behavior, much of his research has focused on differences between the U.S. and Europe. His most recent book is *The Rise and Fall of American Growth: The U.S. Standard of Living Since the Civil War* (Princeton, 2016).