

Book Review

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THE GIFTS OF ATHENA

Historical Origins of the Knowledge Economy

By Joel Mokyr, Princeton, N.J.
Princeton University Press, 2002

The past decade has seen increasing realization that the U.S. economy is powered not by the old factors of production -- land, labor, and capital -- but by new factors: knowledge and innovation.

This understanding is reflected in the resurgence of interest in economists, such as Joseph Schumpeter, who placed entrepreneurship and research at the center of growth, along with the development of the "new growth economics" that explicitly focuses on the role of knowledge in stimulating growth.

Yet federal policymakers and their neoclassical economics advisers remain largely focused on old economy factors: notably, responding to the business cycle and raising or lowering personal income taxes.

It is in this context that "The Gifts of Athena" is important. In it, historian of technology Joel Mokyr updates his work during the past decade on the role of knowledge in economic growth.

Mokyr is clear about his goal: to determine how "new knowledge helped create modern material culture and the prosperity it has brought about." It is not just all knowledge that he is interested in, however. He specifically focuses on "useful knowledge"; that is, "the equipment we use in our game against nature."

Mokyr differentiates between two types of useful knowledge: what he calls "propositional knowledge," which focuses on how nature works; and "prescriptive knowledge," which focuses on how to use techniques.

The former is not embodied just in science but in all kinds of knowing about how the world works. An example would be the development of the laws of thermodynamics.

The latter is embodied in technical manuals and other "cookbooks," but also in the technologies themselves. An example would be the technical knowledge needed to build a working steam engine.

After describing these two kinds of knowledge, Mokyr sets about to explain why the British Industrial Revolution happened when it did. He argues that before this period, which he terms the "Industrial Enlightenment," there had been inventions and innovations, but they had not coalesced to produce what Walt Rostow referred to in the 1960s as "take-off."

Mokyr argues that before 1800, much of the technological progress was in the area of prescriptive knowledge and led, in particular, to singleton techniques. He lists Jenner's 1796 discovery of the vaccination process as an example, because it led to no further vaccinations until the triumph of the germ theory 100 years later.

This was because, Mokyr claims, there was no underlying propositional knowledge to guide further work. In his words, "Many societies in antiquity spent a great deal of time studying the movements of heavenly bodies, which did little to butter the turnips."

It was the "widening of the epistemic bases after 1800" that signaled "a phase transition or regime change in the dynamics of useful knowledge." In particular, the development of positive feedback between propositional knowledge and prescriptive knowledge led to powerful innovation effects. Indeed, Mokyr argues that the Industrial Revolution of the 19th century was built on the scientific revolution of the 17th century and the Enlightenment movement of the 18th century.

It was not necessarily that scientific breakthroughs led to the Industrial Revolution, but rather that more easily transmitted and formalized knowledge, especially propositional knowledge, made innovation easier.

New technical and scientific societies, new journals, handbooks and encyclopedias; cheaper and more widespread postal services and accepted measures of weights and standards all contributed to the spread of useful knowledge.

Moreover, the scientific revolution of the 17th century led to a focus on experimentation and rationality even in technical nonscientific fields. Mokyr makes an important and usually overlooked point about the Industrial Revolution when he argues that it was not so much driven by lone individual heroic inventors but by a social network for innovation. In this case, it was "at most a few thousand people who formed a creative community based on exchange of knowledge."

Indeed, he argues that a key to innovation and growth is the development of institutions that foster communication and trust between individuals who develop propositional knowledge and those who make things using it. In doing so, he takes the neoclassical economists to task for failing to deal very well with "the efficiency of the knowledge production function, that is, the ease with which the efforts are transformed into invention."

Perhaps the book's most important contribution is its discussion of the political economy of knowledge. Mokyr makes a compelling case that in contrast to the reigning paradigm of neoclassical economics, which tends to give short shrift to issues such as politics,

values, and institutions. Technological advance is far more influenced by these factors than is commonly realized.

Citing a long list of cases, he details a litany of factors that can get in the way of technical progress, including religion, government bureaucracies, unions, companies threatened by the innovators, broad anti-technology movements, and regressive consumer groups.

For example, Mokyr documents how an 18th-century guild in Prussia went so far as to issue an ordinance laying down that no artisan "shall conceive, invent, or use anything new." He argues that resistance to technological change stems from two sources that aid and abet each other; the economic interest of the technological status quo, and the resistance of intellectuals who fear new technology.

Some observers might claim that these forces were only a factor in medieval times or in less-developed societies, but the forces of reaction today are by no means weak. Such forces include politics; for example, the George W Bush administration's ban on therapeutic cloning, environmentalists' opposition to biotechnology, the widespread early resistance to e-commerce by affected business interests such as car dealers, real estate agents, and optometrists and resistance by privacy advocates who fear a whole host of new technologies, especially when these are wielded by predatory corporate interests.

It is clear that resistance to progress is alive and well in the early 21st century.

For all of its strengths, though, the book suffers from several limitations. For a book of economic history, it is surprisingly dry and weak on interesting and engaging descriptions of historical events. And there is a certain amount of repetition and long-windedness.

As a result, the book is often hard slogging. The book also is overly focused on England in the 18th and 19th centuries, perhaps because of what Mokyr's past work has covered. The industrial transformations in the United States during the late 1800s and mid-1900s are given relatively short shrift, although an analysis of them could do much to support his arguments.

In addition, Mokyr undervalues the extent to which there were radical innovations in the 20th century, arguing that the science and technology of that time produced mostly "micro-inventions." Yet, the development of the integrated circuit, lasers, radar, antibiotics, mass-production assembly, biotechnology, and the Internet clearly were major innovations.

Mokyr also makes a number of claims that are dubious at best. For example, in citing the failure of the Tucker automobile in the 1950s, he claims that venture capital is "a powerful tool for vested interests keeping out innovators."

On the contrary, one of the reasons why innovators in the United States have emerged so vigorously to challenge competitors, especially as compared to other nations, is precisely because they could turn to independent venture capital firms for financing.

Finally, although Mokyr argues convincingly that "useful knowledge" networks are a key to growth, this predominant focus on knowledge fails to explain why Britain was the site of the Industrial Revolution, while France, which arguably had deeper science base, was not. He touches on the fact that knowledge was seen as being in the service of national interests in France, whereas in England it was more commercial.

But this is an important factor that deserves much more discussion than the few pages it gets. In other words, although the broad-scale development of useful knowledge is key, without the right institutional systems and culture to enable this knowledge to be exploited in commercially useful ways, the results will be limited.

Notwithstanding these limitations, "The Gifts of Athena" is a valuable addition to the growing literature on "knowledge economics" and to the movement to transform economic policy so that it more explicitly supports knowledge-led growth.

Although Mokyr does not suggest much in the way of policymaking, the book does lead to a number of policy considerations. Most important is the idea that to grow the economy, policymakers should concentrate on expanding knowledge (including research and technology) and on expanding the ways in which it is diffused.

Policymakers also need to recognize that a key form of capital in today's "new economy" is not just financial capital, or even knowledge capital, but social capital. As Jane Fountain of Harvard's Kennedy School of Government has argued in a Progressive Policy Institute report: "Innovation, Social Capital, and the New Economy", there have been dramatic changes in the nature of innovation.

Notably, innovation is increasingly produced in networks, and enhancing social capital is key to expanding such network-based innovation. If a new system of innovation is to fully emerge and prosper, then federal science and technology policies, which helped create the broad institutional contours of the postwar R&D system, must now be adapted to support the new institutional relationships among industry, universities, and government.

It has been proposed by any number of studies that there are several specific steps that Congress should take. Some of these include expanding the research and experimentation tax credit to provide a flat 20 percent credit (as opposed the current incremental credit) for any industry expenditures on research consortia and for research partnerships with universities or federal laboratories.

Second, in order to draw university and industry researchers closer together on common challenges, advocates favor establishing an Industry Research Alliances Challenge Grant Initiative to help support industry-led research alliances. Industry members would establish technology "roadmaps," and on the basis of these maps, companies would invest in research conducted at universities or federal laboratories.

In addition, proposals have been made that Congress establish a State Technology Innovation Challenge Grant Initiative to co-invest with states to support regionally based innovation partnerships between small and medium sized firms and universities or federal labs.

Supporting more research, especially collaborative research, is important. But it is equally important to ensure that policymakers are vigilant in fighting today's neo-Luddites who, because of self-interest or ideological reasons, would place roadblocks in front of innovation.

An array of technical areas such as stem cells, agricultural biotechnology, new information technologies, and automation technologies, to name but a few now face significant opposition from such forces.

Mokyr makes it clear that the societies in the past that best resisted regressive forces were those that progressed the fastest. By providing a detailed view of how knowledge-based development has worked in the past, his book provides a valuable service.

About the Author

Robert Atkinson is vice president and director of the Progressive Policy Institute's Technology and New Economy Project, and author of the forthcoming book *Technology, Innovation and Economic Transformation: Understanding America's New Economy* (Edward Elgar).

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