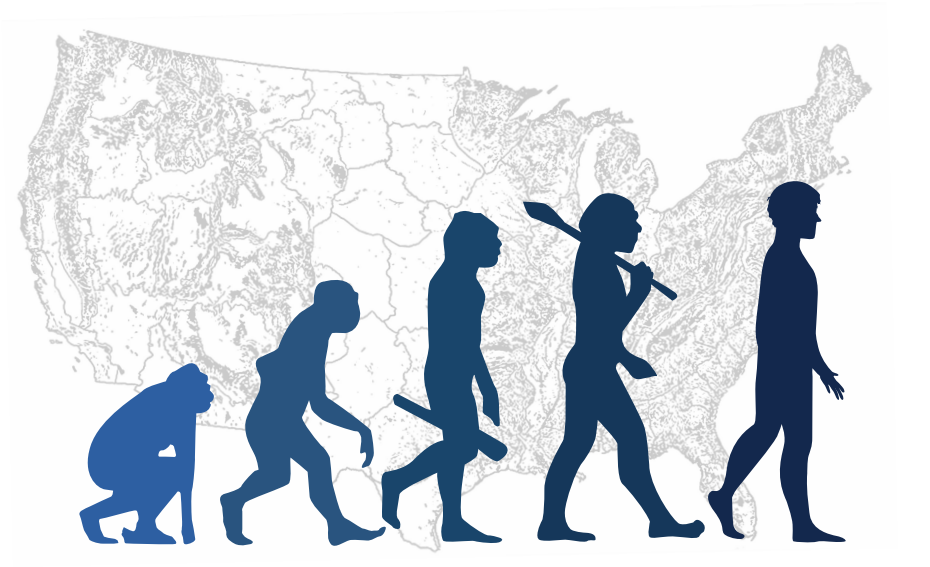

UNDERSTANDING AND MAXIMIZING AMERICA'S EVOLUTIONARY ECONOMY

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DR. ROBERT D. ATKINSON

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OCTOBER 2014

In the conventional view, the U.S. economy is a static entity, changing principally only in size (growing in normal times and contracting during recessions). But in reality, our economy is a constantly evolving complex ecosystem. The U.S. economy of 2014 is different, not just larger, than the economy of 2013. Understanding that we are dealing with an evolutionary rather than static economy has significant implications for the conceptualization of both economics and economic policy.

Unfortunately, the two major economic doctrines that guide U.S. policymakers' thinking—neoclassical economics and neo-Keynesian economics—are rooted in overly simplistic models of how the economy works and therefore generate flawed policy solutions. Because these doctrines emphasize the "economy as machine" model, policymakers have developed a mechanical view of policy; if they pull a lever (e.g., implement a regulation, program, or tax policy), they will get an expected result. In actuality, economies are complex evolutionary systems, which means enabling and ensuring robust rates of evolution requires much more than the standard menu of favored options blessed by the prevailing doctrines: limiting government (for conservatives), protecting worker and "consumer" welfare (for liberals), and smoothing business cycles (for both).

Any new economic framework for America's "fourth republic" needs to be grounded in an evolutionary understanding.

As economies evolve, so too do doctrines and governing systems. After WWII when the United States was shifting from what Michael Lind calls the second republic (the post-Civil War governance system) to the third republic (the post-New-Deal, Great Society governance structure), there was an intense intellectual debate about the economic policy path America should take.[1] In *Keynes-Hayek: The Clash That Defined Modern Economics*, Nicholas Wapshott described this debate between Keynes (a proponent of the emerging third republic), who articulated the need for a larger and more interventionist state, and Hayek (a defender of the second republic and a smaller state), who worried about state over-reach and loss of freedom.

Today, we are in need of a similar great debate about the future of economic policy for America's "fourth republic." Unfortunately, today's debate is mostly a reprise of the 70-year-old Keynes-Hayek debate between the defenders of the third republic (liberals) and those who would try to resurrect the second republic (conservatives). However, as Lind writes, "it remains to be seen whether the global economic crisis that began in 2008 will mark the end of the Third American Republic and the gradual construction of a fourth republic by the 2020s or 2030s."[2]

It is in this context that the concept of evolutionary economics can play an important role, as any new economic framework for America's "fourth republic" needs to be grounded in an evolutionary understanding. In this context, the central task of economic policy is not managing the business cycle—it's driving a robust rate of economic evolution. It's not about maximizing freedom or fairness as the right and left want, respectively—it's about maximizing evolution.

This book provides an overview of the evolutionary economics framework and the history of evolutionary economics thinking. It then discusses the three main drivers of U.S. economic evolution (geographic shifts in production, technological change, and demographic/cultural/governmental change). Finally, it lays out eight principles for an evolutionary economics-inspired economic policy:

- Support global economic integration based on firms' market-based choices, rather than governments making political choices.
- At the same time, work to slow traded sector industry rate of loss where it makes sense.
- Don't impede natural evolutionary loss.
- Limit government barriers to evolution.
- Foster a culture that embraces evolution, including natural evolutionary loss.
- Enact policies to spur organizations to act in ways that drive evolution.
- Support policies to speed economic evolution, especially from technological innovation.
- Develop a deeper understanding of the process of U.S. economic evolution.

EVOLUTIONARY ECONOMICS VS. CONVENTIONAL ECONOMICS

We normally don't see economic evolution. Change, despite all the hype that it is accelerating, is relatively slow and steady. Sometimes we see evolution when we visit a place after being away from it for a long period of time. Then it is obvious things have evolved: there are new buildings, new companies, and new infrastructure in place. We may see evolution when a transformative new product like the iPhone comes on the market. But for the most part we don't notice evolution, leading most of us to believe that economies grow (e.g., GDP increases, jobs expand, etc.) more than they evolve.

The central task of economic policy is not managing the business cycle—it's driving robust rates of economic evolution. It's not about maximizing freedom or fairness as the right and left want, respectively —it's about evolution.

Yet on any given day this year in the United States approximately 620 patents will be issued, 434 new products released, and 439 new production processes adopted.[3] Firms in some industries will get bigger (the average number of employees in non-store retailers—the Amazon.coms of the world—increased 0.03 percent every day in 2013), while others will get smaller (the average size of data processing, hosting, and related services companies shrank 0.07 percent every day in 2013, despite the emergence of cloud computing).[4] Overall though, the trend has been increases in size: in 1958 just 11 percent of the workforce was employed in firms with more than 10,000 employees, while today 27 percent today are.[5] And industries will expand and contract at significantly different rates. For example, throughout 2012 (the last year data are available) value added output in the oil and gas industry expanded by 0.05 percent per day, while with the continued shift to

e-commerce and "big-box" specialty retailers, value added output from general merchandise stores shrank 0.025 percent per day.

In addition, the economy evolves through firm births and deaths. Every day this year about 3,800 firms will close their doors for the last time and another 4,000 will celebrate their launch. Companies close usually because they cannot adapt to new conditions and competitors. Companies start because the owner thinks she has a better mousetrap—but most of the time they do not, and most will fail within the first five years. But this evolutionary process of births and deaths differs over time and industry. In the last two decades, business establishments grew by 0.2 percent per year. As expected, this fell off and even went negative in the recession of 2008 and 2009 but by 2012 had partially recovered.

The pattern by industry of births and deaths is extremely diverse. From 1993 to 2000, the number of firms in the information industry increased almost 1 percent a year (0.9 percent), but within one year (2001) went sharply negative (declining 1.5 percent) and has been negative ever since. In fact, there are 8.5 percent fewer companies in the information industry in 2013 than there were in 2000; not because the industry has shrunk, but because average firm size has increased (see Figure 1). Similarly for retail trade; 1995 was the last year when retail births outpaced deaths. For retail trade, the dynamic has been mostly about increasing firm size of retail superstores (e.g., Home Depot) and the Internet (e.g., Amazon.com).

Manufacturing exhibits similar dynamics, but for different reasons, as 1996 was the last year when manufacturing births outpaced deaths. For manufacturing the story is mostly about global competition, which has made the environment for manufacturing harder in the United States. In contrast, financial services have consistently grown, declining only in the Great Recession. Health and education are the only sectors where births were equal to or greater than deaths over this 20-year period. For education and health, the dynamic has been about increased spending because of demographic changes.

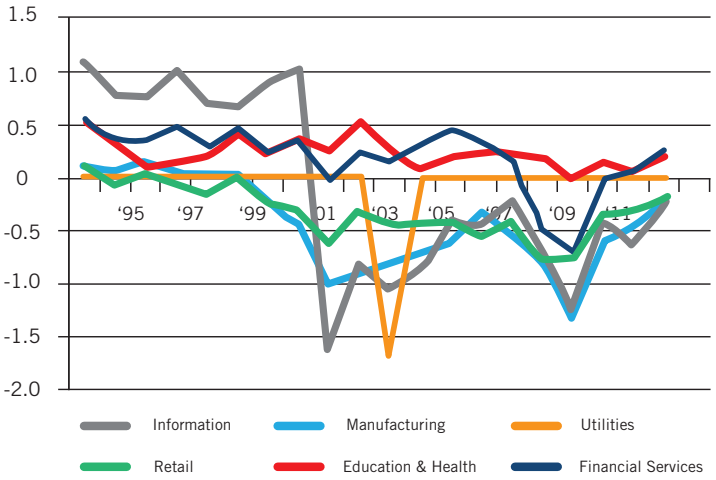

Figure 1: Net rates of firm birth and death by industry: 1993 to 2012

At the sub-industry level these changes are even more dramatic. Between 2006 and 2007 the number of firms in the funds, trusts and other financial vehicles industry increased by 33 percent, but as the financial crisis took hold the number declined by 22 percent the following year. Likewise, the number of firms in the credit intermediation industry expanded rapidly after 1997 as the housing bubble started to take off, but after 2006 the number contracted rapidly (see Figure 2).[6] Likewise, the number of firms in the land subdivision industry, residential construction industry, and real estate agents and broker industry declined by 17.3 percent, 13.3 percent, and 12 percent respectively between 2008 and 2009.

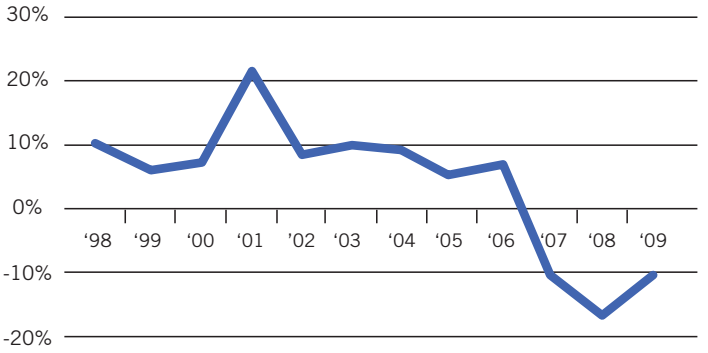

Figure 2: Percent change in the number of firms in the credit intermediation industry, 1998-2009

In contrast, the decline in the book, periodicals and music stores industry has been longer term, actually accelerating after the recovery as new technologies (e.g., e-books and tablets, MP3 players and faster broadband) and new business models (online distribution) have made it easier for consumers to get books and music in other formats and online (see Figure 3).

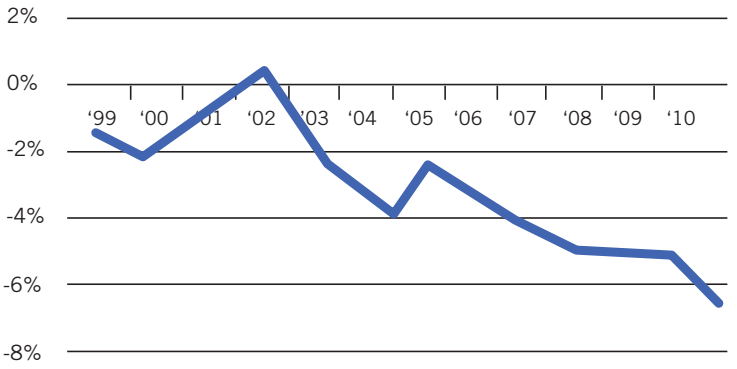

Figure 3: Percent change in the number of firms in the book, periodicals and music stores industry, 1999–2010

Given the increase in incomes, especially for upper-income households, coupled with Americans' increasing interest in health foods and gourmet foods, the number of specialty food stores has grown significantly over the last 15 years, slowing down only with the Great Recession (see Figure 4).

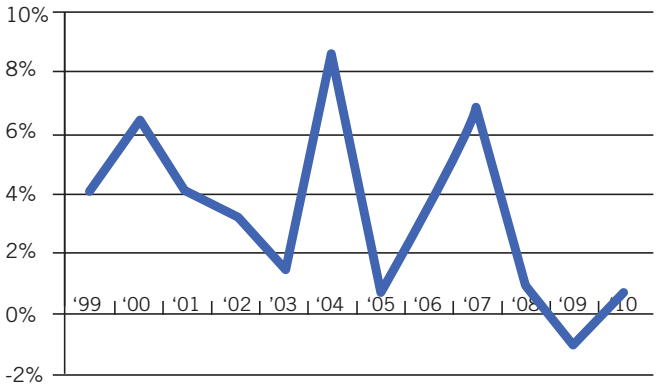

Figure 4: Percent change in the number of firms in the specialty food store industry, 1999–2010

The two dominant schools of U.S. economic thought—neo-Keynesian and neoclassical—give only limited attention to the issue at the heart of economic life: economic evolution.

But notwithstanding all this evolutionary change, here is what conventional economics will report: GDP increased 2.8 percent in 2012, unemployment declined by 0.6 percentage points, inflation grew by 1.7 percent, and real interest rates averaged 1.5 percent. Indeed, while the two dominant schools of U.S. economic thought—neo-Keynesian and neoclassical—capture important aspects of economic reality, they are incomplete because they give only limited attention to the issue at the heart of economic life: economic evolution. These doctrines are grounded in a model of the economy as static, not evolutionary, and the policy recommendations stemming from these doctrines reflect this view.

Neoclassical economics views the economy as a vast marketplace, generating billions of price signals and exchanges daily to achieve the most efficient allocation of goods and services. Neo-Keynesian economics sees capitalist economies as efficient machines which fiscal and monetary policy levers regulate to avoid overheating (inflation) or cooling (recessions). For both doctrines, economies undergo little change, other than growing or contracting or moving to or away from price equilibrium or full employment.

A more accurate model of advanced economies—and one that if followed would lead to a very different national economic agenda—is an evolutionary one, grounded in the work of mid-20th century economist Joseph Schumpeter.[7] In this view, the U.S. economy is an "organism" that is constantly developing new industries, technologies, organizations, occupations, and capabilities while at the same time shedding older ones that new technologies and other evolutionary changes make redundant (e.g., proverbial "buggy whip" industries). This rate of evolutionary change differs over time and space, depending on a variety of factors, including technological advancement, entrepreneurial effort, domestic policies, and the international competitive environment. Indeed, the last factor is critical, for the U.S. economy does not evolve alone but in competition and cooperation with other national economies.

To use a biological metaphor, this is economic Darwinism: economies in a constant state of evolution. But unlike biological evolution, which has no teleological direction, economic evolution (as distinct from devolution) is always in the direction of progress—at least in the long term—because it is driven by humans seeking constant improvement.[8] Indeed, evolution appears to be positively correlated with a societal passion for improvement, or what Columbia University economist Edmund Phelps calls "flourishing."[9] Not every nation or group has the same passion for flourishing; indeed, for much of human history, stability—not evolution—was valued more. But at least for the last quarter of a millennium in the West, evolution is what societies seek.

What is evolution? Evolution includes improvements in productivity (e.g., output per unit of input); innovations that are welfare enhancing (e.g., development of new products, services, and business models); and increases in global competitiveness (the ability to have strong terms of trade with other nations in relation to a nation's trade balance).[10] As defined as such, evolution leads to growth, and indeed is the key driver of growth, especially over the moderate and long term.

But conversely, growth does not always mean evolution.[11] As Phelps writes in *Mass Flourishing*, "In a global economy driven by one or more economies of high dynamism, an economy with low or even no dynamism may regularly enjoy much the same growth rate as that of the highflyers but mainly by being vibrant enough to imitate the adoptions of original products in modern economies."[12] One could very well imagine an economy that grows but doesn't change (e.g., there is just a bit more of everything).

At the same time, this does not mean that change always equals evolution or movement forward. Sometimes it involves devolution; change that makes an economy less vibrant and adaptive. This could come from changes that lead to productivity declines or competitiveness setbacks, as the sizable and unprecedented decline in U.S. manufacturing output in the 2000s reflects.[13] In this case, the failure of U.S. manufacturing to adequately adapt (in part due to U.S. policy failures coupled with predatory mercantilist practices from other nations) meant that this part of the U.S. economy devolved. Devolution can also result from innovations that are welfare-de-

tracting; in other words, innovations that while serving one particular group do not benefit the overall economy. The most noted example was the slew of new financial products (e.g., synthetic CDOs, credit default swaps, etc.) in the late 1990s and 2000s—innovations (new types of services and related business models) that served the interests of the developers of them at the expense of the rest of us.

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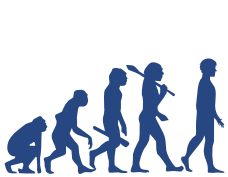
While the economy-wide process of change is almost always evolutionary in nature, this doesn't mean that devolution cannot happen for entire economies at particular times. Unlike species in nature, while economies do not go extinct if they cannot adapt to changes in the environment, they can suffer lower levels of economic performance, as the United States has experienced in the last decade. Indeed, some nations throughout history have not only stagnated, but experienced absolute decline, at least for certain periods.[14] In the first part of the 20th century, Argentina was one of the most prosperous nations on earth, but a century of corrupt governments has meant that it is now a struggling, mid-tier economy. Despite occasional temporal and spatial devolution, over time and for the world as a whole, economic evolution means progress (e.g., increased incomes, better quality of life, more varied and better products and services).

While biological evolution is driven by "Darwinian" natural selection (environmental conditions leading to a selection of the fittest organisms for survival), there are two other common theories offered to explain biological evolution: 1) Lamarckism, where organisms adapt in response to environmental changes, passing those adaptations on to their offspring; and 2) intelligent design, a notion offered up by Christian fundamentalists who reject Darwinism in favor of a theory of biological change directed by God.[15] While biological evolution has one cause (natural selection), economic evolution is driven by all three of these evolutionary forces: 1) natural selection, where "better" and often newer organizations gain market share over "worse" and often older organizations; 2) Lamarckism, where organizations themselves adapt in response to environmental changes and competition in order to continue or even grow; and 3) "intelligent design," where collective action on the part of society through public policies shapes the evolutionary process, for positive evolution or negative devolution.[16]

Three Sources of Economic Evolution



Darwinian

Lamarckism

Intelligent Design

Moreover, while Darwinian evolution is not teleological—there is no intention or end involved—economic evolution is teleological. Indeed, economic evolution is a process whereby humanity's needs are met in new and better ways with less and less work per unit of output. But neither neoclassical nor neo-Keynesian doctrines recognize this directional, teleological conception of the economy as one that should be constantly and relentlessly evolving toward a higher state. To be sure, adherents of both doctrines see the benefits of technological progress and see it as useful, but it is not at the core of their models.[17]

For most neoclassical economists, including both conservative supply-side economists and followers of more moderate "Rubinomics," there is no evolution or goal; there is only the workings of a vast market exchanging goods and services in response to prices, weeding out products consumers don't want and rewarding those they do.[18] There is no good or bad, backwards or forward, other than the exchanges of goods made freely at the prices set by the market. Any movement "forward" stems from increased welfare gained from additional exchanges. Any technological or other sources of change are exogenous to the model, or as Nobel Prize winning economist Robert Solow once stated, "manna from heaven." In this sense, to the extent that neoclassical models consider change, it is seen as growth more than evolution. In other words, market transactions maximize static efficiency and consumer welfare. As former member of the Clinton Council of Economic Advisors Alan Blinder writes, "Can economic activities be rearranged so that some people are made better off, but no one is made worse off? If so we have uncovered an inefficiency. If not, the system is efficient."[19]

Moreover, adherents to the neoclassical doctrine hold that all economic change, even loss which can be prevented or is caused by foreign "predation," is evolutionary (i.e., positive). For them, evolutionary competition between nations does not imply the need to "train to compete"—in other words, the need for a robust competitiveness and innovation policy—it only requires allowing "natural" market forces to take their course. Moreover, for most neoclassical economists, the very notion that economies compete in an evolutionary sense, the way firms compete, is simply not valid.

Notwithstanding the continued dominance of the neoclassical doctrine in America (and also in Commonwealth countries), the Great Recession has stimulated a wave of innovative research across the disciplines of economics and finance, in part informed by the requirement to take uncertainty and coordination failures and the interaction between the financial system and the real economy more seriously.[20] But this work remains at the edges of conventional economics, still seeking to penetrate to the core.

More liberal and progressive economists (termed here neo-Keynesians) also only see growth, not evolution.[21] For them, consumption leads to more jobs, which lead to higher wages, which lead to more consumption, reinforcing this positive growth cycle. The "machine" gets bigger, but not fundamentally different. To be sure, neo-Keynesianism has some good practical advice on what to do in terms of monetary and fiscal policy in periods of sustained deleveraging and inadequate aggregate demand, following the collapse of an asset bubble that caused a financial crisis. But as Phelps writes, "standard economics offers no inkling of what policy initiatives

might solve the stagnation of productivity and wages…Their models were conceived to show how short-term fiscal interventions could shave off peaks and troughs of a short cycle around a rising trend path—not to address a sea change in dynamism bringing stagnation."[22] Moreover, for many liberal neo-Keynesians, the evolutionary process is "red in tooth and claw" with changes leading to destruction (creative or not) and pain, especially for workers swept up by change. Better to seek stasis and stability through regulation, coupled with more generous redistribution schemes.

But for those who subscribe to a Schumpeterian "evolutionary economics" doctrine, economic change is all about evolution and how innovation actually occurs.[23] Indeed, notwithstanding the anemic U.S. labor market recovery and the increase in income inequality, no economic question is more important than how to maximize economic evolution, for this is the key to increased living standards and well-being.

Evolutionary economists believe that the primary drivers of growth are productive efficiency—the ability of organizations to organize production in ways that lead to the most amount of output with the fewest inputs, including labor inputs—and adaptive efficiency—the ability of economies and institutions to change over time to respond to successive new situations, in part by developing and adopting technological innovations. As evolutionary economist Douglass North explains:

> Adaptive efficiency…is concerned with the kinds of rules that shape the way an economy evolves through time. It is also concerned with the willingness of a society to acquire knowledge and learning, to induce innovation, to undertake risk and creative activity of all sorts, as well as to resolve problems and bottlenecks of the society through time. We are far from knowing all the aspects of what makes for adaptive efficiency, but clearly the overall institutional structure plays a key role to the degree that the society and the economy will encourage the trials, experiments and innovations that we can characterize as adaptively efficient. The incentives embedded in the institutional framework direct the process of learning by doing and the development of tacit knowledge that will lead individuals in decision-making processes to evolve systems that are different from the ones that they had to begin with.[24]

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If evolution is teleological, what is the motivation for individuals and organizations to engage in evolutionary behavior? For biological evolution it's the survival of the species. For economic evolution the motivation is different. In capitalist economies, market-driven innovation is said to be motivated by profits. To be sure, profits motivate risk taking and investment. But it is more complicated than that. As Phelps argues, "wealth seeking" can actually compete with "innovation seeking."[25] [In other words, as more and more individuals in America "became interested in making a quick buck," resources (money and people) headed to wealth-seeking sectors like finance, at the expense of innovation-seeking sectors.] Thus, the goal of making money and seeking wealth is not necessarily congruous with the goal of maximizing economic evolution.

In addition, in capitalist societies, not all actors are motivated by profits. The non-profit sector is motivated by other rewards, including doing good. And the motivation for elected officials is all too often to keep things the same, as the electorate that still bothers to vote increasingly rewards stability and special interest rent seeking (e.g., retired voters supporting candidates that support expanding entitlements, teachers supporting candidates that support expanded education funding, etc.). And in more state-directed economies, the motivation for evolution (or devolution) is often political reward or special interest dealing.

While all societies and economies evolve, the pace and nature differs. As Daron Acemoglu and James Robinson write in *Why Nations Fail*, some economies are organized to limit evolution.[26] Sometimes this is because incumbent interests are committed to rent seeking, extractionist behavior and want to limit any evolutionary threats to that. One artisan guild in 18th century Prussia went so far as to issue an ordinance laying down that no artisan "shall conceive, invent, or use anything new."[27] In other cases, the underlying culture is inimical to experimentation and freedom, upon which evolution depends. As historian of technology Joel Mokyr argues, "in every society there are stabilizing forces that protect the status quo. Some of these forces protect entrenched vested interests that might incur losses if innovations were introduced, others are simply do not-rock-the-boat kinds of forces. Technological creativity needs to overcome these forces."[28] Schumpeter agrees: "The resistance which comes from interests threatened by an innovation in the productive process is not likely to die out as long as the capitalist order persists."[29]

The United States remains wedded to a strictly Darwinian economic ideology and rejects "intelligent design" on an almost religious basis.

But even among economies where evolution is embraced or at least accepted, the nature of it differs. In the United States, evolution is more Darwinian in nature than in most other nations. The U.S. political economy accepts and even embraces the creative destruction brought on by new entrants, business models, and technologies more than virtually any other nation. In contrast, in places like continental Europe and Japan, evolution is more Lamarckian in nature, with change being driven more by established companies and less by new entrepreneurial efforts. As Merritt Fox writes, "eight of the 25 largest firms in the United States in 2003 did not exist or were very small in 1960. All of the largest firms in Europe in 1998 were already large in 1960."[30]

But, other nations more readily embrace and practice intelligent design—the idea that government can and should play an active role in driving innovation. For these nations, the idea that nations should have active national innovation and industrial policies is broadly accepted by the political and intellectual elites. In contrast, the United States remains wedded to a strictly Darwinian economic ideology and rejects "intelligent design" on an almost religious basis. In the new, more competitive and innovation-driven global economy, this is a distinct weakness for America.[31]

A BRIEF HISTORY OF EVOLUTIONARY ECONOMIC THINKING

The evolutionary view of economies, while largely ignored in mainstream U.S. economic thought, is not new. Indeed, institutional economist Thorstein Veblen was perhaps the first to coin the term "evolutionary economics" in 1898.[32] But it was Austrian economist Joseph Schumpeter who perhaps has done the most to advance the idea. His 1911 book, *The Theory of Economic Development*, introduced the idea of "new combinations" of new or existing knowledge, resources, equipment and so on to produce evolution—or what he termed "development"—which he distinguished from growth, which simply meant more of the same.[33] As Christopher Freeman wrote, "the central point of his (Schumpeter's) whole life work [is]: that capitalism can only be understood as an evolutionary process of continuous innovation and 'creative destruction.'"[34]

Schumpeter believed that conventional classical and neoclassical economics provided a misleading view of how economies really work, writing that neoclassical economists viewed economic life as "essentially passive…so that the theory of a stationary process constitutes really the whole of theoretical economics," and that he "felt very strongly that this was wrong, and that there was a source of energy within the economic system which would of itself disrupt any equilibrium that might be attained."[35] In his classic 1942 book, *Capitalism, Socialism and Democracy*, Schumpeter articulated his view that to this day sums up the evolutionary perspective:

> The essential point to grasp is that in dealing with capitalism we are dealing with an evolutionary process…the fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates.[36]

Schumpeter focused on the constant innovation and change at the heart of the successful workings of the capitalist enterprise and capitalist system. Indeed, Schumpeter counseled us to judge the performance of an economy not at any one point in time, but "over time, as it unfolds through decades or centuries."[37]

Despite Schumpeter's insights, mainstream Anglo-Saxon economics went on a different path that focused more on price-mediated market transactions on the one hand, and macroeconomic business cycle management on the other—two important issues to be sure, but incomplete in their coverage. However, a few economists followed in the Schumpeterian tradition, although by and large their work was and is ignored to this day by mainstream economists. Perhaps most important of these are Richard Nelson and Sidney G. Winter, who in 1982 published *An Evolutionary Theory of Economic Change*, writing:

> The broader connotations of "evolutionary" include a concern with processes of long-term and progressive change. The regularities observable in present reality are interpreted not as a solution to a static problem, but as the result that understandable dynamic processes have produced from known or plausibly conjectured conditions in the past and also as features of the stage from which a quite different future will emerge by those same dynamic processes.[38]

They were aware that they were challenging what they termed "orthodox" economics and that the struggle for the acceptance of their ideas would be difficult. As they wrote, "many of our economist colleagues will be reluctant to accept the second premise of our work—that a major reconstruction of the theoretical foundations of our discipline is a precondition for significant growth in our understanding of economic change."[39]

Nelson and Winter were right to be concerned. While there has been increasing interest in the evolutionary view (going by a number of different terms, including evolutionary economics, endogenous growth theory, new growth theory, and structural-evolutionary economics), it is by and large still a minority view in the economics profession, at least in the Anglo-Saxon world.[40]

However, some economists have more recently embraced the evolutionary view, using a variety of different approaches. A number of economists and innovation scholars at the Science Policy Research Unit (SPRU) at the UK's University of Sussex have made path-breaking contributions, including Giovanni Dosi, Christopher Freeman, Keith Pavitt, Carlota Perez, and Luc Soete.[41-45]

Little of the work that has been done in the evolutionary economics tradition has been structured in a way to provide useable and actionable guidance to policymakers.

In the United States, the attempt to approach economics from a more evolutionary perspective, or at least to consider technological innovation more directly, has been led by a small but growing number of scholars. Academics such as Philippe Aghion, Peter Howitt, and Elhanan Helpman have written about the importance of general purpose technologies in spurring growth and development.[46] Others, such as Nathan Rosenberg, have attempted to more fully understand the science-driven innovation process.[47]

A number of scholars have continued to work in the Schumpeterian tradition, including Richard Langlois and Richard Lipsey.[48-49] Some scholars, including W. Brian Arthur and Eric Beinhocker, have attempted to incorporate theories of complexity into economic analysis.[50-51] Some in the institutionalist tradition have argued that the economy is best understood as based on institutions and rules just as much as unmediated markets. This includes the work of Nobel Prize winning economist Douglas North.[52] And the Institute for New Economic Thinking, established after the financial crisis of 2008, has led the way in supporting and organizing evolutionary-based alternatives to the neoclassical model.[53] These and other scholars have explicitly sought to incorporate knowledge creation into mainstream economics, as David Warsh's *Knowledge and the Wealth of Nations* documents.

In addition, some scholars coming from the tradition of business have sought to extend their insights into firm competitive advantage to nations, and by extension understanding how national economies evolve. Perhaps most cited has been Harvard Business School Professor Michael Porter's work, including his 1990 book *The Competitive Advantage of Nations*. The McKinsey Global Institute has also done extensive work in this tradition.

The work of these scholars doesn't stand alone; collectively it helps form an overall evolutionary view of the economy which unfortunately is still largely absent from deliberations about U.S. economic policy. And while interest in Schumpeter has undergone somewhat of a revival, it is mostly for his work stressing the importance of entrepreneurship and creative destruction. His deeper insights about economic evolution remain largely unappreciated. Moreover, most economic policy organizations in Washington, as well as virtually all of the leading economic departments in the nation's universities, reflect the conventional, not evolutionary, view of the economy. As valuable as the above work on evolutionary economics has been, little of it has been structured in a way to provide useable and actionable guidance to policymakers.

THREE DRIVERS OF ECONOMIC EVOLUTION

So how exactly does economic evolution occur? Not surprisingly, Schumpeter provides some answers. In his classic 1942 book *Capitalism, Socialism and Democracy* he wrote:

> The opening up of new markets, foreign or domestic, and the organizational development from the craft shop and factory to such concerns as U.S. Steel illustrate the same process of industrial mutation—if I may use that biological term—that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating the new one.[54]

To those two factors Schumpeter identified—opening up of foreign markets (e.g., globalization and changes in economic geography) and changes in organizational development (much of it enabled by technological innovation)—we should add a third: changes in demography, culture, and government policy. Together, these three factors drive the evolution of any economy.

Economic Geography

From a global perspective, economic geography plays no role in evolution. By definition all economic activity takes place on earth and any change is determined by other factors. But for sub-geographies (nations, states, and cities) spatial evolution plays a key role in economic evolution as economic activity shifts from one area to another. Indeed, economies are entities that evolve over both time and space.

Prior to the 1980s, the spatial relocation of U.S. economic activities, based largely on differential levels of production sophistication of the activities, occurred largely within the United States. As Harvard economist Raymond Vernon argued in the 1960s, high-cost nations like the United States would have an advantage in production of goods at the earlier phases of the product life cycle before production became routinized and standardized. As a result, higher-income areas of the United States, mostly in the Northeast and Midwest regions (and California), served as "seedbeds" for the development of new innovations, firms, and industries. However as new product and process innovations matured and become more stable, they could more easily locate in lower-cost regions, often in the U.S. South and West, without any significant loss of economic viability.

As economic geographers John Rees and R.D. Norton wrote in their seminal 1979 article "The Product Cycle and the Spatial Decentralization of American Manufacturing," startup firms and innovations in existing firms will tend to concentrate in more costly urban areas to take advantage of highly skilled labor, external economies, and close ties to managerial and professional staff so important at this stage of production.[55] The organization of production at Lockheed Martin's famous Skunk Works in Burbank, California, demonstrated this. The former head of Skunk Works argued that production and engineering had to be proximate: "a stone's throw was too far away; he [the director] wanted us only steps away from the shop workers, to make quick structural or parts changes or answer any of their questions."[56] But this was because Skunk Works was not about making one million black widgets; it was about developing and producing new products—for example, 100 advanced Blackbird spy planes that required cutting-edge innovation, experimentation and testing.

However, as production of particular products becomes more standardized with much longer production runs, it can more easily shift to lower-cost areas. In this more mature and stable phase of production, the process of testing, changing, and fixing problems is less critical. That was all done in prior years. Now it's principally a process of building a factory (or office) and producing commoditized mass output. And for that, there is a much less critical need to be located in high-cost regions with all the resources they provide.

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This is not to say that industries cannot go back in the product cycle once they reach the commodity phase. Take the case of televisions. As black and white TVs became a commodity, production could shift to low-cost regions like Japan in the 1960s. But as color TV, the next big technological innovation, emerged, early phases of production had to be located in higher-skill, more technologically advanced places. Then, as color TVs became a mature technology, production shifted to low-cost places like China and Mexico. And as the next phase of innovation emerged, high-definition digital TV, production again concentrated in higher-cost places as Japan and South Korea had become. HD TV production is now moving to low-cost areas like China, but the next generation of TV technology (4K ultra HD, 3D, and massive and flexible displays) remains in high-cost places like Japan and South Korea, where firms invent and develop these cutting-edge technologies.

So while for 30 to 40 years after WWII the U.S. economy was evolving spatially with innovation bubbling up in high-cost core regions and then later diffusing to low-cost regions as it matured, this evolutionary spatial dynamic was largely a domestic one.[57] Through the mid-1980s, companies were born in places like Boston and Chicago, but once their technology and/or production systems matured, production moved to places like South Carolina, not South China.

By the late 1970s this process began to change, slowly at first and then much more rapidly as the new globalization took hold. The evolution of trade agreements (from the Kennedy Round to Doha to bilateral/trilateral agreements of note like the North America Free Trade Agreement) now meant that the policy barriers to cross-border trade (e.g., tariffs) were significantly reduced. Moreover, the technology to enable trade got significantly better (e.g., containers, IT-enabled supply chains, larger cargo ships, cheaper air freight, etc.). As technology and policy combined to enable more globally integrated trade and production systems, this evolutionary process of migration now meant that standardized production systems could locate in a much larger array of places, most of them outside low-cost areas of the U.S. (like the South and rural areas), which in comparison to the new overseas regions were not all that low cost anymore.

And that is exactly what happened. First, with the signing of the NAFTA trade agreement, Mexico became the low-cost region of choice for U.S. firms. Then, with the entry of China into the WTO in 2000 and the market reforms of nations like Brazil, India, and many of the nations that comprised the former Soviet Union, U.S. firms had almost unlimited access to low-cost production regions. And it was not just for goods production. With the global information and communications technology (ICT) revolution, firms could increasingly perform information-based services at a distance. These offshore locations were made all the more attractive by the lack of unions and limited regulations, coupled with generous investment incentives provided by governments desperate to attract foreign investment, and at home by a relatively strong U.S. dollar which made offshore costs lower in dollar terms.

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In part because of this (and, as discussed below, the lack of a domestic manufacturing competitiveness policy), U.S. manufacturing jobs peaked in 1979, with production jobs hemorrhaging particularly in the 2000s when the United States lost one-third of its manufacturing jobs, with over 60 percent stemming from loss of global competiveness.[58] And rural U.S. manufacturing was as hard hit as urban manufacturing, and the South as hard hit as the North. During the 1970s, rural factory jobs increased three times faster than urban factory jobs as high-cost urban manufacturing migrated to low-cost U.S. rural areas.[59] But in the 2000s, rural and urban areas lost factory jobs at the same rate, because they were now both part of the higher cost core region (the United States). In the 1970s and 80s, the South was the boom region for manufacturing (hence the term "sunbelt"), while the North was deindustrializing (the "rustbelt"). But of the top ten states in terms of the share of manufacturing job loss in the 2000s, four (North Carolina, Tennessee, Mississippi, and South Carolina) were in the South, all losing more than 37 percent of their manufacturing jobs.[60] Rather than "rustbelt" we had "rust nation."

This spatial relocation process has had differential impacts within manufacturing industries and occupations, with lower-wage, more routinized industries losing jobs and output at a faster pace than other industries. While overall U.S. manufacturing output declined by about 11 percent in the 2000s (when measured properly) and jobs declined by about one-third, some industries and occupations negatively affected by trade lost significantly more (see Tables 1 and 2).[61] It would be expected that the United States would lose more output and jobs in cost-sensitive, less technologically advanced industries like textiles and primary metals. But the nation also saw output declines in moderately technology-based industries like fabricated metals and plastics.

Industry	Decline
Plastics	17%
Fabricated Metals	20%
Furniture	26%
Paper	27%
Nonmetallic Minerals	30%
Primary Metals	36%
Apparel	40%

Table 1: Real output loss, 2000 to 2010 for selected U.S. manufacturing industries[62]

Manufacturing Occupations	Decline in Employment
Furniture Finishers	59.7%
Textile Cutting Machine Setters, Operators, and Tenders	59.8%
Sewing Machine Operators	60.5%
Foundry Mold and Coremakers	65.8%
Textile Winding, Twisting, and Drawing Out Machine Setters, Operators, and Tenders	66.7%
Textile Knitting and Weaving Machine Setters, Operators, and Tenders	69.4%
Sewers, hand	77.5%

Table 2: Decline in employment, 2000 to 2010 for selected U.S. manufacturing occupations[63]

It is important to note that there is one other major change in the spatial environment that has been critical to the evolution of the U.S. economy. For much of the 20th century, especially after WWII, the U.S. economy played the role of global "rainforest" for "species" evolution. In other words, America was the technological leader, with a large share of new industries and firms nurtured and developed in America. In some industries, such as electronics, software, and aerospace, America was the undisputed leader. In others, such as pharmaceuticals, chemicals, autos, machine tools, and steel, it had competitors, but not so strong as to threaten U.S. leadership. As business historian Alfred Chandler documented, America achieved this in part because of the unprecedented scale economies available to U.S. firms, with the U.S. market vastly larger than even our closest competitors.[64]

But scale was only part of the reason. America possessed another key advantage: massive government investment in science and technology, much of it fueled by a national will to achieve military superiority over the Soviet Union.[65] From semiconductors to machine tools to aerospace to the Internet, government funding of research and development—coupled with the procurement of early-stage expensive products (e.g., the Department of Defense was the main buyer of the first semiconductors coming out of Silicon Valley)—helped launch many U.S. technology-based industries to dominance.[66] Indeed, in the mid-1960s the federal government provided more funding for research and development than the rest of the world, public and private, combined. These two factors—market scale and government support—enabled the United States to obtain an enormous technological lead.[67]

But that lead, while substantial, was not insurmountable. Indeed, based on solid engineering competence coupled with significant government support for science and engineering, competitor nations like Germany and Japan began to challenge the U.S. lead by the early 1980s. By the 1990s the Asian "tigers" of Hong Kong, Singapore, South Korea, and Taiwan emerged as strong competitors, again grounded in support for technology but also in "innovation mercantilist" policies, which Japan had pioneered. And more recently in the 2000s, India and China have emerged as technology competitors. In essence, the evolutionary environment went from one where the United States was dominant in generating new industries to replace the ones it was losing—first to low-wage regions in the United States, helping to modernize the long-lagging South and West, and then to low-wage nations—to one where the competition for leading-edge evolutionary "replacement species" is now much stiffer. As a result, it has become more challenging for America to develop new industries, products, and services to replace the more mature ones it is now losing at a more rapid pace to low-cost nations. Moreover, it has become harder to extend the life of more mature production processes so that the U.S. economy captures the benefit from that production for a longer period.

The evolutionary environment went from one where the U.S. was dominant in generating new industries to replace the ones it was losing, to one where the competition for leading-edge evolutionary "replacement species" is now much stiffer.

The new challenges elicited a change in the evolutionary response from the U.S. government. Prior to the late 1970s, U.S. officials had developed an ingrained attitude that the U.S. evolutionary capabilities were so superior that no country could conceivably match them. It was as if we were the "lion" of the savanna with no real competition for our evolutionary niche. President Harry Truman boasted that "American industry dominates world markets and our workmen no longer need fear the competition of foreign workers."[68] In 1953, the President's Advisory Board for Mutual Security called for the unilateral elimination of U.S. tariffs on automobiles and consumer electronics imports because "U.S. producers are so advanced no one can touch them." The State Department even instructed its officers abroad to promote exports to the U.S. market.[69]

But this attitude of self-assured superiority began to change by the late 1970s as foreign evolutionary competition become stiffer. In particular, in the 1980s and early 1990s, Congress and three administrations (two Republican and one Democratic) took a number of steps to bolster U.S. innovation-based competitiveness, including enacting the R&D tax credit, the Cooperative Research and Development Act, the Small Business Innovation Research Program, the Omnibus Trade and Competitiveness Act (which among other things beefed up trade enforcement and expanded the mission of what is now the National Institute of Standards and Technology), and reforms to the National Science Foundation. Combined with the efforts by U.S. businesses to retool themselves around quality and innovation and a significant decline in the value of the dollar, these responses slowed the evolutionary loss. A period of competitiveness stasis followed, with the issue largely receding into the background in the 1990s. This was helped significantly by the

emergence of the Internet-based IT industry in the mid-1990s, which the United States continues to lead, at least in software.

However, by the 2000s, the pace of evolutionary competition for advanced industries intensified even more as more nations realized that they needed to not just be recipients of relocated mature routinized production, but to be recipients and sources of high value-added, innovation-based complex production.[70] Of course, wanting and getting are two separate things. Some nations can want it but are unlikely to get it because they do not have the "infrastructure" for advanced production. Other nations, like the United States, have it but do not appear to want it. But many nations want it and can have it in part because they have put in place advanced and sophisticated innovation-based competitiveness policies.

These nations realized—as the United States still has not—that they were in intense evolutionary competition with other nations. As such the pace of competitive response dramatically ratcheted up in many nations, as they cut corporate taxes, increased R&D tax incentives, expanded funding for R&D, supported exports, and broadly established sophisticated national innovation policies.[71] In the United States, however, the focus on the global "war on terror," the general belief that America's position as the innovation leader was unassailable, and the dominance of neoclassical economics that decried national innovation strategies as unwarranted distortion of optimized price mediated markets, put the U.S. federal government largely on the sidelines in efforts to spur the nation's evolutionary response to changes in global market competition.

This is the principal reason why the United States did not gain a compensating amount of higher value-added traded industries as it lost in lower value-added industries (traded sectors are those where a not-insignificant share of output can be bought or sold outside of the U.S. market). To be sure, the United States improved its trade balance over the last 25 years in a few industries, but only a few. For example, the trade surplus increased 268 percent in chemicals (not including pharmaceuticals) and 86 percent in civilian aircraft, parts, and equipment. This is one reason why employment in the chemical industry declined by 11 percentage points less than employment in manufacturing overall (21 percent vs. 32 percent), and why civilian aircraft employment declined by only 1 percent. But U.S. gains from global specialization in the 2000s were more than offset by losses in most other traded industries (see table 3).

This is not to say that globalization is inherently devolutionary for high-wage nations. In theory it is not, for it means that low-wage nations specialize in commodity-based production that used to be in high-wage nations, and that the latter shift up the value curve to specialize more in higher value-added production and industries, especially knowledge- and technology-intensive industries. But this outcome is not preordained. Some economies, like the United States, have had mixed outcomes—on the one hand losing much production, including high value-added production, while also gaining a lesser amount of offsetting high-value added production, especially in services. The experience of some nations, like Canada, Italy, Spain, and the UK, have been decidedly negative with the hollowing out of industries to globalization outweighing any positive developments from higher value-added specialization. In contrast, nations like Germany and Sweden

have thrived in the new globalization, losing low-end production but gaining at least an offsetting amount of higher-wage, high value-added production.

Finally, before discussing the role of technology in evolution, it is worth noting that technology also shapes spatial evolution. As described above, technologies like containerization have enabled globalization. But production technologies also shape spatial evolution. To the extent that process technologies do not enable higher productivity this leads to special decentralization to low-cost nations.

Low-cost regions like China thrive on being able to generate large production runs at low prices. The Boston Consulting Group (BCG), in an analysis of low-wage competition from China and India, describes the phenomenon this way:

> In the developed world, most industries have invested heavily in automation and have also simplified product design in order to reduce labor content. In low cost countries, where high labor content is less costly than high automation, the tradeoff between capital and labor is radically altered… Product design and manufacturing processes will need to be adjusted accordingly; screws may once again be cheaper than welds, and built-up assemblies may become cheaper than more complex integral designs.[72]

BCG goes on to state that "this source of advantage is rooted in the reintroduction of skillful human hands into highly sophisticated assembly processes, replacing costly monolithic machines." This even describes how one Western company eliminated all conveyor belts in its Chinese factories because labor was so cheap. Increased Chinese wages have moderated this dynamic, but it may play itself out in still lower-cost nations like Vietnam and India.

But process technology could also evolve the other way, leading production back to the United States. For example, cost-efficient customization and shorter production runs favor higher-cost regions. Technologies like 3D printing and CAD (computer-aided design) allow low-cost production of customized products, which means this production is more likely to stay in high cost regions like the United States.[73] There is little point of going to the trouble of moving production to China when production runs are relatively short. But it is unclear how these customization technologies will evolve and whether they will allow more than a minimal amount of production to be generated in the United States.

Likewise, automation technologies can make it cheaper to produce in high-cost regions like the United States. For example, when General Electric moved water heater production back to the United States from China, it redesigned the product for more automated machine assembly, eliminating one out of every five parts.[74]

TECHNOLOGY

If changes in economic geography help shape an economy's evolution, technology shapes not only the geographic opportunities but also drives overall evolution. This is because at heart societies are organized more or less to facilitate efficient production. How we work, learn, communicate, and live are all driven by an imperative to achieve the most outputs with the least inputs. This is why, for example, most of the U.S. population lives in cities, as opposed to in vacation homes at the beach and in the mountains.

The pace of evolutionary competition for advanced industries intensified as more nations realized that they needed to be the recipient and source of advanced, high value-added, complex production.

This is not to say that other forces are not at play, like those seeking to extract rent or limit efficiency, but over time nations where these forces are stronger lose out to those with a stronger ability to organize production systems around best-available technologies. And a nation's production system is determined and shaped by the available "tools"—in other words, by technology. But technology by its very nature progresses, as new knowledge is discovered and new techniques are tried.

Technological innovation reshapes not just specific areas it touches, but larger components of the economy and society. For example, the development of the automobile and affordable refrigeration from the 1920s to the 1950s reshaped the U.S. grocery store industry, allowing large supermarkets to thrive as consumers could now travel longer distances and buy more perishable food that would last for days if not weeks in a refrigerator. More recently the development of the Internet reshaped scores of industries, including retail trade, travel services, news media and others.

So where are we today with regard to the nature and pace of innovation? Many argue that today's technology system is unique, in particular in its pace of change relative to past technological evolution. Go to any technology conference and you are likely to hear from an enthusiastic futurist breathlessly claiming that the pace of innovation is not just accelerating, but that it is accelerating "exponentially."

Indeed, it's become de rigueur for authors claiming to be futurists to extol the coming technology wonders that are in store for us, painting a utopian (or depending on their view, dystopian) picture where technology proceeds exponentially and transforms the world.

No one better epitomizes this view than futurist Ray Kurzweil, the co-founder of the Silicon Valley's Singularity University. Kurzweil writes: "An analysis of the history of technology shows that technological change is exponential, contrary to the common-sense 'intuitive linear' view. So we won't experience 100 years of progress in the 21st century — it will be more like 20,000 years of progress (at today's rate)."[75] But he is hardly alone in these techno-utopian claims. In *Abundance: The Future is Better Than You Think*, Peter Diamandis and Steven

Kotler argue that because the pace of innovation is accelerating exponentially, "within a generation, we will be able to provide goods and services, once reserved for the wealthy few, to any and all who need them."[76] In *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, Erik Brynjolfsson and Andrew McAfee argue that the "second machine age" (the first one was during the Industrial Revolution) is "doing for mental power…what the steam engine and its descendants did for muscle power. They're allowing us to blow past previous limitations and taking us into new territory."[77]

The latest entry to the techno-utopian club is Jeremy Rifkin's *The Zero Marginal Cost Society*. Rifkin argues that within less than 50 years, technology will have developed to the point where there will be virtually no more jobs, where the marginal cost of everything will be zero, and where capitalism will cease to exist. Besides that, not much will change.[78]

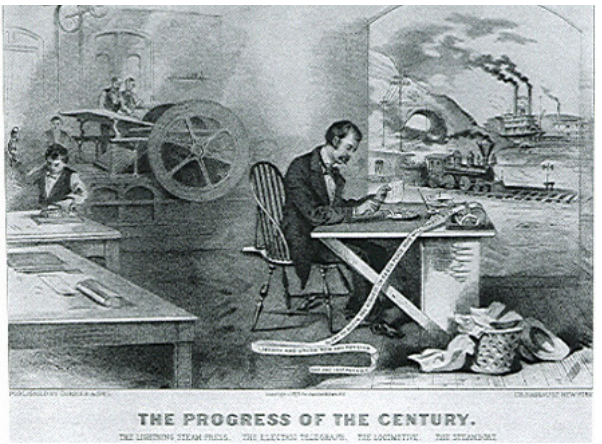


Figure 5: Poster highlighting key innovations of the 19th century: the steam press, the locomotive, the telegraph, and the steamboat [79]

To be sure, evidence of technological change is all around us—smartphones, self-driving cars, amazing drug discoveries, and even drone warfare. But despite these techno-utopian claims, the reality is that there has been little acceleration of the pace of technical change over the last 200 years and there is little evidence that this will change going forward. To be sure, there have been cycles of rates of change, with some periods seeing the development of new "general purpose technologies" (GPTs) and other periods seeing the "installation" and improvements of these technologies.[80] But past periods of GPT development have been just as robust, if not more, than current. Indeed, if we could go back in time and ask someone in 1900 about the pace of technological change, they would likely tell a similar story about its acceleration, citing the proliferation of amazing innovations (e.g., railroads, electric lighting, the telephone, the record player) (See Figure 5). As Figure 6 illustrates, the technological developments of past eras were seen as transformative and powerful, just like today. In fact, as Robert Friedel notes, "even the technological order seems more characterized by stability and stasis than is often recognized."[81]

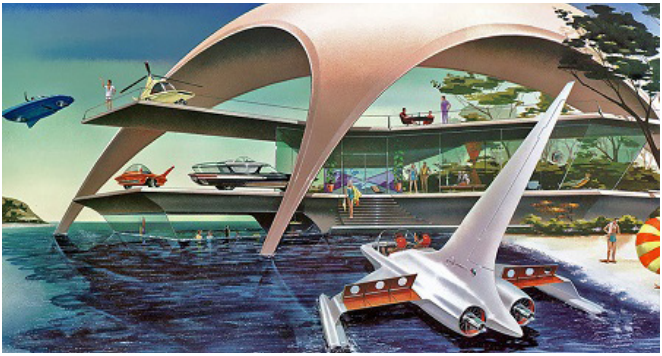


Figure 6: Techno-utopianism has a long history

While the overall pace of innovation has not changed significantly, one reason it appears to have is because of Moore's law. Named after Intel co-founder Gordon Moore, the term refers to a prediction made in the 1960s that computing power would double every two years. Miraculously, it has: computing power is over 1.1 million times faster today than it was 40 years ago. But as important as semiconductor technology is, it is not the only technology shaping evolution. Other technology areas, including materials, life sciences, and energy, experience slower rates of innovation, but even here innovation can be dramatic, often when it is enabled by advances in IT. For example, the cost of sequencing the human genome has fallen from tens of millions of dollars to less than $1,000 in the last decade, although much of this is a result of taking advantage of Moore's law.

And while it is true that there are more resources devoted to innovation (e.g., global R&D spending is at its peak), innovation in many areas is getting harder, not easier. Many of the low-hanging innovations are already discovered. We see this in pharmaceutical innovation, for example, where advances now depend on much deeper levels of understanding of genetics and proteomics and this understanding is won at a much higher cost than in the past. Finally, there is no assurance that Moore's law will continue uninterrupted. In fact, it appears at risk of slowing down.[82]

Others go to the opposite extreme and claim that technological change is now stalled and that we face a steady state world in the future. Economist Robert Gordon has perhaps received the most attention of anyone making this claim. In his Cassandra-like paper, "The Demise of U.S. Economic Growth," he argues that future U.S. growth is likely to be minimal. But his analysis is largely focused on factors like transfer payments, taxes, and income inequality. He should have titled his missive "The Demise of Robust After-Tax Income Growth for Low and Moderate Income U.S. Workers." Despite the unwarrented notoriety of his claim, Gordon fails to make a convincing argument for an overall growth slowdown. This is partly due to his reliance on assumptions about education, inequality, and globalization, coupled with a fundamental lack of understanding of the nature of 21st century innovation. Gordon fails to appreciate the way that decreasing cost and increasing ease of use can transform a technology's potential—which is odd, because he

acknowledges that electricity continued to have major impacts on productivity as it declined in price and improved in functionality and began to play a new role in people's home and work lives. Indeed, technologies are emerging that may make it possible for the pace of technology-based evolution to speed up at least slightly. For example, 3D printing and CAD design systems allow companies to much more quickly prototype new products. Boeing's Phantom Works used rapid prototyping techniques to design and build a working scale model to compete for the Defense Advanced Research Projects Agency (DARPA) "X-plane" competition in less than 30 days.[83]

While the overall pace of evolution has not appreciably changed over the last 150 years, what has changed today is its scope. Prior to the IT revolution, technological evolution was most pronounced in the goods sector—manufacturing and agriculture—and powered by the post-WWII revolution in chemicals and electro-mechanical technologies. Because these technology systems were more easily applied to the goods sector, the pace of "genetic mutation" was greater in these industries and so they evolved much more quickly than other industries. That is one reason why productivity in manufacturing and agriculture grew much more quickly than in services. It's also why a classroom or doctor's office today looks much like it did 50 years ago, while a typical farm or manufacturing plant does not. But the dominant technology system today, ICT, is enabling "genetic mutation" in virtually all industries, including services. Just look at the transformations in sectors like media, news, travel services, retail, banking, taxis, hotels, and others. As Silicon Valley venture capital financier Marc Andreessen writes, "software is eating the world."[84]

The dominant technology system today, information and communications technology, is enabling "genetic mutation" in virtually all industries, including in services.

This development of a broad-based, general purpose technology like IT has several evolutionary impacts. First, it expands output in the core technology system (IT) and creates jobs for individuals who both develop and "install" the technology. This is why from 2000 to 2011, IT occupations in the United States grew 95 times faster than overall U.S. job growth.[85]

But technological innovation spurs evolutionary change through two additional channels. The first is by transforming products and industries. This is the proverbial buggy whip manufacturer case. As autos became widespread, buggies declined and the economy needed fewer workers and firms making buggy whips (and buggies).[86] We can see this dynamic by looking at changes in the technology of recorded music production. In 1939, recorded music meant phonograph records playing at 78 rpms. And the industry needed a particular set of occupations to produce vinyl records. These included assembling adjuster, backer-up, matrix-bath attendant, matrix-groove roller, matrix-number stamper, needle lacquerer, pick-up assembler, pick-up coil winder, record finisher, record press adjuster, record-press man, sapphire-stylus grinder, and sieve gyrator.[87] A sieve gyrator is someone who "breaks up and sifts material (basically shellac) for making phonograph records; places material in a breaker which crushes it; dumps crushed materials in sieve machine which automatically sifts it; returns pieces to

breaker that do not pass through screen."[88] Needless to say there are likely very few if any sieve gyrator jobs left today as most people consume their music on CD players and MP3 players. In a few years, it's likely that even the occupations involved in making music CDs will go by the technological wayside as most music will involve downloading bits from a server to a digital music player.[89]

If we look at some of the occupations of today that largely didn't exist 30 years ago (e.g., green marketers, distance learning coordinators, informatics nurse specialists, nanosystems engineers, cytotechnologists, etc.), we can see the same dynamic. These occupations emerged because technological innovation made them possible. There was no need, for example, for informatics nurse specialists when virtually all medical information was on paper files. Likewise, why have a distance learning coordinator when broadband communications was largely non-existent, or a green marketer when clean tech was a niche product at best?

Finally, industrial and occupational distributions change because some organizations figure out ways to produce goods and services more efficiently. Forty years ago, economist William Baumol described what became known as "Baumol's disease," where some industries that could not raise productivity (or at least did not raise it as quickly as the rate of economy-wide productivity growth) would become a larger share of the economy, at least in terms of nominal output and number of employees. A case in point is the education industry and teachers. It still takes one teacher to teach 30 students in elementary school, just as it did 40 years ago. In contrast, it takes significantly fewer workers to produce a car. As a result, industries with lower productivity growth become a larger part of the economy over time. We see this today with how health care and education cost more and become a larger share of nominal GDP and employment every year.

But Baumol's disease should not be seen as an iron law of evolution. With the development of new technologies, new business models, and new market structures, previously stagnant sectors can become dynamic. A case in point is higher education. One could envision a completely different system where degrees are not granted by universities, but by testing and accreditation bodies, and where a significant share of student learning is IT-enabled, such as through MOOCs (massive open online courses) and "serious" educational gaming.[90] Such changes could dramatically boost higher education productivity, thereby lowering tuition costs.

For industries that do not suffer from Baumol's disease, technology gradually reduces the number of jobs and nominal output relative to the overall economy. In fact, by enabling self-service or complete automation, technology can eliminate certain occupations completely, freeing up labor for work that machines can't do. Seventy years ago, tens of thousands of young men and boys worked in bowling alleys as pin setters, setting up the pins after the bowlers had knocked them down. But the development by AMF in the 1940s of the automated pin setting machine completely eliminated the need for those jobs. Likewise, the development by Otis Elevators in the 1950s of the self-service elevator did away with the need for virtually all elevator operators.[91]

Other technology-induced declines are still significant, if less dramatic. For example, while 180,000 Americans were employed as travel agents at the turn of the millennium, with the emergence of Internet-based travel booking, just over 100,000 are today. Likewise, there are 71 percent fewer telephone operators, 54 percent fewer data entry keyers, and 17 percent fewer postal mail carriers than there were a decade ago, even though the volume of information transactions has grown, all because of the digital revolution. And with the first emergence of superstores, then online book sellers like Amazon, and now downloadable e-books, around 250 book store establishments have closed every year for the last decade in the United States.

By enabling self-service or complete automation, technology can eliminate certain occupations completely, freeing up labor for work that machines can't do.

But with deaths from technology also come births. For example, around 1,100 "electronic shopping stores" have opened every year for a decade, and in 2012 there were 466,000 U.S. jobs related to mobile apps, up from zero in 2007. Indeed, if you examine some of the fastest growing U.S. industries over the last 15 years, most are due to technological innovation (see Table 3). For example, support activities for oil and gas operations grew by 386.1 percent, in part to support natural gas "fracking," which was in turn enabled by innovations, much of it with U.S. Department of Energy origins.[92] Many fast-growing industries are, not surprisingly, in the IT industry, such as Internet publishing, Internet services providers, software, and cellular communications systems. Others—like biological products and surgical and medical instrument manufacturing—are also spurred by innovation, enabling new products to come to market (but also by globalization, which enables access to larger markets for an industry that the United States still has competitive advantage in).

Table 3: Changes in real industrial output by industry and cause. (Opposite)
* 1998-2011 data [93]

Industry	NAICS Code	Real Gross Output Change 1998-2012
Growth Due to Technology		
Internet publishing and broadcasting and Web search portals	519130	1094.2%
Wireless telecommunications carriers (except satelite)	517210	699.9%
Support activities for oil and gas operations	21311A	386.1%
Biological product (except diagnostic) manufacturing	325414	137.4%
Data processing, hosting, and related services	518200	132.7%
Software publishers	511200	116.2%
Primary battery manufacturing	335912	111.2%
Environmental and other technical consulting services	5416A0	101.4%
Computer systems design services	541512	56.7%

Industry	NAICS Code	Real Gross Output Change 1998-2012
Decline Due to Technology		
Electron tube manufacturing	33441A	-54.7%*
Software, audio, and video media reproducing	334611-2	-51.6%*
Magnetic and optical recording media manufacturing	334610	-42.4%
Video tape and disc rental	532A00	-39.0%*
Electronic and precision equipment repair and maintenance	811200	-33.9%
Postal service	491000	-30.2%
Directory, mailing list, and other publishers	5111A0	-26.0%
Couriers and messengers	492000	-19.6%

Industry	NAICS Code	Real Gross Output Change 1998-2012
Growth Due to Societal Changes		
Military armored vehicle, tank, and tank component manufacturing	336992	294.9%
Tortilla manufacturing	311830	103.4%*
Wineries	312130	102.7%
Medical and diagnostic labs and outpatient and other ambulatory care services	6214-5, 6219	78.4%
Securities, commodity contracts, investments, and related activities	523A00	69.4%
Fitness and recreational sports centers	713940	62.8%*
Offices of physicians, dentists, and other health practitioners	6211-3	53.3%
Home health care services	621600	43.3%

Industry	NAICS Code	Real Gross Output Change 1998-2012
Decline Due to Societal Change		
Newspaper publishers	511110	-46.7%

One key question about technological change and industry development concerns the nature of the change. Technological change does not equally reshape all industries and occupations; rather, it has differential impacts. In particular, it appears that over the last several decades, productivity growth has been higher in industries and occupations that perform more routine tasks. As MIT professors Autor, Levy, and Murnane argue, "within industries, occupations, and education groups, computerization is associated with reduced labor input of routine manual and routine cognitive tasks and increased labor input of nonroutine cognitive tasks."[94] This has had some impacts on inequality as more of these occupations have been middle-wage ones.

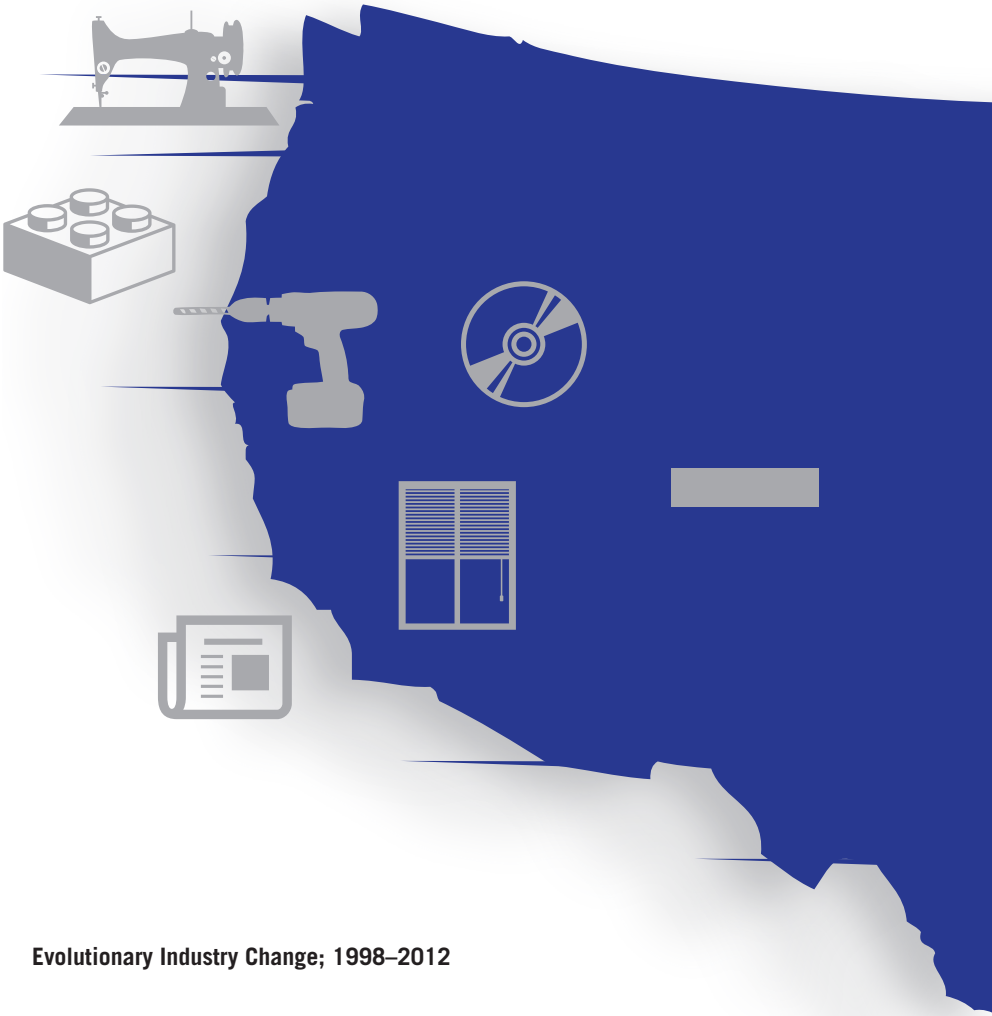
So where does technological change come from? Conceptually, the roots of technical change can be found in two sources, dubbed "*technology-push*" and "*demand-pull*." The latter refers essentially to market dynamics that draw innovations forth, as firms innovate in response to changing market conditions. The former refers to the

Industry	NAICS Code	Real Gross Output Change 1998-2012
Growth Due to Trade Competition		
Surgical Equipment	339112-3	75.5%
Construction machinery manufacturing	333120	56.3%
Analytical laboratory instrument manufacturing	334516	54.6%
Aircraft manufacturing	336411	29.7%

Industry	NAICS Code	Real Gross Output Change 1998-2012
Decline Due to Trade Competition		
Nonupholstered wood household furniture manufacturing	337122	-72.4%
Textile and fabric finishing mills	313300	-58.5%
Blind and shade manufacturing	337920	-54.3%*
Power-driven handtool manufacturing	333991	-45.0%
Doll, toy, and game manufacturing	339930	-35.0%
Ferrous metal foundries	331510	-29.0%

non-market expansion of knowledge and technological development that in turn enables innovation.

The debate over the relative importance of these two sources of technological advancement has lasted for decades, and evolved over time. Several mid-century studies sought an answer to this important question; many of these came down on the side of market demand as the primary driver of technical change, seemingly settling the question. A seminal study by economist Jacob Schmookler found that patenting activity did appear to have a strong relationship with market demand in several industries, most notably railroads.[95] However, later modeling using broader or improved data sets demonstrated that this relationship was weaker than Schmookler had originally found. Schmookler himself would eventually argue that both demand-pull and technology-push were necessary components of innovation. As experts gained a deeper understanding of the technical change process, many similar



Evolutionary Industry Change; 1998–2012

INDUSTRY DECLINE FROM:

Technology: Audio/Video Reproduction, U.S. Postal Service, Videotape Rental

Spatial: Powertools, Textiles, Toys and Games, Blind & Shade Production

Societal/Cultural: Newspaper Publishers

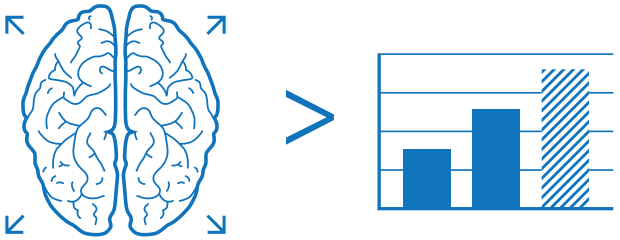
INDUSTRY GROWTH FROM:

Technology: Software, Data Processing, Internet Publishing
Spatial: Aircraft, Lab Instruments, Construction Equipment
Societal/Cultural: Military Vehicle Production, Healthcare

demand-oriented studies were likewise criticized as standing on shaky ground. A common criticism was that these studies placed too much focus on commercially successful innovations that had already been widely adopted, thus biasing the findings toward market demand, while underestimating the role of non-market technology supply. In a review of these studies, economists David Mowery and Nathan Rosenberg wrote, "The notion that market demand forces 'govern' the innovation process is simply not demonstrated by the empirical analyses which have claimed to support that conclusion."[96]

It is the development of knowledge broadly defined, more so than changes in market demand, that enables fundamentally new products and services.

A more sophisticated understanding of technical change recognizes that technology supply and market demand play very different roles at different stages of technological development. Market demand appears to have significantly less influence on more fundamental or radical innovations and more on incremental or "sustaining" innovations. As the quip goes, "the computer was not invented because the cost of typewriter carbon paper increased." In other words, it is the development of knowledge broadly defined, more so than changes in market demand, that enables new products and services. Market demand plays more of a role in shaping the incremental changes to these fundamental innovations.



Expansion of knowledge leads to expansion of economies

Given the inherent uncertainty during the early technology development phase, it is impossible for firms to accurately determine optimal search paths in the "rational" fashion envisioned by neoclassical economics. Whereas the neoclassical doctrine sees firms as rational actors making rational (and thereby efficient) resource choices, "evolutionary economics" recognizes that uncertainty makes truly efficient resource allocation impossible. As economists Richard Lipsey, Kenneth Carlaw, and Clifford Bekar have argued, two firms with the same resources and information about potential technological outcomes may make radically different but equally justifiable choices about where to allocate those resources in pursuit of technology; the "efficient choice" is invisible, or at least impossible to determine.[97]

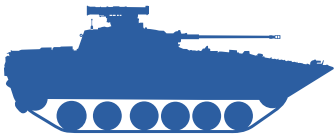
Changes in Demand

The third source of evolutionary change is from changes in the types of goods and services demanded by consumers (whether these are businesses, governments or individuals). Various factors can alter the composition of demand, including demographics, culture, and government.

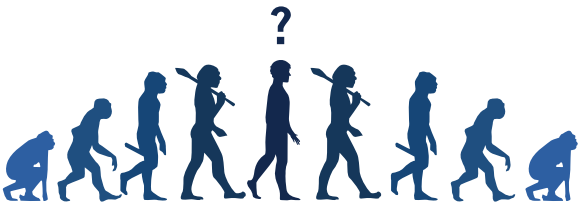
Changing demographics is one driver of evolutionary change. Immigration, especially first- and second-generation immigration, not only makes the economy larger, it changes it. The fact that one of the fastest growing manufacturing industries in the last decade is tortilla manufacturing is likely a reflection of the rapid growth in the number of Hispanic Americans, coupled with a growing taste for Mexican food by more Americans. Likewise, the aging of the population changes what Americans consume and what industries grow and decline. The fact that health care has grown as a share of the economy is a function in part of the growing number of elderly Americans.

Cultural change is another driver. The fact that every third block of many cities seems to have a Starbucks on it is not so much a reflection of new coffee-making technology, but rather that Americans have developed a craving for higher quality coffees. Who would have predicted that there would be a fast-growing occupational category of barista? Cultural attitudes shape economic evolution. For example, the fact that the number of child care workers increased from 400,000 in 2000 to over 630,000 in 2010 is in part a reflection of a change in cultural norms and personal attitudes that are more accepting of both parents of young children participating in the labor force. While one reason newspaper publishing dropped 23 percent from 1998 to 2012 is because of technological innovation (it's easier to get news from other sources), it appears that another reason is cultural, with fewer Americans actually interested in the news.[98]

Government itself shapes evolution. The fact that more Americans are more skeptical of government (and that government has increasingly contracted out to the private sector for services) has meant that government as an industry (as opposed to government as a writer of checks for transfer payments) has grown much more slowly than the rest of the economy over the last two decades. In fact, from 1987 to 2010, federal government output grew at just 11 percent the rate of growth in GDP, while state and local government grew just 57 percent as fast.[99] At the same time, the increased importance placed on national defense after 9-11 has meant that defense has grown. For example, gross output in military armored vehicle, tank, and tank component manufacturing grew 700 percent from 1998 to 2011 as we produced vehicles for American armed forces in Iraq and Afghanistan.



EVOLUTION OR DEVOLUTION?



Evolution implies progress. But as discussed above some structural economic changes can be negative, representing regress, not progress; devolution, not evolution. If policymakers are to craft effective economic policy it is critical to be able to distinguish evolutionary change from devolutionary change. Unfortunately, to the extent conventional economics considers structural economic change, most view it as intrinsically evolutionary (i.e., positive) in nature. For example, according to the conventional view, if the economy loses manufacturing output, as the U.S. economy did in the last decade, by definition this is evolutionary since these changes have resulted from Pareto-optimal choices made by consumers in the market.[100] In other words, consumers and producers are voluntarily making these decisions that benefit both parties in any transaction, so the ultimate outcomes have to be welfare maximizing. This explains the comment of former director of the National Economic Council under President Obama, Larry Summers, when he justified the unprecedented loss of U.S. manufacturing in the 2000s, stating, "We are moving towards a knowledge and service economy. You don't succeed by producing exactly the same thing that other people are producing in the same way just at a lower cost…There is no going back to the past."[101]

Some structural economic changes can be negative in nature, representing regress, not progress; devolution, not evolution

But America lost that manufacturing output because other nations had instituted unfair trade practices, U.S. firms had investment horizons that were too short-term, and the federal government lacked an effective competitiveness policy (e.g., it had a high corporate tax rate, lack of public investment in pre-competitive industrial research, etc.). As a result, many of the losses (but not all) were devolutionary in nature. Likewise, if an industry like financial services grows at very rapid rates and consumes an increasing share of societal resources, neoclassical economics views this as progress and evolution, even if much of the economic activity provides either no net economic value or negative value, as was the case in its role in the financial crisis.

So a key question is: what makes evolution produce "positive" evolution as opposed to negative devolution? The answer depends on which of the three evolutionary forces we are looking at. From the spatial evolutionary perspective, devolution is more likely when other nations are engaged in predation (e.g., unfair mercantilist practices) and the United States has inadequate traded sector policies. From a technological perspective, innovation is usually going to be evolutionary in nature. However, it may be devolutionary in cases where industries are able to

organize themselves to engage in rent seeking; innovation then becomes a tool for expropriation rather than productivity. We need look no further than industries like real estate, where the multiple listing service is used as a tool to limit competition, or finance, where innovation was used to hoodwink less sophisticated investors.

While the evolutionary changes spurred by technology are usually in the direction of progress, changes stemming from demographics, culture, and other demand factors may or may not be. The fact that we have more tortilla production certainly reflects changes in tastes; it means by definition that we have slower growth in "bread" production if people substitute tortillas for bread. The fact that we have smaller government means we have fewer public goods and more private consumption goods. And, while it raises gross output, the fact that there are more immigrants does not—at least through first-order effects—change per-worker output.[102] (High-skill immigration is likely to have more positive evolutionary impacts as it helps support innovation.[103]) Moreover, some culture-demographic based evolution can be devolutionary in nature. An aging population reduces per-capita GDP since old people work less than young people, especially after they retire, and unlike with children, spending on the elderly is not a capital investment that produces returns later. Entrepreneurial vigor and creativity also decline as the population ages. And aging diverts resources from evolution-driving investments (like funding scientific research) to consumption (like healthcare spending).

To see how evolution and devolution play out, consider two kinds of output and job loss: spatial and technological.

Offshoring: "Natural" Evolution or Unnatural Devolution?

As discussed above, over the last two decades global economic integration has dramatically accelerated, leading to a restructuring of the U.S. economy. But is this restructuring evolutionary or devolutionary? Neoclassical economists assume that all offshoring is a reflection of the positive evolution of the U.S. economy. When Kevin Hassett, a scholar at the conservative American Enterprise Institute, states that "manufacturing has been on a more-or-less-steady decline as a share of national output for decades, part of the natural evolution of the U.S. economy," or Larry Summers argues that "America's role is to feed a global economy that's increasingly based on knowledge and services rather than on making stuff," they are reflecting this neoclassical view.[104] Princeton University economist Alan Blinder likewise reflected this view when he wrote: "The TV manufacturing industry really started here, and at one point employed many workers. But as TV sets became 'just a commodity' their production moved offshore to locations with much lower wages. And nowadays the number of television sets manufactured in the United States is zero. A failure? No, a success."[105]

For neoclassicalists, spatial loss is welfare maximizing because it benefits consumers and frees up resources to enable America to concentrate on its "true" competitive advantage. But they equate welfare only with short-term consumer welfare (consumers benefiting from cheaper TVs, toys, etc.), and ignore the negative impact to welfare from reduced production capability, especially higher value added production. And their definition of competitive advantage is tautological—whatever we lose we by definition should have lost because we didn't have comparative advantage in it.

But assuming that all structural change based on geographic loss is positive evolution avoids the hard work of really understanding the causes of the loss of an industry. Lose an industry (or 50)? It's a success. No need to worry that high U.S. corporate tax rates caused this because we should have lost the industry anyway, and after all, we don't even compete with other nations. No need to worry about unfair, predatory foreign trade practices. It's all just free trade and welfare-enhancing Ricardian comparative advantage working its way out.

But let's look more carefully at the assumptions in this argument. To take Blinder's example: he was right that the old black-and-white and then color cathode-ray tube television sets had become commodities where competition was based largely on production cost. With its high costs, the United States did not have competitive advantage in this kind of production. But Blinder's assumption of "technological stasis" betrays an inability to understand dynamic technologies and how product life cycles regularly renew themselves, in part as brand new technologies emerge that can be incorporated into existing product systems.

Product cycle innovation is not just about new industries spawning new startups; it's also about existing firms and industries shedding mature technologies and reinventing themselves around new generations of similar technologies.

Once the United States took the neoclassical economists' advice and did nothing to push back against the decline of the U.S. TV industry, it lost out entirely as televisions evolved from cathode-ray tubes to high-definition, flat-screen TVs—first using liquid crystal displays (LCDs) and then light-emitting diode (LED) displays—and as those technologies were deployed across a wide range of products, from digital advertising signage systems to large-scale video displays. It lost out in manufacturing the multi-million dollar, jumbo-screen displays found in ballparks across the country, as well as the high-definition televisions (HDTVs) found in living rooms from coast to coast. These Asian-manufactured HDTVs are increasingly coming to market as converged devices with computing and connectivity features, 3D capabilities, and 4K ultra-HD resolution.[106] Indeed, one key characteristic of a technology industry is short product life cycles, so that firms have to keep inventing new offerings or risk going out of business.

We see this in many industries. Orville and Wilbur Wright were the founders of the aviation industry over 100 years ago, but innovation proceeds apace in aviation. For example, Boeing's 787 jet is the first airplane made of lightweight composite materials. Over the last 100 years the propulsion power of airplane engines has increased by an order of magnitude about every 25 years on average, while fuel efficiency in terms of burn rate per passenger seat is 70 percent better than it was in the original Comet jet of the 1950s. Despite being more than a century old, aviation is anything but a mature industry where cost drives all.

This neoclassical view betrays a failure to understand that product cycle innovation is not just about brand new industries spawning new high-growth startups (e.g., search engines, biotech, etc.), but is also, when working properly,

about existing firms and industries shedding mature technologies and reinventing themselves around new generations of similar technologies. This is what Japanese and Korean TV manufacturers did, but not U.S. TV manufacturers; it's what German machine tool builders did, but not U.S. builders.

The global restructuring of industries can be evolutionary or devolutionary for nations, depending on policies and corporate practices. It can also be evolutionary or devolutionary for technological innovation overall. As Carnegie Mellon's Erica Fuchs has shown, production location choices are not always evolutionary maximizing from the perspective of global innovation. Her study of the optoelectronics industry shows that production location changes the relative economics of the two competing designs, one emerging, one prevailing, that are currently perfect substitutes for each other on the telecom market.[107] In this case, global redistribution of production allows the short-term costs of the former to be significantly reduced, but at the expense of longer-term innovation. This is because the emerging, innovative designs developed in the United States no longer pay, at least in the short run. In this case, spatial devolution locks in older designs, at least for longer than would otherwise be the case, at the expense of newer ones with "performance characteristics that may be valuable in the long term to the larger computing market and to pushing forward Moore's Law."[108]

Why should policymakers care about slowing spatial devolution—at least the kind of devolution that is not "natural" and could be avoided without resorting to global-welfare-reducing policies? There are three key reasons. The first is that, by definition, sectors subject to spatial devolution are traded sectors. A nation's traded sector comprises those industries and establishments competing in international marketplaces and selling output at least in part to nonresidents of the nation. Traded sectors include almost all of a nation's manufacturing activity, some services (such as software, Internet, and engineering services, and entertainment content like music, movies, and video games), and some of the extraction sectors (e.g., farming and mining). Because these industries face market competition that is global in nature in a way that non-traded, local-serving industries (e.g., retail trade or personal services) do not, their success is by no means assured. For example, while we may not know whether Safeway or Walmart are going to gain market share in the U.S. grocery store industry, we do know that the industry itself will be healthy, dependent only on the income and purchasing habits of American consumers. On the other hand, while we may not know whether Boeing or Airbus are going to gain market share in the growing global aircraft industry, we also do not know whether there will be aviation industry jobs in the United States, since this depends on the United States winning in global competition in this industry. Put differently, if a grocer goes out of business, another will emerge to take its place to serve local demand, but if a traded sector enterprise such as an aircraft manufacturer or software company closes, the one that takes its place may well be located in another country.

Loss of traded sector competitiveness has two economic effects, one short term and one long term. In the short term, traded sector loss is akin to the Federal Reserve Bank raising interest rates or the federal government raising taxes or cutting spending: it serves as a contractionary force. Workers lose their jobs and spend less money, with the effects rippling through the economy. In contrast, non-

traded sector loss (e.g., one department store going out of business) has much less of a contractionary effect because the demand is usually quickly shifted to other non-traded firms in the same industry, who in turn expand output and employment. Long-term effects of traded sector loss are either that the currency falls in value (to make imports more expensive and exports cheaper) and therefore current consumers are worse off, or that the nation accumulates a trade deficit which must be paid off by later generations in the form of reduced consumption. In addition, economy-wide productivity can decline if the lost output is higher than average productivity. In this case, workers will move from high-productivity jobs to lower-productivity ones.

The second reason to care about devolutionary loss is that a not-insignificant share stems from foreign predation. It's one thing if a U.S. traded sector firm cuts production in the United States because it faces a more formidable competitor competing fairly, or relocates to a nation with cheaper factor inputs (e.g., wages, energy, etc.). It's quite another if the firm's U.S. output declines because the foreign competitor is backed by their state using an array of unfair, mercantilist practices (e.g., currency manipulation, export subsidies, state-supported intellectual property theft, etc.).[109]

The third reason is that some of the knowledge and production capabilities lost from spatial devolution can have important spillovers to other sectors and capabilities. Unlike the neoclassical view of the economy which sees firms as atomistic organizations, the reality is that for many sectors, particularly innovation-based sectors, firms benefit from and produce positive "external economies"—in other words, benefits to other firms. Regional "clusters" have become more important for this reason. In fact, the extent to which an industry is geographically concentrated has been increasingly associated with subsequent productivity growth during the last three business cycles.[110] Such industry clustering enables firms to take advantage of common resources (e.g., technical institutes, a workforce trained in particular skills, and a common supplier base), which facilitates better labor-market matching and knowledge sharing.[111] Each firm in a cluster makes the cluster more valuable to other firms. As such, because the benefits of geographic clustering spill over beyond the boundaries of the firm, market forces produce less geographic clustering than society needs. Each firm in a cluster confers benefits on other firms in the cluster, but no individual firm takes the "external" benefits it produces into account when making its own location decisions. Losing traded sector firms that contribute to external economies means that more than just the particular firm output is lost.

In addition, some traded sector firms are vital to a nation's national security. A number of reports have warned about the loss of the U.S. industrial base and its high-tech capabilities, arguing that these trends have the potential to profoundly impact the military. As the National Defense Industrial Association sums up the situation, "If we lose our preeminence in manufacturing technology, then we lose our national security."[112]

It's one thing to say that some traded sector output is more critical than other traded sector output and that policies should work to enhance that output. It's quite another for policymakers to know which kinds of output can and should

be retained in the United States, at least for some period of time. How do they determine which spatial losses are inevitable and which are worth fighting? Isn't the risk that even entertaining the notion that some output can be retained will stir up a hornet's nest of protectionist special pleading and provide an excuse to slow or stop all spatial restructuring—both that which is evolutionary (e.g., losing low-skill, cost-based manufacturing), and that which is devolutionary (e.g., losing high-skill, high value-added production)? But just because there is a risk that policymakers will get it wrong is not an excuse to ignore or obfuscate this important distinction between output that is salvageable and that which we should willingly shed.

Appropriate policy responses have to differentiate between industries (and segments of industry) that die (e.g., move offshore) for "natural" reasons and those that die from "unnatural," preventable reasons.

This suggests that appropriate policy responses have to differentiate between industries (and segments of industry) that die (e.g., move offshore) for "natural" reasons and those that die from "unnatural," preventable reasons. For the former, the appropriate policy response is to help the workers and affected communities transition to new jobs and industries. And this is largely where the neoclassical economic response stops when it comes to spatially-related loss. Trade-induced losses are good (e.g., evolutionary), so they argue, so the role of policy is to support them while perhaps helping those hurt by the change. And the worst thing government can do is to attempt to slow or, God forbid, reverse the loss.

Indeed, for the areas in the United States hurt by globalization, neo-classical advice is that these regions should either seek to be even lower cost (in part by workers being willing to accept even lower wages to compete with China), or that their workers should simply move to higher-cost innovation seed bed areas. But the former strategy is a devolutionary one, not an evolutionary one, as it leads to the retention of industries that naturally should be shed, and to declining, not increasing incomes. And the latter strategy, besides ignoring the fact that workers are not interchangeable pegs and usually have strong ties to community, family, and tradition, ignores the fact that there are significant overall economy-wide costs to such a strategy.

If neoclassical economists see all spatial loss as evolutionary, most liberal neo-Keynesians see all spatial loss as devolutionary and preventable and therefore advocate for policies to slow or eliminate virtually all spatial loss (e.g., offshoring). For them, there is no reason the U.S. should lose textile and apparel jobs in manufacturing or call centers in services. They see the evolutionary process as simply too disruptive and painful to the individuals involved in it. Better to work toward a "steady state" environment where workers are sheltered from such disruption. Indeed, the response of some liberal neo-Keynesians is focused on slowing down that kind of evolution across the board (as opposed to strategically slowing it where that makes sense, while also accelerating the pace of innovation, including in existing industries) by attempting to recreate the conditions of the

pre-1980s U.S. economy. Their view is that if we can just close out the option of spatial deconcentration to low-wage nations by limiting trade—especially with low-wage nations with weak labor and environmental standards (what they call closing down the "low road option")—and absent that, convincing these nations to adopt U.S.-level regulatory and labor standards, that America's low-wage regions and low-wage commodity-based production can once again thrive.

This is an appealing notion to be sure, especially if one takes an unflinching look at the economic pain inflicted by global dislocation. But again, this strategy is devolutionary, not evolutionary, for while policy can and should attempt to guide the evolutionary responses of the economy, it fundamentally cannot turn a rainforest into a savanna. In other words, while one can and should slow deconcentration by spurring productivity and fighting predatory foreign mercantilism, these forces are inexorable and the natural components of spatial loss are evolutionary and positive. To use an example, the United States should probably not be making plastic toys that are given out by fast food restaurants. But we should be inventing and producing advanced, cutting edge polymers.[113]

Some of spatial loss has been evolutionary and good for the U.S. economy, while some has been devolutionary.

The reality is that some of the spatial loss has been evolutionary and good for the U.S. economy (while bad for the workers who lose their jobs, at least in the short term), while some has been devolutionary. In fact, more than half of the loss to U.S. industry from trade in the past decade has not been a result of natural, evolutionary processes. It has been a result of foreign predation or lack of evolutionary adaption here at home.[114] As a result, policymakers need to consider the right policy response for this particular type of loss.

Take the U.S. TV industry experience as an example. One path of TV evolution would be to see that TVs were becoming commoditized and that therefore the U.S. should allow this industry to die as we would move up the value chain to even more innovative industries emerging from our vibrant innovation seed bed. But in the evolutionary economy approach, this offshoring path could be slowed, perhaps for a long time, through a variety of policies, enabling the U.S. economy to capture significant value added. Policies supporting greater automation would enable the industry to better compete with low-wage competitors. Policies could reduce evolutionary attacks by other nations; in the case of TVs, for example, they could have worked against the predatory pricing by the Japanese producers and government in the 1970s and 1980s.[115] Note that the term "predatory pricing" reflects a key factor in evolutionary competition as it stands today—the evolutionary process is often about just that, predation by some countries and their companies against the producers of others. In the case of the Japanese for example, they were pricing their TVs below cost in the United States because they were able to collude domestically in Japan to keep prices higher than a competitive market would warrant. Finally, spatial loss could be slowed by evolutionary adaption within the industry itself, supported by smart government policies. This is what Japan has been doing (although in increasing competition with Korea). For example, in the 1970's the U.S. government could have helped

form a "Sematech" for TVs: a joint industry-government-university alliance to help develop pre-competitive, advanced TV technology.

Why even bother to slow loss? Can't we just create the "new" faster? In other words, speed up evolution? This is in fact the dominant view in U.S. economic policy circles, as many interpret Schumpeter to mean that innovation policy is only about speeding up the evolutionary process by supporting the more rapid emergence of newer entrepreneurial activities and technologies. In other words, it's all about speeding up firm (and technology) birth, not about extending the lives of existing firms and technologies. That is, U.S. economic policy is focused on "new," not "renew."[116] As such, the favored policies focus on speeding this introduction of front-end innovation, through policies to support new firm startup and commercialization of technology breakthroughs.

Slowing the loss rate from spatial relocation—not by protectionism and populist opposition to corporations, but by helping establishments better compete in global markets—is required because we can't expect that "births" from innovation alone will create the jobs we need.

In fact, for some "creationists," any concern about slowing the loss of U.S. jobs is a waste of time at best, and downright harmful at worst. For example, in a *Washington Post* editorial, Zachary Karabell argues that since China steals so much U.S. intellectual property (IP) and engages in so much forced technology transfer, it's a waste of time to try to fight it. We should give up the fight to slow this loss and instead just develop new IP even faster; faster in fact than the Chinese can steal it.[117] Likewise, Council on Foreign Relations scholar Adam Segal says that "we can't compete with China on hardware (e.g., making things)" but we can on software (ideas and innovation), and "an important first step will be helping small startups."[118]

The reality is that no matter how many new firms America creates, if we don't slow down firm death and contraction by reducing foreign innovation mercantilism (including stealing American intellectual property and forcing U.S. firms to transfer technology to their shores), and helping U.S. establishments (including "traditional" manufacturing firms) to boost productivity and innovation, we will find ourselves like Alice in Wonderland, where it takes "all the running you can do, to keep in the same place." Slowing the loss of traded sector activities that we have the ability to keep, at least for a while longer, is a key way to ensure that evolutionary gains outpace devolutionary losses. This is not only possible but desirable since not all back-end loss is ordained by the market.

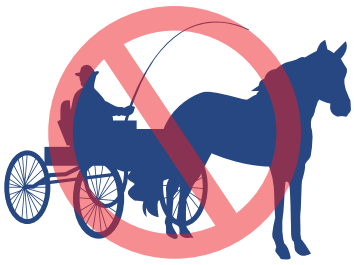
Indeed, the fact that the United States has among the highest effective corporate tax rates on manufacturers among our major competitors speeds up our loss.[119] The fact that other nations practice systematic "innovation mercantilism" and the U.S. does not adequately challenge these actions accelerates our loss. And the fact that compared to other nations, we have under-funded technology and competitiveness policies, as well as export support programs like the Ex-Im Bank,

accelerates our losses.[120] The intense competition from other nations to be the global birthplace for new products and firms is not only new, it's likely permanent.

Slowing the loss rate from spatial relocation—not by protectionism and populist opposition to corporations, but by helping U.S. establishments better compete in global markets—is required because we can't expect that "births" from innovation alone will be plentiful enough to create the jobs and economic activity we need. This is particularly true because as Robert Litan reports, jobs from new startups are at the lowest level in many years.[121] It's unlikely that the U.S. economy can create enough new output to more than replace the loss of output on "the back end" from traded sector loss. In fact, the reason why U.S. activity in early stage, high-growth firm formation has slowed (e.g., reduced venture investments, reduced firm formation, etc.) is precisely because high-growth startups are dependent on a healthy innovation ecosystem, one in which existing firms are innovating and not losing economic activity to other nations unnecessarily. Slowing the loss also gives firms time for the competitiveness response to work—to cut costs and innovate new product offerings.

Buggy Whip Evolution: Creative Destruction and Extinction From Better Technology

The second type of evolutionary "extinction" stems from technological innovation. Indeed, technology is the major driver of evolutionary extinction and creation. Here, neoclassical and evolutionary economists are largely in agreement: extinction and loss stemming from domestic technological innovation is fundamentally evolutionary and positive (provided it is not the result of predation, either domestic or foreign), for it leads to the replacement of less efficient, lower quality, and/or less innovative activities with more efficient, higher quality and/or more innovative activities. In contrast, some on the Left are troubled by such extinction because they place greater emphasis on the welfare of the workers who may suffer from the evolutionary competitor than they do on the beneficiaries of the technological innovation (e.g., consumers, new firms, etc.). But the reality is that economic progress is not possible without extinction from new technology. The job of policy is not to resist the superior species (e.g., the new technology). And while it can help those impacted by the competition to transition to new activities, it should still do everything possible to encourage the development of these new "species." In other words, policymakers need to embrace the evolutionary force of Schumpeter's "creative destruction." This is the kind of evolutionary extinction that both opens the way for and is caused by superior economic species.



This creative destruction—that is, innovation—forces individuals, organizations, and even whole regions and nations to adapt or else suffer the consequences of not doing so. It turns industries (and occupations) into vestigial "buggy whip industries" with little purpose. For those invested in the old—old products, services, industries, occupations, institutions, forms of work organization, and production processes—innovation is risky and often met with trepidation at best. While the rest of us gain handsomely from innovation—after all, the definition of innovation is bringing new value to consumers and citizens—those invested in the old often lose. And all too frequently they fight, often vigorously and effectively, to protect their interests against particular innovations.

This is a mistake that some nations make when it comes to supporting economic evolution. Too many policymakers in too many nations want evolution without extinction or loss. The United States did that in the 1930s when the federal government sided with small business protectionists against large chain stores, like A&P. Indeed, the Federal Trade Commission launched investigations into chain store practices to find out why they were selling goods cheaper than mom and pop stores (they were more efficient).[122] While today's FTC is more on the side of consumers and evolution, other nations are not as fully. Emblematic are comments from French Industry Minister Arnaud Montebourg, who recently stated that when it comes to innovation that can destroy existing companies, "well, we have to go slowly."[123] Yet going slowly means growing slowly. As described below, this does not mean abandoning those hurt by technological evolution, but it does mean not slowing it down.

It's not that Europe does not invent "new" species, or at least new "DNA." They do. For example, a 2004 OECD report prepared by Eric Bartelsman found that the "rates of innovation" between U.S. and EU enterprises were actually the same, and that in contrast to popular belief, Europe was not behind.[124] This is especially the case with regard to Northern European economies. However, Bartelsman found that the United States did a much better job than Europe of more quickly allocating capital and labor to the most promising innovative concepts and startup businesses, so the United States was spawning more "winners," even though the underlying rates of innovation were analogous. This is in part because many European countries (and the European Commission) erect bureaucratic regulatory barriers that impede capital and labor movement and place unnecessary burdens on firm dissolution.[125] With a regulatory system that embraces the precautionary principle—which holds that if an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is harmful, the burden of proof that it is *not* harmful falls on those taking the action—Europe's regulatory approach is actually biased against innovation. To be sure, there can be cases where a precautionary approach is warranted when potential harms are very large and irreversible. But this does not justify applying the precautionary principle writ large. Indeed, despite America's lack of proactive innovation and competitiveness policies, our more open and accepting environment with regard to change and innovation does help partially offset this particular policy deficit.

Too many policymakers in too many nations want evolution without extinction or loss.

POLICIES TO MAXIMIZE EVOLUTIONARY GROWTH

To generate polices to maximize evolution we need to move beyond the neoclassical and neo-Keynesian playbooks. Markets alone are not enough. Resistance to evolution is neither effective nor welfare enhancing. And managing the business cycle should be less important than maximizing evolution. Using evolutionary economics as a guide, the principles of more effective economic policies become clearer. To maximize evolution, policymakers should:

1. Support global integration

2. Slow down traded sector rate of loss

3. Get out of the way of natural evolutionary gain and loss

4. Limit government barriers to evolution

5. Foster a culture that embraces evolution, including natural evolutionary loss

6. Enact policies to to support evolution

7. Support policies to accelerate economic evolution especially from technological innovation

8. Develop a deeper understanding of the evolution of the U.S. economy

Numbers one, three, four and five are about enabling Darwinian and Lamarckian evolution. In other words, to create conditions where firms compete for survival (Lamarckian) and where industries compete for dominance (Darwinian). But numbers two, six, seven and eight are about evolution through "intelligent design." In other words, about an entity (government) shaping the evolutionary process toward a goal (higher per-capita incomes, more innovation, and greater economic competitiveness). Lamarckian policies include policies to help firms better evolve, such as the R&D tax credit and support for STEM education. Darwinian policies are those that enable new entrants to thrive, including reducing barriers to entry and competition. Policies for intelligent design include those

where the government actively supports a particular evolutionary path, such as supporting intelligent transportation systems, spurring innovation in the education sector, or advancing manufacturing innovation by funding public-private research partnerships.

Support Global Integration Based on Firms Making Market-based Choices

Supporting evolution means embracing U.S. integration into global markets and accepting "natural" spatial loss, as long as those losses are not due to unfair, mercantilist foreign practices and as long as the United States has in place policies to help spur innovation and productivity along the entire technology life cycle.

Geographic expansion and integration of markets can allow for a developed nation like the United States to increase its specialization in high valued added, knowledge-based production. Moreover, because innovation-based industries have declining marginal costs, the larger markets coming from global integration result in lower costs/higher revenues, leading to a positive cycle of increased investment in R&D, leading to more innovation.[126] These are not natural monopolies because of the threat from Schumpeterian entry and disruption. But these positive dynamics only occur if foreign mercantilist practices are kept to a minimum and if the U.S. federal government has a robust traded sector competitiveness policy. Neither condition describes present reality. However, with these conditions, global market expansion is a key driver of evolution, and therefore the United States should continue to push for greater global market integration.

Slow Traded Sector Rate of Loss

While the prior recommendation is fairly clear in its implications, this one—slowing traded sector rate of loss—is anything but. The conventional economic doctrines do not provide much guidance on this point. Neoclassical economists see all trade as about specialization that maximizes consumer welfare, even if it is one-sided free trade practiced by the United States and mercantilist by foreign nations. Liberal neo-Keynesians are inclined to want to protect everything and limit global integration. What is needed is some middle space that distinguishes between sectors that are worth saving (or at least slowing down the rate of loss) and those that are not.

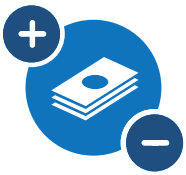
In the face of robust competition for traded sector industries, the United States needs a robust traded sector policy designed to both win in advanced technology sectors and also to slow the loss of more mature industries. Slowing the loss rate from spatial relocation, not by protectionism and populist opposition to corporations, but by helping U.S. establishments better compete in global markets is required because we can't expect that "births" from innovation alone will be plentiful enough to create the jobs and economic activity we need.

So how would policymakers know if spatial reallocation is evolutionary or devolutionary? Clearly not all of it is evolutionary, nor is all of it devolutionary. The first step is to identify why it is being threatened. One way is to determine, when examining the effects of offshoring on U.S. output, whether the loss is due to "natural" market forces, to foreign unfair "predatory" mercantilist practices that attacked and unfairly damaged the U.S. industry, or to a failure of U.S. corporate strategy and government policy. It's highly likely that even absent foreign mercantilist practices the United States would have lost jobs and output in commodity-based, low-skilled components of industries like textiles and apparel. The production cost differentials would still have been very high. The agglomeration economies of production that might keep production "sticky" and in the United States would have still been low. And the ability to transform the industry through technological innovation or appeal to cultural changes, while not nonexistent, would still have been limited, while the external benefits of co-location synergies with other parts of the production process and other industries are also limited. But even here, some components of the industry might be retained through innovation—for example, moving up the value chain to higher-end products, more customized products, and more technology-enabled products (such as nano-based fibers). Moreover, keeping "skin in the game" can be necessary to be competitive in the next technology life cycle, as we have seen with regard to the Japanese TV industry.

But regardless of what happens in less high-tech industries, there is no inherent reason why the United States should have lost the amount and extent of high-tech production offshore that it has. In fact, as the United States lost routinized, lower value added production offshore, a natural evolutionary process would have seen the expansion of complex, higher value added production. After all, that should be America's competitive advantage. But instead, while the United States did gain in a few advanced industries (see above), overall the United States lost global market share and saw increases in the trade deficits in these industries. In fact, the U.S. trade balance in high technology production went from around zero in 2000 to a deficit of over $80 billion today.[127]

Slowing traded sector loss does not mean protectionism and isolationism.
There are two broad policy approaches for slowing traded sector loss. The first is to more readily combat foreign predation (e.g., mercantilist policies). And in some cases this may involve retaliation against foreign nations that refuse to reduce their mercantilist practices. This is particularly important because innovation mercantilist policies, such as intellectual property theft and forced technology transfer, are particularly damaging to the U.S. economy, dependent as it is on early stage product cycle activities. If this application of trade enforcement policies in the fight for free trade is to be termed protectionist, so be it.

The second is to take steps to make the U.S. economy, and in some cases particular traded sectors, more globally competitive. The federal government has done this in the past. In the 1980s when the United States was losing global market share in semiconductors to the Japanese, in part because of unfair trade practices, the semiconductor industry and the federal government jointly developed Sematech, a public-private partnership that played an important role in revitalizing U.S. leadership in this key industry.[128] There are a range of policies that can be implemented. As ITIF detailed in "Fifty Ways to Leave Your Competitiveness Woes Behind: A National Traded Sector Competitiveness Strategy," these policies include steps like supporting pre-competitive manufacturing research, reducing effective corporate tax rates, boosting workforce training in traded sectors, expanding the Ex-Im Bank's spending authority, and enhancing efforts to combat foreign mercantilism.[129] These efforts can also come from the private sector. For example, the Walmart Foundation recently announced a research program to help identify cheaper ways to make certain manufactured products that are now largely imported.[130]



Don't Impede Natural Evolutionary Loss

To the extent that the United States has a national evolutionary strategy, too often it appears to be one about slowing evolution and preserving existing "species." To be sure, resistance to evolution is not new and it has come in both large and small doses. Prior to the Civil War, Southern resistance to America becoming a continental, industrial nation state is perhaps the ultimate case of large-scale resistance to evolution.

Government should not only avoid erecting barriers to natural evolutionary loss; it should actively remove barriers to such disruption.

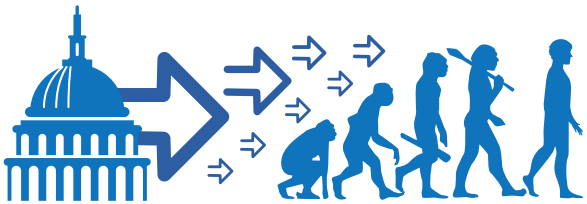
Today resistance is more episodic and particular. Political interests seek to use government to limit competition, especially from new entrants. We see this today with how taxi companies are seeking government help to limit transportation startups like Uber and Lift and how car dealers fight against companies like Tesla selling cars directly. Such cases are the rule, not the exception. Businesses spend billions of dollars to convince governments to protect them. The Texas Legal Review board, made up largely of attorneys, successfully argued that the software program, Quicken Family Lawyer, should be outlawed on the grounds that the company providing it illegally practices law. The list goes on. Optometrists, travel agents, insurance agents, mortgage brokers, college professors, music and video stores, and radiologists are among the professions and industries that have sought, often successfully, government protection from more efficient and lower-cost e-commerce competitors.

Creative destruction drives economic evolution. This means that government should not only avoid erecting barriers to natural evolutionary loss (e.g., the loss of output of some firms and industries coming from disruptive technological change); it should actively remove barriers to such disruption. This means reducing the regulatory and other protections incumbents (big or small) face vis-à-vis more entrepreneurial (big or small) innovators.

Relying on right- and left- wing populist maxims like "ending crony capitalism" gets us no further down the field in understanding how government can drive evolution.

This does not, however, mean favoring innovators over incumbents. For example, there is a strong case to be made that both "bricks and mortar" retailers, as well as online retailers, should be required to collect and remit sales taxes. The point is not to tilt the playing field unfairly toward new entrants. But at the same time it means not favoring or protecting incumbents. For example, the electric car maker Tesla is being prohibited from selling cars directly to consumers because of protectionist laws put in place at the behest of car dealers. The solution in this case is to end dealer protectionism and allow all car manufacturers to choose their distribution model. As Schumpeter wrote, "The resistance which comes from interests threatened by an innovation in the productive process is not likely to die out as long as the capitalist order persists."[131] But that does not mean that policymakers should not actively resist such entreaties. Because as computer scientist Alan Kay, who famously said that "the best way to predict the future is to invent it," says now, "the best way to predict the future is to prevent it."[132]

Finally, just as not all offshoring is devolutionary, not all government policies enacted with the support of business are about limiting evolution. As discussed below, there are many things government does and can do to help business and the economy evolve. Relying on right- and left-wing populist maxims like "ending crony capitalism" gets us no further down the road in understanding how government can drive evolution.[133] Just as with policies about enabling spatial evolution and slowing spatial devolution, policymakers need to distinguish between policies that simply protect incumbents from Darwinian competition and those that support Lamarckian evolution.[134] For example, the U.S. Ex-Im Bank, under attack by some because it helps business, in fact, helps U.S. businesses evolve (and not devolve) in the face of serious foreign competition and generous government support. In contrast, most agricultural subsidies simply prop up food producers and add no value to the economy.



Limit Government Barriers to Evolution

Governments can support evolution, not only by not siding with incumbents to limit new entrants, but by ensuring that most or all of what they do supports evolution. This is particularly true with regard to regulation. To be sure, there are cases where regulation has the effect of spurring evolution. For example, environmental regulations on automobiles may have spurred needed changes in the industry in the 1970s and 1980s.[135] But more often than not, regulatory agencies slow evolution, especially if firms need regulatory approval before acting, or if regulations (like Title II in telecommunications) limit innovation. This is in part because regulatory agencies by and large do not take into account evolution when conducting their activities. Moreover, in many cases they are underfunded and therefore cannot respond in expeditious ways to industry applications.

There are a number of steps the federal government could take in this area. Congress could charge the Congressional Budget Office (CBO) with doing an analysis of all major legislation about how the legislation would affect evolution (e.g., industry structure and competition, innovation, etc.), just as CBO now does fiscal analysis of major bills. Congress or the Administration could task the Office of Management and Budget's (OMB's) Office of Information and Regulatory Affairs (OIRA) with creating an Office of Innovation Review.[136] Regulatory agencies seeking to impose regulations that affect traded sectors in non-trivial ways would be required to have these regulations undergo a review by OMB's OIRA to determine the effect of the regulations, not just on costs (and benefits) in the short term, but on innovation over the medium and long term. They would have the specific mission of being the "innovation champion" within these processes. Third, regulatory policy should enable companies to innovate and change faster. Among other things, this means reducing regulatory delay. Companies should be able to receive regulatory approval or denial in a timely manner and not have to wait years to find out. To do this, Congress needs to ensure that regulatory agencies have budgets that enable them to be adequately staffed, as well as to require them to develop operational strategies for streamlining regulatory approval and minimizing delay.

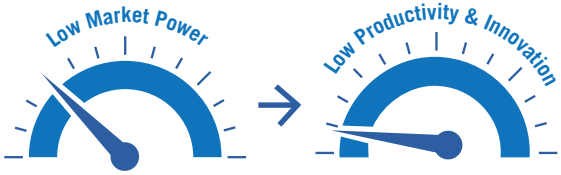
The issue of competition policy and evolution is more complicated. Just as conventional economic doctrines do not adequately consider evolution, the three conventional anti-trust doctrines (Chicago, post-Chicago, and populist) are inadequate guides to effective antitrust policy in the 21st century, in part because they do not adequately incorporate dynamic factors related to evolution.[137] The embrace of the populist doctrine by many between the 1930s and 1950s clearly slowed evolution, as evidenced by the passage of legislation like the Robinson-Patman Act of 1936, which attempted to prevent suppliers from selling at a lower cost to large companies. In *Brown Shoe Co., Inc. v. United States* in 1962, for example, the court declared that Congress intended the Clayton Act "to promote competition through the protection of viable, small, locally owned businesses."[138]

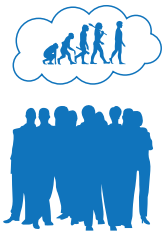
An evolutionary view of anti-trust would recognize the importance of larger firms in driving evolution, in part through their ability to marshal resources to drive innovation and productivity. In addition, the view would recognize that any analysis of market power should be tempered by recognition of the possibility of new entrants, particularly in dynamic industries. As Shapiro and Varian note, "The information economy is populated by temporary, or fragile, monopolies. Hardware and software firms vie for dominance, knowing that today's leading technology or architecture will, more likely than not, be toppled in short order by an upstart with superior technology."[139] As Schumpeter notes, this is a different kind of competition than that envisioned in the conventional doctrine:

> It is hardly necessary to point out that competition of the kind we now have in mind acts not only when in being but also when it is merely an ever present threat. It disciplines before it attacks. The businessman feels himself to be in a competitive situation even if he is alone in his field or if, although not alone, he holds a position such that investigating government experts fail to see any competition between him and any other firms in the same or neighboring field and in consequence conclude that his talk, under examination, about his competitive sorrows is all make-believe.[140]

Indeed, because evolutionary economists look at evolutionary dynamics more than static efficiency, they are more prone to consider how disruptive technologies and new entrants might pose a challenge to firms with market power. Thus, holders of an evolutionary view would argue for a broader view of analyzing market structure along the lines of Michael Porter's "five forces model," which is "a dynamic approach to analyzing industry structure, based on five competitive forces acting in an industry or sub-industry: threat of entry, threat of substitution, bargaining power of buyers, bargaining power of suppliers, and rivalry among current competitors."[141]

In this regard, to support evolution merger review should more thoroughly investigate mergers to determine the nature of market power gain. The key is to distinguish between market power that supports innovation (or other benefits, such as network externalities) from market power that enables simple abuse (higher prices with little gain in terms of productivity or innovation). Market power can often enable the former. As Possas and Fagundes argue, "the basic lesson drawn from the neo-Schumpeterian view is that the potential direction of market power use (or abuse) should not be prejudged as necessarily harmful to competition and welfare, and consequently repressed, from a dynamic standpoint."[142] Indeed, market power can have beneficial aspects, especially for productivity and innovation, and especially in industries with low marginal costs and high fixed costs. In these industries a greater market share means lower overall production costs. Too little market power can in some cases weaken competition because competitors would be less able to innovate and engage in dynamic competition.[143]





Foster a Culture That Embraces Evolution, Including Natural Evolutionary Loss

When people in Silicon Valley talk about evolution, they are referring to technology. In Washington, they are referring to policy. But there is a third factor shaping evolution, and that is culture. As Edmund Phelps writes, steps like limiting regulatory barriers to innovation and ensuring a reasonable business tax system are important, "but without a supportive culture, these steps will not be sufficient: they will not even be taken. The genius of high dynamism was a restless spirit of conceiving, experimenting and exploring throughout the economy from the bottom up—leading with insight and luck, to innovation."[144]

Some cultures have embraced and continue to embrace stasis and not evolution. Indeed, for much of human history stability was valued over evolution. Ensuring that the broader culture and society embraces evolution is critical to allowing firms to actively innovate and governments to support evolution. This means more than embracing creation—which many nations equate with successful innovation— it means also accepting "destruction"and the loss of businesses and jobs that often go with that. This latter piece is very difficult for most cultures to accept, much less embrace.

America's evolutionary success in the past has been driven in part by this embrace of creative destruction. But going forward, fostering a culture of evolution means actively rejecting the increasing vocal chorus of "neo-Ludditism" that pervades American society today. Named after Englishman Ned Ludd, whose followers destroyed textile machines at the beginning of the Industrial Revolution, today's neo-Luddites view innovation not as a force for progress to be encouraged, but as something to be stopped, regardless of the benefits it brings.

The trend in America over the last decade has been toward neo-Luddite technology opposition even to the point where there is an effort to restore the image of the Luddite movement as a progressive one, standing up for human values. When no less an august source as *Smithsonian Magazine* writes the following, it's clear there is a problem:

> The original Luddites would answer that we are human. Getting past the myth and seeing their protest more clearly is a reminder that it's possible to live well with technology—but only if we continually question the ways it shapes our lives. It's about small things, like now and then cutting the cord, shutting down the smartphone and going out for a walk. But it needs to be

about big things, too, like standing up against technologies that put money or convenience above other human values. If we don't want to become, as Carlyle warned, "mechanical in head and in heart," it may help, every now and then, to ask which of our modern machines General and Eliza Ludd would choose to break. And which they would use to break them.[145]

Twenty years ago, if someone wrote that the federal government was hatching a secret plan to forcibly implant radio frequency identification chips under the skin of all Americans, he or she would have been dismissed as a tin-foil hat-wearing crackpot. Today, the person making this claim—Katherine Albrecht in her book *Spychips*—is widely quoted by the mainstream media, testifies at government hearings, and contributes to the *Scientific American*, a journal that increasingly (and ironically) provides a voice for neo-Luddites. [146]

It would be one thing if American neo-Luddites just wrote books and articles. But they constantly press lawmakers and regulators to take action, and influence the broader public to do the same. The neo-Luddite target is broad, including genetically modified organisms, new Internet apps, smart electric meters, health IT, big data, and increasingly productivity itself.[147] For the reality is that the neo-Luddite target is not just these specific technologies, it is the entire project of evolution.

These neo-Luddites want a world in which a worker never loses a job; "consumer" rights trump all else, even lower prices; no personal information is ever shared, even if sharing benefits society and enables a vibrant Internet ecosystem; the environment is protected whatever the costs; and cities are designed for residents who live in apartments and travel by transit to patronize small, local merchants. In short, they want a world where evolution comes to a screeching halt.[148]

Neo-Ludditism also comes in a milder but perhaps more insidious version that is careful to not oppose innovation and evolution outright, but rather raises doubts that appear reasoned and objective. James Pethokoukis of the American Enterprise Institute writes "Not all innovation is alike. Incumbent firms replacing man with machine is a kind of innovation that may lift corporate profits and boost stock prices without necessarily broadly raising prosperity."[149] In reality, replacing man with machines has been the single largest driver of human standards of living in the last century. But now even conservative think tanks, who had been unalloyed defenders of progress and innovation, see it as suspect. Another flavor of neo-Ludditism-lite is the go slow version. Charles Wolf of the Hoover

Institution writes we should "move cautiously, rather than full steam ahead, in the interests of modulating the disruptive effects of impending new technology on societal harmony… In general, more innovation is preferable to less, but that doesn't imply that a lot more is better than just somewhat more." If innovation is good, why would a lot more not be better than just somewhat more?[150] A lot more medical innovation? A lot more energy innovation? A lot more IT Innovation?

If Americans want the nation to regain its position as the global innovation leader, replacing neo-Ludditism with good old fashioned American risk taking and faith in the future needs to be at the top of the agenda. To be sure, if we had a system where the cost of job loss was lower perhaps Americans would be more willing to support economic evolution. But regardless, helping to move the culture back to one that is excited by evolution is key.

If Americans want the country to regain its position as the global innovation leader, replacing neo-Ludditism with good old fashioned American risk taking and faith in the future needs to be at the top of the agenda.

One way to do this is to ensure that students at all levels learn that economic evolution is the goal and that they play a role in it. Regrettably we see the opposite of this in nations where the educational system's emphasis is on rote learning and inculcation of values more oriented to fitting in than innovating. There are troubling signs that this is becoming more and more the case in America as K-12 education becomes increasingly standardized and less creative because of the standards movement. As Phelps writes about the new "Common Core" standards and other efforts to establish standards for expository writing, "what a modern economy needs more than personnel with expository skills is people eager to exercise their creativity and venturesome spirit in ever-new and challenging environments."[151] It is an understatement to say that K-12 education in America provides almost nothing like that for students.

At the same time, schools seem to be more focused on inculcating students with values more suited to enabling stasis than driving evolution. Case in point, one of the best public elementary schools in Maryland, Somerset Elementary School in Chevy Chase, established its six "Character Counts Pillars" (with big banners for each in its "all purpose" room): Respect, Trustworthiness, Responsibility, Caring, Fairness and Citizenship. This kind of psycho-social Ritalin is more designed to ensure students cooperate and get along, rather than, God forbid, excel or stand out. Noticeably absent are values journalist David Brooks identifies as the key "mental virtues", ones much more related to enabling pro-evolutionary behaviors.[152] These include love of learning, courage, firmness, and autonomy. All values that appear to be antithetical to the American educational system today.

If K-12 education has evolved into a place where rote learning is transmitted to students who are encouraged that the highest value is tolerance and getting along, higher education has become politicized by liberal academics imposing their own "Europeanization" of thinking on students, where progress and evolution are seen as foreign values imposed by a capitalist class intent only on its own self-preservation.

A case in point is the fact that many university Science, Technology and Society departments focus more on the negative impacts of technology—its job destroying, environment polluting, surveillance enhancing, inequality creating, obesity inducing, overconsumption spurring, and freedom crushing nature, than they do on it's empowering and progressive effects.[153]

Moreover, with few exceptions we no longer celebrate our innovators. As Charles Murray points out in a study of the historical factors driving innovation, celebration of innovators plays a key role in enabling continued innovation. As he writes:

> In America, inventors once loomed large in the popular imagination. In the classroom, schoolchildren throughout the 19th and early 20th centuries grew up on the stories of Bell and Morse and Edison, of Eli Whitney, Robert Fulton, the Wright brothers, Henry Ford, and more—as well as on stories of awe-inspiring technological achievements like the building of the transcontinental railway and the Panama Canal. There are still occasional exceptions (the movies *Apollo 13* and *The Social Network* come to mind), but they are rare. The genre is out of fashion, as is the ethos that supported it.[154]

To take one example, it is all too common that U.S. high school history textbooks that even mention the building of the transcontinental railroad focus more on how Chinese workers were exploited than on how entrepreneurs, government, and workers achieved one of the most amazing technical feats in the history of mankind.

There is one other aspect of culture that is critical to enabling robust evolution. It's not enough for a culture to passively support evolution; cultures need to also have a teleological goal for evolution. Going to the moon was not about just accepting evolution; it was about setting an ambitious evolutionary goal that society could organize around. As John F. Kennedy proclaimed: "We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard." Setting ambitious evolutionary goals—such as developing clean energy that is cheaper than fossil fuels, curing major diseases like Alzheimer's, and developing highly effective robots that can do the jobs many workers have to do today—can help organize society to do big things that the businesses and the "market" left alone would never do, at least anytime soon. Indeed, nations have historically been unable to muster the political will for significant investment in innovation without it being part of a "national mission," since such spending means giving up current consumption for uncertain future benefits. In the last half of the 1800s, nation building provided the mission for America—just as it does now for China. America knew that it was poised to be greatest nation on earth, but only if we set and achieved big goals. After the late 1940s, when the United States had achieved that goal, the animating mission that helped drive technology innovation became winning the Cold War and stopping the spread of communist dictatorships. But with the dissolution of the Soviet Union, that mission has evaporated. As a result, America is in dire need of a new evolutionary mission as it currently has none.

Finally, the cultural foundations of evolution need to be grounded in a willingness to challenge the status quo in terms of prevailing thinking and established practices and to consider oneself as an autonomous agent, not merely a member of a well-functioning team. Again as Murray writes:

> A major stream of human accomplishment is fostered by a culture that encourages the belief that individuals can act efficaciously as individuals, and encourages them to do so… Throughout most of its history, American culture has run with the concept of the autonomous individual as no other culture has ever done. One of the signal features of American exceptionalism is the fierce belief that, if they are willing to work hard enough, people can achieve whatever they set their minds to. But that sense of autonomy has been deteriorating for at least a half-century."[155]

America is in dire need of a new evolutionary mission.

Indeed, today American education and culture now places the prevailing emphasis on cooperation, rather than independence, courage, and autonomy. As such, we risk squandering our greatest strength. Moreover, too many ideas are off limits for acceptable discourse as a "thought police" on both the right and the left seek to enforce intellectual conformity and punish outliers. Even the notion that innovation is fundamentally social in nature is widely accepted, dared to be questioned, despite evidence that individual struggle and work might be more important than cooperation.[156] In a critique of Ivy League universities, but perhaps one that could be broadened to higher education generally, William Deresiewicz writes: "Our system of elite education manufactures young people who are smart and talented and driven, yes, but also anxious, timid, and lost, with little intellectual curiosity and a stunted sense of purpose."[157]

Changing a culture to one that not just accepts, but positively promotes evolution and the behaviors supporting it is hard; there's no HR 41 or SB 19 to get us there. But cultures do change and the more that elites, the media and others point out how current cultural trends are hindering American evolution, the more chance there is that America can rebuild some of its declining cultural capital for evolution.

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Enact Policies to Incent Organizations to Support Evolution

Darwinian and Lamarckian economic evolution ought to be pretty natural: for-profit and nonprofit organizations compete to survive and thrive. But the neoclassical economic framework that assumes that organizations are rational and act to maximize organizational utility is not borne out by reality. In fact, a number of market failures,

including principal-agent problems, mean that sometimes organizations do not do what is either in society's interest or in their own long-term interest.

We see the latter most clearly in the rise of corporate short-termism. As Edmund Phelps writes, "Once entrepreneurs were wedded to seeing how far their companies would go. Would today's CEOs follow short-termist policies if they cared more about building companies than building their dream houses?"[158] In the United States this pressure to achieve short-term profits has all too often meant sacrificing long-term investment. As the Business Roundtable, the leading trade association for large American businesses, reported, "the obsession with short-term results by investors, asset management firms, and corporate managers collectively leads to the unintended consequences of destroying long-term value, decreasing market efficiency, reducing investment returns, and impeding efforts to strengthen corporate governance."[159] As such, economic policy needs to work to realign the interests of managers and shareholders with the long-term evolutionary interests of the economy.

Such financial pressures have forced many U.S. firms not only to cut the growth of their research budgets but also to reallocate their research portfolios more toward product development efforts and away from longer-term and more speculative basic and applied research. From 1991 to 2008, basic research as a share of corporate R&D conducted in the United States fell by 3.6 percentage points, while applied research fell by roughly the same amount, 3.5 percentage points. In contrast, development's share increased by 7.1 percentage points.[160]

A number of market failures, including principal-agent problems, mean that sometimes organizations do not do what is either in society's interest or in their own long-term interest.

Harvard Business School's Clayton Christensen raises a related concern, that the aggressive pursuit of short-term profitability—which is taught in American business schools mostly as profitability understood in percentage rates of return (because evaluating rates of return in percentages allows easy comparisons with other investment alternatives)—is actually limiting American innovation. As Christensen notes, many American firms focus on a measure called RONA (Return on Net Assets) as a key measure of performance, but this often leads them to focus on reducing the denominator, assets, as many U.S. companies did in outsourcing much of their manufacturing to Asia. Another example, as Steve Denning notes, is firms' "pernicious methodology for calculating the internal rate of return (IRR) on an investment. It causes you to focus on smaller and smaller wins. Because if you ever use your money for something that doesn't pay off for years, the IRR is so crummy that people who focus on IRR focus their capital on shorter and shorter-term wins."[161] When the health of the U.S. economy is widely viewed to be a reflection of the second-by-second stock tickers running incessantly on the bottom of every business cable TV show, we know we have descended into an economy that maximizes wealth-seeking over evolutionary maximization.

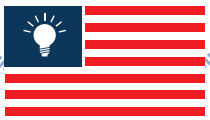
At the same time that business has become increasingly short term, too many governmental and government-related institutions and systems have also become even

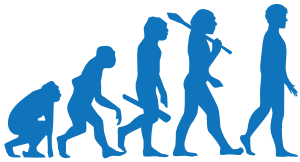
more risk averse and static. Despite the talk about the importance of innovation in education, the U.S. educational system, particularly at the K-12 level, has changed little, and with the increased prevalence of performance-based testing, is not likely to show any spurts of evolutionary change any time soon. Indeed, in many areas that are influenced by government, including transportation, urban systems, health care and others, change appears glacial, particularly in relation to the need for evolution.

So a key question is how does organization change occur: from ideas or structure and incentives? Most people subscribe to a Hegelian explanation: like the philosopher GWF Hegel, who argued that the evolution of the West was driven by a competition of ideas, many today see ideas as the key driver of institutional evolution. Indeed, the notion is that if we just develop and promulgate the right ideas to spur institutional evolution, actors in these systems will see the light and adopt them. To be sure, new ideas are useful, but they are often more likely to be a result of institutional change, than a cause. Waiting for people, often with a deep vested interest in the current system to voluntarily embrace evolution after they read an article or attend a conference will likely mean waiting a long, long time for change. To drive institutional evolution, policymakers would be much better off looking to incentives for existing players to evolve and direct support of evolutionary experiments from new entrants.

For example, to better align business interests with the economy's evolutionary interests, two kinds of policies should be adopted. Regarding corporate governance, government can shelter companies from the harsh demands of shareholders seeking only short-term returns and limit incentives for managers to pursue short-term strategies. For example, Edmund Phelps proposes that corporate law could be amended to prohibit corporations from bestowing golden parachutes to CEOs when they are dismissed. Second, government can provide more generous tax incentives to companies to invest in long-term assets like R&D, worker training, and capital equipment.

For broader institutional evolution, Congress should ensure that all major government funding programs have an institutional innovation component. Indeed, to spur evolutionary innovation, every major government program should have a major set-aside for innovation. Instead of just the Small Business Innovation Research (SBIR) program, which is set-aside for R&D projects conducted by small business, we should have a broader set-aside of government funding to support innovation broadly defined, both technological and institutional. For example, the Department of Education should have a fund to support innovative approaches to education, including funding states to in turn fund new schools support organizations.[162] The Department of Transportation should set aside funding to support the transformation of U.S. transportation systems by providing incentive grants to states and cities to embrace innovations like congestion pricing. HUD could provide grants to the cities that come up with the most innovative "smart city" proposals. Like the UK's Innovation Unit, there should be a unit of the federal government whose sole mission is to support pilot project innovation in state and local government so that new ideas can be tested, and—if they work—scaled up across the nation.[163]





Support Policies to Accelerate Economic Evolution, Especially From Technological Innovation

While rejecting neo-Ludditism in favor of techno-optimism and encouraging business to support long-term evolution is necessary, it is not enough. To maximize innovation, especially technology-driven innovation, nations need a proactive innovation policy.[164] Expecting that entrepreneurs and markets alone will maximize evolution is wishful thinking. This is because innovation entails an information challenge, not just a supply and demand challenge. Evolutionary economist Allan Naes Gjerding has observed that although neoclassical economic doctrine holds:

> that the market mechanism represents the most effective way of coordinating economic activities, evolutionary economics argues that the market must be endowed with inter-organizational arrangements in order to achieve coordinative efficiency in cases where there is not complete knowledge about the characteristics of new products and processes.[165]

Successful innovations are based on knowledge about users' needs and about the value of the innovation to users. In this sense, smart innovation policies try to fill what is fundamentally a knowledge gap. Thus, it is difficult, if not impossible, for individuals and firms to make effective decisions under conditions of uncertainty relying only on price signals. This is why, despite what neoclassical economists believe, innovation is not something that falls out of the sky, or as economist Robert Solow once called it, "manna from heaven." It comes from intentional human action.

This is particularly true given that, increasingly, the interests of economic evolution in the nation and the interests of the firm are diverging, for several reasons. The first is spatial. When Charles "Engine Charlie" Wilson, then the president of General Motors, was asked during his confirmation hearing to become the U.S. Secretary of Defense in the Eisenhower Administration if he could make a decision adverse to the interests of GM, he famously answered that he could—but also that he could not conceive of such a situation "because for years I thought what was good for the country was good for General Motors and vice versa." But as the U.S. economy has globalized and U.S. corporations have become, in the words of former IBM CEO Sam Palmisano, "globally integrated enterprises," such a statement is no longer automatically true.[166] This is not to say that U.S. companies are doing anything wrong, only that their interests are not always the same as U.S. economy interests, any more than GM's interests were the same as Michigan's in the 1950s.

The second systemic problem in the evolutionary system is that firms acting alone in response to price signals will not produce the optimal rate of innovation. This is because economies are evolutionary, complex systems, not just markets. In that context, firms and entrepreneurs cannot capture all the benefits of their own innovative activity, and so will produce less innovation activity than society needs.[167] In addition, because of the complexity of the innovation process, especially today, firms cannot maximize innovation by working in isolation. Instead, they need to interact with suppliers, customers, competitors, universities, research institutes, investment banks, and government entities to gain various kinds of technology, knowledge, information, and market access. Such interactions take time, effort, and resources, and in a fast-moving world, the pattern of cooperation between firms and other agents is far from optimal, not least because of a lack of information about possible useful partners. In addition, "chicken-or-egg" challenges inhibit development of technology platforms. Chicken-or-egg challenges must be overcome for innovation to occur around technology platforms such as NFC (near field communications)-enabled contactless mobile payments, intelligent transportation systems, health IT systems, digital signatures, and the smart electric grid.

This means that to maximize evolution, the critical issue of the role of the state and market should not be framed, as it is currently in Washington, as the state versus the market. Instead, as Eric Beinhocker suggests, the issue should be framed as "how to combine states and markets to create an effective evolutionary system."[168] How to craft an effective evolutionary system that supports organizations (including commercial enterprises, nonprofit organizations, and government entities) in their quest to become more productive in the most effective way is largely an empirical and practical problem that cannot and should not be guided by broad ideologically sweeping statements, like "government always gets it wrong," or "corporate profits are antithetical to the public good."

This means that to maximize evolution, the critical issue of the role of the state and market should not be framed, as it is currently in Washington, as the state versus the market.

Neoclassicalists will point to examples where government got it wrong. Moreover, they will argue that "intelligent design" is a myth at best and a statist, socialistic ruse at worse. For them, evolution comes only from "Darwinian" or "Lamarckian" forces. As neoclassical economist/journalist Robert Samuelson writes, government's "ability to influence technology, business practices, and worker skills, is at best limited."[169] Clearly Samuelson is simply ignorant of the fact that many of the most important innovations of the last century, from the Internet, to natural gas fracking, to the human genome, to the Google search engine were based on government support of research.[170] Despite this clear historical record neoclassicalists continue to perpetuate the myth that government's ability is limited because they believe that government intervention is by definition distortionary and welfare reducing. On the other side, neo-Keynesians will argue against policies that help businesses, believing that they almost always come at the expense of workers and the downtrodden.

But decisions about where to draw the line between what should be public, what should be private, and what should be public and private together should be guided by actual experience, data, research, and logic. If there is any ideology governing this, it should be that smart public-private partnerships can play a key role in helping non-governmental organizations become more innovative and productive. As Greg Tassey writes, "the future of U.S. advanced manufacturing will be determined not only by the efforts of individual companies, although such efforts are of course indispensable, but also by the extent to which the U.S. public–private system for bringing new waves of technology to market is updated and reformed."[171]

But are government policies to support technological innovation really evolutionary? Aren't they akin to providing more "food" to animals on the savanna so that they just get fatter, not better? This would be an appropriate analogy if the policy were to give non-traded companies cash subsidies. But ensuring that companies have a larger pool of knowledge and skilled workers to draw upon is actually enabling Lamarckian evolution by helping firms get more productive and innovative.

Ensuring that companies have a larger pool of knowledge and skilled workers to draw upon is actually enabling Lamarckian evolution by helping firms get more productive and innovative.

It is beyond the focus of this book to lay out a detailed innovation agenda, but a few key areas stand out.[172] First, the government has a key role to play in marshaling resources for innovation, particularly in funding scientific and engineering research—not just at agencies like the Department of Defense, National Institutes of Health, and National Science Foundation—but through incentives like prizes and the R&D tax credit. The U.S. R&D tax credit ranks a poor 27th in the world in terms of tax incentive generosity.[173] And federal government R&D as a ratio to GDP now lags behind a number of countries. It should do more to support the development and international recruitment of STEM talent. Indeed, knowledge generation is a key to speeding up evolution. If mankind had perfect knowledge we would already have human-like robots, cures for all diseases, low-cost clean energy, space planes, and most other things we can only dream of. In addition, as discussed above, the federal government should identify a few key challenges—like the development of low-cost, low-carbon energy sources and affordable and effective robotics—and devote significant resources to their attainment, as President Kennedy did with putting a man on moon. This means doing things like dramatically expanding, rather than cutting, federal support for scientific and engineering research and making the research and experimentation tax credit much more generous.

But to effectively drive evolution, government needs to do more than simply fund factor inputs to organizations. It needs to engage in an active innovation policy. This includes policies to spur technology transfer and commercialization and to support pre-competitive industrial research consortia.

Accelerating economic evolution also means focusing on how government and government-related industries (education, health care, and transportation) can be transformed by technology. Indeed, these sectors are primary targets for evolution and technological innovation, but evolution will be slow unless the government actively creates policies to support and spur innovation.

If government is going to not only remove barriers to evolution but also proactively support evolution, it also needs to take steps to help workers and communities negatively affected by evolution adapt. If we are to embrace a vision of much more rapid evolution, it is not only fair to establish a system to assist those hurt by "creative destruction," it makes political sense as well in order to reduce opposition to evolution. America would be well advised to adopt the Northern European "flexicurity" system, which is premised on the notion that employment security is based not on limiting layoffs, but on giving workers greater ability to move to new jobs, in part through support for acquisition of viable skills.

Develop a Deeper Understanding of the Evolution of the U.S. Economy

An evolutionary approach to economic policymaking requires an evolutionary-based U.S. economics statistics system. Established after World War II, the current system was designed to help facilitate fiscal and monetary policy in order to avoid another Great Depression, and as such, measured things like the number of houses built and cars manufactured. It did not consider spatial evolution, as reflected by the still-limited data on state and metropolitan economies and limited data on how offshoring affects the U.S. economy.[174]

Notwithstanding the hundreds of millions of dollars spent every year and the thousands of economists working for the federal government, the exact nature of U.S. capabilities and challenges with regard to the competitiveness of its traded sectors is only weakly understood.[175] At least since after the Great Depression, the federal government has never felt the need to develop strategic economic intelligence to fully understand the competitive position of its traded sectors.[176] As George Washington University scholar Andrew Reamer notes, the opaqueness and limitations of our national statistical system for measuring innovation, productivity, and competitiveness makes achieving this insight daunting.[177]

Government would be much better positioned to effectively support economic evolution if it had a stronger statistical and analytical base. Among other things, the federal government should do a better job of:

- Measuring imports and exports in its Annual Survey of Manufacturers;
- Measuring foreign direct investment so it can distinguish between "greenfield" new plant investment and foreign purchases of existing U.S. establishments;
- Analyzing capital expenditures made by industry, including distinguishing between additions to new establishments and building new ones;
- Expanding state-level data, including for manufacturing property, plant, and equipment;
- Building an import price index so it can fix the productivity measurement problem with regard to imported manufacturing inputs;
- Expanding the Bureau of Economic Analysis's five-year benchmark surveys of companies with facilities overseas to identify the type of products manufactured abroad and the number of employees at these facilities; and
- Developing a consumer basket of goods that measures changes in consumption that is driven by technological innovation.

CONCLUSION

Economies are best understood not simply or solely as markets or machines, but rather as complex evolutionary systems that change yearly, monthly, and even daily. Usually these changes represent progress (evolution), but sometimes they represent regress (devolution). The key for policymakers is thus several-fold. First, policymakers need to recognize the forces for evolution that come from all parts of the system, including from smart government policies, and support those forces. Accelerating the rate of evolution is the most important thing they can do when it comes to economic policy.

Second, policymakers need to differentiate between loss on the "back end" of the United States which represents natural evolutionary adaptation as the U.S. economy becomes more specialized in knowledge-based, high value-added production, and that which represents avoidable loss due to either foreign predation or lack of an effective adaption strategy domestically. Reducing or slowing preventable spatial loss is in the service of evolution. Indeed, nations need to better manage the entire "technology life cycle" to maximize domestic value added, much of which, as Tassey shows, occurs in the middle and later stages of the technology life cycle.[178] Too many in the United States wrongly believe that a nation can thrive by only being successful in the early stages of technology life cycles, letting other nations specialize in later stages.

Third, effectively spurring economic evolution means that the traditional macro and micro economic frameworks need to be supplemented with new frameworks. Macroeconomic policy is still needed, but it does little to directly spur evolution, other than to provide a background environment that is hopefully more suitable for institutions that innovate and evolve. Microeconomics all too often focuses on the role of price signals in market transactions—a useful, but also insufficient focus. What is needed is a "mesoeconomic" policy focus that examines how innovation systems and institutions are organized to drive evolution. As Nobel Prize-winning economist Douglass North stated, "We must create incentives for people to invest in more efficient technology, increase their skills, and organize efficient markets."[179] This means establishing a robust national innovation system that facilitates learning and innovation among economic actors.[180]

Taking these steps will help maximize U.S. economic evolution to dramatically improve the standards of living and quality of life of future generations of Americans.

ENDNOTES

1. Michael Lind, *Land of Promise* (New York: Harper, 2013).
2. Ibid., 5.
3. From the NSF BRIDS survey. According to the survey, 158,000 firms introduced new goods or services between 2008 and 2009, while 160,000 introduced a new production process.
4. Economic Census of the United States, All sectors: Core Business Statistics Series: Advance Comparative Statistics for the U.S. (2007 NAICS Basis): 2012 and 2007.
5. Dane Stangler and Sam Arbesman, "What Does the Fortune 500 Turnover Mean?" (Ewing Marion Kauffman Foundation, June 2012), http: www.kauffman.org/~/media/kauffman_org/research%20reports%20and%20covers/2012/06/fortune_500_turnover.pdf.
6. The Bureau of Labor Statistics defines the industry as "Industries in the Credit Intermediation and Related Activities subsector group establishments that (1) lend funds raised from depositors; (2) lend funds raised from credit market borrowing; or (3) facilitate the lending of funds or issuance of credit by engaging in such activities as mortgage and loan brokerage, clearinghouse and reserve services, and check cashing services."
7. This notion of evolutionary economics is certainly not new, but it is underappreciated. See: Richard Nelson and Sidney G. Winter, *An Evolutionary Theory of Economic Change* (Cambridge: Belknap Press,1982).
8. Despite what some religious conservatives say, scientific theory holds that evolution occurs by random changes in DNA and the natural selection of traits that are more fit.
9. Edward Phelps, *Mass Flourishing* (Princeton, NJ: Princeton University Press, 2013), 21.
10. Robert D. Atkinson, "Competitiveness Innovation and Productivity: Clearing Up the Confusion" (ITIF, August 2013), http://www2.itif.org/2013-competitiveness-innovation-productivity-clearing-up-confusion.pdf.
11. Indeed, one leading regional economics journal is titled "Growth and Change" to drive home the point that the two concepts are indeed separate.
12. Phelps, *Mass Flourishing*, 21.
13. Robert D. Atkinson, Luke A. Stewart, Scott M. Andes, and Stephen J. Ezell, "Worse than the Great Depression: What Experts are Missing About American Manufacturing Decline" (ITIF, March 2012), http://www2.itif org/2012-american-manufacturing-decline.pdf.
14. Daron Acemoglu and James Robinson, *Why Nations Fail* (New York: Random House, 2012).
15. Jean-Baptiste Lamarck developed the theory of inherited acquired characteristics where changes in the environment led to adaptions in the organism that were passed on to the next generation. See: http://www.merriam-webster.com/dictionary/lamarckism.
16. This use of the term "intelligent design" is only meant to refer to economic evolution, not to the purported biological theory.
17. This is why a field of economics that focused more on innovation was called "endogenous growth theory" because it made innovation a part of the model, not exogenous to it.

18. Robert D. Atkinson and David B. Audretsch, "Economic Doctrines and Approaches to Antitrust" (ITIF, January 2011), http://www.itif.org files/2011-antitrust.pdf.
19. Alan S. Blinder, *Hard Heads, Soft Hearts* (New York: Basic Books, 1987).
20. One leading supporter of such research is the Institute for New Economic Thinking. See: http://ineteconomics.org/.
21. Certainly some "New Keynesians" basically accept the neoclassical framework and methodology but endorse the concept of an active fiscal and monetary policy during downturns. Paul Krugman would fit into this camp quite well.
22. Phelps, *Mass Flourishing*, 312.
23. Atkinson and Audretsch, "Economic Doctrines and Approaches to Antitrust."
24. Douglass C. North, *Institutions, Institutional Change and Economic Performance* (Cambridge, MA: Cambridge University Press, 1990), 80-81.
25. Phelps, *Mass Flourishing*.
26. Acemoglu and Robinson, *Why Nations Fail*.
27. Joel Mokyr, *The Gifts of Athena* (Princeton, NJ: Princeton University Press, 2002), 259.
28. Joel Mokyr, *The Lever of Riches* (New York: Oxford University Press, 1990), 12.
29. Joseph Schumpeter, *Capitalism, Socialism and Democracy* (New York: Harper Perennial, 1975), 132-133.
30. Merritt B. Fox, "Promoting Innovation: The Law of Publicly Traded Corporations," *Capitalism and Society*, no.5-3 (2010): 1.
31. Robert D. Atkinson, "Understanding the U.S. National Innovation System" (ITIF, June 2014), http://www2.itif.org/2014-understanding-us-innovation-system.pdf
32. For example, in *The Theory of the Leisure Class*, Veblen writes: "But the evolution of economic life in the industrially more mature communities has now begun to take such a turn that the interest of the community no longer coincides with the emulative interests of the individual."
33. Joseph Schumpeter, *The Theory of Economic Development* (Cambridge, MA: Harvard University Press, 1934).
34. Christopher Freeman in *Techno-economic paradigms: essays in honor of Carlota Perez*, ed. Wolfgang Drechsler, Erik Reinert, and Rainer Katte (London: Anthem Press, 2009), 126.
35. Joseph Schumpeter, "Preface to the Japanese Edition of "Theorie der Wirtschaftlichen Entwicklung," in *Essays on Entrepreneurs, Innovations* (Piscataway, NJ: Transaction Publishers, 1989).
36. Schumpeter, *Capitalism, Socialism and Democracy*, 82-3.
37. Ibid.
38. Nelson and Winter, 10.
39. Ibid., 4.
40. Such views are much more deeply embedded in European economic thinking. For example, see: http://www.econ.mpg.de/english/research/EVO/discuss.php#p2013. See also: *Journal of Evolutionary Economics,* the *Journal of Institutional Economics*, sponsored by the European Society for Evolutionary Political Economy and the *Evolutionary and Institutional Economics Review*, sponsored by the Japan Association for Evolutionary Economics.

41. Christopher Freeman, *Unemployment and Technical Innovation: A Study of Long Waves and Economic Development* (Westport, CT: Greenwood Press, 1982); Christopher Freeman, *The Economics of Industrial Innovation* (Harmondsworth, UK: Penguin, 1974); Christopher Freeman, "Networks of Innovations: A Synthesis," *Research Policy* 20 (1991): 499; Christopher Freeman and Francisco Louca, *As Time Goes By: From the Industrial Revolution to the Information Revolution* (New York: Oxford University Press, 2001).
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46. Philippe Aghion and Peter Howitt, "On the Macroeconomic Effects of Major Technological Changes," in *General Purpose Technologies and Economic Growth*, ed. Elhanan Helpman (Cambridge, MA: MIT Press, 1998), 21–144.
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54. Schumpeter, *Capitalism, Socialism and Democracy*, 83.

55. John Rees and R.D. Norton, "The Product Cycle and the Spatial Decentralization of American Manufacturing," *Regional Studies* 13, no. 2 (1979).
56. Ben R. Rich and Leo Janos, *Skunk Works* (New York: Little, Brown and Company, 1994), 10–23.
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ACKNOWLEDGEMENTS

The author wishes to thank the following individuals for providing input to this report: David Beier, Eric Beinhocker, Stephen Ezell, Gail Fosler, Bethany Imondi, William Janeway, Joe Kennedy, Alex Key, Michael Lind, Lenny Mendonca, Joe Morgan, Adams Nager, Greg Tassey and Howard Wial. Any errors or omissions are the author's alone.

ABOUT THE AUTHOR

Dr. Robert Atkinson is the President of the Information Technology and Innovation Foundation. He is also the author of the books *Innovation Economics: the Race for Global Advantage* (Yale, 2012) and *The Past and Future of America's Economy: Long Waves of Innovation that Power Cycles of Growth* (Edward Elgar, 2005). Dr. Atkinson received his Ph.D. in City and Regional Planning from the University of North Carolina at Chapel Hill in 1989.

ABOUT ITIF

The Information Technology and Innovation Foundation (ITIF) is a Washington, D.C.-based think tank at the cutting edge of designing innovation strategies and technology policies to create economic opportunities and improve quality of life in the United States and around the world. Founded in 2006, ITIF is a 501(c) 3 nonprofit, non-partisan organization that documents the beneficial role technology plays in our lives and provides pragmatic ideas for improving technology-driven productivity, boosting competitiveness, and meeting today's global challenges through innovation.

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Can the United States Adopt a New Evolutionary Economics Framework to Guide Our Next Economy?

In the conventional view, the U.S. economy is a static entity, changing principally only in size. But in reality, our economy is a constantly evolving complex ecosystem. The U.S. economy of 2014 is different, not just larger, than the economy of 2013. Understanding that we are dealing with an evolutionary rather than static economy has significant implications for the conceptualization of both economics and economic policy.

In this book, Robert Atkinson argues that the conventional economic frameworks fail to provide policymakers with the guidance needed to drive an advanced, globalized 21st century economy. Rather, we need to embrace "evolutionary economics." In this context, the central task of economic policy is not managing the business cycle—it's driving robust rates of economic evolution. It's not about maximizing freedom or fairness as the right and left want, respectively—it's about maximizing the rate of evolution.

This book provides an overview of the evolutionary economics framework and the history of evolutionary economics thinking. It analyzes the three main drivers of U.S. economic evolution – geographic change, technological change, and demographic/cultural/governmental change. It then lays out eight key principles for an evolutionary economics-inspired economic policy.

Dr. Robert D. Atkinson is one of the country's foremost thinkers on evolutionary economics. With an extensive background in technology policy, he has conducted ground-breaking research projects on technology and innovation, is a valued adviser to state and national policymakers, and a popular speaker on innovation policy nationally and internationally. He is the author of *Innovation Economics: The Race for Global Advantage* (Yale, 2012) and *The Past and Future of America's Economy: Long Waves of Innovation That Power Cycles of Growth* (Edward Elgar, 2005).

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