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Understanding the U.S. National Innovation System

BY ROBERT D. ATKINSON | JUNE 2014

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In the conventional view, innovation is something that just takes place idiosyncratically in "Silicon Valley garages" and research and development (R&D) laboratories. But in fact, innovation in any nation is best understood as being embedded in a national innovation system (NIS). Just as innovation is more than science and technology, an innovation system is more than those elements directly related to the promotion of science and technology. Rather, it also includes all economic, political, and other social institutions affecting innovation (e.g., a nation's financial system; organization of private firms; the pre-university educational system; labor markets; culture, regulatory policies and institutions, etc.).

Indeed, as Christopher Freeman defined it, a national innovation system is "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies."[1] Innovation systems matter because a nation's innovation success depends on its national innovation system working effectively and synergistically.

Better understanding of the origins, development and operation of a nation's innovation system can help policymakers identify key strengths and weaknesses and policy changes needed to enhance a nation's innovation performance. Because of a variety of factors, no nation's innovation system is exactly the same as others. Each system is unique and each needs to be understood in this context.

This report first briefly describes the historical evolution of the U.S. national innovation system. It then describes the broad elements of the national innovation system organized

around what is termed the "innovation success triangle": the business environment, regulatory environment, and innovation environment. In addition, for each element it provides a subjective and informal ranking of the U.S. strengths relative to other nations.

THE INNOVATION SUCCESS TRIANGLE

One way to conceptually organize all the factors determining innovation in a nation is to think of an innovation success triangle, with business environment factors along one side of the triangle, the trade, tax and regulatory environment along another, and the innovation policy environment along the third. Success requires correctly structuring all three sides of the innovation triangle.

An effective business environment includes the institutions, activities, and capabilities of a nation's business community as well as the broader societal attitudes and practices that enable innovation. Factors specific to business include: high-quality executive management skills; strong IT (or as many other nations refer to it, ICT—information and communications technology) adoption; robust levels of entrepreneurship; vibrant capital markets that support risk taking and enable capital to flow to innovative and productive investments easily and efficiently; and a business investment environment that strikes the right balance between short- and long-term goals. Broader factors include: a public acceptance and embrace of innovation, even if it is disruptive; a culture in which inter-organizational cooperation and collaboration is embraced; and a tolerance of failure when attempting to start new businesses.

An effective trade, tax and regulatory environment features a competitive and open trade regime, including serious efforts by government to protect its businesses against foreign mercantilist practices; support for competitive markets such that new entrants, including those introducing new business models, can flourish; processes by which it's easy to launch new businesses and to bring innovations to market; transparency and the rule of law; a reasonable business tax burden, especially on innovation-based and globally traded firms; a strong and well-functioning patent system and protection of intellectual property; regulatory requirements on businesses that are, to the extent possible, based on consistent, transparent, and performance-based standards; limited regulations on the digital economy; limited regulations on labor markets and firm closures and downsizing; a balanced approach to competition policy; and government procurement based on performance standards as well as open and fair competition. To be sure, a good regulatory climate does not mean simply the absence of regulations. As we saw with the recent financial crisis, the right kinds of regulations are critical to ensuring that markets work and innovation flourishes. But nations need a regulatory climate that supports rather than blocks innovators and that creates the conditions to spur ever more innovation and market entry, while at the same time providing more regulatory flexibility and efficiency for industries in traded sectors.

The final leg of the innovation triangle is a sophisticated and strong innovation policy system. While markets are key to innovation, without effective innovation policy, markets will underperform.[2] An innovation policy system includes: generous support for public investments in innovation infrastructure (including science, technology, and technology

transfer systems); support for digital technology infrastructures (such as smart grids, broadband, health IT, intelligent transportation systems, e-government, etc.); targeting R&D to specific technology or industry research areas; funding sector-based industry-university-government research partnerships; reshaping the corporate tax code to spur innovation and IT investment, including R&D and capital equipment and software incentives; a skills strategy, including high-skill immigration and support for science, technology, engineering, and math (STEM) education; encouraging private-sector technology adoption, especially by small and mid-sized manufacturers; supporting regional industry technology clusters and regional technology-based economic development efforts; active policies to spur digital transformation in the private and nonprofit sectors; and championing innovation in the public sector.

MAJOR DEVELOPMENT STAGES OF THE U.S. NIS

In order to better understand the U.S. innovation system, it's worth examining the history of the United States in terms of innovation and innovation policy. Clearly this brief overview cannot do justice to this enormously complex topic, but it can provide a basic outline.[3] For its first 125 years after independence, the United States was not at the global technology frontier—that advantage was held by select European nations, first the UK and then Germany. However, with the emergence of the steel-based industrial revolution of the late 1890s, the United States joined the ranks of the world leaders, producing a host of leading-edge innovations. As business historian Alfred Chandler showed, the large American market enabled U.S. firms to successfully enter new mass production industries, such as chemicals, steel, and meat processing, and later autos, aviation, and electronics.[4] Because scale mattered so much to innovation and firm competitiveness, U.S. firms like DuPont, Ford, GE, GM, Kodak, Swift, Standard Oil, and others became global leaders.

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Scale helped, but the United States had other advantages. One was the "greenfield" nature of development. Unlike Europe, which had to overcome a pre-industrial craft-based system, the American economic canvass was newer, enabling new forms of industrial development to be more easily established. Another advantage was the unrelenting commercial nature of the American culture and system, where commercial success was valued above all else. As President Calvin Coolidge famously stated: "The business of America is business."

This is not to say that policy did not play a role. In the early half of the nineteenth century, government support for canals, railroads, and other "internal improvements" helped create larger markets. In the 1860s the federal government created the system of research-based land grant colleges through the Morrill Act. Funding for agricultural research helped power agricultural productivity, which freed up tens of millions of farm workers to power America's growing factories and helped create larger markets for industrial producers. In addition, since the founding of the Republic, the federal government had a robust patent system embedded in the Constitution. Moreover, policy to spur competition—through the Sherman Antitrust Act of 1890 and the Clayton Antitrust Act of 1914—was used to ensure that firms had the incentive to continue to innovate. And as Charles Morris's *The Dawn of Innovation: The First American Industrial Revolution* showed, wars (including the War of 1812, the Civil War and WWI) energized government-funded technology and industrial

development, which helped metal industry innovation such as precision metal measurement and interchangeable parts. But notwithstanding these factors, by and large America's industrial innovation prior to WWII was principally powered by private inventors and firms.

This changed dramatically after WWII with the emergence of a more science-based system of innovation (inspired in part by Vannevar Bush, director of the U.S. Office of Scientific Research and Development during WWII) which would become dominated by large firms and the federal government. The establishment—initially in the Great Depression and then after the war—of large, centralized corporate R&D laboratories helped drive innovation in an array of industries, including electronics, pharmaceuticals and aerospace. On top of this, the massive federal support for science and technology in WWII helped develop the "arsenal of democracy" that the Allies used to beat back the Axis powers threat. This strong federal role continued after the war, with substantial funding of a system of national laboratories and significantly increased funding of research universities. Federal funding of research helped drive innovation and played a key role in enabling U.S. leadership in a host of industries, from software, hardware, aviation, and biotechnology. For the most part this research was funded through mission-based agencies seeking to accomplish a particular federal mission (e.g., defense, health, energy) and through a system of peer-reviewed basic research funding at universities.

In fact, the explicit promotion of innovation and productivity as an economic goal was largely ignored and even rejected through most of the post-war period. To be sure there were occasional efforts during the Kennedy, Johnson, and Nixon administrations, but these were small scale and largely short-lived. The first major post-war federal effort to explicitly support industrial innovation was made by the Kennedy administration in 1963 with its proposal for a Civilian Industrial Technology Program (CITP). The administration proposed CITP to help balance the overriding focus of federal R&D on defense and space exploration, both of which had increased as the United States sought to counter the Soviet Union in the Cold War.[5] The CITP program was to provide funding to universities to do research helping innovation in sectors thought to help society, such as coal production, housing, and textiles. But despite the administration's efforts to launch the program, Congress did not approve it, in part because of industry opposition that feared disruptive technologies. For example, the cement industry opposed the program because it feared that innovation in housing technology might reduce the need for cement in construction.

Two years later the Johnson administration was able to get a redesigned effort through Congress, but only after making a number of changes. The new program, the State Technical Services program, was to fund university-based technology extension centers in the states that would work with small and mid-sized companies to help them better utilize new technologies. But despite the program's success, the Nixon administration eliminated it, largely on the grounds that this was an inappropriate federal intervention into the economy. However, the Nixon administration proposed its own initiative, the new Technology Opportunities Program, again to support technology in solving pressing social challenges, like developing high-speed rail and curing certain medical diseases. But again the program was not funded by Congress.

These attempts by the federal government to explicitly support commercial innovation were at best made in fits and starts and never really got off the ground. Moreover, they were not guided by any overriding vision or mission, unlike the government's efforts to develop defense and space technology, which were motivated by the need to respond to the Soviet threat. And they certainly were not linked to overall economic policy, which remained focused principally on reducing business cycle downturns, and, depending on the political party in power, reducing poverty.

This system began to gradually change in the late 1970s with the emergence of competitiveness challenges from nations like Japan and Germany. It was with the election of President Jimmy Carter in 1976 that the federal government began to focus in a more serious way on the promotion of technology, innovation, and competitiveness. The motivation for this was the major recession of 1974 (the worst since the Great Depression), the shift in the U.S. balance of trade from one of surplus to one of deficit, and the growing recognition that nations like France, Germany, and Japan now posed a serious competitiveness challenge to U.S. industry.

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These efforts were followed up by efforts by Congress and the Reagan and Bush I administrations. Indeed, policymakers responded with a host of major policy innovations, including passage of the Stevenson-Wydler Act, the Bayh-Dole Act, the National Technology Transfer Act, and the Omnibus Trade and Competitiveness Act. They created a long list of alphabet soup programs to boost innovation, including SBIR (Small Business Innovation Research), NTIS (National Technical Information Service—expanded), SBIC (Small Business Investment Company—reformed), MEP (Manufacturing Extension Partnership), and CRADAs (cooperative research and development agreements). They put in place the R&D tax credit and lowered capital gains and corporate tax rates. They created a host of new collaborative research ventures, including SEMATECH, the National Science Foundation (NSF) Science and Technology Centers and Engineering Research Centers, and the National Institute of Standards and Technology (NIST) Advanced Technology Program. And they put in place the Baldridge Quality Award and the National Technology Medal.

Moreover, it wasn't just Washington that acted. Most of the 50 states transformed their practice of economic development to at least include the practice of technology-led economic development. Many realized that R&D and innovation were drivers of the New Economy, and that state economies prosper when they maintain a healthy research base closely linked to commercialization of technology. For example, under the leadership of Governor Richard Thornburgh, Pennsylvania established the Ben Franklin Partnership Program that provides matching grants primarily to small and medium-sized firms to work collaboratively with Pennsylvania universities.

But by the time Bill Clinton was elected in 1992, America's competitiveness challenge appeared to be receding. Japan was beginning to face its own problems, in part stemming from the popping of its property bubble and increasing value of the yen. And Europe was preoccupied with its internal market integration efforts. Moreover, with the rise of Silicon Valley as a technology powerhouse and the rise of the Internet revolution and companies

like Apple, Cisco, IBM, Intel, Microsoft, and Oracle, America appeared to be back on top, at least when it came to innovation. As such, the pressures for Washington to focus on industrial innovation and competitiveness policy receded.

Soon after, information technology entered into a new phase, with more powerful microprocessors, the wide-scale deployment of fast broadband telecommunications networks, and the rise of Web 2.0 social network platforms. As a result, it became clear to many policymakers that IT (or ICT) was now a key driver of growth and competitiveness, and that effective economic policy now had to get IT policy right.

Toward that end, the Bush II administration and Congress undertook a number of initiatives. Building on the Clinton administration's Internet Governance Principles which argued that government should take a light touch toward regulating the Internet, the Bush administration took a number of steps to spur IT innovation, including deregulating broadband telecommunications (now that most American homes had access to at least two broadband "pipes" – cable and DSL), freeing up radio spectrum for wireless broadband, taking a light touch with respect to regulating online privacy, and using IT to transform government itself (e-government).

But while IT was thriving, U.S. industrial competitiveness was not. The United States lost over one third of its manufacturing jobs in the 2000s, with the majority lost due to falling international competitiveness, not superior productivity.[6] The United States went from running a trade surplus in high-technology products in 2000 to around a 100 billion dollar deficit a decade later. The Great Recession, both a result of this loss of competitiveness and a cause of further industrial decline, may represent a watershed moment in U.S. history, one that represented the high-water mark of U.S. industrial leadership. But that will likely depend on the nature of the national policy responses over the next decade.

In any case, the state of U.S. industrial innovation and competiveness has gained renewed attention after the losses of the 2000s, the Great Recession and the emergence of robust new technological competitors, including, but not limited to China. Because of this, the Obama administration has proposed a number of initiatives, including the establishment of a National Network of Manufacturing Innovation (three centers have already been announced); an expansion in the research and experimentation (R&D) tax credit; increased funding for science agencies (including NSF, NIST, and DOE [Department of Energy]); policies to expand the number of STEM graduates; patent reform; and increased efforts to limit unfair foreign "innovation mercantilist" policies, among others. Congress has also introduced a variety of similar measures. However, partisan differences fueled in part by a growing populism from the right and the left (anti-government for the former; anti-corporate for the latter) coupled with a large federal budget deficit and a political unwillingness to raise taxes on individuals or cut entitlements, has meant that progress to shore up the weaknesses in the U.S. innovation system has been extremely limited.

ELEMENTS OF THE U.S. NIS

As described above, there are three elements of a national innovation system: the business environment, the regulatory environment, and the innovation policy environment. This section describes each and the U.S. performance.

Business Environment

The business environment consists of three broad factors: market and firm structure and behavior, the system for financing business, and related social and cultural factors affecting how business operates.

Market and Firm Structure and Behavior

Managerial Talent

When it comes to managerial talent it appears that the United States is the world leader and this factor has played a role in explaining past U.S. innovation leadership. As professor John Van Reenan and colleagues have shown, "when it comes to overall management, American firms outperform all others."[7] In part this comes from environmental factors that force better management: more competition and more flexible labor markets. But it may also come from the fact that the United States developed the discipline of management (in the 1950s) and perfected it through its extensive system of business schools at universities.

There are three elements of a national innovation system: the business environment, the regulatory environment and the innovation policy environment.

Time Horizon and Risk Appetite of Firms

Despite the high quality of many U.S. managers, they increasingly find themselves in firms buffeted by pressures for short-term performance, which in turn reduces their ability to invest for the long-term. For example, in a 2004 survey of more than four hundred U.S. executives, over 80 percent indicated that they would decrease discretionary spending on areas such as R&D, advertising, maintenance, and hiring in order to meet short-term earnings targets, and more than 50 percent said they would delay new projects, even if it meant sacrifices in value creation.[8] This focus on maximizing short-term returns means that companies are effective in reducing waste and pulling the plug on poor investments. But at the same time, this pressure to achieve short-term profits all too often has meant sacrificing long-term investment, which is the majority of investment in innovation. 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."[9]

ICT Adoption

U.S. firms are among the world leaders in adoption of information and communications technologies (e.g., hardware and software). U.S. firms invest more as a share of sales and of overall capital investment in hardware, software, and telecommunications than almost any other nation. For example, these investments are almost twice as high as Korean investments. And as Van Reenan and Bloom have found, not only do U.S. firms invest more, but U.S. firms appear to get more benefit out of IT investment than many other countries' firms. In part this is because U.S. firms are more willing to use IT to fundamentally restructure production processes.[10]

Business Financing System

Venture and Risk Capital

With the establishment of the American Research and Development Corporation in 1946, the United States pioneered the venture capital industry and remains a leader. Hundreds of private venture capital firms across the nation analyze and fund investment opportunities. The industry does more than invest funds; it also helps with key management functions such as serving on boards and advising on business strategy. However, while the venture sector has grown over the last 15 years, it has tended to focus its investment upstream and in larger deals, leading some to argue that there is a capital gap in earlier stage, smaller deals. In addition, while most venture capital placements are concentrated in a few states (e.g., California and Massachusetts, and to a lesser extent Colorado and Washington), there is some venture funding in almost every state. There is also a robust "angel capital" system in the United States made up of private individuals of high net worth who invest money into entrepreneurial, high-growth companies.[11]

Some state governments have also established programs to help with venture funding, particularly to smaller and earlier stage startups. Some have also created angel capital networks to help private funders better coordinate their efforts and find deals. And the federal government, through the Small Business Administration's Small Business Investment Company, provides capital subsidies to some private sector venture firms, while the Small Business Innovation Research (SBIR) program provides modest research grants to small firms.

Firm Finance (Debt and Equity)

Firms in the United States have access to a wide array of financing sources, the vast majority provided by the private sector. While the initial public offering (IPO) market is smaller than it has been in the past, many growth-oriented innovation-based firms are able to obtain capital through IPO placements. However, with the IPO market more limited, increasingly the "exit" strategy for small, high-growth startups is acquisition by larger, more established technology companies, with Facebook's recent acquisition of WhatsApp being one of the largest ever.[12]

Government financing for firms is quite limited. Existing firms can raise additional money on highly traded and liquid equities markets. And corporate debt, either through bonds or loans, is widely available. At the federal level, the Small Business Administration provides some direct and indirect lending for small firms, but this is not targeted to innovation-based firms or firms in traded sectors. And many state governments provide modest financing for industrial expansion and early stage firms.

Cultural Factors

As scholars such as Francis Fukuyama, Raquel Fernandez, Lawrence Harrison, and Samuel Huntington have shown, cultural factors such as trust, group orientation, and risk taking have impacts on innovation and growth.[13]

Nature of Customer Demand

As Michael Porter's work on competitive advantage indicates, nations with demanding consumers are in a better position because this puts pressures on firms to innovate and be more efficient.[14] While there are little good data on this, it appears that American consumers are more demanding than in many nations. Moreover, thanks to the Internet, and applications like Yelp and others, most U.S. consumers have immediate access to a wealth of information about businesses. We see this in terms of comparing U.S industries to ones in Europe. For example, standard business traveler hotel quality in the United States appears to be far superior to Europe, in part because American consumers demand higher quality.[15] Columbia professor Amar Bhidé has also argued that the "venturesome consumption" nature of American consumers—that is, their eagerness to be early adopters of and experiment with new products and technologies—has played a role in supporting U.S. innovation success.[16]

Risk Taking and Entrepreneurship

In part because the United States is a nation of immigrants, who by definition took a major risk to move from their native country, the country has a strong culture of risk-taking and entrepreneurship.

The United States has long been seen as having a culture of "Yankee ingenuity," meaning a deep-seated interest in tinkering, inventing, and making things better. At the same time, in part because the United States is a nation of immigrants, who by definition took a major risk to move from their native country, the United States has a strong culture of risk-taking and entrepreneurship. Combine that with a distinct culture of individualism, and this makes it easier for people—whether they are a Steve Jobs or a worker on the shop floor—to question established ways of doing things.[17] Moreover, unlike many nations, failure in starting a new business does not doom a professional career (in fact, it's been said that some Silicon Valley venture capital firms don't want to see entrepreneurs' business plans until they're on their third startup).

Attitudes Toward Science and Technology

For much of American history, American culture was characterized by a general belief in the inevitability of social and economic progress. Historian Merritt Roe Smith discusses the sampling of books from the period of the 1860s to the early 1900s with titles such as: *Eighty Years of Progress; Men of Progress; Triumphs and Wonders of the 19th Century; The Progressive Ages or Triumphs of Science; the Marvels of Modern Mechanism; Our Wonderful Progress; The Wonder Book of Knowledge;* and *Modern Wonder Workers.*[18] As economist Benjamin Anderson wrote in the 1930s, "on no account must we retard or interfere with the most rapid utilization of new inventions."[19] While America still largely tilts toward innovation, the anti-innovation forces in U.S. culture appear to be stronger today than ever before in American history. Whether it is fears of job loss from automation, privacy loss from the Internet, or environmental damage from nano-tech or biotech, anti-technology forces—in the media, "public interest" groups, and the public at large—have expanded, making it harder for the U.S. economy to press ahead with innovation. [20]

Collaborative Culture

While innovation is about competition, it's also about "coopetition" and cooperation—in other words, groups working together to drive innovation. This has become more important to enabling innovation, especially as innovation has become more challenging with more organizations embracing open innovation. As Fred Block found, the nature of the U.S. innovation system has changed dramatically over the course of the last 40 years.[21]

Using a sample of innovations recognized by *R&D Magazine* as being among the top 100 innovations of the year over the last four decades, the data finds that while in the 1970s almost all winners came from corporations acting on their own, more recently over two-thirds of the winners have come from partnerships involving business and government, including federal labs and federally funded university research. The culture of collaboration in places like Silicon Valley and Boston's Route 128 is one of the keys to their success. Likewise, the ability of some leading U.S. universities to work cooperatively with industry has been key to driving regional innovation hubs and clusters. These collaborative learning systems, especially in clusters, are supported in part by strong intellectual property (IP) protections—people aren't afraid that if they talk and share they will lose proprietary IP.

Time Horizon and Willingness to Invest in the Future

For much of American history, Americans have been willing to sacrifice current consumption for future income by supporting high levels of private and public investment. Over the last three decades this has become more challenging, as the focus for most voters and the overall political system has shifted toward current consumption. In the 1960s, when federal support for R&D amounted to 1.75 percent of GDP, this meant that Americans were willing to invest 2.8 percent of their income in government R&D.[22] Today, with per capita incomes almost three times higher in real dollars, Americans are only willing to invest 0.48 percent of their income in government R&D (just 17 percent of the 1960s level). To see the extent of this shift to the present-day side of the continuum, consider that in the 1960s, the total of government investment in R&D, infrastructure, and education, plus the trade surplus (or deficit) minus the national debt equaled 3.1 percent of GDP. In the 1970s, this figure fell to 0.8 percent, but was still positive. In the 1980s, it went negative, to -3.3 percent of GDP. In other words, America was cutting investments in the future while running up bills for the future. In the 1990s, with the decline in the trade and budget deficits, this composite figure improved slightly, to -1.3 percent. However, from 2000 to 2010, it plummeted to -4.5 percent of GDP, an all-time low. In other words, from the 1960s to 2010, there has been a shift of 7.6 percentage points in the amount of investment for the future and future debt. Combine this change in attitude with a very large national debt, and it becomes increasingly difficult for federal elected officials to ask American voters to pay more to support expanded financial support for innovation (either directly through spending or indirectly through tax incentives like the R&D credit).

Trade, Tax, and Regulatory Environment

While the business environment plays the key role in determining innovation success, government policy plays a powerful enabling (or detracting) role, particularly through the broad areas of trade, tax and regulatory policy that shape the innovation environment.

Regulatory Environment

Industry Structure and the Nature of Competition

Generally, the United States has embraced an approach to competition and competition policy based on maximizing consumer welfare. In contrast to the "ordoliberal" tradition of EU antitrust policy which embraces both economic and social goals, and in particular focuses on preserving competition for its own sake, the U.S. approach is much more

oriented to maximizing consumer—as opposed to producer—welfare, and is focused on anti-competitive behavior more than on market power per se.[23] In addition, the system is based on a strong rule of law. While there is considerable disagreement about exactly where anti-trust policy should be on the continuum of more or less competition, one can make the case, as Michael Lind does in his book *Land of Promise*, that U.S. anti-trust policy has been too stringent, limiting the emergence of the kind of scale needed to win in global competition, and too focused on consumer welfare rather than overall economic welfare.[24]

Regardless, compared to other nations, the U.S. NIS erects relatively few barriers to entry for firms to break into existing markets, thus ensuring robust competition and the constant threat of "Schumpeterian" creative destruction. We have seen this in industries as diverse as financial services, energy production, and transportation. In addition, the U.S. system attempts to create a level playing field with e-commerce competitors, enabling new entrants to disrupt existing markets and business for the advantage of the consumer. However, that may be changing as entrenched interests in industries such as real estate, car sales, taxi services, hotels, legal services, and others seek to use laws and regulations to limit competition.

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Regulatory System for Entrepreneurship

Academic research shows that delays caused by entry regulations are associated with lower rates of firm entry.[25] The United States ranks relatively high on the World Bank index of ease of starting a business, but not as high as some nations like Canada, which has made this a top priority.[26] Moreover, it is not only relatively easy to start a new business, but it is also easy to close one or lay off workers, at least in the non-unionized, non-governmental share of the economy.[27] The latter is important, for if entrepreneurs cannot easily close or downsize businesses and if investors cannot obtain reasonable capital recovery rates, the incentives for entrepreneurship are reduced.[28]

Role and Form of Regulation

The U.S. system of regulations, many of which affect innovation, begins with Congress passing legislation and sometimes requiring executive branch agencies to promulgate regulations. These agencies go through an extensive public notice and comment period in which individuals and organizations can submit written comments that the agencies are required to review. In addition, the Office of Information and Regulatory Affairs (OIRA) within the White House Office of Management and Budget also conducts cost-benefit reviews of some proposed regulations, particularly those with high expected costs. To the extent that OIRA finds a "significant" federal regulation inconsistent with its cost-benefit analysis, it can return the regulation to the promulgating agency (which can then revise or withdraw it). Although OIRA's analysis does not always trump that of the agency, it does dominate. And of course, if agencies do not change their regulatory decision, Congress can also act and change the law. And this process is generally quite transparent. For example, the Clinton administration inserted greater transparency into the OIRA review process by requiring, inter alia, public disclosure of all communications between OIRA personnel and individuals not employed by the executive branch.

While regulation is not always performance-based, in the last two decades there has been a greater awareness among regulators of the importance of focusing regulations more on

what the government wants to achieve, while leaving the means by which to achieve it up to the decision of the regulated entities. There is some recognition that this form of regulation is more efficient and spurs more innovation than regulation that prescribes the means.

However, it appears that the U.S. regulatory burden on innovation has grown over the last decade, both in extent and orientation. As we see in areas like agricultural biotech and privacy, the pressures for more regulation grow. Moreover, most regulatory agency budgets have been cut or limited, making it harder for them to both modernize technologies and processes and expand staff so that they can respond quickly to firms seeking regulatory approval. We see this in areas as diverse as patent approvals, drug and medical device approvals, and approvals of new airplanes.

Transparency and Rule of Law

Regulations have less of a negative effect on innovation and growth when they are transparent and backed up by the rule of law so that they are consistently applied. This has generally been a strength of the U.S. system, which enjoys a well-developed, independent judiciary and a legislative framework (e.g., the Administrative Procedures Act) that works to hold government executive agencies accountable for obtaining public input and basing rules on evidence.

Tax, Trade and Economic Policy

Macroeconomic Environment

Macroeconomic policies can provide an overall supportive policy for innovation. U.S. macroeconomic policy has been predicated on monetary stability, focused on limiting inflation. Some have argued that in its efforts to limit inflation the Federal Reserve Board has placed too little relative emphasis on full employment, especially since the late 1970s. And while the American Recovery and Reinvestment Act was the exception, U.S. macroeconomic policy relies principally on monetary policy, rather than fiscal policy, to adjust cyclical growth rates. In addition, because of the overriding focus on consumer as opposed to producer welfare, as well as a belief that markets should determine prices, U.S. policy toward its currency (and that of other nations) is largely non-interventionist, and to the extent that it is interventionist, it is to defend a strong dollar (which helps consumers but hurts most producers, especially in traded sectors).

Tax Policy

While the prevailing view toward U.S. tax policy is that it should be neutral vis-à-vis various economic activities, the reality is that it is somewhat interventionist, sometimes for good policy reasons (e.g., the R&D tax credit, accelerated depreciation) and other times because of special interest pressures for particular tax provisions.[29] But most policymakers strive for a tax code that does not favor particular industries over others, even if this means that some traded sectors exposed to international competition pay more than some non-traded sectors.[30] Moreover, the U.S. corporate tax rate is quite high (in both statutory and effective terms).[31] In addition, the U.S. R&D tax credit is relatively anemic compared to other nations, ranking just twenty-seventh in R&D tax generosity.[32] And the United States

is also one of the very few nations that does not use a border-adjustable value added tax (VAT).

Trade Policy

The United States' approach to trade policy is based on the belief that nations have revealed comparative advantage and that an open and market-based trading system enables nations to achieve that advantage to the benefit of its consumers. This has led the United States to focus mostly on signing new trade agreements. However, in recent years, there has been a growing focus on trade enforcement (including the establishment of an Interagency Trade Enforcement Center) based on the belief that the benefits from trade will be less if other nations are not playing by the rules developed by the World Trade Organization. Nevertheless, funding for trade enforcement efforts is relatively anemic, with the Office of the United States Trade Representative (USTR), Department of Commerce's International Trade Administration (ITA), and State Department trade efforts significantly under-funded.

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When it comes to trade promotion, the United States does very little compared to other nations. Funding authority for the Ex-Im Bank is limited compared to many other nations.[33] Funding for foreign direct investment (FDI) attraction is also a fraction of what other nations invest. However, the Obama administration has made some efforts in these areas, including establishment of the Select USA organization.

Intellectual Property

The U.S. system of intellectual property protection has its roots in the U.S. Constitution, which gave Congress the powers to promote "the progress of science and useful arts" by providing inventors with the limited but exclusive right to their discoveries. This applies to copyrights and patents, with trademarks similarly protected by Congress under the Commerce Clause (Article I, Section 8, Clause 3). The view then, as well as now, is that without reasonable protection for their IP, inventors and creators (e.g., individuals or companies) would innovate and create less. Patents and trademarks are governed by the U.S. Patent and Trademark Office (PTO) in the Department of Commerce. Copyright is governed by the Librarian of Congress. And of course, Congress writes the laws under which these agencies must function, and mostly objective courts can rule on their decisions.

While there is some disagreement within the United States over exactly how strong IP protection should be, the differences are largely at the margin (with some arguing for slightly stronger protection and some for slightly weaker), or over particular issues regarding implementation (e.g., the debate over the proposed Stop Online Privacy Act [SOPA] legislation regarding how to identify and limit access to foreign infringing websites). Part of this overall debate has stemmed from the fact that there is some evidence that during the late 1990s and early 2000s the U.S. Patent and Trademark office was perhaps too liberal in issuing patents, in part from a large patent backlog and from the development of novel applications (e.g., business methods patents). However, after recent passage of patent legislation that allowed an increased budget for the PTO, some of these problems appear to have receded. However, there is a still a challenge from what some refer to as "patent trolls," a pejorative term used for a person or company that enforces its

patents against one or more alleged infringers in a manner considered unduly aggressive or opportunistic, often with no intention to manufacture or market the product.

Standards

The U.S. commercial standards system (as opposed to standards for health, safety, and the environment) is characterized by a voluntary, consensus-based global system. By and large, the government itself does not get involved in picking particular industry standards. For example, in the dispute between HD and Blu-ray high-definition video players, the government did not pick a standard, rather letting cooperation and competition between industry and the emergence of consumer choice determine the winning standard. These standards processes are coordinated by industry trade associations and by the American National Standards Institute (ANSI). ANSI facilitates the development of American National Standards (ANS) by accrediting the procedures of standards developing organizations (SDOs). These groups work cooperatively to develop voluntary national consensus standards. American National Standards are usually referred to as "open" standards. In this sense, "open" refers to a collaborative, balanced, and consensus-based approval process. The content of these standards may relate to products, processes, services, systems, or personnel. ANSI has served in its capacity as administrator and coordinator of the United States private sector voluntary standardization system for more than 90 years. Initially funded by five engineering societies and three government agencies, the ANSI remains a private, nonprofit membership organization supported by a diverse constituency of private and public sector organizations. ANSI and other SDOs also work at a global level with their counterparts around the world to develop voluntary, consensus-based global standards. While the National Institute of Standards and Technology (NIST) is a federal laboratory, its work largely involves metrology (measurement), not private sector standard setting.

Relative to private sector R&D funding trends, federal support for R&D has fallen substantially as a share of GDP from its high levels in the 1960s

Innovation Policy Environment

Innovation policy refers to policies specifically designed to spur innovation in a nation, as opposed to other policies that shape the overall environment for innovation. In general, U.S. innovation policy is less sophisticated and less well thought out than it is in many other nations. This is due in part to the dominance of the neo-classical economic consensus in the United States, which eschews these kinds of policies as inappropriate intervention into the economy, and in part to the "Hertz syndrome" (we think we are number one and therefore do not try harder).[34]

Research and Technology

Support for Research in Universities and Research Labs/Research Institutes

The U.S. system for supporting scientific research is based on two fundamental aspects: support for mission-oriented research (e.g., defense and health) largely to federal labs, and support for basic, curiosity-directed research through university funding. The federal government financed approximately $140 billion of R&D activity in 2013.

Relative to private sector R&D funding trends, federal support for R&D has fallen substantially as a share of GDP from its high levels in the 1960s (during the Cold War and the race to the moon). There have been occasional efforts to increase funding. In the late

1990s and early 2000s, funding for the National Institutes of Health (NIH) was doubled in order to accelerate health innovation, but as a share of GDP, NIH funding has since fallen by 25 percent.[35] In response to the war on terror and the Iraq and Afghanistan wars, federal funding for defense and homeland security R&D was significantly increased. Moreover, from around 2010 there has been a modest increase in federal government support for R&D from around 0.78 percent of GDP to 0.88 percent. However, since then and with the budget sequester, federal support for R&D has fallen over 10 percent.[36] Moreover, fiscal challenges facing the federal government suggest that any increases in the future will be difficult to achieve and that inflation-adjusted declines are possible.

Federal Labs

The United States funds a system of between 80 to 100 government research laboratories (some are government operated, while some are private contractor operated). The largest labs are funded by the departments of Defense, Energy, and Health. For the most part, research is funded to help agencies better achieve mission goals.[37] While not part of the National Labs system, the Defense Advanced Research Projects Agency (DARPA) and Advanced Research Projects Agency-Energy (ARPA-E) have also played an important role in the development of cutting-edge technologies initially designed to support core agency missions (e.g., defense or energy efficiency) that over time have yielded substantial technology spinoffs to the U.S. and global economy (e.g., the Internet, lasers, etc.).

University Research

University research is supported through a number of agencies, including DOD (Department of Defense), DOE, and NIH, to help them achieve mission goals. However, the National Science Foundation funds university research largely unrelated to agency mission goals. While the system is based on the conception of the linear model of research (first proposed by White House science advisor Vannevar Bush in the post-war period and based on the notion that funding for investigator-directed basic research will lead to valuable outcomes automatically), some argue that federal funding for university research should take a more explicit account of the needs of the commercial economy and promote tech transfer. However, in part because of cuts at the state government level and more recently federal funding cuts, university R&D levels relative to GDP in the United States lag behind many nations.[38]

Technology Transfer Systems

Prior to the 1980s, technology transfer (from universities or federal labs to the commercial marketplace) was largely an afterthought, at least as far as federal policy was concerned. To be sure, some institutions, like MIT and Stanford, had long played an important role in working with industry and supporting new business spin-offs. But such efforts were largely due to unique institutional factors and were not widely adopted by publically-supported research institutions. However, since the 1980s a range of policies have been put in place to help better commercialize research. Congress passed the Stevenson-Wydler Technology Innovation Act in 1980. The legislation stated that "technology and industrial innovation are central to the economic, environmental, and social well-being of citizens of the United States." The Act made a number of changes to better enable the transfer of technology from federal laboratories to commercial use. Likewise, the Bayh Dole Act changed the intellectual property rules governing federally funded research at universities, allowing

universities to retain the IP rights, giving them more incentive to commercialize research. Congress also passed the Federal Technology Transfer Act of 1986, the National Defense Authorization Act for FY1991, the Technology Transfer Improvements and Advancement Act, the Technology Transfer Commercialization Act, and the Omnibus Trade and Competitiveness Act in 1988 (that among other things created the Technology Administration in the Department of Commerce, reorganized the National Bureau of Standards into the National Institute of Standards and Technology and created a number of programs to help industry with innovation, including the Malcolm Baldrige Quality Award, the Advanced Technology Program, and the Boehlert-Rockefeller State Technology Extension Program). In addition, some agencies, like NSF and NIH, have begun pilot programs to better link their funded research to commercialization outcomes. Overall, while policies have been put in place to help spur commercialization, the only federal agency explicitly focused on commercial innovation is the National Institute of Standards and Technology.

Support for Research in Business

In the United States, most commercial activities are conducted by private, for-profit firms. The United States generally does not support R&D directly in firms, unless that R&D is related to achieving a core mission, especially defense. In part this is because of an aversion toward anything that might smack of heavy-handed industrial policy, but it also reflects a belief that firms are often better positioned to identify the technology areas of most commercial promise. However, the federal government does support an array of policies to help firm-level innovation. For example, in 1981 Congress established a tax credit for business research and development expenditures. This provision, the first of its kind in the world, allowed companies to claim a 20 percent tax credit on increases in expenditures on research. In addition, the Small Business Innovation Research Program (which requires federal agencies to allocate a small share of their R&D budgets to small business research projects related to agency mission goals) was established in 1984. Likewise, Congress passed the Cooperative Research and Development Act in 1984 which allowed companies to gain an anti-trust exemption for participating in pre-competitive R&D consortia. More recently, Congress revised the research and experimentation tax credit to create a slightly more generous and more effective Alternative Simplified Credit.

All of these measures are largely technology and firm agnostic, supporting innovation itself (e.g., the R&D credit). However, the federal government has supported some industry-specific efforts related to industry R&D. For example, SEMATECH and the StarNet program have supported advanced R&D in the semiconductor industry.[39] The latter program with industry and government funds a number of university research centers focused on advanced semiconductor research.

More recently, the Obama administration has proposed establishment of a National Network for Manufacturing Innovation (NNMI), modeled in part on efforts like the German *Fraunhofer* centers.[40] The first NNMI established was a DOD center for additive manufacturing (named "America Makes") that brings together firms, universities and several government agencies in a unique public-private partnership. The administration recently announced funding for three new centers focused on digital manufacturing,

lightweight materials, and next-generation power electronics. But these four centers, while focused on spurring commercial innovation and manufacturing competitiveness, are also focused on achieving key government mission agency goals. Congress is considering broader NNMI legislation which would expand the number of centers, and importantly, make the choice of centers and technologies determined by industry.[41] Industries would have to commit funding to the centers and take a leadership position in order to receive matching federal funding.[42] However, the proposed funding levels are relatively limited, especially when compared to what other nations are committing. For example, on a per-GDP basis, Korea invests 89 times more than the United States on industrially-oriented research, Germany 43 times more, and Japan 15 times more.[43]

Systems of Knowledge Flows

Innovation Clusters

On a per-GDP basis, Korea invests 89 times more than the United States on industrially-oriented research, Germany 43 times more, and Japan 15 times more

The concept of innovation clusters has been long understood by regional planners (harkening back to "Marshallian" manufacturing learning districts in the early 1900s). However, it was not until Harvard Business School Professor Michael Porter popularized the notion of clusters in the 1990s that many governments in the United States began to focus more explicitly on spurring innovation clusters. Of course, the emergence of a few high-profile clusters such as Silicon Valley and North Carolina's Research Triangle Park (RTP) lent credibility to the notion that innovation clusters can power innovation and growth. Despite this, the federal government has played little explicit role in the development of innovation clusters. To be sure, funding from the federal government (especially DOD in Silicon Valley and Boston's Route 128 and NIH in RTP) has played a key role in the development of some U.S. innovation clusters. But explicit innovation cluster policies have been the province of states and sub-state regions, in part because these units of governments are "closer to the ground" and have a better sense of which clusters are important. Toward that end, many U.S. states have innovation cluster programs and policies.[44]

Industry Collaboration Systems (with academia and research institutes)

Compared to many nations, the United States has a highly developed and successful industry-research institute collaboration system. Universities like MIT, Cal Tech, and Stanford are models that the rest of the world, and indeed, other universities in America, look to for inspiration. There is no single reason for U.S. success at university-industry collaboration; rather, a number of factors play a role. One factor is cultural. A long tradition of John Dewey-like pragmatism has dominated U.S. universities, leading them to view collaboration with industry not as something that sullies the purity of basic research, but rather as something that is useful and can advance knowledge. In addition, the U.S. system, with a diversity of kinds of universities and ownership (with a large number of world-class private universities), has created a more competitive environment where universities innovate and compete to work with industry. On top of this, U.S. universities are much less hierarchical than universities in many nations, where faculty must wait until they become full professors to work with industry or start new companies. Finally, in many states, public colleges and universities are encouraged and supported by state and local governments in their efforts to work more closely with industry. Despite this overall positive record, it's important to note that there is still great diversity in commercialization

performance. For every MIT or Stanford, there are 10 universities where commercialization is more haphazard and less effective.[45] The National Science Foundation's Engineering Research Center (ERC) and Industry/University Cooperative Research Center (I/UCRC) programs have also played a role in facilitating university-industry collaborative research into complex engineered systems.

For every MIT or Stanford, there are 10 universities where commercialization is more haphazard and less effective.

Acquiring Foreign Technology and Exporting U.S. Technology

In part because the U.S. economy is so large and because it generally is at the leading edge of technology development, there has been little explicit policy directed at acquiring foreign technology. The general policy approach has been to welcome inward foreign direct investment because of the technology transfer that it brings. To the extent that government supports inward FDI attraction, that support has been at the state and local levels. For example, in the 1980s and 1990s, states aggressively courted Japanese automobile company investment in part for the jobs they provided, but also because of the technology transfer that occurred as U.S. auto firms were more easily able to learn the Japanese system of auto production. However, more recently the Obama administration has established Select USA, a small initiative in the U.S. Department of Commerce designed to work with the states to help attract foreign investment.

In addition, the United States monitors foreign acquisitions of U.S. companies through the Committee on Foreign Investment in the United States (CFIUS). CFIUS is an inter-agency committee authorized to review transactions that could result in control of a U.S. business by a foreign entity ("covered transactions"), in order to determine the effect of such transactions on the national security of the United States. Most foreign acquisitions of U.S. companies do not even trigger a CFIUS review, and few transactions are rejected. In part this reflects a belief that foreign acquisitions of U.S. firms can in many cases provide needed injections of capital, know-how, and market access that can help the U.S. establishment become more competitive.

With regard to exporting technology, there are few limits on exporting U.S. commercial technologies to other nations, unless those technologies have potential benefits for current or potential military adversaries. As a result, the Department of Commerce's Bureau of Industry and Security oversees the transfer of certain sensitive U.S. technologies to some foreign nations. But again, the number of technologies covered is relatively small. Moreover, in the past decade there has been increasing pressure from industry and others to reduce the restrictions in order to boost U.S. innovation competitiveness, in addition to the U.S. government.

Technology Diffusion and Adoption

In the United States there are several policies and programs related to diffusion and adoption. For over a century, the U.S. Department of Agriculture has supported a system to help farmers and ranchers adopt the best production technologies. These include a system of agricultural land grant colleges, agricultural research stations, and a county-wide system of agricultural extension agents. In 1989, Congress created a similar, albeit much smaller system to help small and medium-sized manufacturers adopt new technologies. The program, the Manufacturing Extension Partnership (MEP), is run by the National Institute of Standards and Technology and administrated by over 60 regional centers. There are

other much smaller systems in place run by other agencies to help firms with issues such as energy efficiency and worker safety. However, relative to many other nations (e.g., Germany and Japan) U.S. support for these systems is quite modest.[46]

Human Capital System

Education/Training (K-12)

The United States's K-12 education system is largely operated at the state and local level, with thousands of local school districts. Unlike many other nations, the United States has not established federal control of the K-12 system. However, the development by the states (and supported by the federal government) of the new "Common Core" standard is a move in that direction.

Compared to many other nations, the performance of U.S. K-12 students on internationally comparable standardized tests like PISA and TIMMS is generally lacking. Some argue that the poor performance reflects a lack of national curriculum standards, while others argue that it is more structural in nature (teachers unions resistant to change, or too little choice for parents in which school to send their children). However, it is generally not a result of lack of funding, as U.S. funding per pupil is above the OECD average. In part this poor performance is because of the higher share of students in the United States from socio-economically disadvantaged families.

One feature of the U.S. K-12 system that is different from that of many other nations is the increased diversity of kinds of schools. Since the 1980s, the growth of "charter" schools (publically funded, but privately operated) has been significant, with many of the charters focusing on unique pedagogical approaches. In addition, the United States has a higher share of students in private (religious and non-denominational) schools than most other nations. Finally, despite the relatively mediocre test scores, the U.S. K-12 education system does appear to do a better job than many national education systems in encouraging independence and creative thinking among students. In many schools students are encouraged to not just engage in rote learning (e.g., "drill and kill") but in more creative activities and independent thinking. This appears to play a supportive role in U.S. innovation and entrepreneurship. However, with the rise of the standards movement, such activities may diminish, rather than flourish.

Higher Education

The American higher education system is diverse and distributed in nature. As described above, states manage public universities and colleges while private universities are funded though tuition and charitable donations. For private schools, some students can afford high tuitions while others receive financial aid from the universities. Public state schools are subsidized, but with the fiscal problems of state governments, tuition rates have increased significantly as public funding has been cut. This is one reason why the United States has fallen behind many other nations in higher education enrollment rates.

In addition, there is little national or state effort to guide students in their choice of what they study. On the one hand this helps students choose majors in response to market forces; it also means that there is an undersupply of graduates in science, technology,

education and math (STEM). Because of the competition between schools, it is possible that the U.S. system will be transformed by the rise of massive open online courses (MOOCS) with a significant increase in higher education productivity as more students take more classes online. Moreover, an increasingly large share of students participating in master's or Ph.D. programs in STEM fields at U.S. universities are foreign born, reflecting both the global quality of U.S. research universities and the difficulty in developing a pipeline of U.S. students studying toward STEM degrees.[47]

Skill/Technical Training

In the United States, skills training is largely seen as a private sector responsibility. As such there is no national system for employer-based skills training. In the old economy, employers played a stronger role in skills training. Some industries and firms took the lead with the establishment of training institutes and industry-wide apprenticeship programs. But over the past three decades most of these efforts have ended as firms see such investments in "public goods" as something they can no longer afford. As such, overall private sector investment in skills training has declined by about one-third as a share of GDP in the last decade.[48]

To the extent that there is a federal role (through the Department of Labor), it is focused largely on helping disadvantaged individuals obtain skills. However, the National Skill Standards Act of 1994 created a National Skill Standards Board (NSSB) responsible for supporting voluntary partnerships in each economic sector that would establish industry-defined national standards leading to industry-recognized, nationally portable certifications. The vision was that each industry would define and validate national standards for the skills it was seeking and credential individuals against those skills. One key reason for doing this was so that companies would have a better way to assess the skills of prospective and current workers and so that workers would have a better way to identify and gain the skills they needed to be successful. But the federal government failed to provide matching funding to establish this standards-based system. Moreover, in the 2000s, the national sectoral approach was abandoned in favor of a regional approach.

However, a number of states have established skills training programs. For example, Wisconsin and Georgia have strong youth apprenticeship programs. Some states and local school districts have established career academies within high schools. Several have established regional skills alliances—industry-led partnerships that address workforce needs in a specific region and industry sector. For example, Michigan has provided competitively awarded startup grants and technical assistance to 25 industry-led regional skills alliances. Pennsylvania's $15 million Industry Partnerships program brings together employers and workers (or worker representatives, when appropriate) in the same industry cluster to address overlapping human capital needs. Other states have established tax credits for company investments in workforce development. California has a deduction for training expenses if a company has spent a certain share of sales on training. Firms in Rhode Island can deduct up to 50 percent of training costs on their corporate income taxes.

Moreover, a core component of the U.S. skills training system is the system of community colleges the nation enjoys. The community college system is a critical partner in training

the current and future workforce. Community colleges play a vital role in training job seekers with the skills to obtain a good job while simultaneously helping employers obtain the workers they need to stay competitive. For example, more than half (55 percent) of the 1,600 community colleges in the United States offer specialized training in manufacturing skills. The Obama administration has proposed $8 billion to fund a "Community College to Career Fund" for community colleges to partner with businesses to train two million workers in a range of high-growth areas, such as advanced manufacturing, while earning industry-recognized credentials; however, so far Congress has not provided the funding.

Immigration Policy

More than many nations, the United States has relied on high-skill immigration to support its innovation system. This has paid off to date. At least seven studies have examined the role of immigrants in launching new companies in the United States, and all conclude that immigrants are key actors in this process, creating from 15 percent to 26 percent of new companies in the U.S. high-tech sector over the past two decades.[49] Some U.S. states have seen even greater beneficiaries: nearly 40 percent of the engineering and technology firms founded in the U.S. states of California and New Jersey between 1995 and 2005 were founded by foreign born-immigrants.[50]

At least seven studies have examined the role of immigrants in launching new companies in the United States, and all conclude that immigrants are key actors in this process.

The United States has several systems to encourage high-skill immigration, including a policy to provide permanent residence to some STEM workers and a temporary employer-sponsored work visa system (H1b). However, there is a general recognition that the system needs serious reform, in part to make it easier for high-skill immigrants to gain a path to citizenship. One reason for the relatively successful U.S. immigration system is that immigrants are more easily assimilated into the society than they are in many other nations. According to one study, the U.S. ranked ninth in terms of integration policies, and first in terms of its strong anti-discrimination laws and protections.[51] The U.S. also ranked high on the access to citizenship scale because it encourages newcomers to become citizens in order to fully participate in American public life.

Overall Innovation Policy System

There is no national, coordinated innovation policy system in the United States. While some nations have developed national innovation strategies (e.g., Germany, Sweden, and Finland), the United States generally has not. This reflects in part a belief that innovation is best left to the market and that the role of government, to the extent there is one, is to support "factor inputs," such as knowledge creation and education.

FUTURE EVOLUTION OF THE U.S. INNOVATION SYSTEM

National innovation systems are evolutionary, not static. Moreover, the innovation environment itself evolves, which can change the relative strength of an NIS or individual components as they either reflect a better or worse fit with the new environment. As such, a nation's overall innovation system, as well as individual components, can improve or degrade. For the U.S. innovation system it appears that the direction of change is toward relative worsening, especially when compared to some other national systems whose governments are putting in place a suite of policies designed to win in the global race for innovation advantage.[52]

Clearly the United States appears to have sustainable strengths in a number of areas, including factors such as managerial talent, enterprise use of ICT, and business cultural factors such as demanding customers and a collaborative culture.

But there are a number of other factors where the U.S. position is clearly trending down, especially in relation to other national innovation systems. These include funding support for universities and federal labs and other innovation inputs as federal policymakers continue their unwillingness to prioritize investment in the federal budget process. Indeed, this is a component of a broader factor of the unwillingness of American society to invest in the future and in collective goods. There is little evidence that American voters are willing to sacrifice additional current income and consumption for investments in the future. At the same time, this pressure for immediate gratification reflects itself in the investment decisions by publically traded corporations. Again there is little evidence that the pressures from equities markets for immediate returns will abate any time soon. Even more, there is a disturbing turn to "neo-Ludditism" in America as so-called "public interest" groups, the media, and an increasing share of the public adopt an anti-innovation attitude, whether it relates to genetically modified organisms, the use of data, or automation. Given the complicity of the media in this process, which increasingly adopts the view that "fear grabs eyeballs," the likelihood is that neo-Luddite, anti-progress forces will strengthen, not weaken, making the overall innovation environment more problematic.

For similar reasons, reform of the regulatory system as it affects innovation is equally problematic. Most Democrats look at any efforts here as an attempt to gut needed protections and therefore view even simple common-sense reforms as opening up the floodgates of deregulation. Moreover, most liberal Democrats believe that business, especially large businesses, are regulated too lightly. At the same time, most Republicans are reluctant to increase funding for regulatory agencies, believing that this will simply empower them to regulate more, rather than regulate more smartly and expeditiously.

Finally, there are a number of areas where it is either unclear what the future trends are likely to be or that depend on policy choices which are possible in this political environment. For the former, one key factor is entrepreneurship and risk taking. While there does not appear to be any appreciable diminution of the American entrepreneurial spirit, there has been a significant decline in entrepreneurial activity, as Robert Litan has shown.[53] It is not clear if this is a long-term, structural decline, or something that is a response to overall U.S. competitiveness decline that would rebound if the right innovation policies were put in place.

For the latter, there are a number of areas where policy may make a significant difference. One is high-skill immigration. While there is a general bi-partisan consensus in favor of liberalizing high-skill immigration, opposition from the left and the Tea Party right make future progress problematic. [54] There are a number of other areas where there is reasonable bi-partisan consensus for action, including STEM education, manufacturing technology support programs (e.g., the Congressional RAMI legislation), FDI attraction programs (e.g., Select USA), funding for technical skills training, and increased resources for trade enforcement. But to date, Congress has been preoccupied with matters other than

enhancing U.S. innovation and competitiveness, and even if they did focus their attention here, the overall budget impasse (Democrats unwilling to cut entitlement spending, Republicans unwilling to raise taxes on individuals) suggests that little of substance will happen in these areas. Finally, while corporate tax reform is an area where some progress is possible, it is at least as likely that nothing major will happen or even that changes will be detrimental for innovation and competitiveness. The latter could occur if corporate tax reform is revenue neutral and rate reduction is paid for by reducing or eliminating pro-innovation incentives like accelerated depreciation and the research and experimentation tax credit. In addition, vested business interests are likely to oppose any changes that reduce particular deductions or incentives. Finally, to the extent that liberal Democrats favor corporate tax reform, it is to increase overall tax revenues.

In summary, as nations compete to win the global innovation race, some will sprint out ahead, others will remain stuck in the middle of the pack, and still others will struggle to get out of the starting gate. Nations face different challenges in the race. No nation has it entirely right just yet, although a few come close. While some nations—such as Japan and much of Europe—have strong innovation policy systems, many of them suffer from limited regulatory and business environments. In contrast, the United States has reasonably good business and regulatory environments (although as noted above, many important factors are trending downward), but a weak innovation policy environment. The nation that can put together all three sides of the innovation success triangle most effectively is likely to be the nation that wins the race and reaps the rewards in greater economic vitality and prosperity. Thus, the challenge for the United States going forward is whether it can make the needed changes to its innovation system to meet the new competition. Our economic future will depend on the answer.

The nation that can put together all three sides of the innovation success triangle most effectively is likely to be the nation that wins the race and reaps the rewards in greater economic vitality and prosperity.

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