14 US innovation strategy and policy: an indicators perspective

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1. INTRODUCTION

For most of the second half of the twentieth century, the United States led the world in innovating new products, processes and systems, in developing and implementing innovation strategy and policy, and in gathering and publishing innovation indicators.

Over the past decade or so, the United States has lost its lead in each of these important domains. Rather than leading the world, the United States now seeks to maintain its position as one among many leaders and to catch up with other leading countries and regions of the world in several of these domains.

This chapter first describes and assesses US innovation strategy and policy, considering both their implicit and explicit characteristics. It then turns to a discussion of the state of innovation indicators research and analysis in the United States, including a few thoughts about how innovation indicators both inform and influence policy choices.

2. US INNOVATION STRATEGY AND POLICY

In this chapter, innovation strategy refers to the deep, underlying structure of societal choices about how best to accomplish broad national innovation goals. Innovation policy, on the other hand, refers to the set of specific public policies that are intended to influence the rate and direction of innovative activity and that seek to manage the consequences of new technological applications on behalf of society.

US Innovation Goals

In the United States, there is widespread agreement that innovation and change are, on the whole, good things. Even as Americans venerate the past and its links to the present, it is a rare person who opposes innovation and change *per se*. Innovation is understood to be a central feature of

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a dynamic, competitive and growing economy. Innovation is frequently called forth as a means to address or even resolve public problems and issues, ranging from national security to public health. Innovation is also understood to be critical to maintaining the privileged position of the United States in competition with other nations. And innovation is widely appreciated as a source of new ways for Americans to amuse, entertain and improve themselves.

Thus one can safely say that it is a settled goal of the United States to be a leading place where innovation happens and where its benefits are enjoyed.

Along with the goal of strong leadership in innovation comes a somewhat different and definitely more contentious goal of ensuring that the United States and its citizens and residents are protected from the important and undesirable consequences of the use of innovations.

Achieving either or both of these goals – an innovative society and a protected society – requires an array of policies within a broad set of strategies. These strategies and policies are our focus here.

US Innovation Strategies: Implicit and Explicit Elements

The implicit elements of US innovation strategy are deeply enmeshed in the core concepts and beliefs underlying the nation's history, culture and Constitution. They are rarely articulated directly in discussions of innovation strategy or policy, yet they condition attitudes toward what government should do and how. The implicit elements of US innovation strategy include:

- innovation largely originates in the private market sector, which should be supported and encouraged;
- market activity, both domestic and international, should be free of unnecessary encumbrances;
- education should be universal through the primary and secondary levels and should allow for flexibility and 'second chances';
- labor mobility in place and role, including immigration from other countries, is highly valued;
- initiative and entrepreneurship are key to the growth and development of both individuals and groups;
- governments (federal and state) have legitimate roles in both innovation and protection, but the roles are circumscribed by constitutional limits on the powers of each to act.

Nearly every debate and discussion about innovation strategy and policy in the United States takes place in the context of these implicit elements of

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innovation strategy. These implicit elements both support and constrain the range of viable innovation strategies and policies that might be considered by policy makers. Proposed policies that might be in conflict with one or more of the implicit elements of national strategy of the sort listed above are not likely to get a hearing, much less be adopted by the political process.

In discussions of innovation policy alternatives in the United States, it is common for someone to ask 'whether this [proposed policy] represents an appropriate government role'. As a logical matter, the person asking the question may not realize that 'appropriate' alone is not a well-defined criterion for decision. Appropriate only has meaning in the context of some agreed-upon standard. In the case of innovation strategy and policy, the implicit elements of innovation policy lie behind the determination of what is appropriate.

The explicit elements of US innovation strategy are considerably more familiar to students and practitioners of innovation strategy and policy than the implicit elements. The explicit elements include:

- research and development (R&D), wherever it is conducted, should be supported and encouraged because it is the central activity that enables and conditions innovation;
- strong intellectual property rights, especially patents, should be maintained because they are key to ensuring that investors in innovative activity can anticipate profiting from those investments and are, therefore, critical to the advance of technology;
- partnerships and other collaborations among firms in different sectors and between industry, universities and government should be facilitated, because synergies in innovation arise from the diverse mix of capabilities of each;
- both supply- and demand-side approaches to innovation should be employed; that is, innovative activity in general as well as to address specific defined societal challenges should be encouraged;
- when imposing social controls on the use of technologies, performance-based standards rather than design-based standards should be used whenever feasible.

The Obama Administration's Innovation Strategy

Just eight months after his January 2009 inauguration, President Obama issued a formal statement of his Administration's innovation strategy (Executive Office of the President 2009). The 22-page strategy document includes a rich array of commitments to act to strengthen US innovation, organized under three broad themes:

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- invest in the building blocks of American innovation;
- promote competitive markets that spur productive entrepreneurship;
- catalyze breakthroughs for national priorities.

The first two categories follow a supply-side approach to innovation, providing resources and changing the 'rules of the game' under which innovation can flourish. The third category is unabashedly demand side, focusing on promotion of innovations to address identified national problems.

While the Obama strategy speaks to the importance of transparency and accountability in government, it does not address the state of or need for improved innovation indicators. In a few places, largely having to do with R&D investments, the strategy does call for specific measurable quantitative changes, such as its commitment to raise aggregate US R&D spending to 3 percent of GDP.

The 2009 Obama strategy document set forth an ambitious agenda of actions on many fronts to stimulate innovation generally and for specific purposes. Some of the actions – especially those related to short-term increases in R&D spending and certain forms of loan guarantees for commercialization of new technology – had already been realized in the American Recovery and Reinvestment Act (ARRA) of 2009, the so-called 'Stimulus Package', adopted in February 2009. Action on many of the other proposals, however, has been blocked by the Republicans in the House of Representatives and/or their colleagues in the Senate as part of the general Republican strategy of blocking passage of the President's policy initiatives.

In February 2011, the Obama Administration issued a revised national innovation strategy (National Economic Council 2011). The revised strategy goes along the same general lines as the first version with significantly greater detail in many areas and with changes in emphasis that reflect evolving concerns about innovation and closely related public policy topics. The revised strategy incorporates many dozens of specific program and budgetary initiatives, as well as changes in regulation of business and industry, all intended to stimulate and encourage innovation. The strategy document reflects an expansive perspective on what constitutes innovation policy, with major sections devoted to such matters as investment in physical and information technology infrastructure, production of clean energy, new agreements and enforcement of existing agreements on trade, manufacturing, intellectual property protection, cyber security, space development, educational reform and so on. Once again, while the revised strategy document includes projections of many policy outcomes or goals in quantitative terms, it does not make explicit reference to the challenges

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of measuring or developing indicators of the activities and outcomes it projects.

Other Sources of US Innovation Strategy and Policy

Public policy in the United States consists of more than the initiatives of the presidential administration, regardless of their level of ambition and complexity. Other actors, including the Congress, the courts and the individual state governments, are also key contributors of public policy regarding such matters as innovation.

Under a strict interpretation of the US Constitution, public policy making at the federal level is actually the responsibility of the Congress, not the President or his administration in the executive branch of government. For at least the last half-century, however, most of the initiatives for changes in public policy have come from the executive branch. Final action on those initiatives, as well as provision of funding when needed, however, remains in the hands of the Congress. It has been said about modern US governance that 'the President proposes, but the Congress disposes'. (The origin of this aphorism is not known.) It is this mechanism that has allowed the Republicans in the House and Senate to block many of President Obama's innovation-related initiatives. President Obama was able to side-step these blocking actions on some items of his innovation agenda by taking advantage of the unusually broad grant to the President by Congress of discretion over spending the stimulus funds that was incorporated in the ARRA to provide funds for one or two years for such purposes as R&D spending, technology commercialization loan guarantees and other related purposes.

Most of the US states have acted to encourage and stimulate innovation (SSTI 2011). Traditionally, states have had the responsibility for economic development in the United States, although the federal government has often been a partner with the states in such activity. Many aspects of innovation policy are state responsibilities within the economic development framework. In its report on state activities in 2011, SSTI notes that states were particular active in that year in such areas as higher education, research, tax incentives, regionally focused activities and investment incentives. In 2009, the states spent a total of approximately $1.2 billion on R&D, with about 75 percent of this amount coming from non-federal sources including the states themselves (NSF 2012a). When compared with total US spending on R&D in 2009 of just over $400 billion (NSF 2012b), it is apparent that the state role in R&D spending is relatively small. In other areas, including tax incentives and direct grants for investment, the state role is much more prominent.

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3. INNOVATION INDICATORS IN THE UNITED STATES

Systematic exploration of new innovation indicators in the United States dates back at least to the early 1980s (Hill et al. 1983). Hill and colleagues tested nearly three dozen possible new indicators of innovation to supplement the traditionally collected and reported data on R&D spending, the scientific and engineering workforce, patents applied for and awarded, and bibliometrics. Following relatively successful preliminary testing of candidate indicators by Hill, Hansen and colleagues, NSF fielded a trial survey of some of them. However, response rates to the indicator questions were unacceptably low and the effort was terminated after two rounds.

In 2002, the NSF commissioned a wide-ranging study by the National Research Council of measuring R&D investments in the United States (NRC 2005). In addition to its examination of the R&D statistics, the study committee reviewed the state of the art of innovation indicators in the United States, Europe, Canada and Australia. The committee made two recommendations for action by NSF leading to the establishment of a set of innovation indicators for the United States. It said:

> The panel recommends that resources be provided to SRS [Science Resources Studies] to build an internal capacity to resolve the methodological issues related to collecting innovation-related data. The panel recommends that this collection be integrated with or supplemental to the Survey of Industrial Research and Development. We also encourage SRS to work with experts in universities and public institutions who have expertise in a broad spectrum of related issues. In some cases, it may be judicious to commission case studies. In all instances, SRS is strongly encouraged to support the analysis and publication of the findings.
> . . .
>
> The panel recommends that SRS, within a reasonable amount of time after receiving the resources, should initiate a regular and comprehensive program of measurement and research related to innovation. (NRC 2005: 101)

Based on the NRC committee's recommendations, the NSF Division of Science Resources Studies (SRS, now NCSES, the National Center for Science and Engineering Statistics) embarked on an effort to incorporate a small number of questions regarding innovation in the annual survey of R&D expenditures in industry. This was done in connection with a broad revision of the entire industrial R&D survey. The new survey, now called BRDIS (Business Research and Development and Innovation Survey), was released in 2008 (NSF 2010a). Details about BRDIS are available at (NSF undated a). The current version of the BRDIS survey questionnaire is on line at www.nsf.gov/statistics/srvyindustry/about/brdis/surveys/srvybrdis_2009.pdf.

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From the point of view of innovation indicators, the most important aspect of BRDIS is that it asks several questions designed to illuminate the firm's engagement in innovative activity and its success in that activity as measured by contributions of 'the new' to the firm's sales. It also probes widely into collaborative activities with other firms, academic institutions and government laboratories, as well as foreign entities. And it asks for the levels of R&D investment by lines of business, by state and by country, as well as in several specific areas of technology.

NSF has released key results regarding whether firms innovate from the first round of the new BRDIS survey, applicable to the year 2008 (NSF 2010b). The results show that about 22 percent of manufacturing firms introduced product and 22 percent introduced process innovations, whereas about 8 percent of firms in non-manufacturing introduced product and 8 percent introduced process innovations. The percentage of firms that introduced innovations varies substantially across industries within the major sectors. The results also indicate that firms that spent more money on R&D tended to be more likely to have introduced innovations. Unfortunately, in the first BRDIS survey, NSF did not ask for a breakdown of sales attributable to innovations, but it did so in the second round. Results from the second-round survey are not available as of this writing.

It is clear that NSF has embarked on an important new direction in querying business firms about their innovative activities and their results. Over the next several years, as experience is gained with BRDIS in both NSF and industry, increasingly valuable results are likely to become available. It is to be hoped that the rich array of data now being asked for can be fully exploited to gain new insights into where innovation happens in the US economy, how significant it is to firm performance, and how various institutional linkages and practices contribute to the success of firms' innovative activities.

Proceeding along a different track, the Secretary of the US Department of Commerce (DOC) convened an expert panel in 2006 to examine the possibilities for new innovation indicators (Department of Commerce 2008; Aizcorbe et al. 2009; Rose et al. 2009; ASTRA undated).

The DOC panel took a somewhat unusual approach to its consideration of innovation indicators. Rather than reconsider the kinds of firm-level data and information as the basis for indicators typical of previous innovation indicator studies, which NSF was beginning to test around the same time, the panel focused instead on how innovation might better be captured and reflected in the National Income and Product Accounts. In fact, the panel rather abruptly dismissed other approaches to indicators, saying:

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> Detailed innovation surveys such as the European Community's Community Innovation Survey are used by statistical organizations in [the] European Union and some other countries including Australia and Canada. Relatively new, and only tested among manufacturing firms in the U.S., the surveys collect information on different varieties of innovations, including 'new to the firm, new to the industry and new to the world.' They also collect extensive information on innovation expenditures (e.g., capital investment, training and marketing costs) and costs of protecting innovation (e.g., patent and copyright costs). However, such surveys are very costly and have encountered both definitional and response rate problems.

In addition to foreswearing further consideration of such indicators as those used in Europe, the panel made only passing mention of the activities of the NSF in collecting and publishing an array of innovation-related indicators through the reports of the National Center for Science and Engineering Statistics and the National Science Board's biennial document, *Science and Engineering Indicators*. The panel ignored, except by implication, the past efforts of the NSF in supporting both research on and testing of an array of potential innovation indicators, including its contemporaneous activity leading to the BRDIS survey discussed above. And the panel apparently disregarded any consideration of a wide array of possible micro-level indicators proposed to it by a study committee convened by the Alliance for Science, Technology and Research for America (ASTRA undated).

What the DOC panel did do was address in some depth the interpretation of Total Factor Productivity (TFP) data and possibilities for improving collection of the underlying data so as to help reveal the outcomes of innovation as reflected in trends in TFP. The panel also commented on the need and possibilities for collection of new data on investments in so-called 'intangibles', drawing in part on a background paper on the topic by Rose et al. (2009).

Going beyond its charter, the panel also called for new studies and analyses of the impact of government regulation and legislation on innovation. Such calls have been a staple of innovation policy studies for decades. Generally, studies find that the effects of regulation on innovation are highly contingent on the form of the regulation, the nature of the industry, other forces affecting the industry concerned, and how innovation is measured. Those effects can be both positive and negative. The notion that regulation can stimulate profitable innovation is often referred to in the economics literature as the 'Porter Hypothesis' (Porter and van der Linde 1995; Ambec et al. 2011; Wikipedia undated). However, the positive effects of regulation had been noticed much earlier (see, e.g., Hill et al. 1975; Ashford et al. 1979).

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4. BARRIERS TO INNOVATION INDICATORS IN THE USA

In comparison with most European countries, Canada, Australia and others, the United States has not progressed as far in developing, testing and implementing a national system of innovation indicators. That this should be the case may be a bit puzzling, since the USA led the way in creating national systems of accounts, in measuring national investments in science and engineering, and in early research on indicators.

It is certainly not for a lack of interest in indicators, nor is it for the want of efforts to advocate for their adoption. Rather, the answer can be found in a set of cultural and political features of US society. These include a reluctance to impose costs of government data collection on respondents, a reluctance to share what is considered to be confidential information belonging to the firm, and a closely related political tradition of minimizing government in general.

It is an unfortunate coincidence that early interest in innovation indicators emerged around the same time that determined opposition to federally imposed data reporting requirements was also ascendant. The latter culminated in the passage by Congress of the Paperwork Reduction Act in 1980. This law gave the Office of Management and Budget in the Executive Office of the President the responsibility to oversee all federally sponsored data collection and created a strong presumption against new data reporting requirements. The same year saw the election of Ronald Reagan as president and the surprise victory of numerous conservatives to the US Senate, a combination that reflected in part a successful new 'small government' politics and that led to the use of the Paperwork Reduction Act authorities to impose severe limits on new and existing data collections.

An integral part of the opposition to federal reporting was industry's opposition to reporting about such sensitive topics as innovation, which invariably links closely to business strategy and competitive actions. Individually, of course, companies would like to have access to systematic data on the innovation performance of companies and especially of those in their lines of business. On the other hand, understandably, they would prefer not to have to share that kind of data about themselves. One of the keys to successful adoption of the new BRDIS survey discussed above was a major effort by NSF to solicit the views and inputs of the business community on the needs for and uses of the data to be collected and the manner of its collection (NSF undated b).

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5. RELATIONSHIP OF INNOVATION INDICATORS TO PUBLIC POLICY

The Political and Intellectual Setting

While it is not always apparent from American politics, nor is it universally true, it is generally the case that policy-making processes in the USA are data-driven. Interest groups of every persuasion muster numbers to justify their advocacy for, or opposition to, public policies. The administrative agencies of the federal government are under great pressure from a variety of sources to make decisions about both regulations and implementing actions that can be justified to the courts and in the court of public opinion by appeal to facts and evidence. In the government of the United States with its separation of policy-making powers between the Congress and the executive branch, each tries to convince the other and their political supporters of the rightness of their position by drawing on data.

In addition, policy makers, pundits and ordinary citizens live in a sea of statistics and data about everything from the batting averages of baseball players to the probabilities that life exists on other planets. Americans are accustomed to reading statistical reports every day about sports, the weather, the financial markets, public opinion and so on.

It is no wonder, then, that there is a desire among policy makers and those who would try to influence them for indicators of industrial innovation. They want to know 'how we are doing' and 'where we are headed' on innovation as much, or nearly so, as on high-school graduation rates or the number of gold medals won by the USA in the Olympic games.

The desire for performance data has only been reinforced by the passage of the Government Performance and Results Act of 1992 ('GPRA'), which requires federal agencies to collect data on their performance and their results, and to report those data to Congress and the public. As part of the general movement toward greater accountability in government, GPRA and subsequent actions emphasizing accountability and transparency have substantially elevated the importance of policy makers and government officials being able to demonstrate quantitatively that their actions have significant and positive consequences.

Innovation policy has not escaped the expectation for quantitative demonstration of needs and outcomes. Data on innovation are in demand. There is a problem, however. 'Innovation' does not lend itself to direct measurement. Unlike a barrel of oil, a ton of steel, or the number of university graduates in chemistry, we have no way to conceptualize or measure a unit of innovation. We know that innovation is generally good and that more of it would be better, but we have no way to measure how much we

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have (of course, innovation is not always good, indicators could also be useful in knowing how much 'bad' innovation might be happening).

Thus we must fall back on indicators of innovation – constructs that point to but are not the same as the measures of innovation we would like to have (Hill and Hansen 1988).

The Reciprocal Relationship of Indicators and Public Policy

The needs of policy makers shape the demands for innovation indicators. Conversely, the availability of innovation indicators tends to shape the demand for public policies. So, for example, policy makers frequently ask for an assessment of the competitiveness of US industry or specific industries compared with those of other nations. As it is usually understood, an important component of competitiveness is the success of firms in generating new technologies that gain significant shares of international markets – that is, the innovativeness of those firms or industries. At present, while many surrogate indicators can be examined – such as R&D expenditures, patents, numbers of employed scientists and engineers, and the like – there is no truly satisfactory answer to the question of the relative innovativeness of US versus foreign firms or industries.

Conversely, the mere fact that we can develop good indicators of R&D investments on a national, sectoral or industrial level leads policy makers to consider policy measures to encourage additional R&D spending at various levels, regardless of whether more R&D would necessarily lead to more innovation.

It will be interesting to see whether the availability of the new BRDIS-based indicators of the proportion of firms in an industry or sector that offer new products or processes to the marketplace will lead to policy interventions intended to help make a greater fraction of firms innovative. That is, will the new indicators, whose meaning is far from clear on an aggregate level, create a demand for policy innovations intended to affect them?

Policy makers are frequently told that one or the other industry or sector is becoming more, or perhaps less, innovative as compared with itself in past years, in comparison with other industries or sectors, or compared with those in other countries. Logically, they seek evidence of the comparative innovativeness as reflected in indicators. The evidence, again, often takes the form of R&D spending, patents applied for or granted, or balance of trade. None of these is a fully valid indicator of innovativeness, and some of them – such as patents applied for – are heavily influenced by firm practice and culture or by industry structure rather than by innovativeness *per se*.

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In the national security arena, where a 'technological lead' is a cornerstone of US defense policy, it is especially important to be able to assess the state of technology and the ability of various countries to develop new technologies, especially breakthrough technologies, which might pose new national security threats to the USA and its allies. Once again, indicators of innovation are sought.

In addition to entirely new indicators that might provide a richer picture of the innovativeness of US firms and industries, policy makers often ask for more nuanced or finely detailed versions of existing indicators. For example, since it is widely understood that patents vary widely in their significance, policy makers might ask about patent performance based on some selection of the most important patents. This need has been met to some degree by the development of the so-called 'triadic patent', which is a patent applied for in the USA, the EU and Japan. The argument is that these sorts of patents represent concepts that are expected to have economic value in all of the world's major markets and are therefore the most significant. Policy makers also frequently ask for breakdowns of industrial R&D expenditures or patenting by state or substate region or by firms of various sizes, and so on. They also frequently ask about the state of innovation for specific technological fields, such as avionics, optoelectronics, nanotechnology, biotechnology, solid state physics and the like.

In summary, in the USA, policy makers are nearly always interested in more data, better measures, more detail, or greater granularity on a geographic, sectoral or technology basis. They would also like to have indicators, not just of the current state of innovation, but of the likely direction of innovation in the future. Furthermore, the availability of new innovation data almost always leads to policy initiatives intended to improve upon whatever is being indicated, even if the indicator is an inferior partial indicator of what is 'really' desired to be enhanced.

6. CONCLUSION

The USA is unfortunately behind many competing countries in developing, testing and routinely gathering data on a variety of new innovation indicators. Even if no new indicators were developed in the USA, simply catching up with the state of the art of innovation indicator production around the world would greatly enhance its understanding of where it stands and where it is headed. Recent initiatives by the National Center for Science and Engineering Statistics in NSF, as well as those in the Department of Commerce, should improve the ability of policy makers to understand and act on innovation policy on a more informed basis over

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the next half-dozen years. The pace of improvement is glacial, however, owing to the need for each initiative to overcome institutional inertia in government and the skepticism and lackluster cooperation with data collection in the private sector.

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