Made in America

by Carl J. Schramm

04.20.2010

INNOVATION AND the founding of the United States were good for one another. The American Revolution and the subsequent creation of the Constitution were in part byproducts of the Scottish Enlightenment; they set the intellectual groundwork for economic achievement—then as radical an idea as a self-governing democracy. Interestingly, while the breakthroughs in political thought made by Montesquieu and Locke influenced the founders, to them the notion of growth was as yet inchoate. Prior to 1800, economic expansion was so negligible that it was hardly even imagined. From the fall of the Roman Empire to the beginning of the Industrial Revolution, annualized rates of growth are estimated to have been a mere 0.25 percent.

Yet in the eighteenth century, in the face of burgeoning world trade and bustling commerce in Europe and North America, Scotland's intellectual giant David Hume outlined the clear link between economic development and political systems. His colleague Adam Smith—who happened to publish *The Wealth of Nations* in 1776—suggested in no uncertain terms that state action had real implications for commerce and human welfare. These insights were imported to our shores with the prescient belief by our founders that the system they designed would bring with it economic expansion. This view was based on an innate sense that individual freedom found authentic expression in commerce: innovation and rising living standards would result from a freer political system. In turn, various economic interests competing in a market—James Madison's famous "factions"—would help guarantee political freedom.

By the time Alexis de Tocqueville arrived in the 1830s to chronicle the American experience, an early form of entrepreneurial capitalism was already in bloom. He observed that among our common characteristics was a fascination with money and the making of it. Imagine coming from France, where one's occupation and social order were largely ordained by

birth (the French Revolution notwithstanding), and looking at the unbounded freedom Americans had to make their own futures. Left to individual citizens, this freedom was the overarching theme of de Tocqueville's narrative, accurately recorded but perhaps not fully understood.

Early America was alive with a conversation about how knowledge could be shaped into science and the expansion of welfare—a drive for usefulness that, while owing some inheritance to Britain, found a uniquely American expression. Without a culture of the state directing life, the field was open to anyone who sought to bring his wits to bear on solving problems that could improve the human condition. Thus, there was never any question about the democratization of science and know-how in the new nation. The haughty redoubts of European academies, guarding old knowledge and monitoring the new, never truly emerged in early America in part because they offended the notion that anyone was free to contribute.

So, more than any other nation, America produced an iconic citizen—the innovator. And so powerful was this image it became recognized as part of our national character. Famed historian Frederick Jackson Turner's "frontier hypothesis" argued that all Americans were pioneers. Some of us explored the earth, a number made discoveries in science, and still others "fiddled," creating inventions like the telegraph. Among us were engineers who developed automobiles, radios and rockets that could carry humans into space and entrepreneurs who could turn the discoveries of their countrymen into new companies that often became breakthroughs themselves.

TODAY, THIS national self-identity as world-beating innovators feels threatened; the United States has reached its peak, now tracing the apparently inexorable trajectory of decline followed by great powers of the past. The evidence, seemingly, is abundant. China's new alabaster cities gleam, India manages the backrooms of many American businesses and Iran flaunts its newfound nuclear capabilities. As the story goes, this all came about because of a slow-footed America that failed to understand how circumstances were changing and failed to keep pace with the frontier. One usual suspect is the inability of our schools to educate our young

properly. More Chinese children take the SAT in English on certain Saturdays than Americans. Our universities no longer produce sufficient numbers of engineers. Indian graduates from Bangalore alone could populate all the slots in American graduate programs for computer science. We hear that the Indian Institutes of Technology are better than MIT. And on top of all this, we are told (with a contradictory tone of betrayal) that many of the scientists and engineers who threaten our technological prowess learned their innovative skills in the American academy.

This composite narrative of American decline occurs periodically and is clearly in tide once again. The assumption is that American leadership is being displaced. It is unclear, however, that this is either a valid conclusion or an inevitable one. In fact, China's and India's entrance into the modern world economy was assisted by American entrepreneurial capitalism. The appearance of its permutations in Beijing and New Delhi has resulted in a stunningly unprecedented reduction in global poverty. Moreover, even with all the growth in China and India, both countries' per capita levels of wealth remain fractions of the American enterprise. And, much of the economic performance in those nations is related to the continuous and, until recently, accelerating expansion of the American economy.

Innovation and its consequences must be seen as part of a tremendously complex system. Its very nature defies any simple description—"innovation" is really an epiphenomenon of a vast number of factors, including human talent, training, extant technology, economic freedom, individual imagination, shared social norms, family composition, role modeling, financial systems, long-term personal expectations, government rules (e.g., patents and bankruptcy), international markets, social infrastructure, and combinations of these and other forces that we cannot begin to conceptualize.

AMERICAN'S POSITION at the global frontier of innovation has been challenged once before: when, in 1957, the Soviets launched Sputnik, the first earth-orbiting satellite. Immediately, the United States set out to close the technology gap that had suddenly appeared. The Second World War—and the subsequent emergence of the United States as *the* global economic power—had been won largely on the basis of extraordinary American

production capacity and the innovation that made it possible. Now, such an ability seemed to be not only a competency of our enemy but, worse, the Soviets seemed to be beating us at our own game.

Overnight, the United States committed itself to regaining the lead not only in engineering but also in research and development. In 1958, the new Defense Advanced Research Projects Agency (DARPA) was established as an entity to encourage and fund new discoveries that might be vital to recapturing our edge over the Soviets. The warnings and prescriptions advanced by engineer Vannevar Bush in his 1945 report, "Science, the Endless Frontier" (which formed the basis for creation of the National Science Foundation in 1950), emerged as the focal point of a national effort to establish an American edge in innovation.

The push to regain leadership in science required moving way beyond the normal precincts governed by the Pentagon. President John F. Kennedy's goal to send a man to the moon, while no doubt meant to be a direct response to the Sputnik scare, served also to release huge investments by government and corporations into the vast array of technologies needed to support the lunar mission. Telecommunications, computers and materials science were but a few of the areas where we developed new knowledge, and new industries, overnight.

Soon after, in the 1970s, the federal government declared "war" on cancer. The National Institutes of Health (NIH) rapidly became the quarterback and funder of what might be truly seen as the beginning of large-scale research in medicine. The expansion of medical knowledge, much of it dependent on the technologies developed in defense research and the lunar-mission programs, produced nothing short of a revolution in health care between 1960 and 1980. It created our capacity to speak of "evidence-based" medicine for the first time.

GIVEN THAT until World War II government had played a very small role in steering research or directing business, when Washington turned toward a national effort to "win the space race" it was in entirely new terrain. Often lost in the telling, our success was achieved not only because of a massive influx of government money but also because the new ideas and technology

that emerged reflected an extraordinary innovation in managing an unprecedented private-public partnership. In retrospect, government's management of the space race was itself an innovation, one that might be called "light touch" public administration. It provided funding and left an assembly of private and public actors to coordinate among themselves what was the most efficient way toward a solution.

But American economist Mancur Olson also realized that even as we were achieving these space-race milestones, our democracy was operating differently. Science and social-welfare funding redefined the federal government as a dispensing agent whose disbursement decisions could be profitably influenced by private actors. Olson saw the sclerosis that would emerge in innovation because of expanding government funding. In time, the entities populating this model of innovation—public funding, private contracting—would become protected government suppliers. The capacity for competition in ideas would narrow as various groups became rent takers. Their real-dollar value would decline as their protected status grew.

Most disturbingly, the narrative that increased government funding was the only model for American innovation gradually hardened into accepted fact. In the 1970s and early 1980s, confronted with inflation, sluggish economic growth, faltering domestic corporations and rising global competition, the impulse was to ratchet up public research expenditures.[1] The same impulse arises today: increase federal research funding and we will see a corresponding increase in innovation.

YET THIS prescription does not reflect reality. Research-based innovation has evolved along a certain developmental arc. In the seventeenth and eighteenth centuries, metalworkers, watchmakers and other technologists led innovation; technology informed science. By the early 1900s this relationship was turned on its head as scientific research became increasingly important. This link was formalized in the creation of corporate research and, later, the university lab. This model—in which innovation is more deliberately pursued and, indeed, routinized—dominated most of the twentieth century.

But in the last twenty years, and increasingly so today, new and young

companies—entrepreneurs—are essential to innovation in the United States, both in terms of performing research and development and in commercializing breakthroughs. Over the past several years, in fact, research in small companies (with fewer than five hundred employees) has grown more rapidly than in large companies.[2]

It should be no surprise then that we have approached a point of declining marginal returns to federally funded research. The chart below illustrates what we might think of as the general law of federally funded research: increasing R&D funding is accompanied over time by a falling marginal return of innovation, whether measured by outputs such as patents and licenses or more traditional measures like publications and citations. In most of the past decade, federally funded academic research has outpaced that financed by industry at a rate of twelve to one. This increase has not been accompanied by what might be expected in terms of returns. Patents and licenses by universities have risen, but the value they generate in dollars and impact has not kept pace—more does not necessarily mean better. Academic publication output, too, has lagged research spending, as has the number of "highly cited" articles.[3]

OUR PERSPECTIVE on innovation has continued to be oriented toward the "big science" model of the first three-quarters of the twentieth century rather than on the all-important entrepreneurs of the present day. And because the government has focused on professor-scientists, universities have been given an extraordinary institutional advantage. Additionally, the funding has been connected to single individuals who became known as "principal investigators (PI)." This approach did everything to enforce and solidify a model that is actually quite at odds with traditional models of how science moves forward. Great scientists are indeed critical—they are the people we know by reputation. But, increasingly, organizing modern science around the star-scientist model is seen to have distinct limitations, many of which operate against achieving further breakthroughs.

Investigation commonly involves many individuals who have various specialties. But the insights of many younger scientists are often assumed to be those of the PI, an outcome hard for junior scientists to challenge; they are often students working under the senior investigator on their

graduate projects. The result is a narrowing of those in the population of researchers who feel free to offer novel insights, lest they be appropriated by others higher up the ranks or suppressed because they might upset a consensus held by the establishment.

Indeed, the federal-financing model has created a “club” of well-funded scientists controlling research. Federal research money is distributed on what was meant to be a competitive basis. Thus, scientists apply for grants. The government’s decision of whom and what to fund is delegated to review panels of peer scientists. Clearly, incentives exist for competing scientists to work together in an implicit cartel to ensure that those inside the tent enjoy continuing government support. This reality, when coupled with the fact that unorthodox thinkers might remain silent in an attempt to curry favor (and funding) from their colleagues, helps to reinforce conventional wisdom. This has only negative implications for innovation.

The federally sponsored research model has also been distorted by the practice of making sure that money is spread more evenly among congressional districts. This practice incorrectly presumes that science talent in universities is somewhat evenly distributed. Places such as Johns Hopkins and Stanford have attracted top thinkers for decades. Their faculties are much more likely to include professors and teams primed to make breakthroughs. Yet, in the last three decades, NIH funding has been directed to researchers who are unlikely to make as effective use of its support. As a result of this practice, many investigators at major research centers, who in 1980 might have had four or five grants supporting their research, are now limited to one or two. We have to accept the fact that while native talent for medical innovation may be evenly distributed throughout the country at birth, the long self-selection and winnowing process of undergraduate and graduate education results in natural aggregations of scientists eager to work in proximity to one another. The concentration of innovators is not geographically even because the search for efficiency drives individuals to seek propinquity. North Dakota will be a long-time coming before it can compete with San Diego in terms of biomedical talent that is likely to contribute to inventing the future.

Universities also have adopted administrative procedures that serve as a further brake on research. Apart from the tremendous regulatory

overburden imposed by government on everything from the design of laboratories to rules governing the payment of students working in clinical settings, many of our research universities have acted to slow the transit of new discoveries into commercial applications. Using the Bayh-Dole Act that renounces any government claim to the intellectual property stemming from federal funding, universities themselves have asserted property claims over the work of individual professors in an attempt to gain income from industrial users. This means the commercialization process—taking innovations from the lab to market—is often slowed if not completely stalled by university administration.

Other social forces have only contributed further to slowing rates of innovation. The distortions of tort litigation in our legal system, for instance, is a disincentive for companies to experiment with new products and take risks—why spend millions developing products that might become the target of costly lawsuits in the near future? Likewise, the drive by labor unions and many nativist politicians to bar entry to well-educated, highly creative immigrants has obvious dampening implications for expanding innovation. The mosaic of arguments—be they from environmentalists resisting industrialization because of its potential harm to the natural world, or development experts who believe that the redistribution of the reserve capital of developed nations to undeveloped ones will end up benefiting both—all point to slower growth and a world that has less regard for the promise innovation holds to eradicate poverty. This intellectual resistance begets a dismissive stance toward innovation.

THERE CAN be no doubt about the importance of innovation to our future. Concerted action is necessary—but it cannot be the action called forth by those voices from industry and academia, which amounts to little more than self-serving arguments to further entrench their favored rent-taking position. Rather, a new paradigm should drive public and private thought and action. If we see innovation as central to the future we imagine for America and its role in making the world a better place—as we should—it will be a new conceptualization of why innovation matters and how innovation happens that will make the difference.

This requires that we understand how innovation works. It does not relate

to merely shifting more money toward industry and universities for research and development or to labor unions for retraining. Technological innovation is not a "pull" phenomenon in the first place. The nation cannot expect more innovation by lining up people who would benefit from it. To use a trite example, did you know you needed an iPod before there was such a thing?

Technology is a "push" phenomenon. Innovators, inventors and entrepreneurs have to have ideas, and the ability to test them—real-market signals that their ideas have economic value—before there will even be a need for industry to produce new technologies or the jobs that they will produce.

So, how do we engineer more push inside our economy for new technology? Giving public handouts to the business-academia complex won't bring us close to the levels of innovation we need to achieve higher GDP growth. The reason is that neither these actors, nor government itself, can achieve the levels of innovation necessary without major structural changes.

IN OUR complex society, government must be the most important instrument in bringing about a resurgence of innovation. But its traditional stance—reflecting the dominant view of public-policy schools, namely, that there is no problem that government cannot solve with money—must be set aside. What is required is for Washington to operate with the "light touch" approach that characterized our greatest periods of innovation—the advance of railroads during the nineteenth century, the World War II–era developments in military technology and the space race of the Cold War. In each case, government saw that its role was not to be permanent. It was to point toward a future goal, but the assets it needed to lead were largely in the private sector. Thus, the competencies of private industry and private universities were to be judged superior to the internal competencies of government itself. We had then as we need now a sense of the "whole of American power" approach to solving this problem.

Ironically, what is perhaps the most appropriate model for the future is what set the last half-century of federally funded innovation in motion:

DARPA. To this day, the institutional construct of DARPA stands apart from other agencies, such as the NIH. An idea's potential governs the funding decision, not necessarily the bona fides of the researcher or the proposing institution. Moreover, funding decisions are much more efficient—experts inside DARPA are empowered to move quickly. This process avoids the "consensus science" risk of peer review—and hence the possibility of reaching a false conclusion, as has happened on important issues in the past. DARPA grants are administered in such a way that if an innovation is not forthcoming they can be quickly terminated as well. Practical usefulness is the objective—not endless churning in laboratories.

It goes without saying too that if executive agencies should go gingerly about the task of betting on new innovations, Congress should have a very restrained hand in directing funds to specific new technologies. Earmarking budget resources for certain favored districts can direct investment to places where there is likely to be little return.

Universities will also be part of this story. But to play a meaningful role, they must reform the way they operate. Universities no longer work as the entrepreneurial institutions they were conceived to be: rigidities of departmental structure; imposition of vast internal-regulatory bureaucracies; lifetime tenure as a means of reducing labor mobility; and readiness to use scarce resources to provide teaching in marginal areas all dampened the academy's once flexible, can-do atmosphere. One need only grasp that degrees awarded in recreation and leisure studies outnumber degrees in *all* foreign languages to understand how distant universities stand from any conception of a nexus between education and innovation, and global competition in a larger sense.[4]

We know that some universities are much more productive than others. Those that are seem to share similar characteristics. J. Rogers Hollingsworth, a historian at the University of Wisconsin, finds that they emphasize teamwork in research. They rely much less on imposing a central bureaucratic culture. They possess a meaningful culture of interdisciplinary work, understanding that it is the drawing together of insights from multiple fields that allows new fields and innovations to emerge. Hollingsworth singles out the Rockefeller University (née Institute for Medical Research) as the model for such efforts. Increasingly, it

appears that a handful of universities or schools are beginning to move in this direction. Stanford recently changed its tenure rules to strengthen interdisciplinary work. And, Arizona State has gone some distance to shake unchanging disciplinary cultures by building whole new schools and institutes where interdisciplinary efforts are focused on innovation. Its Sky Song facility, centered specifically on the applications of new science, is one such example.

THIS EXPERIENCE points to the most important intellectual anchor in thinking about innovation going forward: America's rate of innovation should not be constantly analyzed through an international comparative lens. Innovation is as innovation does. The only measure of innovation that counts is the aggregate growth rate of an economy, adjusted for the composition of a nation's industries—e.g., much of China's economy is manufacturing for the rest of the world using technology imported from, among other places, America. In this regard, the Chinese economy is a derivative economy of the United States. Other high performers, like Ireland and Israel, are too. As the financial crisis made abundantly clear, when the American economy falters, the growth rates in other economies stumble as well. We should seek expansion at rates equal to or higher than those that have prevailed for the last century—roughly 3 percent. Indeed, an expansion of innovation should rest on a national goal of achieving growth at, say, 4 percent on an annual basis for the next one hundred years.

For us, only American innovation counts. American innovation should be a self-referencing phenomenon. What we achieve by way of innovation should thus not be seen as opposed to innovation abroad. In many cases, such as the development of jet engines several decades ago, the invention was made elsewhere, but the innovation occurred in the United States. What matters isn't necessarily how *much* innovation a country generates (by whatever metric), but what it *does* with innovation, irrespective of provenance.

Finally, innovation must be seen as a domestic issue, measured by what we are currently achieving, what we can accomplish with our human capital and existing institutions, and those new institutions that we might create.

In this regard it is counterproductive to see innovation as part of a drama involving the restriction of trade and immigration. Nations, like people and competing companies, enjoy different competencies through time and have competitive edges or liabilities as a result. Freedom in the trade of goods, ideas and the movement of people should be counted as one of our great advantages. Those who would save American jobs by restricting trade or immigration choose a path that will cost us in the long run. America's great competitive edge is our innovative and entrepreneurial capacity and culture. My colleague Ben Wildavsky has written of the important role of the United States in such "brain circulation," as well as the myriad benefits we derive from it.

WHEN I was in high school, every prom ended with a Barbra Streisand song where it was observed that "people who need people are the luckiest people in the world." Imagine how lucky we are to be able to look back on the achievements of individual talents expressing human creativity in commercial innovation. In 1964, Nobel laureate Gary Becker developed a theory that empirically established that people were more important to an economy than physical capital. Becker's now-obvious observation is central to conscious attempts to induce more innovation. In his book *The Vital Few*, economic theorist Jonathan Hughes points out that the welfare of society, connected as it is to innovation and entrepreneurship, hangs on a very small number of our fellow citizens. Using entrepreneurs as a surrogate, the six hundred thousand new firms started every year not only drive all long-term economic growth but also are the engine of virtually all new job creation.[5] Imagine what our future might be if we could double the number of people whose imaginations brought forth new ideas—innovations—that could be turned into commercial products and new firms. America will be a leading driver in this enterprise. We are the land of innovation.

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[1] Groups such as the Council on Competitiveness, which today consistently sounds the alarm of decline, have their roots in the anxiety prompted by the Japanese economic "threat" in the 1980s. Many of those who now promote "competitiveness" and "innovation" agitated then for the United States to emulate the more government-managed economy prized by Tokyo. I will leave it to the reader to imagine the alternative history that might have resulted had we taken such advice.

[2] In fact, the government's Small Business Innovation Research program (SBIR), in which small companies are eligible for federal grants, is but one important model for how federal funding should be done in the future.

[3] See, for example, chapter five of the NSF's *Science and Engineering Indicators 2008*.

[4] National Center for Education Statistics, *Digest of Education Statistics: 2008*, Table 271.

[5] Dane Stangler and Bob Litan, *Where Will the Jobs Come From?* (Kauffman Foundation, November 2009).