

Innovation in Cities and Innovation by Cities

BY ROBERT D. ATKINSON | FEBRUARY 2012

Places need to recognize that the economic development “playbook” they rely on needs to be updated reflect the new realities of the global innovation race.

Innovation is in vogue. Companies want it. Places want it. Why? Because the success of companies and places depends more on innovation than ever before. Despite its luster, many public and private sector leaders cannot really define innovation and therefore, stumble when trying to encourage or harness it. This paper suggests four challenges sub-national places face when it comes to innovation:

1. Understanding the integral link between private sector innovation and public innovation policy in economic development;
2. Understanding that innovation comes in many forms and phases of production and development;
3. Focusing on not just innovation in places, but innovation by places, i.e. states and localities must themselves try new policy approaches; and finally—
4. Creating partnerships between places, especially local places and the national government.

But before discussing these challenges, the paper first discusses why places should care about innovation.

WHY SHOULD PLACES CARE ABOUT INNOVATION?

Innovation—the creation and adoption of new products, services, processes, and business models—drives economic development, employment and income growth, and the competitiveness of places, especially high-cost, developed places. As the Organisation for

Economic Co-Operation and Development (OECD) Secretary-General Angel Gurría commented at the release of the OECD's Innovation Strategy in March 2010, "Countries need to harness innovation and entrepreneurship to boost growth and employment, for innovation is the key to a sustainable rise in living standards."¹ He could just as easily and accurately substituted the word "places" for "countries."

In today's knowledge-based, global economy, innovation is becoming the coin of the realm. In recent years, a growing number of economists have come to see that it is not so much the accumulation of more capital that is the key to improving standards of living; rather it is innovation.² When Klenow and Rodriguez-Clare decomposed the cross-country differences in income per worker into shares that could be attributed to physical capital, human capital, and total factor productivity, they found that more than 90 percent of the variation in the growth of income per worker was a result of how effectively capital is used (that is, innovation), with differences in the actual amount of human and financial capital accounting for just 9 percent.³ In other words, it is how capital is used that drives countries' long-term economic growth.

Regional economists have likewise found that innovation drives growth at the sub-national level. Porter found that differences in patenting intensity account for 30 percent of the variation across regions in the average wage.⁴ Likewise, Goldstein found that business patenting and business R&D expenditures support greater gains in regional per-worker earnings.⁵ One reason why technology industries drive income growth is that average wages in high-tech clusters are \$63,970 versus \$43,180 in non-high tech traded clusters.⁶ One key factor that appears to drive higher incomes in a region is a higher share of employment in knowledge-based industries.⁷ States with higher concentrations of knowledge-based industries, including professional services and high-tech manufacturing, have higher incomes. Weissbourd found that the percentage of a metropolitan area's earnings in the information sector (e.g., business services, IT) had a positive and significant effect on wage growth.⁸ Likewise, using the data in ITIF's *The 2007 State New Economy Index* report, there was a relatively strong correlation between absolute growth in per-capita income between 1999 and 2005 and the share of workers employed in IT occupations (0.47) and high-tech jobs (0.43).⁹ Innovation is also supported and enabled by knowledge workers, which is why there is a strong correlation between the share of knowledge workers, particularly workers with a college degree, and per capita income.¹⁰ Weissbourd found that for each two percent growth in the proportion of college graduates in a metro area, income growth increased by about one percent.¹¹ Gottlieb found that between 1980 and 1997 the metro areas with the most educated populations enjoyed per-capita income increases two times greater than metro areas with the least educated populations.¹² Moretti found that raising the overall education level of an area increases the wages of all workers in the area and contributes to economic growth.¹³ Likewise, Iranzo and Peri found that the share of the workforce with a college degree is a key factor in explaining state economy productivity.¹⁴ Bauer found the same relationship between college degrees and relative per-capita personal income.¹⁵

The most entrepreneurial regions possess the highest proportion of the population with a college degree.

Higher levels of college education also appear to be related to levels of entrepreneurship and new firm formation and fast growing firms. One study of metropolitan areas found

Places can no longer rely solely on old economy strategies of keeping costs low and providing incentives to attract locationally-mobile commodity-based branch plants or offices.

that the most entrepreneurial regions possess the highest proportion of the population with a college degree.¹⁶ And these talented workers are more mobile among metropolitan areas: places with a high proportion of talented workers and which can attract more are better poised for economic growth than those who don't.¹⁷

One reason why innovation drives growth is that, on average, innovative industries pay higher wages. In the United States, average compensation per employee in innovation-intensive sectors increased 50 percent between 1990 and 2007—nearly two and one-half times the national average.¹⁸ These data lead to one conclusion: higher levels of skills and knowledge of workers and the nature of their activities create a virtuous economic cycle in a given region. This is a major reason why so many places around the world are competing so vigorously in the race for global innovation advantage; they want to be the home to the next 1,000 high-paying innovation jobs.

Innovation—the wellspring of that “gale of creative destruction” of which Schumpeter wrote—achieves its outsize economic impact through two principal channels: First, by empowering productivity improvements and second by spurring new activities (and firms) that create higher value. With regard to the former, over the last decade, in industry after industry, firms have adopted computers and software to streamline operations and boost efficiency. As a result, the production and innovative use of IT has been responsible for at least 50 percent of the acceleration in the growth in U.S. total factor productivity between 1995 and 2008, contributing to a U.S. economy that is approximately two trillion dollars larger in terms of annual GDP than it would be otherwise.¹⁹

With regard to the latter, innovation empowers the creation of new (and ideally more productive and competitive) firms. This turbulent, dynamic process of firm churn and turnover is a vital source of renewal and growth. (Indeed, if innovation were a coin, the other side of that coin would be change, for the two are inextricably linked.) Innovation's demand for constant renewal holds true at both the firm- and economy-level. At the firm level, research by Carl Franklin and Larry Keeley suggests that firms that do not replace at least 10 percent of their revenue stream annually with new products or services are likely to be out of business within five years.²⁰ The emergence of IT has only accelerated this dynamic, across both IT-producing and IT-consuming industries. As Brynjolfsson writes, “We see much greater turbulence and volatility in the information industries, reflecting the gale of creative destruction that inevitably accompanies disruptive innovation.”²¹ In fact, this has contributed to a dramatic widening since the mid-1990s in the disparity in profits between the leading firms in industries that use technology intensively. Today, leaders truly benefit from innovation while innovation laggards pay a stiff price.

At the national economy level, there is a well-developed literature of the importance of entrepreneurship on regional growth. One review of 87 separate analyses concluded that entrepreneurs engender a sizeable portion of job creation, productivity growth and produce and commercialize high quality innovations. In addition, entrepreneurial firms produce important spillovers that affect regional employment growth rates of all companies in the region in the long run.²²

This role of innovation as a key growth factor is very different from historic model where containing costs was so central. Today, places can no longer rely solely on old economy strategies of keeping costs low and providing incentives to attract locationally-mobile commodity-based branch plants or offices. In fact, even places in the United States that traditionally relied on low costs now have a difficult time competing for facilities producing commodity goods and services against nations whose wage and land costs are less than one-fifth of those in the United States. In part, this is because there is much less per-capita income (and by extension wage) divergence between high and low cost places in the United States. For example, in 1958, Alabama's per-capita income was 69 percent of the U.S. average, making it a choice location for industries seeking lower cost production locations. But by 2007, it was just 84 percent of the U.S. average, reflecting its relative increased costs.²³ Likewise, North Carolina went from 70 to 87 percent of the U.S. average during the same period. But per-capita income divergence between the United States and some developing nations is three to four times higher than it was at its peak in the United States between the average and low cost states. For example, in 1958, Chinese per-capita income was just 5 percent of U.S. levels. And while China has made considerable progress in catching up, by 2009 it was just 18 percent of U.S. levels.²⁴ In other words, wages now vary little within the United States but a lot between the United States and other nations, making it clear that we should stop using low labor costs as an economic development tool.

Because of this, a larger share of places in the United States must look for competitive advantage in earlier-stage product (and service) cycle activities, in activities too complex to be done in countries with less skill and technical capabilities, or in activities that can use technology to achieve robust productivity levels to offset lower labor costs overseas. This can mean either fostering new entrepreneurial activities or helping existing firms move up the value-chain to develop higher-value-added products and services that less developed nations simply can't make, at least not as well. This helps them not become commodity producers searching for any number of interchangeable low cost locations. This also includes helping firms lead in process innovation (to automate production and produce more with fewer workers). In short, regions need to be places where existing firms can become more productive and innovative, where new firms can emerge and thrive, and where locationally-mobile establishments want to locate because of the rich innovation environment.

As a result, if places are going to meet the economic challenges of the future they will need to make the promotion of innovation a larger part of their economic development policy framework. Fundamentally, places need to be strategic about what sectors they invest in and what kinds of jobs they want to support. The days of economic development strategies of many states and communities being based on "shoot anything that flies and claim anything that falls" should be banished to the 20th century.²⁵ Likewise, in a global economy where low value-added, commodity production of goods or services can gain significant competitive advantage in nations with low wages (and artificially depressed currency valuations), places are fighting a losing battle by competing on the low end.

Places need to design their economic development strategies to support on programs and policies that enable firms to gain the factors of competitive advantage that enable them to

compete with commodity producers in low-wage nations. Yet, all too often places have not fully revised their economic strategies and policies to reflect this new world.²⁶ As I discuss next, this is in part because too many places are guided by the wrong economic development doctrine.

AN “INNOVATION ECONOMICS” DOCTRINE FOR ECONOMIC DEVELOPMENT

In the last decade, many places have put in place new economic development policies and programs focused on productivity, innovation, and entrepreneurship. But this change has not come without struggle and despite making inroads, it is by far the predominant approach to economic development in most places. As Atkinson and Audretsch write, “Innovation policy has gotten short shrift in the U.S. political dialogue largely because the three dominant economic policy models advocated by most economic advisors—and implicitly held by most policymakers—ignore the role of innovation and technology in achieving economic growth in the global, knowledge-based economy of the 21st century.”²⁷

If places are going to meet the economic challenges of the future they will need to make the promotion of innovation a larger part of their economic development policy framework.

It would be one thing if those involved in the strategic management of places were perfectly objective and relied on analysis to shape policy. Then the challenge would be one of simply presenting the evidence of why innovation is key to the economic success of place. But they are not. Not because of some inherent flaws or limitations, but because economics and economic policy are inherently shaped by doctrine. Indeed, virtually all individuals involved in state economic development policy—whether steeped in economics or not, whether in government or not—hold beliefs or economic doctrines that profoundly shape how they view the economy, what they see as important and not important, and, most importantly, what they believe is, and is not, the correct economic development policy. These doctrines or frameworks guide their thinking and deliberations, and help them make sense of an incredibly complex economy that is changing rapidly. Indeed, as John Maynard Keynes once stated, “Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist.”

At the sub-national level, four main economic doctrines compete for the attention and allegiance of state policymakers: *the conventional economic development doctrine* whose guiding philosophy might be boiled down to “shoot anything that flies, claim anything that falls;” *the neo-classical economics paradigm* that eschews economic development incentives and programs in favor of just having low taxes on business and few regulations to create a good business climate; *the populist neo-Keynesianism doctrine* that advocates for policies to directly improve the lives of workers through measures such as more progressive taxes, higher minimum wages, and public spending. None of these doctrines will lead to a robust innovation-based economic development approach. However, the outline of a fourth doctrine, what can be termed innovation economics, has emerged, with its focus on spurring innovation and growth from within.²⁸ (See Table 1)

The Conventional Economic Development Doctrine

Emerging from practice developed largely after World War II when the competition between states for increasingly mobile economic assets (usually branch plants of factories) began to heat up, the conventional economic development doctrine (CED) is based on the idea that the best way to grow the economy is to attract (or retain) capital (usually establishments of big, multi-state firms) by making specific deals that include tax breaks, loans, and grants. The idea is that these mobile establishments are seeking the lowest costs, and the job of a state is to put forth the best package to attract them. While CED has evolved in the last several decades to encompass a broader array of concerns, such as workforce development and infrastructure, it's still largely about the art of the low-cost deal at its core.

The Neo-Classical Business Climate Doctrine

Neo-classical economists are skeptical of the government's ability to pick winners and costs, and they generally look askance at traditional economic development efforts. Rather, they favor eliminating firm-specific subsidies and using the savings to cut taxes for all firms. Unlike holders of the CED, who see some firms and industries as more important to a state economy than others (e.g., traded firms that export outside the state), holders of the neo-classical business climate doctrine (NCBC) believe that state economic policy should not favor any one firm or sector over another, but should support a good overall business climate. Conservative holders of the NCBC doctrine define that as principally low taxes (and few specific incentives) and limited regulation.²⁹ Liberal holders of the NCBC doctrine usually also oppose firm-specific deals and, instead, favor creating a good business climate for all firms through expanding factor inputs like better K-12 education and transportation infrastructure.

Both the CED and NCBC doctrines provide some useful insights. The CED doctrine is right in that, ultimately, if places are to succeed, they have to care about their economies' sectoral composition, and targeting assistance to particular sectors and firms can be a key component of increasing a place's wealth—in this case, firms that export their products and services out of the region. Likewise, the NCBC doctrine is right in that places whose taxes and/or regulatory burdens are very high, and who do not at least offset these burdens with world-class public goods (e.g., education system, transportation, etc.) face a disadvantage relative to other places that, in the long run, will hurt their economic success.

Notwithstanding these positive contributions, in many areas these doctrines serve as a flawed guide to economic policy in the new global, innovation-based economy. First, in the new global economy where routinized economic activities now can be done in other nations with dramatically lower cost structures than even the lowest-cost U.S. state, it makes little sense for places to chase the low-cost tiger. In the neo-classical economics paradigm, most firms were seen as having stable production functions and were seeking to produce at the lowest possible cost by reducing the price of factor inputs (e.g., land, materials, labor, and taxes). Accordingly, firms, markets, and entire economies were seen as existing in a rough equilibrium, albeit one occasionally upset by marginal changes in input prices. If, for example, labor costs increased in a region because of stronger demand, labor-intensive production processes would move to regions with lower labor costs until

equilibrium was regained. Because firm decisions were seen as highly responsive to marginal changes in prices, the role for state policy was to keep costs low, including by subsidizing business costs. But, in the new global economy, an increasing share of firms' production functions are anything but stable and routine. Rather, they are characterized by innovation and change. In this environment, firms are looking more to adapt and keep at the leading edge, than simply eking out a few dollars in production costs by moving a routine facility yet again.

Moreover, low costs—especially if they come at the expense of the factors that enable firms to innovate and learn: a good education system, research universities, robust broadband telecommunications, a good quality of life to attract and retain knowledge workers, and a dynamic transportation network—are not enough to create competitive advantage for innovation-based firms. This is not to say that places can blithely ignore costs and put up with inefficient bureaucracies, unreasonable regulations, and very high levels of taxes. But to believe that low costs, not controlling for public services, are the major driver of economic wellbeing is to miss the realities of the New Economy.

Second, the NCBC and CED both premise their views on the fact that the most important goal in economic development is attracting out-of-state business establishments. As such, they give short shrift to helping existing firms grow and helping new firms start up. But in the New Economy, entrepreneurship is much more important than firm attraction is to economic success. Consider the fact that the number of industrial manufacturing relocations and significant expansions fell from an average of 5,139 per year for 1995-2000 to 3,162 in 2005.³⁰ Assuming that each of these establishments creates 100 jobs, this means that, in any year, they were responsible for creating around 316,000 new jobs. In contrast, small firms (with fewer than 100 employees) created three times as many (946,000) jobs in 2005.³¹

Finally, in a world where competitive advantage is created, not inherited, simply reducing the burden of taxes and regulations provides no assurance that a state's economic structure will evolve in ways that provide it with sustainable advantage. Indeed, there is a very slight negative correlation (-0.04) between the increase in per-capita income growth between 1990 and 2005 and overall tax burden as measured by the Tax Foundation.³² In other words, overall state tax climate had no effect on per-capita income growth.³³

Neo-Keynesian Populism

Ultimately, the goal of economic development is not to help business, it is to help state residents, including workers. Helping business is the means by which to accomplish this goal. However, for holders of the neo-Keynesian populist doctrine, helping workers directly is not only the goal, it's the means. As such they focus more on making sure that the wealth generated in a state goes to the people that need it most. They see most economic development issues as boiling down to a question of who gets the benefits: working people, or rich people and corporations. As such, they favor policies such as making the state tax code more progressive, expanding unemployment insurance, and funding affordable housing. They criticize policies that provide incentives for businesses, even if those incentives are targeted on producing innovation (e.g., R&D tax incentives). To the extent

that they promote policies to improve economic development directly, they tend to be focused on policies that achieve progressive ends, such as expanding human capital (e.g., universal pre-K, making college more affordable, and workforce training), spurring “green” infrastructure, investing in transit and high-speed rail, and limiting corporate tax giveaways.³⁴ To the extent they support business development it’s often with a focus on helping particular kinds of individuals (micro-enterprise support, minority- and women-owned businesses) and particular kinds of businesses thought to be socially progressive (e.g., green businesses; worker cooperatives, etc.).

The neo-Keynesian populist doctrine also provides some useful insights. Holders of the doctrine are right to call attention to the real goal of economic development—helping workers—and right to criticize economic development practices that lose sight of that. Likewise, they are right to ensure that business incentives be focused on creating good jobs and right to note that workforce development, infrastructure, and quality of life are key components of economic development.

Neo-Keynesians put the cart before the horse, forgetting the fact that the main job of economic development is to help the private sector be prosperous in ways that create good jobs, so that social policy can later redistribute some of these gains.

Notwithstanding these positive contributions, in many areas the doctrine serves as a flawed guide to economic policy. Most importantly, as much as they might want to believe otherwise, places are in competition for economic activity, not just with each other but with other places around the world. As such, this new competition imposes practical limits on how far places can go in redistributing wealth before they reduce their attractiveness for private-sector growth. Second, while neo-Keynesian populists are right to call for greater accountability for corporate incentives, not all corporate incentives are the same. There is a significant difference between a tax break given to a low-wage retail firm and an R&D tax credit used by high-tech firms employing high-wage workers making products exported outside the state. The former is usually a waste of public monies, while the latter is a public investment that generates real economic benefits.³⁵ Finally, neo-Keynesians put the cart before the horse, forgetting the fact that the main job of economic development is to help the private sector be prosperous in ways that create good jobs, so that social policy can later redistribute some of these gains.

Innovation Economics

Holders of the innovation economics doctrine believe that ultimately what determines economic success in a state is the ability of all institutions (private, non-profit, and government) to innovate and change. Because of this, innovation economics focuses less on issues such as the overall business climate or the number of firm-specific deals and more on policies that can spur firm (and entrepreneur) learning and innovation.³⁶ As a result, when examining how the economy creates wealth, innovation economics is focused on a different set of questions:

- Are entrepreneurs taking risks to start new ventures?
- Are workers getting skilled and are companies organizing production in ways that utilize those skills?

- Are companies investing in technological breakthroughs? Is government supporting the technology base (e.g., funding research and the training of scientists and engineers)?
- Are regional clusters of firms and supporting institutions fostering innovation?
- Are research institutions, such as universities, transferring knowledge to companies and individuals?
- Are policymakers avoiding imposing protections for companies against more innovative competitors?
- Do individuals and firms have the right incentives and tools to adequately invest in new ideas and commercialize them?
- Are policies supporting the ubiquitous adoption of advanced information technologies and the broader digital transformation of society and the economy?
- And are state and local economic development efforts organized in ways that fit these new realities?

The new economic development model recognizes the fundamental insight that innovation and entrepreneurship are keys, and that both take place in the context of institutions.

Moreover, adherents of innovation economics do not believe that low costs alone are enough to drive growth or innovation, rather seeing that low costs can come the expense of public investments in factors like research universities, infrastructure and worker skills, ultimately leading to less, not more wealth generation. In addition, because innovation is so important, particularly in export-based firms, they believe that there is a role for government to target policies toward innovation (such as R&D tax credits, technology-focused university-industry research centers, and sector-based regional skills alliances). As such “distorting” the “free market” when done in these innovation-promoting and growth-promoting ways is an appropriate use of public action.³⁷

Building on the IE doctrine, a new model of economic development has emerged within the last decade, focusing less on attracting routinized branch-plant production facilities to states through targeted tax incentives and more on growing entrepreneurial and innovation-based firms in the state through targeted support for innovation. While this new approach to economic development encompasses “technology-based economic development” (TBED), it also goes significantly beyond it to integrate a focus on innovation into all economic development activities, including support for manufacturing, skills, industrial recruitment, etc. In short, the new economic development model recognizes the fundamental insight that innovation and entrepreneurship are keys, and that both take place in the context of institutions.

This means that the new economic development focuses much more extensively on promoting technological innovation, supporting dynamic acquisition of workforce skills, spurring entrepreneurship, supporting industry cluster and knowledge networks, and lowering business costs, but in ways that, at the same time, boost quality of life. Innovation

economics shift the focus of economic policy toward creating an institutional environment that supports technological change, entrepreneurial drive, and higher skills.

This is not to say that some of the insights generated by the other three doctrines are not important. Nor is it to say that simply creating science and technology programs is enough to succeed. It is to say, though, that, ultimately, places will do better if their policies are guided by an innovation economics doctrine, since it better suits the new global economic realities faced by places.

While some may dismiss this discussion of doctrines as ethereal and irrelevant, getting the underlying doctrine or world view is, in fact, critical to getting the right policies and programs in place. For, while the coach may call the plays, the playbook lays out his choices. And the current playbooks in places now limit the plays that the coach (economic policymakers) can call.³⁸ So what are some of the plays and strategies a coach with the innovation economics playbook would use? That is the subject of the next section.

| | Conventional Economic Development | Neo-classical Business Climate | Neo-Keynesian Populist | Innovation Economics |
|--------------------------------------|--|--|---|--|
| Source of Growth | Capital investment | Capital investment | Worker incomes | Innovation and organizational learning |
| Principal Economic Development Means | Drive down costs through firm-specific subsidies | Drive down costs through lower taxes and reduced regulations | Drive up wages and benefits and foster more progressive taxes and public spending | Spur firm innovation through targeted supports (e.g., research, financing, skills, etc.) and incentives for firms to produce these themselves. |
| Object of Policy | Recruitment of out-of-state firms | Recruitment of out-of-state firms | Small business and socially-conscious business | High growth entrepreneurs and existing firms |
| Quality of Life | Minor importance | Not important | High importance | Moderately important to attract and retain knowledge workers. |
| Goal | Get big | Get big | Get fair | Get more prosperous |

Table 1: Economic Development Doctrines and Economic Development Policy

CONCEIVING OF INNOVATION HOLISTICALLY

Innovation has become a central driver of national, regional and local economic wellbeing and competitiveness—and this is why so many places are engaged in the race for global innovation advantage. But to maximize innovation-based economic development, places

need to understand and embrace an accurate and holistic definition of innovation. Innovation is a mindset, a philosophy and approach to doing things as much as it is a technical improvement to a new electronic gadget. For too many involved in spurring innovation in places, innovation has been understood in an engineering context, entailing either the creation of new or improved goods, such as the original iPod or its brethren, or enhanced machines or devices, such as lasers or the computer-controlled machine tools by which products are manufactured. In this context, it is often conceived of as something that pertains only to the R&D activity going on at universities, national laboratories, or corporations.

While that is all true, it is much too limiting. Innovation is about shiny new products, R&D, and technology. But it is about much more. The OECD defines innovation as, “the implementation of a new or significantly improved product (that is, a physical good or service), process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations.”³⁹ Indeed, innovation in services has become increasingly important, as service industries now account for more than 80 percent of the U.S. economy.⁴⁰ Thus, the understanding of innovation has broadened from a purely scientific and technical focus to include the application of information technologies, evolution of new business models, and creation of new customer experience or service delivery approaches that transformed virtually all service sectors, from retail, logistics, and hospitality to health care, professional services, and financial services.

Innovations can also arise at many different points in the innovation process, including conception/ideation, research and development, transfer (the shift of the “technology” to the production organization), production and deployment, or marketplace usage. By definition, all innovations must contain a degree of novelty, whether that novelty is new to the firm, new to the market, or new to the world. It’s also important to remember that an innovation is not just anything new; it must also constitute a viable business concept. Figure 1 charts the dimensions of potential innovation opportunity in the innovation value chain, revealing implications for both companies and countries alike.

| | | Phase of Development | | | | |
|--------------------|-----------------------|----------------------|------------------------|----------|-----------------------|-------|
| | | Conception | Research & Development | Transfer | Production/Deployment | Usage |
| Type of Innovation | Products | | | | | |
| | Services | | | | | |
| | Production process | | | | | |
| | Organizational models | | | | | |
| | Business model | | | | | |

Figure 1: The Innovation Value Chain

Thus properly conceived an innovation agenda benefits workers, firms, and regions that depend on manufacturing as well as those that depend on information technology and high school and community college graduates as well as Ph.D.s. Properly conceived, innovation is not just about creating more jobs for engineers and managers in high technology industries. It is also about providing more and better training for incumbent workers in manufacturing and “low-tech” services and reorganizing work processes so that their companies can perform better.

Unfortunately, when officials in many places hear the word innovation they think high-tech industry. In fact, many places focus even more narrowly on just a few “popular” technology industries, particularly ones like biotechnology and clean energy. Too many places want to be the next big hub for a particular industry. Yet, as Cortright argues, not every place can be a biotech hub, for example.⁴¹ Places would be better off focusing a broad range of innovation phases, including helping firms use new process technologies and develop new business models.

Places cannot effectively drive an innovation economy if they are not also spurring institutional innovation. In other words, innovation by places is key to innovation in places.

INNOVATION BY PLACES

At both the national and regional levels there is increasing evidence that growth is driven by innovation, not by capital accumulation.⁴² The implication for economic development in places is both straightforward and profound. Lower costs and capital attraction can no longer be principal source of a place’s long-term growth. Instead, places need to ensure that their economic environment is conducive to supporting technological change, entrepreneurial drive, and higher skills. This new model of economic development is grounded in the view that it is only through actions taken by workers, companies, industry consortia, entrepreneurs, research institutions, civic organizations, and governments that an economy’s productive and innovative power is enhanced.

The keys to success in the new economy now and into the future appear clear: supporting a knowledge infrastructure (world class education and training); spurring innovation (indirectly through universities and directly by helping companies); and encouraging entrepreneurship. Much has been written on this. But places cannot effectively drive an innovation economy if they are not also spurring institutional innovation. In other words, innovation *by* places is key to innovation *in* places. Success in the new economy requires that a whole array of institutions—universities, school boards, firms, local governments, economic development agencies—to work in new and often uncomfortable ways. At the end of the day, this is a challenge of leadership. Places with leaders who challenge their institutions and businesses and who follow through with bold new policies focused on innovation, learning, and constant adaptation—will be the ones that succeed and prosper.

Institutional innovation is important because, while the U.S. economy has undergone a transformation to a technology-driven, global new economy, many of our institutions and governing structures have not. This is not unique. Throughout America’s history there is a lag between the speed of technological transformation and the corresponding institutional, cultural, political, societal, and individual transformation. Scientists, engineers, and entrepreneurs are often driven to change the world through rapid development of new technologies and development of new business models. The rest of society takes longer to

catch up, being committed to old ways of doing things, old investments, old skills, old institutional arrangements, and old attitudes. As a result, during periods when a new techno-economic system is emerging, organizations, institutions, laws, governments, the built environment, and attitudes and culture lag behind. Christopher Freeman notes that as the new technology system emerges, it produces “major structural crises of adjustment, in which social and economic changes are necessary to bring about a better match between the new technology and the system of social management of the economy.”⁴³

If places are to meet these challenges of creating more innovation-based economies, they will need to include “institutional innovation.” The scope for such far reaching and fundamental innovation is wide ranging, including areas such as transportation, education and training, health care, land use planning and zoning, regulation, transportation and the organization of local government.

Create Different and Better K-12 Schools

States and cities have been focusing on improving K-12 education now for over two decades because they recognize the importance of higher skills to regional economic success. Yet, the results have been largely disappointing. High schools are unable to retain as many as one in four students to graduation. And nearly half of the drop outs point to boredom and lack of interest in classes (no small surprise since most students have little choice in what they learn since the system designed for standardization and must by its nature ignore the individual needs of each student.)⁴⁴ Moreover, even the students who do graduate are not well prepared. In one survey, firms reported that 60 percent of applicants with a high school degree or GED were poorly prepared for an entry level job.⁴⁵ Respondents to a Conference Board survey rated high school graduates as “deficient” in 10 skills (including written communications, critical thinking and team work) and excellent in none.

Perhaps it should not be surprising that K-12 “reform” has fallen short of expectations, given that most of it has not so much been about reform but about doing the same but more of it. Most of the efforts to date have been to get traditional schools to do better, usually by making them more rigorous: more core courses, more standards, more high stakes tests, more hours in the school year, more homework, more teachers getting more pay, and better textbooks. And this all takes place within a K-12 framework premised on standardized curricula, little choice for students, and a focus on being taught particular academic subjects (some with dubious relevance to actual careers).

So long as this is the principal strategy there is little room for innovation; for testing and developing new forms of school and schooling. Rather schools need to move to student-centered, customized learning with a focus on skills rather than on mastering any particular academic content. Success now depends on finding new forms of school and schooling, and in particular shifting education away from its mass production model to a mass-customization model.

This means that states will need to take a risk on embracing more fundamental innovation, or in the words of Harvard Business School’s Clayton Christensen, policymakers will need

to embrace disruptive innovation. Given the largely poor experience of incumbent businesses at responding to innovation, the likelihood of the existing education sector embracing disruptive innovation is not great. As a result, it's time for places to focus on creating real alternatives. As Ted Kolderie, a founder of the national charter school movement and leader of Education Evolving, argues, "If the district sector does—cannot or will not—produce the schools we need then the states will have to get somebody else who will."⁴⁶ In other words, states need to not only work to improve existing schools, but also creating new entities that will create different and better schools. In short, a one-bet strategy that only tries to change existing schools will not work.

While there are new models popping up that present an alternative to conventional schools, the trend is actually the other way with all schools becoming more alike, all following the academic instruction, test-based model. As a result, states need to aggressively work to provide a wide array of educational options: career academies in high schools, charter schools, vouchers, specialty math and science high schools, entrepreneurial education, and project-based learning high schools.⁴⁷ One promising approach, which not only more closely resembles the real work life but is often more intrinsically interesting to students, is project based learning. Rather than focus on "teaching" every child the exact same information, the focus would be on letting students learn in areas that interest them and organized around project-based learning. Perhaps the leading example of this today is Minnesota's New Country School, a public charter school that describes itself the following way:

States need to aggressively work to provide a wide array of educational options: career academies in high schools, charter schools, vouchers, specialty math and science high schools, entrepreneurial education, and project-based learning high schools.

The school is "based upon the idea that students will be most engaged in the learning process when they have a personal interest in what they are learning. Instead of sitting in a teacher-driven classroom all day long, students learn through the exploration of topics that interest them on their own terms, and largely at their own pace. Each student is a member of a team of 12-20 students, managed by an adult advisor who helps to facilitate the learning process. Instead of grades, students receive credit for their work... The process is completely flexible, and can be tailored towards specific learning styles, prior student knowledge, student motivation, etc."⁴⁸

But this is just one type of institutional learning innovation. Another example is Project Lead the Way, which offers engineering and biomedical science curricular in over 1,500 high schools, often through career and technical education programs.⁴⁹ The program focuses on these two substantive areas, but also on learning how work as a contributing member of a team; lead a team; use appropriate written and/or visual mediums to communicate with a wide variety of audiences; public speaking; listening to the needs and ideas of others; thinking and problem solving; managing time, resources and projects; researching, data collection and analysis; and going beyond the classroom for answers.

Another approach is to establish high schools with an emphasis on mathematics, science and technology. A number of states have developed such schools, such as the North Carolina School for Science and Mathematics, the Illinois Mathematics and Science Academy, the Thomas Jefferson High School in Virginia. Texas' T-STEM initiative seeks to create specialty STEM high school academies throughout the state. These schools are a

powerful tool for producing high school graduates with a deep knowledge and strong passion for science and math that translates into much higher rates of college attendance and graduation in scientific fields.⁵⁰

The point is that if places are to make real progress in education it's time to fundamentally rethink the current model and provide a wide array of types of schools and learning environments. Doing so will take leadership and vision on the part of policymakers.

Create Stronger Incentives for Higher Education to be a Partner in Regional Innovation

A key part of many regions' innovation infrastructure is colleges and universities. In an economy more dependent on innovation, universities and colleges are playing a more active role in spurring innovation and commercialization. Between 1994 to 2004, licensing income increased from \$1.96 million per university to \$7.06 million, while university-based start-ups increased from 212 in 1994 to 510 in 2007.⁵¹ And the number of patent applications filed by United States universities increased from 7,200 in 2003 to 11,000 in 2007. And university R&D as a share of GDP has increased from 0.055 percent in 1995 to 0.075 in 2008.⁵² Because of this key role, many places have instituted a range of programs (e.g., research centers of excellence, industry-university grant programs) to spur universities and colleges to be more engaged in economic development. Still other ideas have been proposed, including letting faculty bypass tech transfer offices, letting faculty entrepreneurship count toward their service requirements, and let successful patent applications count as publications for tenure review purposes.⁵³ While these programs are often worthwhile, they don't go to the heart of the problem: higher education and places have different missions and goals. Faculty are rewarded more for publishing than for working with industry or commercializing discoveries.⁵⁴ And to the extent that universities are concerned about knowledge transfer, they are largely focused on maximizing revenues, not enhancing in-state economic growth.

If places are to better align the mission of higher education with state economic development goals, they need to consider more systemic approaches. One is to tie a portion of states' higher education funding to the success of individual institutions at meeting the places economic development goals. These goals might include doing research related to key industry clusters, providing technical assistance to companies in the region, and transferring technology to companies. Universities and colleges that do well in meeting these goals relative to others would receive a larger share of state funding.

The key to success for such a system would be to develop the right performance metrics. These metrics might include patents received, licensing income, technical assistance provided to industry, and others. One important metric is a university's success in obtaining industry funding. A company's willingness to fund research or license technologies is perhaps the clearest measure of industrial relevance. States might provide public state universities and colleges with one dollar of state funding for every dollar from out-of-state firms and two dollars for every dollar from in-state firms.

One limitation of this metric is that smaller and younger firms are likely to have a harder time generating the funds to support academic research or license intellectual property. States could address this issue in one of two ways. They could establish matching grant programs for small firms along the lines of Maryland's Industrial Partnerships (MIPS) program, Connecticut's Yankee Ingenuity program, and Pennsylvania's Ben Franklin Partnership Programs. For example, MIPS provides funding, matched by participating companies, for university-based research projects that help companies develop new products or solve technical challenges.

A related program is Kentucky's research and development voucher program. The program, which has been copied by Georgia, North Carolina and Puerto Rico, provides a repayable voucher to Kentucky firms that invest in universities in Kentucky to commercialize technology. Firms must invest, in cash and in-kind, one dollar for every dollar of state funds. Alternatively, states could create a more generous R&D tax credit for expenditures by firms at universities with small firms eligible for a more generous credit (e.g., 50 percent).⁵⁵

The advantage of a performance-based approach is that it would be up to universities and colleges to figure out the best way to be more relevant to the state's economy. Universities might establish external advisory councils made up of industry leaders to provide insight into research trends and entrepreneurial activities. They might make it easier for faculty to work with industry or start new companies. They might streamline intellectual property procedures to make it easier to commercialize innovations. But the bottom line is that universities and colleges would have a much stronger motivation to be more effective economic development partners.

Places should also create new kinds of institutional arrangements to produce trained workers better suited for the innovation economy. Instead of just reflectively spurring more enrollment in higher education, states should focus their efforts much more on expanding apprenticeship programs, school-to-work programs, industry-skills alliances, tax credits for employer-based training, and employer-community college partnerships. A number of states have moved in this direction. Wisconsin and Georgia have strong youth apprenticeship programs. A number of states and local school districts have established career academies within high schools. A number of states have established regional skills alliances—industry-led partnerships that address workforce needs in a specific region and industry sector.⁵⁶ 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 multiple employers, and workers or worker representatives when appropriate, in the same industry cluster to address overlapping human capital needs. In addition, Pennsylvania has supported a number of specialized industry-led training institutes, such as the Precision Manufacturing Institute, the Advanced Skills Center, and New Century Careers.⁵⁷ 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.⁵⁸

Places should also be focusing on spurring innovation within universities in terms of how pedagogy is organized.

Places should also be focusing on spurring innovation within universities in terms of how pedagogy is organized. Take the case of engineering education. Almost two decades ago a small cadre of visionaries from the corporate and academic sectors got together to examine the state of U.S. engineering education. What they saw gave them pause. Too much of engineering education was rooted in a model of teaching and research that was over one hundred years old. This didn't help students become engineering innovators, nor did it effectively link engineering to businesses. Given the increasingly global and collaborative nature of engineering, this cadre began urging the addition to engineering curricula of teamwork, project-based learning, entrepreneurial thinking, and communication skills, as well as a greater emphasis on social needs and human factors in engineering design.

In 1997, an entirely new college was created in the suburbs of Boston to put that vision into practice. The Franklin W. Olin College of Engineering was created as a highly selective, undergraduate engineering institution designed to prepare students “to become exemplary engineering innovators who recognize needs, design solutions, and engage in creative enterprises for the good of the world.”⁵⁹ But the founders of Olin realized that they had to completely change the model of engineering education for this to work. They started with perhaps the most radical change: doing away with academic departments and faculty tenure. They made a commitment to diversity with the result that 44 percent of their all-engineering student body is female, compared to approximately 20 percent nationally, and 17 percent is accounted for by minorities. They decided that engineering education had to be interdisciplinary and integrated with hands-on learning and research opportunities for students.

By all measures, Olin has been a tremendous model of institutional innovation. Approximately 80 percent of Olin graduates go into STEM fields; 25 percent of Olin graduates are involved in start-up entrepreneurial enterprises (either full- or part-time), with 10 percent starting their own enterprises. Moreover, on the National Survey on Student Engagement (NSSE), which assembles annual data from first- and senior-year students attending hundreds of colleges and universities, Olin's “Active and Collaborative Learning” Benchmark Score is among the highest in the nation. Employers of Olin graduates see them as exceptional.

If we want to win the innovation race, it's not enough to just create one Olin, we need hundreds, not only for engineering education, but in area after area of American society: K-12 education, health care, university technology transfer, transportation, electric utilities, government services, social services, etc. Over the years these institutions have become stagnant, bogged down by the weight of convention, tradition, and inertia. We need to be engaged in systemic innovation in our institutions, trying many experiments and widely adopting the ones that work (just like the private sector does). Most importantly, this means that our conception of innovation policy needs to be broadened from its conventional focus on science and technology to include institutions.

CAN PLACES WIN THE INNOVATION RACE ON THEIR OWN?

No man is an island, and no place—city, state, or even nation—can succeed on its own, regardless of how innovative it is. This is particularly true for states and cities. Many in

Unless the federal government develops an effective national innovation and competitiveness strategy, all the state and city actions in the world will not be enough.

Washington are enamored with the idea of states and cities as the laboratories of democracy for innovation policy, largely because they can be pro-innovation policy without having to embrace federal innovation policy, which may, heaven forbid, look and sound like the dreaded “industrial policy.” But it is a dangerous illusion to believe that state or city policy actions alone can solve the U.S. competitiveness and innovation challenge. Likewise it is an equally dangerous illusion that places can succeed without a robust national innovation policy.

Unless the federal government develops an effective national innovation and competitiveness strategy, all the state and city actions in the world will not be enough. State and city economic development policies play a necessary, but not sufficient role in national competitiveness. Addressing the competitiveness challenge will require considerably more public investment than states and cities can afford. The resources available to the federal government, even in an era of budget deficits, are considerably more than those available to the states and cities combined. While states might invest several billion dollars in R&D, the federal government invests upwards of \$70 billion and much of what subnational places do to spur innovation involves building on this key federal innovation infrastructure. Moreover, while some states provide R&D tax credits and other tax incentives for innovation, federal corporate tax rate incentives for innovation are multiple times greater.

To date, unfortunately, the discussion of the sub-national and federal role in competitiveness has largely been kept separate. Sub-national governments do their thing, the feds theirs. Sub-national governments don’t spend time supporting broad collective action (e.g. a robust federal innovation policy); they are too worried about making sure they remain competitive. And with a few exceptions (such as the Economic Development Administration; NIST’s Manufacturing Extension Partnership) the federal government largely ignores innovation in places. As such it’s time for a new state-federal partnership for innovation and competitiveness.

Both parties bring valuable resources to the table. The federal government is able to marshal resources and drive incentives so that state actions benefit the entire nation, rather than simply redistributing economic resources within the nation. But in an economy where economic policy increasingly must focus on firms, industries, and knowledge-enhancing institutions, as opposed to simply managing the business cycle, states are ideally situated as they are closer to firms, especially small and medium-sized enterprises, and have more control over some innovation infrastructure inputs (such as public higher education).

However, an effective partnership will not be possible unless the federal government begins to see states and regions as important partners. All too often the feds believe that there is one uniform national economy where regional agglomerations are a side show at best. Moreover, to the extent states and regions even have a policy role, it’s too often to follow the federal government’s lead. A true partnership will require that federal decision makers and program managers understand that states and regions can play an important role and that a top-down, one-size-fits-all federal approach will only stifle the most important role states and regions can play: generating policy innovations and developing policies and operating programs suited to the unique requirements of their regional economies. Given

this new understanding, the federal government should expand support for key programs such as the Manufacturing Extension Partnership, the Small Business Innovation Research Program, the Small Business Investment Company Program, and the Technology Innovation Program and create new kinds of industry-university research centers modeled after the German Fraunhofer centers.⁶⁰

But even if sub-national places had a real partner in innovation policy in Washington, that still would not be enough. For every place and every globally traded firm faces competition not just from other places and traded firms in the United States but from other nations around the globe. To take a recent case, consider the solar energy company Evergreen Solar. A Massachusetts company that was seen, not just by Massachusetts policymakers but federal policymakers, as representative of the new fast growing clean energy economy, the state of Massachusetts provided over \$40 million in subsidies for Evergreen to build a production facility in the state. But faced with competition from China, Evergreen shut their plant, eliminating over 800 jobs. It planned to keep open its factory in China, built with a \$33 million investment by the local Chinese government. But even with state help, Evergreen couldn't compete with Chinese solar producers who have seen their share of the global market for solar energy go from 5 to 50 percent in the last decade. It's not because Evergreen was not an innovative company or that Chinese companies were more innovative. Certainly a major reason for the closure of the Evergreen was that the Chinese government is engaged in massive "innovation mercantilism" providing a wide array of subsidies for their solar energy producers, including free electricity, low cost land, cash subsidies, and government procurement preferences. And on top of that Chinese solar producers and all Chinese exporters benefit from at least a 40 percent subsidy on exported products in the form of an undervalued renminbi currency. As *The Boston Globe* wrote: "What gave the state's investment in Evergreen Solar its air of futility wasn't the folly of developing solar-energy technology in Massachusetts; it was the idea that little Massachusetts, with its handful of millions in economic-development resources, could compete against China by itself."⁶¹ Indeed.

When a country like China is that committed to winning in a key innovation-based industry and is willing and able to engage in a wide array of mercantilist practices, some of which violate various global trading agreements, no matter how good the innovation policies of places are, they will not lead to innovation activity. Only if the federal government takes aggressive and sustained action to combat innovation mercantilism will sub-national places stand a fighting chance. Helping places win the race for global innovation advantage will require action directed abroad to dramatically reduce unfair and protectionist foreign trade practices. Only the federal government can prosecute a more proactive trade policy that fights foreign mercantilist actions, including currency manipulation, closed markets, intellectual property theft, standards manipulation, high tariffs, forced offsets for market access, and other unfair trading practices.

This gets at what sub-national places should be doing to most effectively spur innovation-based growth in their economies. The most effective action they can take is not to create a new program or policy to generate innovation-based economic activity within their

boundaries, it is to educate and lobby Washington on why it has to develop a comprehensive national innovation policy that includes help for sub-national regions.

CONCLUSION

While there are people, companies and public servants all over the country who “get” the importance of innovation, as a nation we do not have a coherent understanding of what innovation is, why it is important to economic development and how to drive innovation with innovation public policy. It has become obvious that successful management of places requires enabling robust levels of innovation in places. But most places are a long way from achieving that goal. They face an array of challenges, such as improving education and worker skill levels, investing in R&D, overcoming established business practices and forging stronger public-private partnerships. Even if they master them all, this is no assurance of success. But without mastering the challenges success is even less likely. Places need to recognize that the economic development “playbook” they rely on needs to be updated reflect the new realities of the global innovation race. The tattered playbook of cutting costs and simply letting the market work its magic needs to be tossed aside. Winning the race will require robust “innovation in innovation policy”—that is creating new approaches to how places spur innovation. Finally, sub-national places need to recognize that they are not just competing against other places in the United States, or even other places around the world, but rather other sub-national places backed by their national governments. Just as Boeing is competing against China and the Chinese government, San Diego is competing against Shanghai and the Chinese government. Places should no longer assume they can win the race for global innovation advantage on their own and recognize they are competing against robust national-local partnerships. Places not only need to overhaul their policies but to insist regional and national policies support that overhaul.

ENDNOTES

1. OECD, "Economics: Innovation Central to Boosting Growth and Jobs," (May 27, 2010), http://www.oecd.org/document/36/0,3343,en_2649_34273_45324068_1_1_1_1,00.html.
2. Elhanan Helpman, *The Mystery of Economic Growth* (Cambridge, Massachusetts: Belknap Press, 2004).
3. Ibid, 32.
4. Michael E. Porter, "The Economic Performance of Regions," *Regional Studies* 37.6-7, (Aug./Oct. 2003): 553.
5. Harvey A. Goldstein and Catherine S. Renault, "Estimating Universities' Contributions to Regional Economic Development: The Case of the U.S.," in *Spillovers and Innovations: City, Environment and the Economy*, ed. G. Maier (Vienna, Austria: Springer-Verlag, 2004).
6. Porter, *Regional Studies*, 564.
7. Donald Grimes and Lou Glazer, "A New Path to Prosperity? Manufacturing and Knowledge-Based Industries as Drivers of Economic Growth," (working paper, Michigan Future Inc. & University of Michigan, Ann Arbor, MI, 2004).
8. Robert Weissbourd and Christopher Berry, "The Changing Dynamics of Urban America," (RW Ventures, CEOs for Cities, March 2004), 32.
9. Robert D. Atkinson and Daniel K. Correa, *The 2007 State New Economy Index: Benchmarking Economic Transformation in the States* (Washington, D.C.: ITIF, February 2007), http://www.itif.org/files/2007_State_New_Economy_Index.pdf.
10. Porter, *Regional Studies*, 564.
11. Weissbourd and Berry, "The Changing Dynamics of Urban America."
12. Paul D. Gottlieb and Michael Fogarty, "Educational Attainment and Metropolitan Growth," in *Economic Development Quarterly* 17, 4 (2003): 325-336. In addition, Erickcek and McKinney found that places with a higher share of college educated residents experienced a greater increase in per-capital income. George A. Erickcek and Hannah McKinney, "Small Cities Blues: Looking for Growth Factors in Small and Medium-Sized Cities," (staff working paper 04-100, Upjohn Institute for Employment Research, June 2004), <http://www.upjohninst.org/publications/wp/04-100.pdf>.
13. Enrico Moretti, "Estimating the Social Return to Higher Education: Evidence from Longitudinal and Repeated Cross-Sectional Data," in *Journal of Econometrics* 121 (Los Angeles, CA: Department of Economics, UCLA, 2004): 175-212.
14. Susana Iranzo and Giovanni Peri, "Schooling Externalities, Technology and Productivity: Theory and Evidence from U.S. States," in *Review of Economics and Statistics* 91, 2 (2009): 420-431.
15. Paul W. Bauer, Mark E. Schweitzer, and Scott Shane, "Knowledge Matters: The Long-Run Determinants of State Income Growth," (paper presented at the 2008 annual meeting of the Southern Economic Association, Washington, D.C., 2008).
16. Advanced Research Technologies, LLC, "The Innovation-Entrepreneurship NEXUS: A National Assessment of Entrepreneurship and Regional Economic Growth and Development," (SBA Office of Advocacy/Edward Lowe Foundation, April 2005), <http://www.sba.gov/advo/research/rs256tot.pdf>.
17. See Joseph Cortright, "The Young and Restless in a Knowledge Economy," *CEOs for Cities* (2005), http://www.ceosforcities.org/rethink/research/files/CEOs_YNR_FINAL.pdf.
18. Arti Rai, Stuart Graham and Mark Doms, "Patent Reform: Unleashing Innovation, Promoting Economic Growth, and Producing High-Paying Jobs," (white paper, Department of Commerce, April 13, 2010), 1, http://2001-2009.commerce.gov/s/groups/public/@doc/@os/@opa/documents/content/prod01_009147.pdf.
19. Patrick Brogan, "The Economic Benefits of Broadband and Information Technology," *Media Law and Policy* 18 (2009); Robert D. Atkinson et al., *The Internet Economy 25 Years After.com: Transforming Life and Commerce* (Washington, DC: ITIF, March 2010), <http://www.itif.org/files/2010-25-years.pdf>.
20. Larry Keeley, "The Taming of the New: Larry Keeley Workshop on Innovation," (workshop, Puget Sound SIGCHI, Seattle, September 18, 2007); Carl Franklin, *Why Innovation Fails* (London: Spiro, 2003).
21. Erik Brynjolfsson and Adam Saunders, *Wired for Innovation* (Cambridge, MA: MIT Press, 2009).
22. Mirjam Van Praag and Peter H. Versloot, "The Economic Benefits and Costs of Entrepreneurship: A Review of the Research," in *Foundations and Trends in Entrepreneurship* 4, no. 2 (2008): 65-154.

23. Bureau of Economic Analysis, "Regional Income Accounts."
24. Penn World Tables, http://pwt.econ.upenn.edu/php_site/pwt_index.php.
25. This was how one North Carolina economic development official described his state's strategy for economic development in the 1990s.
26. For example, Maryland provides a job creation tax credit to any firm creating at least 25 jobs, at any wage level. Comptroller of Maryland, Business that Create New Jobs Tax Credit. <http://business.marylandtaxes.com/taxinfo/taxcredit/newjob/default.asp>.
27. Robert D. Atkinson and David Audretsch, "Economic Policy and Policy Differences: Why Washington Cannot Agree on Economic Policies," (technical report, ITIF, Washington, D.C., 2008), <http://www.itif.org/files/EconomicDoctrine.pdf>.
28. See www.innovationeconomics.org.
29. As the Tax Foundation notes, "Good state tax systems levy low, flat rates on the broadest bases possible, and they treat all taxpayers the same. Variation in the tax treatment of different industries favors one economic activity or decision over another." Chris Atkins and Curtis S. Dubay, State Business Tax Climate Index, 4th ed. (background paper, Tax Foundation, Washington, D.C., October 2006), <http://www.taxfoundation.org/research/show/78.html>.
30. "Year-to-Date New Plant Report," (Conway Data, Inc, 1991–2005).
31. Bureau of Labor Statistics, "Business Employment Dynamics."
32. The actual correlation is positive, but a high score on the Tax Foundation index represents low taxes and vice versa. In this regard, there is a negative correlation between per-capita income growth and low taxes.
33. Perhaps one reason for this result is that the Tax Foundation index does not measure actual tax burden, but rather measures like tax rate. In other words, it simply assumes that states with higher rates but more deductions (for example, the R&D credit) are worse than states with lower rates and no deductions. But, from the perspective of the firm, they are the same in terms of amount of taxes paid.
34. Economic Analysis and Research Network, "Economic Development," (accessed September 23, 2008), <http://www.earncentral.org/economic-development.htm>.
35. Robert D. Atkinson, "The Research and Experimentation Tax Credit: A Critical Policy Tool for Boosting Research and Enhancing U.S. Economic Competitiveness," (technical report, ITIF, Washington, D.C., September 2006), <http://www.itif.org/files/R&DTaxCredit.pdf>.
36. Joseph Cortright, "New Growth Theory, Technology and Learning: A Practitioner's Guide," *Reviews of Economic Development Literature and Practice* 4 (U.S. Economic Development Administration, 2001), http://www.eda.gov/ImageCache/EDAPublic/documents/pdfdocs/1g3lr_5f7_5fcortright_2epdf/v1/1g3lr_5f7_5fcortright.pdf.
37. Robert D. Atkinson, "Corporate Tax Reform: Groupthink or Rational Debate?" (technical report, ITIF, Washington, D.C., July 2011), <http://www.itif.org/files/2011-corporate-tax-reform.pdf>.
38. See for example, *OECD Science, Technology and Industry Scoreboard 2007: Innovation and Performance in the Global Economy* (Paris: OECD, 2007).
39. OECD, The OECD Innovation Strategy (Paris: OECD, 2010), 20, http://www.oecd.org/document/15/0,3343,en_2649_34273_45154895_1_1_1_1,00.html.
40. Tekes, "Seizing the White Space: Innovative Service Concepts in the United States," in *Technology Review*, no. 205 (2007): 72-74, http://www.tekes.fi/en/document/43000/innovative_service_pdf.
41. Joseph Cortright and Heike Mayer, "Signs of Life: The Growth of Biotechnology Centers in the U.S.," (working paper, Brookings Institution, Washington, D.C., June 2002), http://www.brookings.edu/reports/2002/06_biotechnology_cortright.aspx.
42. William Easterly and Ross Levine, "It's Not Factor Accumulation: Stylized Facts and Growth Models," in *World Bank Economic Review* 15 (2001): 177-219.
43. C. Freeman and C. Perez, "Structural crises of adjustment, business cycles and investment behavior", in *Technical Change and Economic Theory*, eds. G. Dosi, C. Freeman, R. Nelson, G. Silverberg, and L. Soete (London: Pinter, 1988): 38-66.
44. Clayton M. Christensen, Curtis W. Johnson, and Michael B. Horn, *Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns* (New York: McGraw Hill, 2008).
45. Robert Lerman, "Are Skills the Problem? Reforming the Education and Training System in the United States," in *A Future of Good Jobs?* (Kalamazoo, Mich.: W.E. Upjohn Institute for Employment Research, 2008).

-
46. Ted Kolderie, *Creating the Capacity for Change: How and Why Governors and Legislatures are Opening a New-Schools Sector in Public Education* (Education Week Press, 2004).
 47. The National Foundation for Teaching Entrepreneurship Website, (accessed September 23, 2008), <http://www.nfte.com/whatwedo/programs/>.
 48. Minnesota New Country School Website, (accessed September 23, 2008), <http://www.newcountryschool.com/>.
 49. Project Lead the Way Website, (accessed September 23, 2008), <http://www.pltw.org/index.cfm>.
 50. Robert D. Atkinson, Dennis Lundgren, Martin J. Shapiro, Jerald Thomas, and Janet Hugo, "Addressing the STEM Challenge by Expanding Specialty Math and Science High Schools," (technical report, ITIF, Washington, D.C., March 2007), <http://www.itif.org/files/STEM.pdf>.
 51. AUTM U.S. Survey, Statistics and Metrics Committee, AUTM U.S. Licensing Survey: FY 2004 (2004): 16, 24, 28, <http://www.autm.org/events/File/04AUTMSurveySum-USpublic.pdf>.
 52. National Science Foundation, "Science Indicators."
 53. Robert E. Litan, Lesa Mitchell, and E.J. Reedy, "Commercializing University Innovations: Alternative Approaches," in Working Paper Series (May 16, 2007), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=976005.
 54. For example, Dean Richard Schmalensee of MIT's Sloan School of Management writes that "Unfortunately, under the current academic reward system, what matters most is having an impact among peers, mainly by getting specialized research published in influential journals. The [university] system isn't designed to evaluate or reward someone who invests significant time in the field learning about industry X and working on its problems, even though that investment may produce a superb observer of what's happening in the field who then brings that direct knowledge to bear on both their teaching and research," *Business Week Online*, November 27, 2006), <http://www.businessweek.com>.
 55. Robert D. Atkinson, "Hearing on Tax Policy and the High-tech Sector," *Testimony Before the California Assembly Committee on Revenue & Taxation*, California Congress, December 5, 2011, <http://www.itif.org/files/2011-tax-policy-high-tech-testimony.pdf>.
 56. "State Sector Strategies: Regional Solutions to Worker and Employer Needs," NGA Center for Best Practices (Washington, D.C., 2006).
 57. Precision Manufacturing Institute Website, <http://www.pmionline.edu/>; William F. Goodling Regional ASC Website, <http://www.advskills.org/index.html>; New Century Careers Website, <http://www.ncsquared.com>.
 58. Rhode Island Economic Development Corporation, "Workforce Development," http://www.riedc.com/riedc/business_services/6/.
 59. Franklin W. Olin College of Engineering Website, "About Olin: Overview," 2010, http://www.olin.edu/about_olin/overview.aspx.
 60. "Boosting Competitiveness by Connecting Science and Industry: Insights from German's Innovation Model," (event, ITIF, Washington, D.C., October 2011), <http://www.itif.org/media/boosting-competitiveness-connecting-science-and-industry-insights-germanys-innovation-model#video>.
 61. "Evergreen Solar's Failure Shows US Weakness in Clean Energy," *The Boston Globe*, August 18, 2011, http://articles.boston.com/2011-08-18/bostonglobe/29901685_1_clean-energy-evergreen-solar-renewable-energy.

ABOUT THE AUTHOR

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

ABOUT ITIF

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

FOR MORE INFORMATION CONTACT ITIF BY PHONE AT 202.449.1351, BY EMAIL AT MAIL@ITIF.ORG, OR ONLINE AT WWW.ITIF.ORG.