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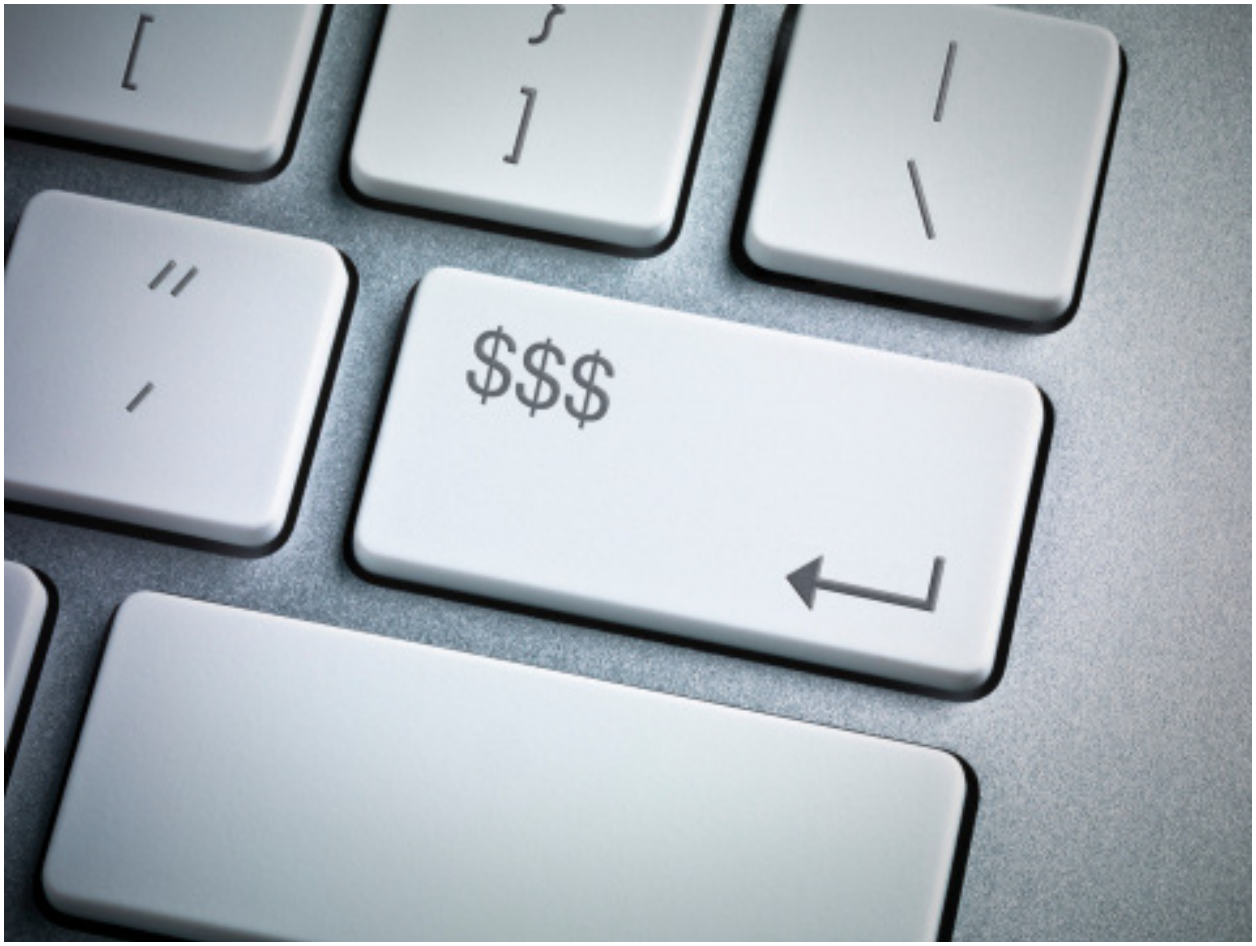

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Technology and the Innovation Economy

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Innovation and entrepreneurship are crucial for long-term economic development. Over the years, America's well-being has been furthered by science and technology. Fears set off by the Soviet Union's 1957 launch of its Sputnik satellite initiated a wave of U.S. investment in science, engineering, aerospace, and technology. Both public and private sector investment created jobs, built industries, fueled innovation, and propelled the U.S. to leadership in a number of different fields.

In this paper, I focus on ways technology enables innovation and creates economic prosperity. I review the range of new advances in education, health care, and communications, and make policy recommendations designed to encourage an innovation economy. By adopting policies such as a permanent research and development tax credit, more effective university knowledge commercialization, improving STEM worker training, reasonable immigration reform, and regional economic clusters, we can build an innovation economy and sustain our long-term prosperity.

The Link to Economic Prosperity

Researchers have found a link between technology innovation and national economic prosperity. For example, a study of 120 nations between 1980 and 2006 undertaken by Christine Qiang estimated that each 10 percentage point increase in broadband penetration adds 1.3 percent to a high income country's gross domestic product and 1.21 percent for low to middle-income nations.[1]

In addition, Taylor Reynolds has analyzed the role of communication infrastructure investment in economic recoveries among OECD countries and found that nearly all view technology development as crucial to their economic stimulus packages.[2] He demonstrates that there is a strong connection between telecommunication investment and economic growth, especially following recessions. These kinds of investments help countries create jobs and lay the groundwork for long-term economic development.

As a result, many nations around the world are investing in digital infrastructure as a way to jump-start economies weakened by the recent financial collapse. The decline in stock market valuations, rise in unemployment, and reduction in overall economic growth has highlighted the need to target financial resources and develop national priorities. In conditions of economic scarcity, countries no longer have the luxury of being passive and reactive. Instead, they must be proactive and forward-looking, and think clearly about how to create the basis for sustainable economic recoveries.

Not surprisingly, given its long-term potential, a number of countries have identified information technology as a crucial infrastructure need for national development. Broadband is viewed in many places as a way to stimulate economic development, social connections, and civic engagement. National

leaders understand that cross-cutting technology speeds innovation in areas such as health care, education, communications, and social networking. When combined with organizational changes, digital technology can generate powerful new efficiencies and economies of scale.[3]

People Understand Importance of Innovation, But Doubt U.S. Future

Despite the importance of the connection between technology innovation and economic prosperity, public opinion surveys reveal interesting results in people's views about innovation. A 2009 *Newsweek*-Intel Global Innovation Survey interviewed 4,800 adults in the United States, China, United Kingdom, and Germany. Researchers found that "two-thirds of respondents believe innovation will be more important than ever to the U.S. economy over the next 30 years."[4] People understand the basic point that innovation has been key to past prosperity and is vital moving forward.

The survey also found interesting differences between Americans and the Chinese in what they think is important to future advances. According to the survey, "Americans are focused on improving math and science education, while Chinese are more concerned about developing creative problem-solving and business skills."[5] Apparently, people from the respective nations have different fears about their current innovation training and what is necessary for future innovation.

However, there is a remarkable divergence between Americans and Chinese in assessments of the contemporary situation. Americans are remarkably pessimistic about their own future. When asked how the U.S. was doing in 2009, only 41 percent of Americans thought our country was ahead of China on innovation compared to 81 percent of Chinese who felt the U.S. was ahead.[6] Americans worried that their country was falling behind on innovation while other countries were moving forward.

There are objective reasons behind this American pessimism. There are too few Americans studying the traditional STEM fields of science, technology, engineering, and math. Due to our immigration policy, it is difficult for foreign students who are educated in the United States to stay here, get jobs, and contribute to American innovation the way many immigrants have done in the U.S. previously.[7] With our current debt and budget deficit levels, Americans worry about our long-term ability to invest in education and research in the way we did in the past and produce positive results.

An analysis of patents granted shows that our country's long-term dominance has come to an end. In 1999, American scientists were granted 90,000 patents, compared to 70,000 for those from all other countries.[8] By 2009, though, non-U.S. innovators earned more patents (around 96,000) compared to Americans (93,000). This represented the first time in recent years where non-Americans had garnered

more patents.[9]

The United States spends only 2.8 percent of its federal budget on national research and development as a percentage of GDP. This is less than the 4.3 percent spent by the government in Sweden, 3.1 percent by Japan, and 3.0 percent by South Korea, but higher than that of Germany (2.5 percent), France (2.2 percent), Canada (1.9 percent), or England (1.9 percent). Europe as a whole devotes 1.9 percent to research and development, while industrialized nations spend around 2.3 percent.[10]

If one adds together all the science and technology workers in the United States as a percentage of the workplace, 33 percent of American employees have science or technology positions. This is slightly less than the 34 percent figure for the Netherlands and Germany, but higher than the 28 percent in France and Canada,.[11]

The productivity in this area has fueled considerable demand for those with science and engineering expertise, and it has been difficult for the United States to produce sufficient knowledge workers.[12] Thirty-eight percent of Korean students now earn degrees in science and engineering, compared to 33 percent for Germany, 28 percent for France, 27 percent for England, and 26 percent for Japan. The United States has fallen behind in this area. Despite great demand for this kind of training, only 16 percent of American graduates have backgrounds in science and engineering.[13]

In America, the private sector surpassed the federal government in 1980 in terms of the amount of money spent on research and development. By 2003, commercial companies provided 68 percent of the $283 billion spent on research and development, compared to 27 percent from the federal government. Of this total, $113 billion came from the federal government, while $170 came from the private sector. According to information from the National Science Board, the percentage of research and development spending coming from the federal government has dropped from around 63 percent in the early 1960s to 27 percent today, while that of the private sector increased from 30 to 68 percent.[14]

The Need for a Clear Focus on Innovation

In moving forward, it is clear that information technology enables innovation in a variety of policy areas. According to Philip Bond, the president of TechAmerica, "each tech job supports three jobs in other sectors of the economy." And in information technology, he says, there are five jobs for each IT position.[15]

Faster broadband and wireless speeds also enable people to take advantage of new digital tools such as GIS mapping, telemedicine, virtual reality, online games, supercomputing, video on demand, and video conferencing. New developments in health information technology and mobile health, such as emailing X-rays and other medical tests, require high-speed broadband. And distance learning, civic engagement, and smart energy grids require sufficient bandwidth.[16]

High-speed broadband allows physicians to share digital images with colleagues in other geographic areas. Schools are able to extend distance learning to under-served populations. Smart electric grids produce greater efficiency in monitoring energy consumption and contribute to more environment-friendly policies. Video conferencing facilities save government and businesses large amounts of money on their travel budgets. New digital platforms across a variety of policy domains spur utilization and innovation, and bring additional people, businesses, and services into the digital revolution.

In the education area, better technology infrastructure enables personalized learning and real-time assessment. Imagine schools where students master vital skills and critical thinking in a personalized and collaborative manner, teachers assess pupils in real-time, and social media and digital libraries connect learners to a wide range of informational resources. Teachers take on the role of coaches, students learn at their own pace, technology tracks student progress, and schools are judged based on the outcomes they produce. Rather than be limited to six hours a day for half the year, this kind of education moves toward 24/7 engagement and learning fulltime.[17]

These represent just a few of the examples where innovation is taking place. Technology fosters innovation, creates jobs, and boost long-term economic prosperity. By improving communication and creating opportunities for data-sharing and collaboration, information technology represents an infrastructure issue as important as bridges, highways, dams, and buildings.

Getting Serious about Innovation Policy

To stimulate innovation, we need a number of policy actions. Right now, the United States does not have a coherent or comprehensive innovation strategy. Unlike other nations, who think systematically about these matters, we make policy in a piecemeal fashion and focus on short versus long-term objectives. This limits the efficiency and effectiveness of our national efforts. There are a number of areas that we need to address.

Research and Development Tax Credits: An example of our national short-sightedness is the research and development tax credit. Members of Congress have extended this many times in recent years, but they generally do this on an annual basis. Rather than extend this credit over a long period of time, they renew it episodically and never on a predictable schedule.

This makes it difficult for companies to plan investments and pursue consistent strategies over time. Due to political uncertainties and institutional politics, we end up creating inefficiencies linked to the vagaries of federal policymaking.[18] While companies in other countries invest and deduct on a more predictable schedule, we shoot ourselves in the foot through a short-sighted perspective. Bond notes that "23 countries now offer a more generous and stable credit" than the United States.[19]

Commercializing University Knowledge: Universities represent a crucial linchpin in efforts to build an innovation economy. They are extraordinary knowledge generators, but must do a better job of transferring technology and commercializing knowledge. University licensing offices must speed up their review process in order to encourage the formation of businesses. Universities should think more seriously about innovation metrics so they allocate resources efficiently and create the proper incentives.

Right now, many places count the number of patents and licensing agreements without much attention to the businesses created, products that are marketed, or revenue that is generated. They should make sure their resources and incentives are aligned with metrics that encourage technology transfer and commercialization.[20]

STEM Workforce Training and Development: The United States is facing a crisis in STEM training and workforce development. There are many dimensions of this challenge, but one of the most important concerns is the low number of college students graduating with degrees in science, technology, engineering, and math. Few American students are developing proficiency in these subjects, which is hindering the country's economic future. Past American prosperity has been propelled by advances in the STEM fields. Skills in these areas helped the country win the space race and the Cold War and we need them now as we transition to a technology driven economy.

To deal with this problem, President Barack Obama's Council of Advisors on Science and Technology (PCAST) has produced an official report that calls for the creation of a Master Teachers Corps. Among other recommendations, the report emphasizes two actions: 1) hiring 100,000 new STEM teachers and 2) paying higher salaries to the top 5 percent of STEM teachers.[21] However, in an era of budget cutbacks and attacks on teacher unions, it has been difficult to build support for raising teacher salaries in general and adopting differential pay in particular.

In his 2011 State of the Union, the President restated his commitment to putting education at the forefront of the national agenda, emphasizing the need for quality teachers, investment in STEM education programs, and a "bold restructuring" of federal education funding. He called for identifying effective teachers and creating reward systems to retain top-performing individuals.

It is vital to address these issues because basic facts about STEM teaching and competency are not well known. Failing schools not only harm students, they weaken the overall economy. With the U.S. facing a crisis of massive proportions in terms of its ability to innovate and create jobs, it is imperative that we transform STEM teaching to prepare students for the future economy. Real emphasis should be placed on teacher investment because research has shown that teachers are the primary factor in ensuring student growth and achievement.

An Einstein Strategy for Immigration Reform: We need reasonable immigration reform. One of our most important challenges is a new narrative defining immigration as a brain gain that improves economic competitiveness and

national innovation. A focus on brains and competitiveness would help America overcome past deficiencies in immigration policy and enable our country to move forward into the 21st century. It is a way to become more strategic about promoting our long-term economy and achieving important national objectives.[22]

We need to think about immigration policy along the lines of an "Einstein Principle." In this perspective, national leaders would elevate brains, talent, and special skills to a higher plane in order to attract more individuals with the potential to enhance American innovation and competitiveness. The goal is to boost the national economy, and bring individuals to America with the potential to make significant contributions. This would increase the odds for prosperity down the road. It has been estimated that "over 50,000 workers with advanced degrees leave the country for better opportunities elsewhere."[23]

O-1 Genius Visas: In order to boost American innovation, current policy contains a provision for a visa "brains" program. The so-called "genius" visa known as O-1 allows the government to authorize visas for those having "extraordinary abilities in the arts, science, education, business, and sports." In 2008, around 9,000 genius visas were granted, up from 6,500 in 2004. The idea behind this program is to focus on talented people and encourage them to come to the United States. It is consistent with what national leaders have done in past eras, where we encouraged those with special talents to migrate to our nation.

However, this program has been small and entry passes have gone to individuals such as professional basketball player Dirk Nowitzki of Germany and various members of the Merce Cunningham and Bill T. Jones/Arnie Zane dance companies.[24] While these people clearly have special talents, it is important to extend this program in new ways and target people who create jobs and further American innovation. This would help the United States compete more effectively.

EB-5 Job Creation Visas: There is a little-known EB-5 visa program that offers temporary visas to foreigners who invest at least half a million dollars in American locales officially designated as "distressed areas." If their financial investment leads to the creation of 10 or more jobs, the temporary visa automatically becomes a permanent green card. Without much media attention, there were 945 immigrants in 2008 who provided over $400 million through this program.[25] On a per capita basis, these benefits make the program one of the most successful economic development initiatives in the federal government.

This is a great way to tie U.S. immigration policy to job creation. If a goal of national policy is to encourage investment and job creation, targeted visas of this sort are very effective. Such programs explicitly link new immigration with concrete economic investment. They also generate needed foreign capital ($500,000) for poor geographic areas. There is public accountability for this policy program because entry visas are granted on a temporary basis and become permanent only AFTER at least 10 jobs have been created. This kind of visa program is the ultimate in targeting and quality control. Unless the money is invested and leads to new jobs, the newcomer is not allowed to stay in the United

States.

H-1B Worker Visas: Right now, only 15 percent of annual visas are set aside for employment purposes. Of these, some go to seasonal agricultural workers, while a small number of H-1B visas (65,000) are reserved for "specialty occupations" such as scientists, engineers, and technological experts. Individuals who are admitted with this work permit can stay for up to six years, and are able to apply for a green card if their employer is willing to sponsor their application.

The number reserved for scientists and engineers is drastically below the figure allowed between 1999 and 2004. In that interval, the federal government set aside up to 195,000 visas each year for H-1B entry. The idea was that scientific innovators were so important for long-term economic development that we needed to boost the number set aside for those specialty professions.

Today, most of the current allocation of 65,000 visas run out within a few months of the start of the government's fiscal year in October. Even in the recession-plagued period of 2009, visa applications exceeded the supply within the first three months of the fiscal year. American companies were responsible for 49 percent of the H-1B visa requests in 2009, up from 43 percent in 2008. The companies which were awarded the largest number of these visas included firms such as Wipro (1,964), Microsoft (1,318), Intel (723), IBM India (695), Patri Americas (609), Larsen & Toubro Infotech (602), Ernst & Young (481), Infosys technologies (440), UST Global (344), and Deloitte Consulting (328).[26]

High-skill visas need to be expanded back to 195,000 because at its current level, that program represents only six and a half percent of the million work permits granted each year by the United States. That percentage is woefully inadequate in terms of the supply needed. Entry programs such as the H-1B, O-1, and L-1 visa programs grant temporary visas for a period of a few years to workers with special talents needed by American employers. They enable U.S. companies to attract top people to domestic industries, and represent a great way to encourage innovation and entrepreneurship.

Regional Economic Clusters: We need regional economic clusters that take advantage of innovation-rich geographic niches. There are several examples of successful and geographically-based clusters such as Silicon Valley, Boston's Route 128, and the Research Triangle in North Carolina. In each of these areas, there is a combination of creative talent associated with terrific universities, access to venture capital, and state laws that promote innovation through tax policy and/or infrastructure development.

Research has demonstrated that these innovation clusters generate positive economic results. According to a Brookings report by Mark Muro and Bruce Katz, "it is now broadly affirmed that strong clusters foster innovation through dense knowledge flows and spillovers; strengthen entrepreneurship by boosting new enterprise formation and start-up survival, enhance productivity, income-levels, and employment growth in industries, and positively influence regional economic performance."[27]

The question is how to promote such clusters in other geographic areas. There clearly are other places with the underlying conditions that foster technology innovation. But Muro and Katz caution that political leaders can't force clusters that don't already exist and that they should let the private sector lead in encouraging cluster formation. It is important to leverage existing resources and take advantage of workforce development programs, banking rules, educational institutions, and tax policies.[28]

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Endnotes

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