

Higher Education and the Future of U.S. Competitiveness¹

David Attis

Competitiveness has become a buzzword recently. Nearly every day in the press we read accounts of “America’s competitiveness crisis,” our “innovation shortfall,” or how the United States is “losing its edge.” A growing number of Americans from all walks of life and all political persuasions worry that the rise of emerging economies threatens our continuing prosperity. These concerns have led to a flood of reports during the past few years charting America’s putative decline and proposing a range of solutions.

The need for action—and the recent sense of urgency—was neatly crystallized by Thomas Friedman’s 2005 book *The World Is Flat*. As incomes have stagnated, many have pointed the finger at offshoring, seeing in the rapid rise of India and China the explanation for the struggles of working Americans.

The Changing Competitive Environment

The global competitiveness environment has indeed changed dramatically during the past decade. As the smoke from the Internet boom cleared, Americans began to notice that other countries had made tremendous gains in science and technology, dramatically narrowing America’s historic lead. China has pulled ahead of the United States in high-technology exports, and U.S. trade in advanced technology has fallen into deficit. The European Union now generates more scientific publications and graduates more PhDs in science than the United States. China graduates nearly three times as many four-year degrees in engineering, computer science, and IT and is projected to graduate more PhDs in science and engineering by 2010.²

In many ways, this is simply the consequence of our own success. Throughout the 1990s, other countries recognized and began to imitate the U.S. model of economic growth—improving access to higher education, increasing government investment in R&D, and lowering

barriers to trade and investment. At the same time, multinational corporations (often led by American companies) accelerated their globalization, both to gain access to the enormous and rapidly growing consumer markets in emerging economies and to tap into overseas talent pools. Not only have call centers, accounting departments, and other back-office functions been reorganized globally, but even R&D can now be performed all over the world. America's unique advantages are no longer so unique.

In an effort to address these concerns, political leaders in both parties have taken up the banner of competitiveness. And these days, competitiveness means science, technology, and innovation. In his 2006 State of the Union address, President Bush launched his American Competitiveness Initiative, explaining, "By investing in research and development, unleashing the innovative spirit of America's entrepreneurs, and making sure that our economy has workers highly skilled in math and science, we will lay the foundation for lasting economic prosperity."³ Legislation with these goals passed both houses of Congress with bipartisan support in 2007.⁴

The Council on Competitiveness released *Innovate America*, the report of our National Innovation Initiative, in December 2004. Our report contained more than 80 recommendations, not just for the federal government but also for companies, universities, and state and local governments. It was designed to address the entire innovation ecosystem. Recent legislative proposals, however, have focused on five main areas: increased federal funding for basic research (especially in the physical sciences), more support for K–12 science education (especially teacher training), better incentives for graduate education in the sciences, increased high-skills immigration, and making permanent the tax credit for corporate investment in R&D.

While there is a pretty broad consensus that these are all good things to do, on their own they are by no means sufficient to achieve the results that policy makers desire. They are all based on the assumption that increasing the inputs to innovation (R&D spending, scientists, and engineers) will generate a corresponding increase in outputs. Higher education—the performer of the vast majority of basic research and the source of new scientists and engineers—plays a central but rarely explicit role in the discussion. It is the black box that magically transforms federal research dollars and high school seniors into U.S. prosperity. For this reason, the next phase of the competitiveness debate must look inside the black box and attempt to understand how our colleges and universities can better promote innovation.

Enabling Innovation

While most people accept (and econometric evidence supports) the contention that federal R&D funding contributes to U.S. economic growth, in a global innovation environment it is no longer true that basic research performed in the United States will necessarily benefit American firms or American workers. Rather, the economic benefits depend on the degree to which universities (together with entrepreneurs, venture capitalists, and corporations) can translate the results of basic research into marketable innovations. The benefits now also depend on how corporations choose to commercialize and produce those innovations through global networks. Doing the research here no longer necessarily means that the technologies, the factories, or the jobs will be created here.

This is not to say that federal R&D spending is a waste of money, but it does force us to think about the mechanisms by which such funding promotes innovation in the United States. If knowledge is universal, why should it matter where it is produced? Geographical origin may not matter from the perspective of a peer review panel, but a large amount of scholarship has shown that from the perspective of someone trying to commercialize knowledge, place does matter. Venture capital, for example, is highly localized, and innovative activity tends to “spill over” from universities to the regions that surround them.

The main reason is that tacit knowledge—the kind of knowledge that cannot be captured explicitly in publications or patents—is often the most valuable kind of knowledge. Cutting-edge scientific and technical knowledge is embodied in people more than in machines or equations. And it flows through informal networks that tend to be highly concentrated in specific locations. As regional economic development expert Randall Kempner likes to say, “Innovation is a contact sport.” And the lesson from economic geographers and regional economic developers is that it is the personal connections between academics, corporate researchers, entrepreneurs, and venture capitalists that enable innovation. These networks are very difficult to copy and can take decades to evolve.

What does this mean for higher education? It means that the degree to which higher education contributes to innovation depends not just on the level of inputs but perhaps even more strongly on how the people at educational institutions engage with the outside world, particularly within their region. This is an area in which government policies play very little role and where individual institutions are struggling to find better ways to encourage new forms of behavior. It requires a rethinking of how faculty are rewarded and how students are educated.

More Than a Numbers Game

It has become an article of faith among CEOs that America currently has a shortage of scientists and engineers. And many of the recent policy proposals include mechanisms to encourage more Americans to go into science and engineering. Proponents of this view point to difficulties in filling technical positions (particularly those that require American citizenship due to security restrictions), declining enrollment in science and engineering programs, looming waves of retirement among baby boomer scientists, and the fact that the entire annual supply of H1-B visas (for highly skilled immigrants) is used on the first day they become available.

The underlying assumption is that companies are desperate for people with the type of clearly defined scientific knowledge and technical skills indicated by a PhD, but at the same time, companies say that the skills they find most valuable—collaboration, communication, creative problem solving—are not typically found in science and engineering graduates. While the public debate has focused on the need for technical skills, it is the nontechnical skills that are often the hardest to find. (Increasingly so, as the number of technical graduates around the world increases exponentially.) Innovation, these companies realize, depends on more than science and technology. It requires a hard-to-define, and perhaps even harder-to-teach, ability to transform science and technology into products and services that customers can use.

As countries around the world have improved science education, increased their investment in R&D, and encouraged global corporations to invest in high-technology manufacturing or research, an ever broader range of science and technology capabilities have essentially become commodities. High-tech manufacturing, qualified engineers, PhD researchers, and advanced laboratory facilities are now widely available around the world. On their own these factors no longer provide the competitive advantage they once conferred. As a result, national governments now obsessively pursue innovation and creativity in an attempt to define a new niche.

Yet the debate in the United States continues to focus on graduating ever greater numbers of scientists and engineers as the key to increasing U.S. competitiveness. While we must continue to improve standards and encourage more students to study science and engineering, we need to acknowledge that we will never win the race to produce the highest test scores or the most engineers. Simple demographics dictates that we will never outproduce China in engineers. But that does not mean that America's innovation capacity is doomed. The best test-takers do not always make the best innovators, and a range of countries with high test

scores—such as Japan, Singapore, Korea, and China—are increasingly worried that their educational systems stress conformity at the expense of creativity. The challenge is not to train the most scientists and engineers but to train the scientists and engineers (and artists and anthropologists and managers) who are best able to work within the global innovation system to create valuable new products and services.

Two examples illustrate the types of higher education challenges that go beyond simply increasing funding or graduation rates for scientists and engineers.

Like most institutions, Georgia Tech was facing declining enrollment in computer science and its graduates were facing increasing competition from highly skilled and significantly cheaper graduates in emerging economies. They were struggling to redefine the relevance of a computer science degree. One employer remarked, “Don’t send me engineers who can be duplicated by a computer. I am sending that work to India. Send me engineers who are adaptable, who can think across disciplines.” Georgia Tech remade their computer science curriculum using the concept of “threads” (<http://www.cc.gatech.edu/education/undergrad/bcs/the-8-threads>). A computer science major now consists of two threads out of eight possible options—Foundations, Embodiment, Intelligence, Computational Modeling, Platforms, Information Internetworking, People, and Media. Each thread defines a problem—how can people interact with machines, how can computers simulate natural phenomena—that provides a context and a meaning for individual computer science courses as well as courses from other departments such as anthropology or design. The goal is both to keep students engaged and to help them develop the skills that will enable them to solve real-world problems.

Another example is the Professional Science Master’s degree, a two-year master’s degree that combines graduate-level courses in science or mathematics with skills-based coursework in management, policy, law, or other subjects (<http://www.sciencemasters.com>). Rather than training academic researchers, the program is intended to cultivate practitioners with advanced technical skills but also with communication, collaboration, and leadership skills. Each degree program is focused on a specific niche—such as applied genomics, computational chemistry, or food safety and toxicology—developed with input from industry and typically tailored closely to the needs of a local industry. The goal is to identify the skills demanded by innovative companies rather than to simply turn out more PhDs.

The same forces that demand a rethinking of science and engineering education are also reshaping the demand for skills from the broader population. The global proliferation of information technology

has enabled a “trade in tasks” that opens more and more American workers to potential foreign competition. But those pundits who focus exclusively on offshoring often fail to recognize that its effects are often dwarfed by the impact of automation. The American call center worker is more likely to lose his or her job to IVR (interactive voice response) technology than to an offshore call center. Both offshoring and automation enable routine tasks to be performed at a lower cost, reducing the value of jobs structured around routine tasks but increasing the value of jobs that require more complex tasks that cannot easily be automated or offshored. The salient distinction is not necessarily between those with more or less education but between those whose work can be replaced by a computer or someone far away using a computer versus those whose productivity is enhanced by a computer.⁵

The irony is that our education policy emphasizes standardized testing at precisely the moment when anything that can be standardized can be done more efficiently by a computer or outside the United States. The 2006 Spellings Commission on the Future of Higher Education extended this mass production metaphor to the world of colleges and universities. Expanding access, increasing quality, and improving accountability are all important—even essential—goals for higher education, but turning out a larger number of graduates according to some minimum specification will not address the most important challenges that we face as a nation.

Conclusion

If innovation were simply a numbers game, our future would indeed be bleak, but the strength of U.S. higher education has always been more than sheer numbers of graduates. America’s phenomenal economic success has rested in large part on the dynamism of our economy, driven by the creativity, innovativeness, and entrepreneurialism of our students and faculty. That is our competitive advantage and it is our greatest hope in a world of more nearly equal competitors.

Recent debates about America’s competitiveness have resulted in some very insightful analysis and many useful proposals, but they tend to rest on the mistaken assumption that we can spend ourselves out of this problem. Asking how much the federal government should spend on basic R&D or how many scientists and engineers we need are the wrong questions. We should instead be asking how research can drive regional and national competitiveness, what skills students need to contribute to innovation and, ultimately, how higher education can support American competitiveness.

Endnotes

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2. Council on Competitiveness, *Competitiveness Index: Where America Stands* (February 2007), <http://www.compete.org/publications/detail/357/competitiveness-index-where-america-stands>.
3. Domestic Policy Council, Office of Science and Technology Policy, “American Competitiveness Initiative: Leading the World in Innovation,” February 2006, <http://www.whitehouse.gov/stateoftheunion/2006/aci>.
4. The America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act (COMPETES), H.R. 2272, was signed into law by President Bush on August 9, 2007.
5. See Frank Levy and Richard J. Murnane, *The New Division of Labor: How Computers Are Creating the Next Job Market* (Princeton, NJ: Princeton University Press, 2005).

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