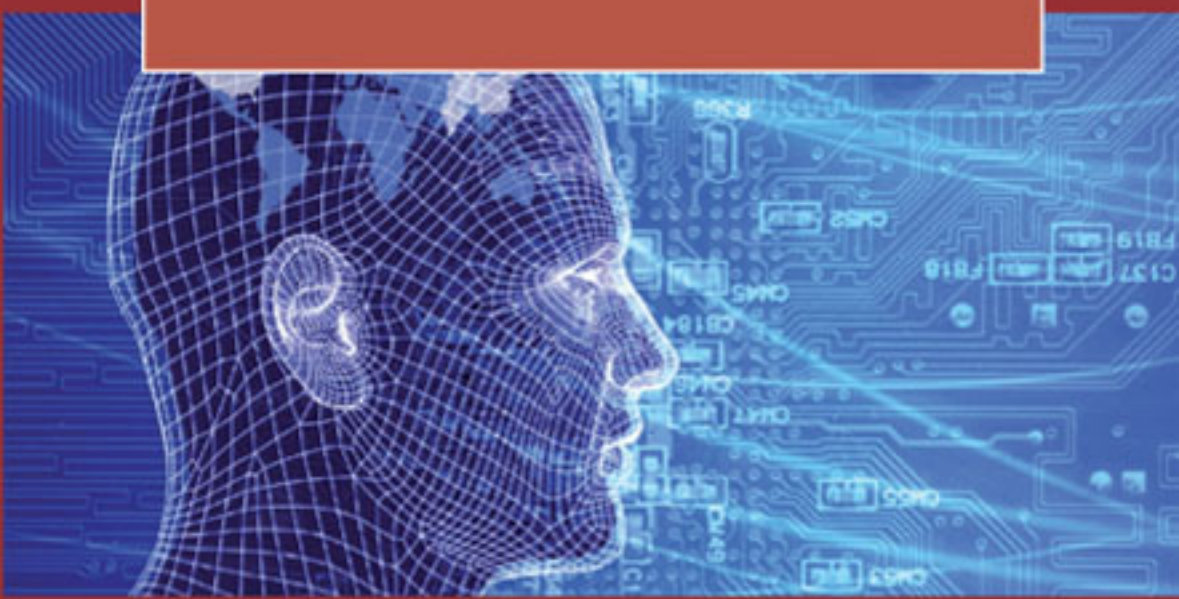
# Education for Innovation

## Implications for India, China and America

Robert L. DeHaan and
K. M. Venkat Narayan (Eds.)



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*Implications for India, China and America*

Robert L. DeHaan and K. M. Venkat Narayan
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# PREFACE

The India, China and America Institute (ICAI), in collaboration with Emory University, held its first international conference on Education for Innovation on March 2–3, 2007 under the able leadership of two of its eminent research directors, Professors Robert L. DeHaan and K. M. V. Narayan.

The ICAI, a non-profit research institute, was founded in 2005, based on my strong belief that while the 20th century was driven by ideologies of advanced countries, the 21st century will be driven by markets of emerging economies. Clearly, the two leading emerging economies which will dramatically impact the rest of the world (and particularly the United States) will be China and India, now commonly referred to as Chindia.

The ICAI's mission is to understand and foster economic development through free market approaches, driven by public-private partnerships in six major sectors of the world economy. These are: agriculture, education, healthcare, technology, energy and security. Until now, all of these sectors have been driven largely by government in terms of policies, budgets and market regulation based on political agendas and ideology. All of them have one thing in common: they are the resources of a nation; whoever has access to them will have both comparative and competitive advantages.

Because of the size of their populations, as China and India become the largest domestic consumption markets and, at the same time, continue to serve the rest of the world as manufacturing and service centers, their need for natural, industrial and human resources will be unprecedented. Consider the impact on global resources that America had, with less than 300 million in population, as it became the largest domestic consumption market in the world as well as one of the largest export nations. A worldwide race for resources is inevitable as we see the world's geopolitical alignments shift, resulting in strange political bedfellows among resource-rich nations and Chindia. We already see that the area with the greatest influence in Africa is no longer Europe, as was traditionally true from the colonial days. Today it is China and to some extent, India. The same is also true in Caribbean and Latin America.

Education is at the heart of this race for resources. It is the highest "value add" multiplier of what is possibly the most versatile of all resources, namely human capital. For example, the value added on an agricultural resource such as a grain of wheat when converted into a consumable loaf of bread is about five-fold: the cost of raw material (wheat) as a percentage of retail price of the finished product (loaf of bread) is less than 20 percent. The value added of an industrial resource such as a rough diamond from

the mine made into a finished marketable diamond is about twenty times: the cost of the mined diamond is less than 5 percent of the retail price of the finished product. The value added of education to a human resource, on the other hand, is literally infinite. There seems to be no upper limit of what a human being can do if he or she is educated.

While primary and secondary education through literacy and industrial employment are great values added, the single biggest multiplier seems to be higher education. Furthermore, the single largest multiplier in higher education is innovation through research and development (R&D). Indeed, the rise of Europe (especially Germany, France and England) and more recently the United States as super-economic, political and military powers can be directly attributable to their encouragement of and investment in R&D and innovation which led to the Industrial Revolution.

In my view, both China and India have understood this reality. They were the top two economies of the world both in trade and GDP until the late 1400s and would have continued their dominance but for the industrial revolution in Northern Europe and later in the United States. China, in particular, has not only understood this strategic advantage but has proactively decided to massively invest in education and R&D. Today, China is already the second largest investor in R&D, having just surpassed Japan in that regard. Taking the number of worldwide patents filed as an indicator of innovativeness, China is predicted to become at least number three behind Japan and the United States in a short period of time. China is also massively investing in higher education with a focus on research, rather than only on teaching, by following the American model of research-driven universities and other types of higher education institutions.

Similarly, India has also understood the importance of education for innovation. It is trying to reform its current model of education from knowledge dissemination to knowledge creation. Important in that strategy is the recent establishment of a separate knowledge commission directly reporting to the Prime Minister.

In my view, the evolution of education as a driver of innovation through R&D will be different between China and India. The China model will be more government-initiated and government-funded and will resemble the European model and ideology. The Indian model, by contrast, is likely to be based more on a free market ideology, initiated by the private sector with a strong preference for public-private partnerships.

In any case, as both large emerging economies invest in education for innovation, the global impact on the race for resources will be massive. Since education for innovation is a long-term, outcome-oriented process, there will predictably be short-term shortages of R&D talent and brain

drains of that talent from advanced economies, especially from the United States, to China and India. This will be manifested not only in Chinese and Indian research scientists in the United States returning to their homelands, but will likely involve large numbers of non-Chindian scientists and engineers going to work for Indian and Chinese enterprises. Indeed, this already seems to be a clear private-sector strategy of Indian enterprises as they acquire large R&D-driven European or American corporations.

I want to congratulate Professors DeHaan and Narayan for inviting outstanding thought leaders from around the world to the ICAI Emory conference and for editing this volume on Education for Innovation. Each article in this book is thought-provoking. Those of us fortunate enough to have attended the conference learned a lot, and I believe the volume will benefit many others.

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The distinguished authors of each chapter of this book represent a range of different perspectives on education, innovation, economic development, and comparative international analysis. We wish to recognize the important contributions that they have made to the creation of this volume and to their

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Robert L. DeHaan
K. M. Venkat Narayan

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# I. HOW DOES INNOVATION PROMOTE ECONOMIC GROWTH?

ROBERT L. DEHAAN AND K. M. V. NARAYAN

# 1. EDUCATION FOR INNOVATION

*A Tri-National Overview*

## INTRODUCTION

> A society's competitive advantage will not come from how well its schools teach multiplication and periodic tables, but from how well they stimulate imagination and creativity.
>
> – Albert Einstein, 1953 Einstein Letters, from W. Issacson (2007). Einstein: His Life and Universe (pp. 6–7). New York: Simon and Schuster.

As we enter the knowledge-driven global economy of the 21st century, Einstein's admonition (above) seems ever more relevant. Scholarly experts and world leaders of India, China and the United States—the three most populous and largest economies—acknowledge that innovation will be the well-spring of economic development in the 21st century. The challenge, of course, will be to determine how to turn ordinary citizens into innovators; how to educate a society to be inventive and creative; to answer the question: What is education for innovation?

China's recently announced Eleventh Five-Year Plan pledges the government to "emphasize technology innovation, cultivate talents with creativity and completely improve our capacity of self-innovation so that top universities in China will become an important force for the establishment of an innovative nation" (China Education and Research Network, 2006). In similar terms, the National Knowledge Commission of India recognizes that its higher education institutions "contribute to economic development, social progress and political democracy…They create knowledge. They impart knowledge. And they disseminate knowledge. Universities must be flexible, innovative and creative" (National Knowledge Commission, 2006).

In developing nations such as India and China, this need for innovation and innovative thinking for future economic growth has become increasingly apparent, as manufacturing and investment have begun to move more and more easily across borders in our ever "flattening" world. Other developing countries are drawing attention as sources of even less expensive labor, compelling both India and China to move their economies into more information-oriented and technological realms so they do not remain

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merely the world's workshops. They must rapidly become competitive as sources of product development, technological creativity and marketing. Only by lifting their economies up the scale of technology and information content can they continue to grow at the pace necessary to help the large portions of their populations that have yet to be touched by economic prosperity.

To maintain its position of economic leadership, the need for an educational system in science, technology, engineering and mathematics (STEM) fields that promotes innovation applies equally to the United States. The U.S. National Science Board sums up the argument in a recent report (National Science Board, 2006):

> America's competitive edge in this "flat world," its strength and versatility, all depend on an educational system capable of producing young people and productive citizens who are well prepared in science and mathematics…. If not, our Nation risks raising generations of students and citizens who do not know how to think critically and make informed decisions based on technical and scientific information. Nor will they have a firm grasp of academic language necessary to advance into STEM careers and produce the innovation and discovery necessary to maintain our Nation's prosperity for the future.

In similar language, a distinguished panel convened by the U.S. National Research Council concludes that:

> The United States takes deserved pride in the vitality of its economy, which…is derived in large part from the productivity of well-trained people and the steady stream of scientific and technical innovations they produce (National Research Council, 2006).

India, China and America all face significant challenges in their efforts to increase the innovative capacity of their citizens through education. For the United States, obsolete teaching methods in schools and early college years repel students from STEM careers and promote rote learning (DeHaan, ch. 7, this volume), while competition from other governments and multi-national corporations draws research talent and investment away. The challenge for China may be more cultural. A historic reliance on rote learning and an educational system that encourages social hierarchy and uniformity are often cited as barriers to innovation. When even Chinese expert sources acknowledge such problems, it catches the attention of the world community. An April 1, 2007 article in The New York Times describes a small but growing effort among Chinese educators and students

"to blend a Western emphasis on critical thinking, versatility and leadership into their own traditions" (Hulbert, 2007). Although India has a history of a more open attitude toward innovation and innovative thinking than China, the country is burdened with remnants of a highly hierarchical educational tradition and a severely limited educational infrastructure. Moreover, its mostly rural population struggles with the elements of food and shelter, leaving few resources for even basic literacy education for many (National Knowledge Commission, 2006).

Against that background of an international desire to understand how STEM education can better promote innovation and economic development, participants from places as distant as New Delhi, Beijing and Jerusalem gathered in Atlanta in early March 2007 at a conference on *Education for Innovation in India, China and America*. Sponsored by Emory University and the India, China, America Institute (ICAI), the conference brought together distinguished speakers (see Contributors, pp. 267–272) and a participant audience of about 130 government officials, educators, policymakers, students and representatives of the corporate community to discuss a series of critical guiding questions:

- What are inventiveness and ingenuity and how are these traits related to innovation in the marketplace?
- What are the most effective educational strategies to promote these abilities?
- What is the relationship between education for innovation and national competitiveness or economic development?
- What measures can these three most populous countries take to promote cooperation and sharing rather than hostile competition in their efforts to educate an innovative citizenry?

To frame the overall implications of the tri-national relationship for the conference, ICAI Founder Jagdish Sheth described the explosive, almost simultaneous growth of China and India, referring to "Chindia," the term introduced by Jairam Ramesh (2006) to highlight the combined impact of these two nations on the economies of the world. Sheth suggested that responses of the United States and other developed nations to the Chindia challenge must be to increase research and development (R&D) spending, improve the search for global talent, encourage public-private partnerships, and actively recruit students at all levels to come to the United States to study. These can be the means whereby healthy competition can remain cooperative and collaborative rather than hostile.

In the following chapters, the contributors to the conference summarize and discuss ideas, some of which they brought as presentations to the gathering, and some that arose from the active discussions at the conference.

The first section of the book explores the fundamental mechanisms linking innovative capacity with economic development.

## HOW DOES INNOVATION PROMOTE ECONOMIC GROWTH?

In his wide-ranging chapter entitled *Higher Education and Innovation as Competitive Advantages*, Steinbock (Ch. 2) introduces readers to the relationship between sustainable national competitiveness and the two major determinants considered in this volume: higher education and innovation. Along with innovation, higher education is a critical contributor to sustained competitiveness. Steinbock shows that the United States, leading European economies, Japan and the East Asian "tiger" economies (Singapore, Hong Kong, Taiwan, Republic of Korea) rank highest in competitiveness and innovation worldwide, whereas India and China are well behind. However, measured in terms of relative growth, China and India are progressing far faster than those more advanced nations, and in terms of higher education and innovation, their steeper initial growth trajectories have already been instituted, as evidenced by the rise of multiple cutting-edge industries in both nations.

The relationship between education that promotes innovation and national competitiveness or economic development is the main thrust of the remaining four chapters in the first section. Maryann Feldman (Ch. 3) notes that modern economic growth is a complex phenomenon increasingly dependent on innovation – the ability to create economic value through the creative application of knowledge. Knowledge is arguably the most important commodity of any modern economy. The higher education system is essential for the creation of this currency, perhaps best considered as embodied in human capital—individuals who have received the benefit of education and who are able to appreciate, integrate, and augment knowledge and innovate. Skilled human capital requires investments in higher education – institutions dedicated to advanced learning, sophisticated research and public service important to the functioning of the modern economy. The question she poses then is how the roles of the institutions that support innovation are changing in China, India and the United States, and what these changes portend for competitiveness and economic growth. But the unit of analysis, she notes, must be smaller than whole countries. Innovation is not spread evenly across the citizenry; it tends to be concentrated in local regions, exemplified by Silicon Valley in the United States, the PRC's Pudong district, and Bangalore in India. Academic institutions provide the basis for the range of skills required for advanced economies and form the fabric of such competitive regions. Certainly as the