The Global Scientific Race

"The low ranking of India compared to China, Japan and South Korea in technology standings and world-standard universities should be a matter of grave concern and generate a national debate leading to policy change."

[BY SREERAM CHAULIA]

One of the campaign issues in this year's historic American presidential elections was innovation and its decline in the world's most technologically advanced country. The manifestos of both Barack Obama and John McCain contained lengthy policy prescriptions to prevent the slide of the United States from global leadership in science and technology.

To highlight the salience of the topic, within days of his victory, Obama began putting in place a "comprehensive technology policy" to expand the access and applications of the Internet. Among the president elect's proposals is appointment of the country's first ever 'Chief Technology Officer', who will be tasked with modernising communications infrastructure, enriching e-governance and "improving America's competitiveness."

Of particular import is Obama's commitment to enhancing "technology literacy", so that "all public school children are equipped with the necessary science, technology and math skills to succeed in the 21st century economy." He envisions a highly skilled American workforce of science and engineering graduates who would push the frontiers of cutting-edge developments in electronics, nanotechnology and biotechnology.

Obama's pledge of doubling federal funding for research in the physical sciences and engineering intends to reverse the trend of diminishing US governmental spending in these cardinal areas since 1970. For a variety of reasons, including wilful neglect by the state, science in the United States has witnessed a relative fall both in interest in the field and in national capability. Its K-12 (Kindergarten to Grade 12) education system lacks qualified teachers in science and mathematics, translating into a secular drop in the number of US citizens entering engineering graduate schools. A typical computer-engineering classroom in any American university most likely has an Asian instructor with a preponderance of Asian (Indian, Chinese and Korean) students and hardly any local American presence.

The proportion of science and engineering doctorates awarded in Asia and Europe is rising, but it is dipping in the United States. About 60 percent of all scientists and engineers with doctorates in the US today are foreign-born, an ominous statistic during deep economic crisis when retaining talent from abroad is an ordeal. Both Obama and McCain took pains to stress reform of the US immigration system with an eye on retention of technically skilled foreigners, who are searching for greener pastures in the growth engines of Asia.

The World Economic Forum recently downgraded the US from first to seventh place in its ranking of nations' preparedness to benefit from advances in information technology. In *Business Week* magazine's ranking of the world's information-technology companies, only one of the Top 10 is based in the US. While the US remains the Mecca for awarding patents, nearly 60% of those filed in the country within the IT sector now originate in Asia.

China has already supplanted the America as the world's number one high-technology exporter. Fifty-two percent of all academic degrees in China are in science or engineering and the crowd of

Chinese universities in the list of world-class academic institutions is swelling. The London *Times*' World Universities Ranking of 2008 features six Chinese names (Peking University, Tsinghua University, Fudan University, University of Science and Technology, Nanjing University and Jiao Tong University) in contrast to only two Indian ones (IIT-Delhi and IIT-Mumbai).

According to researchers at the Georgia Institute of Technology, China will soon surpass the US in the critical ability to develop basic science and technology, turn those developments into products and services, and then market them to the world. The 2007 'High Tech Indicators' study ranks 33 countries on technological standing, which includes measures like productive capacity and national orientation towards science. China has an overall score of 82.8 on this index, compared to 76.1 for the US, 66.0 for Japan, 44.4 for South Korea and a meagre 20.70 for India.

The authors of the study attribute China's remarkable progress to its state-driven obsession for training swarms of scientists and engineers who ensure that the country's innovative capacity climbs new horizons. In some areas of *avant-garde* research and development like nanotechnology, Chinese scholars are clearly in the lead with more academic publications than even their American peers.

Often derided as the 'world's factory' due to its specialisation in low-value-added manufacturing, China is clubbing its comparative advantage in industrial exports with inventions high up on the value chain to dominate the global market in 'technology products.'

American leadership of the global economy after World War II was predicated on its massive technological superiority over its nearest rivals, the European Union and the USSR. But with new competitors from Asia playing 'fast catch-up' today, one cannot blame observers like the former US Secretary of State Henry Kissinger for lamenting that America is "falling behind". Writing in the *International Herald Tribune* in May this year, Kissinger lambasted the American educational system "that creates too few engineers and technologists in comparison with our competitors" and whittles away the country's industrial and economic base.

The fundamental micro-level obstacle that the Obama administration will face in trying to turn around the dismal state of American science is the absence of an incentive structure to encourage young citizens to evince greater interest in the subject. In rosier economic times, the US used to take the easy route of importing scientists and doctoral candidates from elsewhere to create a low-income, low-prospect career path in the sciences that native-born Americans could avoid. Local Americans opted for lucrative opportunities in professions like business, law, medicine or numerous forms of skilled manual work that offered premium hourly wages in a labour-shortage economy.

The hard grind that inevitably accompanies a career in science was thus bypassed by American citizens, who could command equal or even better lifestyles than technologists by entering other vocational streams that require lesser application and brilliance. The resulting loss to the US economy and global power was not evident to individual Americans, who were spoilt for choice of jobs as long as they got a college degree in some field.

Until worried strategists like Kissinger and corporations like the US National Academy of Sciences began ringing alarm bells about the tightening global scientific race, the national climate for innovation was ignored and left to individual labour market decisions. The push Obama promises to give to this impending crisis will be a big break from the George W Bush-era conservative religious outlook that discouraged the scientific temper and crippled R&D in latest arenas such as embryo stem cells.

In developing countries of Asia, the incentive problem is somewhat different. Higher education in science and engineering is seen by millions of Chinese, Koreans and Indians as the only ladder for employment and success in life. Every year, so-called 'cram schools' in these countries coach aspiring engineers to ace entrance examinations that open the doors to prosperity and achievement. The security offered by an engineering degree is unmatched in these fast growing economies and is much sought after as a life-making qualification.

Yet, the low ranking of India compared to China, Japan and South Korea in technology standings and world-standard universities should be a matter of grave concern and generate a national debate leading to policy change. According to the New Delhi-based National Knowledge Commission, as the Indian economy grows, "fewer students are opting for the pure sciences and this has led to a talent crunch, seriously impeding the development of the future generation of scientists."

Parallel to the 'rational' American cop out vis-à-vis scientific careers, young Indians are choosing the short cut of engineering degrees instead of the long haul of pure science research in branches of physics, chemistry and mathematics. India is indeed producing record numbers of engineers and doctors, but it has far fewer scientists who make lasting contributions to knowledge.

The Knowledge Commission is cognisant of the success of China and South Korea in building adequate incentives for facilitating pure science research through prudent investments, but its mission is handicapped by the less attractive salaries and future prospects that await average Indian PhD candidates who slave away in under-funded laboratories and workrooms.

The main spectre haunting scientific R&D in India is the absence of meaningful tie-ups with industry and the corporate sector. The concept of private firms investing in universities in order to reap the dividends of inventions and discoveries made by research scientists has worked wonders in the US and elsewhere. The industry-academia marriage is all the more necessary in a poor country like India, where the state exchequer is cash strapped and obligated to address the vast array of problems plaguing primary education.

To expect the government to transform popular attitudes towards pursuing science is credible in a context such as Obama's America, where the state can mobilise the needed resources. In India, though, the mantra of 'public-private partnership' will work much better, provided all stakeholders appreciate that this is one race we cannot afford to lose if our ambition is to be recognised as a great power in the world.

Sreeram Chaulia is a researcher on international affairs at the Maxwell School of Citizenship and Public Affairs in Syracuse, New York.