FAR EASTERN ECONOMIC REVIEW THE MARCH 2006 ISSUE

Essays

The Siren Song of Technonationalism
March 2006

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South Korean scientist Hwang Woo-suk achieved world-wide fame last year when he published a paper claiming to have been the first scientist to create 11 patient-specific stem cell lines. He seemed on the brink of developing genomic technologies that would mark a new era in scientific history. However, in November 2005, allegations surfaced that Mr. Hwang had fabricated his results. After three weeks of furious denials and nonstop public attention in South Korea, he admitted that his breakthroughs were indeed fraudulent.

Mr. Hwang's rise and fall was all the more humiliating for South Koreans, who had embraced him as a symbol of South Korean pride and made him the object of the kind of public adulation usually reserved for rock stars. Adoring crowds had attended Mr. Hwang's press conferences. The South Korean government supported his research to the tune of $65 million. The government named Mr. Hwang Korea's first "supreme scientist," and even issued postage stamps in his honor.

Global reaction to the Hwang debacle tended to emphasize the "Korean" nature of the issue. There emerged the sense that Koreans were proudly nationalistic but insecure—a people obsessed with international recognition. Such is Korea's need for external validation that major bookstores in downtown Seoul display portraits of previous Nobel Prize winners that are followed by a blank spot under a Korean flag and a question mark, pointedly asking: Who will be the first Korean winner?

However, the Hwang affair is not merely the product of one small country's unique culture. As a (former) living national treasure, Mr. Hwang is an example of a phenomenon that embraces the entire region.

Technological development in Asia is driven by government policy, and that policy is motivated in large part by technonationalism, or the desire of Asian states to free themselves from dependence on Western technologies. A common fear in countries like China and South Korea is that reliance on market forces might result in imported expertise and an improvement of manufacturing capabilities, but that such reliance will do nothing to elevate homegrown companies from followers to leaders in technological innovation. Especially when there is widespread apprehension that China will remain the low-technology, labor-intensive workshop to the world, many countries see themselves as being squeezed simultaneously on both the low-cost manufacturing side and on the more knowledge-intensive high-tech front. In such a context, bureaucrats are continually looking for policies that both protect the domestic market and raise the innovative capacities of local firms.

The long-term success of such policies remains uncertain. The rise of advanced industry in some Asian countries is as much the result of flexible labor markets, transparent corporate governance, and reactive capital markets as it is the result of new government resources flowing to cutting-edge research projects. The political impact of tying economic development to technological innovation, however, is more immediate. As more and more Asian nations develop their own leading technologies through direct or indirect governmental support, the point of conflict between trading nations in the future will concern the control of patents and other intellectual property rights as well as the free flow of ideas and talent. The days of market access for manufactured goods being the chief point of trade contention may be on the verge of eclipse.

The Search for Independence

Almost all Asian countries view science and technology as vital to achieving economic and political objectives. Here we use Asia broadly to denote all countries from India through Southeast Asia up to Japan, but especially the economies of South Korea, China, Japan and India. For example, speaking at a national conference on innovation in January 2006, Premier Wen Jiabao of China noted that "independent innovation" (zizhu chuangxin) was core to the country's development strategy over the next 15 years. Without independent innovation, Mr. Wen continued, China would be unable to claim an equal place in the world or achieve national honor.

P.V. Indiresan, the former director of the Indian Institute of Technology Madras, put the problem this way: "The future of both China and India is at risk, because neither owns the technology it operates; the intellectual property continues to remain in the West….The short answer to this problem is that we should develop our own technology; we should acquire so much intellectual property that the West will be as much dependent on us as we are on them."

This attitude of nationalistic technological development should not come as a surprise when placed in the appropriate historical context. South Korea, Japan, and Taiwan were the archetypal "developmental states"—their central government bureaucracies directed public and private resources toward national economic plans, protected infant industries, and intervened in markets through tax- and interest-rate policies, as well as through industrial subsidies and guidance for the development of specific industries.

Even though reform, democratization and the 1997 Asian financial crisis have weakened the control of bureaucrats over the economy in these countries, official efforts to formally and informally direct the economy persist. Indeed, regulation is still the dominant environmental factor influencing how businesses actually operate. As a potential engine of national economic growth and prestige, technological development continues to receive political attention in these advanced Asian states.

National technology policies in China, Japan, South Korea and India are obviously tailored to the particularities of their respective economies, but these countries have adopted remarkably similar strategies to raise indigenous capabilities and to exploit the opportunities created by the globalization of science. More resources are flowing to research and development and education in all of these countries. In China, expenditures on R&D rose from 0.6% of GDP in 1995 to 1.44% in 2005; the goal for 2020 is 2.5% of GDP. In India it increased from 0.84% in 1997 to 1% in 2004, while in South Korea, expenditures moved from 2.25% in 1999 to 2.64% in 2003.

Efforts are also being made in China, Japan, South Korea and India to expand and strengthen doctoral programs, especially in science and engineering. In support of the drive toward a

knowledge-based economy, Chinese universities have awarded a growing number of advanced degrees. In 2004, China graduated approximately 73,000 doctorates in science and engineering. Between 1981 and 2001, there were approximately 51,000 people who received their doctorates in the same fields. Through its National Science Fund for Distinguished Young Scientists, the National Science Foundation of China seeks to promote especially promising scientists under the age of 45. In South Korea, universities awarded almost 2,900 doctoral degrees in science and engineering in 2000 (up from 945 in 1990). In 1999, South Korea announced "Brain Korea 21" to further strengthen graduate education in the natural sciences, upgrade research infrastructure, and provide research funds for interdisciplinary programs such as biotechnology and materials science.

A large share of these new scientific resources is being dedicated to research on science's outer frontiers—in areas where the West does not clearly have a dominant lead. Mr. Hwang's work in stem cell research (seen as the precursor to cloning technology) is part of a region-wide effort to build up the biotechnology sector. India's Department of Biotechnology hopes to expand the sector five-fold over the next five years, creating at least 10 biotech parks by 2010. China's Ministry of Science and Technology, along with the Beijing municipal government and the National Development and Reform Council, founded the National Institute of Biological Sciences in 2003 with an initial investment of nearly $109 million and a plan to hire 30 U.S.-trained professors in the life sciences.

Nanotechnology has also attracted a great deal of government attention. Japanese investments in nanotechnology now total $1 billion annually, and South Korea has ambitious plans to spend $2.36 billion before 2011. In contrast, federal funding for nanotechnology R&D in the U.S. was estimated at $1.08 billion in 2005, having increased from $464 million in 2001.

In sectors where Western companies dominate, Asian governments have looked for and promoted locally owned alternatives. Looking for a substitute for Microsoft's operating system, the Chinese, Japanese and South Korean governments have formed a strategic alliance to promote Linux development in Asia. In 2003, South Korea announced plans to replace proprietary software on government pcs and servers with open-source alternatives like Linux by 2007.

The Chinese have been especially active technological competitors in areas where Western prowess is already established. Chinese scientists have been developing new standards for third generation cellphones, WiFi, Authentication and Privacy Infrastructure, and Radio Frequency Identification, among other technologies.

Even as some Asian countries push toward developing their own technologies, however, the degree to which they continue to rely on Western know-how is clear. The ongoing partnerships between foreign and Asian firms, the promotion of Western-trained scientists in Asia, and the welcome that outsourced multinational R&D facilities receive provide some indication of the long road Asian nations have yet to travel before they can surpass their Western guides.

Collaboration with foreign firms and universities is still central to Asian technological development strategies. Partnerships and joint ventures bring access to technology, global distribution networks, new markets and management skills. Seoul National University and Cornell University, for example, have cooperated on a project in agricultural biotechnology, and Intel partners with several Chinese companies such as Hisense, Tsinghua Tongfang and Founder Technology.

There has been a real effort to reach out to Asian diasporas in places such as Silicon Valley and Cambridge University. Successful Chinese, Korean, and Indian scientists are being successfully lured back to their home countries to new labs in new research centers stocked with the most advanced equipment. The Shanghai and Beijing municipal governments offer returning technology entrepreneurs tax breaks, subsidized office space and access to government-investment funds.

These two strategies—collaboration and building transnational networks—show how the pursuit of technonationalist objectives in a globalized world is neither straightforward nor easy. Mr. Wen's January speech about "independent innovation" was accompanied by commentaries in Science and Technology Daily that quickly pointed out that self-reliance did not signal the abandonment of the "open door" policy and that "independent" did not equate to "insular" or "closed." Domestic firms themselves, moreover, have business strategies that may conflict with nationalist goals.

R&D offshoring also throws a rather ambiguous light on technonationalist aims: Who, after all, benefits more from these technology transfers? Much attention has been paid to the cost benefits Western companies receive from moving some (or all) of their engineering to Asia. Scientists and engineers can be hired in some Asian countries for one-tenth to one-third the salary offered in some Western countries. Labor is not only cheap; it is increasingly highly skilled. Bill Gates has called Microsoft's Beijing R&D center the company's most productive, and hp now hires more engineers abroad, mainly in India and China, than it does in the U.S.

As we enter a new stage of globalization in which R&D can be outsourced to Asia just as manufacturing long has been, technonationalist countries like China and India indeed welcome such investment—and ensure the liberal trade policies necessary to facilitate it—because the multinationals that are driving the globalization of technology are perceived as partners in the achievement of core national goals. If such investments come into conflict with the host countries' goal of achieving technological independence, however, we should not be surprised to discover less support for openness and transnational flows.

The very forces of globalization that are encouraging such knowledge transfers, however, are also undermining the abilities of Asian nations to effectively implement technonationalist policies—or any top-down development strategy, for that matter. WTO restrictions on import quotas, tariff barriers, and export subsidies have gradually created more open and market-oriented economies. As a result, policy makers have gradually replaced state-led, highly centralized models of technological innovation with a more flexible and open system, increasingly dependent on foreign enterprises. As they have globalized, Asian societies have become less susceptible to top-down direction.

Implications

Asia's "open" technonationalism has produced noticeable successes and reflects a genuine increase in science and engineering capabilities. While the U.S., Japan, and the eu remain the major producers of scientific papers, there has been strong growth in output by Chinese, Taiwanese and Korean scientists. According to the U.S. National Science Board, citation of literature from East Asian authors more than quadrupled in volume during the 1990s. A similar pattern emerges with patents. The vast majority of patents issued in the U.S. go to American inventors, but the numbers granted to Asian inventors has expanded by almost 100 times.

According to the World Intellectual Property Rights Organization, China was among the top 10 countries for patent applications in 2005.

Combined with a rising middle class and increasingly sophisticated consumers, new science and technology capabilities in Asian countries are shifting Asian consumers away from reliance on American and European high-end products. In certain technology sectors—cellphones and chip design in particular—there is already a concentration of researchers, designers, manufactures, and end-users in Asia necessary to sustain indigenous innovation.

There is the possibility that this emerging technological strength in Asia might develop into a truly regional system—one where Asian engineers and companies interact with each other as much as they interact with Western scientists. South Korea and China have established a cooperative venture fund for information technology, and a Chinese broadcasting company and the South Korean state-run Electronics and Telecommunication Research Institute will launch digital multimedia broadcasting in April 2006. India's hcl established a joint venture with Japan's NEC in 2005 to develop embedded software, mobile technology, and high-performance computing.

During his April 2005 trip to India, Premier Wen spoke of the potential combination of Chinese hardware and Indian software, claiming, "We will be able to lead the world in the sector and a day will come when we can herald the beginning of the Asian century of information technology." Over the last two years, Indian companies like Wipro, Infosys, and TCS have aggressively established new businesses and R&D centers in Shanghai and Beijing to gain access to China and the rest of Asia.

A regional Asian technology market will lead to increasing competition with the eu and the U.S. over standards and ipr issues, especially in leading technologies sectors such as biotechnology, nanotechnology and information technologies. Economic conflict between the West and Asia, which previously had been confined to access to manufacturing or finance, will in the future include science and technology. Already IPR is one of most contentious issues in Sino-U.S. relations, and the Bush administration is deploying "antipiracy attaches" to China as well as Brazil, India, Russia, Thailand and the Middle East.

As regional markets develop, the pattern of U.S.-Chinese technology relations over the last five years may come to define the region's interaction with the world economy at large. The pattern of these relations has, to date, followed this cycle: The Chinese government initiates new efforts to develop indigenous technologies through indirect measures such as use of value-added taxes, government procurement, or standard requirements; The American business community pushes back from such initiatives followed by pressure from Washington; Beijing retreats and regroups. What was once typical of a bilateral relationship will come to describe the Asian region's interactions with the EU and the U.S., with one major difference: the creation of a regional market tied to Asian technology standards will make Beijing, Seoul, or Delhi less likely to give into pressure to abandon technonationalist policies.

For the global economy, the key question is not whether nationalism will continue to drive technology development, but whether it will continue to reinforce globalization. If it does—and this seems the most likely outcome over the near term—the multinational technology companies are going to have to maneuver in an extremely complex environment. Asian states will continue to offer attractive incentives to foreign firms to relocate R&D, while simultaneously using other policy tools to raise the technological capabilities of domestic companies. These firms will

increasingly compete with the multinationals over technological and design sophistication, not just over low prices and cheaper manufacturing costs. As competitive pressure increases, the Asian states are likely to gradually end preferential policies for multinationals.

There will be little good news at home either. A growing concern about the rise of Asia and the need to protect domestic innovative capacities—as well as relations with Asia that are characterized by almost continual tensions over IPR—will create an environment in the U.S. and the EU in which the multinationals will come under increasing political pressure to keep R&D and other high-skill employment in country.

The twin forces of nationalism and globalization could, however, push in opposite directions. Changes in the security environment are the most likely scenario that would lead policy makers to more forcefully control the free flow of ideas or talent. Already worried about the rise of China's military power, the U.S. defense and commerce departments are currently considering new regulations limiting the ability of foreign students and researchers to work with information and technology that is export-controlled. Job loss in developed countries, especially among knowledge workers believed to be immune from the vagaries of international competition, could generate a backlash against globalization. A failure of Asian firms to actually work their way up the value chain and begin to control proprietary technology may also cause decision-makers to question whether they can truly break free of dependence on Western technology through integration with the global economy.

The rise and fall of Hwang Woo-suk is a cautionary tale of excessive nationalism's interference with scientific progress. However, the important point is not the sordid details of one man's hubris, but rather that Mr. Hwang is representative of a wave of technonationalist science and engineering throughout Asia that is increasingly world-class. The Asian financial crisis of 1997 led some to believe that Asian countries were capable only of being a source of cheap labor for Western manufacturing firms. However, these countries are now rapidly increasing their science and engineering skills with extensive government support.

It will not be surprising to see innovation and technological challenges arising from countries not historically known for their scientific prowess. While globalization is a part of this story, an important—and often overlooked—element of this story is the nationalist agenda promoted by Asian states. The world may be flatter, but it is still populated by nation-states seeking to increase their wealth, power, and status.

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