

China's New S&T Reforms and their Implications for Innovative Performance

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I would like to thank the Committee for providing me an opportunity to address the members regarding the issue of innovation in China. Having just returned from China this past weekend, where I had a chance to participate in the US-China Innovation Dialogue as a member of the American experts group, I had a chance to gain a firsthand view of the latest Chinese thinking about the opportunities and challenges they face in fostering fundamental improvements in their innovation capabilities and performance. I also had a wonderful opportunity not only to exchange ideas with long-term friends and associates within China's Ministry of Science and Technology (MoST) and the Chinese Academy of Sciences (CAS), but I also had the benefit of several productive meetings with the local S&T bureau in both Wuhan (in Hubei province) and Chengdu (in Sichuan province), respectively. These meetings afforded me an opportunity to deepen and broaden my understanding of where Chinese officials think they stand today in terms of their innovation trajectory and what hurdles they must overcome if their country is to move in the direction of shifting from a manufacturing oriented to a knowledge-driven economy.

The committee has asked me to present some of my views on where China stands in building an infrastructure to support its innovation drive. Perhaps the best way to consider this issue is to examine two items. First, I believe it is important for us to analyze the differences between the policies and initiatives contained in the recently concluded 11th Five Year S&T Plan (2006-2010) and the current 12th Five Year Plan for S&T (2011-2015). And second, I think it is important for us to consider and review the very important on-going discussions that have been occurring in China over the last 12-18 months regarding the next stage of S&T reform in China. By providing some insights into both of these matters, I believe we can secure a better grasp of China's current concerns and apprehensions regarding its own innovation capabilities.

From my perspective, the issue of China's efforts to create a more innovation oriented economy has been embedded in a great deal of hyperbole, exaggeration, and embellishment. The media, combined with an increasingly larger and larger segment of the policy community, seem to be caught up in conjuring up the image of China as a steadily emerging, albeit significant, technology threat to the United States. Very little in-depth serious research has been conducted on Chinese innovative performance across the broad range of key sectors that are the focus of China's national and local policymakers. While there is little doubt that Chinese leaders have articulated ambitious goals and intentions for catching up and even leap-frogging Western countries in some key technological fields, the reality is that China has a long way to go before it presents a serious overall threat to US competitiveness and scientific leadership.

In the 1980s, when China S&T specialists were asked why China lags significantly behind the West and Japan in science and technology, most responses focused on three critical deficits: 1) not

enough money to support meaningful R&D at all levels; 2) not enough talent in terms of qualified scientists and engineers; and 3) a backward infrastructure that had little modern equipment and advanced computing capability. Ironically, when somewhat that same type of question is posed today, the first response among most serious experts would be: 1) there is more than enough money, with R&D/GDP spending growing some twenty-plus percent over the last half dozen years; 2) there seemingly is more than enough talent with undergraduate and graduate enrollments in science and engineering continuing to grow since 1999 by leaps and bounds; and 3) there is more than enough equipment considering the fact that today China has some of the most modern laboratories in the world with some of the most advanced equipment in place. So, one might then ask, so what is wrong? What's not working? What is the problem?

Unlike many who believe that post Olympics 2008, Chinese leaders have exhibited more self-confidence and perhaps an ample dose of arrogance in the midst of a pronounced surge in nationalism, I would like to suggest that in the realm of science and technology affairs, China's leadership has been beset by a growing apprehension about the failure of their S&T system to deliver the type of performance expected given the significant increases in resources and attention being thrown at the innovation system at all levels. While traditional metrics such as growth in numbers of patents and increases in the number of SCI citations all seem to suggest China is on the road to becoming a more significant player in the global innovation system, the fact is that there is something missing in terms of the anticipated commercial impact associated with these growing numbers.

In the aftermath of the global financial crisis, Chinese leaders have focused much on their attention on what they believe will be a new era of profound change in the realm of science and technology. More specifically, along with the continued importance of information technology and new materials, PRC officials believe that the 21st century will be dominated by two new technological revolutions, one in life science and biotechnology and one in cleaner alternative energy and associated technologies. Whereas China largely missed out on both the microelectronics and computer revolutions because of the debilitating effects of the Cultural Revolution (1966-76), today's leaders have committed themselves and the Chinese S&T community to ensure that China plays a prominent, if not leadership role, in developing and driving the advanced frontiers in biotechnology and clean energy. At stake for Chinese leaders is more than just competitive advantage in economic terms, though this clearly is important, especially as one tries to understand the specific drivers underlying the massive push for indigenous innovation. The paramount drivers are political and have been political since 1978 when the PRC launched its so-called "four modernizations program." Having had to deal with the technological problems brought on by the Sino-Soviet rupture in the late 1950s as well as confront the restrictions on technology transfer imposed by the former COCOM and the continued efficacy of US export controls, Chinese leaders view greater technological autonomy as the primary way to diminish, if not eradicate, the ability of the US or any other nation to use denial of access to technology as a form of leverage designed to influence Chinese behavior, internal and external. Thus, failure to make significant progress along the innovation curve leaves China not merely unable to facilitate its own critically needed economic transition, but it also leaves China with a sense of political exposure that simply is unacceptable to Beijing.

Unfortunately, for PRC officials, as suggested earlier, the Chinese innovation machine has not proven to be the unstoppable juggernaut that increasingly seems to be the picture painted by many Western observers. In the new 12th Five Year Plan for S&T, there is a striking change of tone in the language deployed when compared with the 11th S&T FYP. For example, the term "gongjian" (conquer

as in a battle or conflict) is used in the 12th S&T FYP when discussing the promotion of indigenous innovation; instead of portraying the move towards an innovation-driven nation as largely a change in the foundation of the Chinese economy, it is now put forth in terms of a being “crucial stage” in the overall development of the country. The promotion of indigenous innovation—which seemingly has become an anathema to the entire US government and American business community is stressed even more strongly in the 12th S&T FYP. The 11th S&T FYP identified many existing problems in the S&T system, including a) weak original innovation capability; b) loose linkages between industry and research; c) a shortage of high level innovative S&T personnel; d) poor efficiency in the allocation of resources; and e) need to further deepen the implementation of indigenous innovation policy. In the 12th FYP, these same problems also are highlighted, but added to the list is a new problem dealing with “disorder in the prevailing institutional mechanisms” (jizhixing zhantai) for supporting S&T advancement. Moreover, it also is noted that because of the still underdeveloped nature of Chinese indigenous innovation capability, the country has not been able to make sufficient progress the domain of economic and social sustainability.

The very real dissatisfaction with progress along the path of greater indigenous innovation capability is noticeably manifested in the large number of national and regional media reports in China observing the local visits of senior leaders such as Li Changchun and Wu Bangguo as well as Hu Jintao and Wen Jiabao—all of whom have been traveling around the country admonishing provincial and municipal officials to make greater efforts to promote indigenous innovation. The repeated messages about the promotion of indigenous innovation appear to highlight a distressing gap between the S&T aspirations of the central government in this area and the reality on the ground in terms of both enterprise behavior and the lack of tangible success at the local government level in helping to realize Beijing’s explicitly stated goals.

One particularly interesting change in the 12th S&T FYP is the removal of one of the key indicators of “technology development” highlighted in the 11th S&T FYP, namely, the metric for calculating “dependence on foreign technology.” The so-called “40%” metric appears to have been taken out of the newest FYP document, perhaps because Chinese leaders recognize that much of the technological advance in China necessarily will be a product of the blending of both foreign and domestically derived technologies and that the effort artificially to lessen the utilization of imported technology and know-how might actually stifle some forms of domestic innovative activity.

Two other elements also were added to the 12th S&T FYP. One is the new emphasis on building and strengthening innovation bases and platforms. The focus here appears to be on more effectively leveraging and sharing key technological resources and equipment to support innovation efforts. This also may mean greater emphasis on harnessing technology clusters to harvest innovation. The other element involves a more explicit emphasis on the further growth of China’s high-level talent pool and the creation of a number of “innovation teams” to bring together innovative people. In spite of the quantitative jump in the numbers of scientists and engineers in China, the reality is that the PRC still faces a serious talent shortage in terms of the supply of qualified individuals with either advanced technical or managerial skills. Taken together with the other changes noted above, the 12th S&T FYP projects a more imperative tone and greater sense of urgency in advancing the country’s capabilities for achieving indigenous innovation.

The official launch of the 12th FYP for S&T was augmented by publication of an important article written by Premier Wen Jiabao that appeared in the CCP journal titled “Qishi” (Truth) in July

2011. Premier Wen's article seems to have provided the impetus for a very wide ranging debate and discussion about new directions for S&T reform in China. In a remarkably frank statement, Premier Wen notes that "Chinese capacity for indigenous innovation is weak, that Chinese industrial technology is at a low level, and that both Chinese basic and cutting edge research are relatively unimpressive." He also states in rather explicit terms that "the Chinese science and technology system is incompatible with the needs of economic and technology development." Clearly, Premier Wen takes care to note the major progress China has made in terms of manned spaceflight, high speed rail, experimental fast reactor, superconductivity, hybrid rice, gene sequencing, and supercomputing (the Tianhe-1) and the development of a high performance processor (Loongson). Nonetheless, Premier Wen is quite strident in his comments about where China stands: "China lacks original innovation capability; rarely proposes new issues, new theories or new directions in science; and core technology still is controlled by others and many important industrial technological needs rely on foreign countries."

Finally, but perhaps most critical, Premier Wen discusses the inherent flaws in the existing science and technology management system, citing three critical deficiencies: a) the existence of structural and institutional obstacles for achieving a market oriented technological innovation system with enterprises as the mainstay; b) the macro S&T decision making mechanisms and organizational structure is irrational—caused by institutional fragmentation; and c) the enthusiasm and creativity of the majority of scientists are not fully mobilized. To remedy these defects, he presents three measures: 1) accelerate the onset of the enterprise-led technology and R&D innovation system; 2) clarify the role and functions of the market, government and enterprises, and especially accelerate the transformation in the role of the government, including the establishment of separate operating mechanisms for S&T decision-making, policy implementation, and evaluation ; and 3) continue to push forward with the reform of scientific research institutions.

As suggested, the Qiushi article seems to have sparked the beginning of a major series of policy discussions about the directions for S&T reform, with some sources even suggesting that the Ministry of Science and Technology be abolished and its operating functions be given to the Ministry of Education, the Ministry of Industry and Information Technology, etc. In this regard, there also have been suggestions that China needs an overarching organization similar to OSTP in the US. From the Chinese perspective, such an organization would have the clout and capacity to serve as a paramount coordinating mechanism for helping to drive macro-level policy while leaving the day-to-day functions of providing research grants and allocation R&D funds to other ministries and related organizations. While it seems unlikely that MoST will be abolished or even that such a decision would be the right option to pursue, the fact that such a radical possibility has even surfaced further suggests that the leadership continues to search for an adequate solution to the continued poor performance of the innovation system.

The imperative nature of the issue also can be seen in just how rapidly the Chinese S&T system has responded at lower levels to a call for enhancing innovative performance and fixing the problems that surround the operation of the innovation system. In February 2012, the media reported that Nanjing had been selected as a pilot city for national S&T reform. Nine new policies were identified focusing on the management of scientific and engineering talent, greater technology protection, and the encouragement of technology startups. In that same month, Shandong province announced that it was launching an effort to establish a new management system to strengthen supervision and management of S&T activities, establish the dominant position of enterprises, promote deeper cooperation with the Chinese Academy of Sciences, Chinese Academy of Engineering and the China National Natural

Science Foundation, and build a more flexible talent pool to enhance S&T innovation efforts. In March 2012, Guangdong province issued a similar series of pronouncements, with Li Xinghua, the Director General of the S&T Department of Guangdong province, stating that a series of newly created research institutions would become the focal point for helping to deepen S&T reform and improving regional innovation. In addition, Guangdong province is the first province in China to launch formal legislation concerning indigenous innovation and its application—a reflection of that province’s intention to move quickly and expeditiously away from its current economic orientation. Both Hubei province and Xinjiang also initiated efforts in the same month to embark on a new phase of S&T reform, suggesting that the entire S&T system has been engaged in the process of deliberating how to introduce and implement major changes into their local S&T structure. With the growing role of the localities in providing financial support for innovation efforts and the clear steps being taken to bring innovation-related decision-making closer to the point of actual R&D and related activities, the actions at the local level reflect the seriousness with which the central government’s directives are being received and acted upon.

All of the actions described reflect three important trends that have implications for how we view the thrust and direction of China’s innovation efforts. First, the current system clearly is not working well and several radical changes seem to be in the making. Just how far the leadership is willing to go to unleash China’s full innovative potential remains to be seen. A general tone of dissatisfaction continues to pervade the highest echelons of power in Beijing in terms of the real imbalance between the growth in S&T inputs and resources and the limited achievements on the output side in terms of real innovative breakthroughs. While some observers of China’s innovation system have argued quite persuasively that the PRC’s strong emphasis on indigenous innovation and push for radical versus incremental innovation represents a costly mistake and misallocation of resources, the fact remains, however, that Chinese leaders have an ambitious agenda for science and technology advance that simply will not be satisfied by accepting a more limited role as a process oriented, incremental innovator in the global innovation system. The political will and desire in China to be among the global technological leaders simply will continue to trump the apparent economic logic of such a more limited role.

Second, the increasingly imperative nature of achieving greater innovation performance seems to be driving China in the direction of greater reliance on the market for spurring innovation, especially as more and more initiative and investment is being expected from the enterprise. In addition, it also is driving a new sense of urgency for enhanced IPR protection, especially from inside of China from among Chinese enterprises, many of whom appear just as worried as their foreign counterparts about IPR theft, copying, pirating, etc. This is not surprising since this is very similar to the path taken by Japan, South Korea, Taiwan, and Singapore as they moved from their prior emphasis on low cost manufacturing to more R&D and design oriented emphases in their economies. This could bode well for Western, Japanese and Korean firms, among others, who have lobbied strongly and steadfastly for stronger IPR legislation and enforcement in China over the last decade or longer.

Finally, the growing focus on the enterprise in terms of innovative initiative, which initially had been adopted as a major policy thrust in the “15 Year Medium-to-Long Term Plan for Science and Technology (2006-2020)” launched in early 2006, seems to have awakened a new sensitivity to the dynamic role to be played by small and medium firms in the innovation system. It is clear that heretofore large, state owned enterprises have been the major beneficiary of the central government’s

strong emphasis on innovation and technological advance. Many of the firms on the list of China's so-called "most innovative enterprises" issued by MoST are indeed SOEs. Frequently, they have been given significant access to capital and related resources that simply have not been available to smaller firms. As of the result of the new S&T reforms and the questions raised by both domestic and foreign experts, e.g. World Bank 2030 report, however, there is a renewed emphasis on the catalytic role that SMEs could play as engines for bringing new ideas to market in ways that larger firms simply are unwilling or will-equipped to do. In some ways, therefore, we may be witnessing the emergence of a new architecture of innovation in China, one with more impetus coming from the local versus central level as well as one where smaller firms can receive the necessary support and guidance to allow them to become successful component of the Chinese innovation system. Add to this mix the growing role of foreign R&D centers and the increasing number of returnees, especially in such fields as life science and biotechnology, and it can be said that the innovation landscape in China may be poised for a dramatic change in the center of gravity. Will it lead to a substantially more innovative China, only time will tell? Still, one thing appears to be very clear, namely that necessity of enhancing innovative performance combined with a renewed inclination to clean up some of the burdensome bureaucratic problems inherent in the existing S&T system seems to have unleashed a new willingness to experiment and breakdown existing sacred cows across the entire S&T machinery in China.