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Chinese Technology Policy and American Innovation

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Hearing on China's Five Year Plan, Indigenous Innovation and Technology Transfers, and Outsourcing

I would like to thank the co-chairs and the other distinguished members of the Commission for the opportunity to speak to you today. It is an honor to be invited.

China's leaders are clearly unhappy with the long-term prospects of remaining "factory to the world." It is energy and labor-intensive and costs are rising. It is polluting. And policymakers fear that Chinese companies will remain dependent on and be forced to pay high royalties to foreign technology companies.[1]

Chinese firms, using their low labor cost advantage, have succeeded as manufacturers and assemblers of IT products; yet internationally competitive standards and platforms, which require large fixed outlays and deep technological expertise that can only be acquired over time, have so far remained out of reach. Chinese policymakers fear that they will remain trapped in this position. In the words of one Chinese commentary: "Chinese companies lack core technology, depend on foreign companies for crucial parts, are at the lower end or the middle range of the global industrial chain, rely on multinational companies for technological support and rely on the global sales chain…"[2]

Moreover, Chinese analysts and policymakers have become increasingly frustrated with the level of spill-over and technology transfer from Western R&D. Some critics claim that foreign firms "crowd out" domestic firms in the market for highly skilled labor, monopolize technology standards, and thwart technology transfer and knowledge spillovers.[3] Reflecting an aggrieved nationalistic feeling about this relationship, articles in the Chinese press complain that foreign companies own the technology used to enter Chinese characters—"the embodiment of five thousand years of Chinese civilization," in the description of one Chinese commentator—on a cell phone keypad. So with each of the tens of millions of cell phones sold in China, a payment is made to a foreign company for the use of character input technology.[4]

The Chinese phrase for indigenous innovation, *zizhu chuangxin*, was introduced in a 2006 state-issued report, "Guidelines on National Medium- and Long-term Program for Science and Technology Development." The report contained a mix of top-down, state-directed policies alongside bottom-up efforts meant to foster technological innovation. The top-down measures echo China's old state planning system. They include raising the share of GDP dedicated to R&D to 2.5 percent by 2020 from 1.5 percent today, and investing in eighteen science and engineering "megaprojects", including initiatives to develop nanotechnology, new drugs, high-end generic microchips, and aircraft.

The 12th Five Year Plan (2011-2015) calls for "cultivating and developing" seven strategic industries: alternative energy, biotechnology, information technology, high-end equipment manufacturing, advanced materials, alternative-fuel cars, and energy-saving and environmental technologies. While it is doubtful that the final numbers will be this large (or that the sectors themselves could absorb such investment), public reports suggest that the government is considering investments of up to $1.5 trillion in these strategic industries.[5]

Indigenous Innovation

These more traditional S&T policies have been accompanied by efforts to encourage, and in some instances, force foreign companies to transfer technology to Chinese firms. One of the most comprehensive efforts to create technological autonomy, or at the very least reduce the payment of licensing fees to foreign companies, has been the development of competing technology standards. As a phrase popular in technology circles in China puts it, "third-class companies make products, second-class companies develop technology, first-class companies set standards." In December 2003, for example, the government announced that WLAN Authentication and Privacy Infrastructure, or WAPI, would be the mandatory standard for any wireless product sold in China. The Chinese standard essentially came out of nowhere, mandated by a government agency without consultation with private companies, Chinese or foreign. In addition, Beijing's decision—due to "national security concerns"—not to share an algorithm included in WAPI would have forced Intel and other foreign companies to cooperate with one of twenty-four Chinese vendors licensed to develop the competing standard.

While standards battles have for the moment become less prominent, the Chinese state has found other policy tools to pursue indigenous innovation. In 2009, for example, the Chinese government announced that companies that wanted to be included as recognized vendors in the government's product procurement catalog would have to demonstrate that their products included indigenous innovation and were completely free of foreign intellectual property. Yet, since research and development is a global, collaborative process, no individual high-tech product is completely independent of technology from outside of China. As a result, in April 2010, China ordered several high-tech companies to turn over the encryption codes to their smart cards, Internet routers, and other technology products if they wanted to be listed in the procurement catalog.

In addition, constantly in the background is Beijing's failure to protect intellectual property rights [IPR] in the Chinese market, leading to massive theft and piracy. As U.S. Chamber of Commerce Senior Director for Greater China Jeremie Waterman testified before the International Trade Commission in June 2010, this weak legal environment allows Beijing to "intervene in the market for IP [and] help its own companies 're-innovate' competing IPR as a substitute to American and other foreign technologies."[6]

While these top-down efforts to force technology transfer have garnered the most attention in the United States, Japan, and Europe, the MLP also promotes what can be called innovation strategy—more bottom-up, multifaceted efforts to create a business environment supportive of innovation and entrepreneurship. The bottom-up efforts draw from the experience of Silicon Valley and revolve around university-industry collaboration, venture capital, and small-start-ups. At least eight provisions directly or indirectly concern

small and medium-sized technology businesses. The guidelines reduced the enterprise income tax for high-tech firms that invest heavily in R&D and provided financial support through soft bank loans.

In these sections, the report also promises greater protection for intellectual property rights: "we must build a system of rule of law," the report states, "that respects and safeguards IPR, promotes consciousness of IRP throughout the entire country, raises standards for IPR management, increases the strength of IPR protection, and cracks down heavily on all kinds of behavior that infringes on IPR, according to the law."

If the guidelines are of two minds on policy options, they are clear on ultimate objectives: China will become "an innovative nation in the next 15 years and a world power in science and technology fields by the middle of the 21st century." By 2020, the report states, China should reduce its "degree of dependence on technology from other countries to 30 percent or less" (down from 50 percent today as measured by the spending on technology imports as a share of the sum of domestic research and development (R&D) funding plus technology imports). Noting that reliance on other countries—especially the United States and Japan—is a threat to Chinese national and economic security, the paper calls for China not to purchase any "core technologies in key fields that affect the lifeblood of the national economy and national security" such as next generation Internet technologies, high-end numerically controlled machine tools, and high resolution earth observation systems.

Software and Hardware of Innovation

The impact of these policies on Chinese capabilities remains uncertain at best. While China has shot up the patent list, becoming the world leader in filing in 2011, many of the patents filed are for new designs or appearance, and have little to do with improvements in product or process. A large number of the patents are what the Chinese call utility patents, which are easier to prepare and file and do not undergo substantial review. Government policies have inflated the number of filings by subsidizing the filing fees for inventors, providing tax breaks for companies that file, and changing *hukou* status (resident permits) for inventors. Moreover, these filings have very little to do with innovation and are about positioning Chinese companies to sue foreign firms as they enter local markets for alleged patent infringement.

The efforts to define and develop Chinese standards have also produced mixed results. For example, the Chinese third generation cell phone standard, TD-SCDMA, has serious technological shortcomings; it is slower and less stable than W-CDMA. Rollout has continually been delayed and two of the three Chinese mobile companies, China Telecom and China Unicom, were allowed to use international technologies. China Mobile, the company required to use TD-SCDMA, has been trying to move to TD-LTE, the fourth generation technology based on international standards, as quickly as possible.

Overall, the Chinese approach is likely to be counterproductive. It is difficult to drive innovation with a top-down technology policy that picks national champions and critical technologies, and fails to protect intellectual property. Most important, the software of innovation—the social, political, and cultural institutions and understandings that help move ideas from lab to marketplace—remain undeveloped. The inputs of innovation are not the same as the process of innovation. Labs can be built, money invested, prominent professors recruited, and policies developed. But without respect for the rule of law and intellectual property rights, as well as a culture of individual initiative and openness, these steps will not produce the intended results.

The innovation process can very schematically be described as requiring new ideas, talent, and firms, and policies that foster and regulate the preceding three steps. For each, there are significant gaps between the build-out of physical infrastructure and the development of the institutions and practices of innovation. Within government labs, for example, strong bureaucratic control of research agendas and professional careers as well as deference toward authority makes it difficult to create a culture of individual initiative and

creativity. While it was the attacks on human rights dissidents and the theft of Google's intellectual property that garnered the most attention outside of China, those hurt the most by the hacking may have been Chinese scientists. Of the 784 scientists who responded to a survey conducted by *Nature*, 84 percent said that Google's departure would "somewhat or significantly" hamper their research; 78 percent said it would "somewhat or significantly" affect international collaboration.[7]

There has been a significant explosion of entrepreneurship and new firm creation. But the incentives remain to copy successful business models and technologies from the West and apply them to the local market. Start-ups and private companies have difficulty acquiring capital, and they often turn to local governments and technology plans for funding. As a result, they must often pursue the technologies and development trajectories of interest to government bureaucrats. These officials are likely to identify the cutting-edge with already existing products, creating incentives for reverse engineering and copying.

Impact on American Economy

Despite the limited impact of Chinese policies on raising indigenous capabilities, American firms clearly view them as a barrier to doing business. In AmCham-China's 2011 Business Climate Survey, 40 percent of respondents believed indigenous innovation policies will hurt their business in the future; 26 percent said they had already lost business because of the policies.[8] It is worth noting, however, that more view indigenous innovation as a future problem, and that the degree of hurt must be tolerable for American companies for they report both increased revenues and profits over 2009 and plans to continue investment in the China market. Also as Philip Levy of the American Enterprise Institute notes, the economic implications of these policies is difficult to gauge because they are changing so rapidly; they are often presented in draft form and then revised after complaints from the foreign and domestic business communities.[9]

The more important effects of indigenous innovation may not reveal themselves for a while and they may be more indirect. Over the last three decades, research has become increasingly collaborative, involving suppliers, customers, and university labs. A survey conducted by the Information Technology and Innovation Foundation, for example, found that over the last thirty-five years, fewer commercial innovations were the product of large firms acting independently.[10] In addition, independent corporate labs working on "blue sky" questions are disappearing. As research has gone collaborative, the locus of innovation has expanded from individual universities and corporate labs to ecosystems made up of networks of technology firms, capital markets, and research universities.

These ecosystems are not easily created or maintained. Remove any one component—manufacturing or R&D—from the system and you risk destabilizing the complex interactions between firms that drive technological discovery in the United States. The shift of corporate R&D to China, whether because firms need to be closer to final customers or they are responding to pressure from Chinese policymakers, could destabilize the interaction of all the other parts of the innovation ecosystem. The real impact of indigenous innovation policies may not be in raising Chinese capabilities, but in throttling American ones.

U.S. Response

It is important to remember that indigenous innovation is more of an objective than a specific set of policies. One set of policies may be replaced by another because the goals of reducing dependence on foreign technology, producing Chinese intellectual property rights, and creating Chinese technology champions are deeply and widely held. Already the focus on standards has been complemented by the use of procurement strategies, and moving forward some other set of policies may replace procurement. In the end, American policy begins to look like a game of whac-a-mole, beating down one initiative only to see another one pop up.

While seemingly in the minority, there are parts of the Chinese bureaucracy, however, that still believe it possible for China to raise its technological capabilities through more trade-friendly policies. They have not forgotten that opening to the world brought foreign investment, access to global customers and distribution networks, and technology transfer. Moreover, as Chinese firms look to expand abroad, they may also be an ally in the fight against indigenous innovation. Their future is in global, not in balkanized technology markets. The challenge is to identify these actors and then strengthen them as they push back against more mercantilist policies.

The United States must continue to confront China on indigenous innovation. Raising it to the top of the agenda at bilateral summits is important, for it signals intent and interest. A strong display of concern from the American side at the January 2011 meeting helped produce a commitment to delink government procurement strategy from innovation policies, though it is too early to know if China will follow through on the promise. Multilateral pressure is especially important; Japan and the European Union are pressing China on the same set of issues and Beijing has in the past been willing to step back when several governments, and government and the private sector, speak with one voice.

Because the leverage the United States has over China is bound to be small, a response at home is also essential. The United States needs to exploit its software, its social and cultural strengths: the ability to conduct cutting-edge, interdisciplinary research; recognize new markets and consumer demands; manage across time, distance, and culture; tolerate risk and support entrepreneurship; and welcome new ideas and talent no matter what their origin.

Money has to flow to early-stage start-ups. Under the Obama Administration's "Startup America" Initiative, the government will launch a $1 billion early-stage innovation fund that will provide a 1:1 match to private capital raised by early stage funds. Cuts in payroll taxes help lower the cost of hiring new workers, but the government should also consider reducing or eliminating capital gains taxes for investments in start-ups.

The government's role in funding basic research has become even more important as business has shifted away from funding "blue sky projects with uncertain immediate commercial use but with the promise of big breakthroughs.[11] Alcatel-Lucent, for example, announced in 2008 that Bell Labs—responsible for six Nobel Prizes as well as the invention of the transistor, the laser, and numerous other communication and computer technologies—would no longer conduct basic research in material physics and semiconductors, but instead would focus on networking, high-speed electronics, wireless, software, and other commercial applications.

The Obama administration has signaled its intention to try and fill this gap with federal funds. While the FY 2012 budget proposes $148.9 billion for federal research agencies, a slight decrease (0.3 percent) from FY 2010, its 10.6 percent increase ($66.9 billion) for basic and applied research will produce the largest federal research investment in real terms in history, according to the American Association for Advancement of Science.[12] Federal investment in R&D, however, remains hostage to the larger political debate about how to reduce spending and the deficit.

No matter the final numbers, it is essential that the money funds high-risk, high-return R&D. Hard times make scientists more conservative, as they seek to secure grants by writing proposals that extend what they already know, not striving toward something new. To counteract the tendency to stay in comfortable territory, more money should be directed to early-career grants and to support well-designed failures—ideas that push the envelope of accepted paradigms.

The results of federally funded R&D are widely available and thus mobile. It is entirely possible that companies can develop the findings of basic research to create high-wage jobs outside of the United States. The R&D tax credit can be used to ground these results locally by forging ties among industry, universities, and government. Research consortia involving three companies or investments in collaborative research at a

federal research laboratory or an American university could be offered a tax break equal to 20 percent of their R&D spending.

There has also been too much focus on how many scientists and engineers the United States educates as opposed to how they are trained and what they need to know. Many future breakthroughs are likely to emerge from multidisciplinary work at the nexus of biology, physics, computer science, and mathematics. As a result, young entrepreneurs must be familiar with several different branches of the sciences, as well as be able to draw insights from design, psychology, economics, and anthropology.

Openness is essential, and the United States must remain the place where the most talented and skilled still yearn to come. Visa regulations must be reformed and the path to citizenship for highly-skilled immigrants made much smoother.

Conclusion

While many of the policies that fall under the rubric of indigenous innovation clearly make it more difficult for American companies to operate in China, the long-term impact on Chinese competitiveness remains uncertain at best. It is difficult to create an environment that rewards individual initiative and creative risk-taking from the top down. Moreover, the focus on reducing dependence on the advanced economies means that Chinese officials focus on known technologies—the latest Intel microprocessor or Nvidia graphic processing unit—often encouraging copying and reverse engineering, not new developments.

Despite the limited efficacy of these policies, the United States must still push back against them. Protests have proven most effective when the pressure is multilateral and not just from Washington, and when governments and businesses speak with one voice. Still, policymakers should expect movement from Beijing to be limited—Chinese policymakers are deeply committed to the idea of technological independence, and one set of policies is likely to be replaced with another.

This means that changes at home are essential. As long as the United States maintains its comparative advantage—an open and flexible culture and a web of institutions, attitudes, and relations that move ideas from the lab to the marketplace—it can prosper and play a dynamic role in the new world of globalized innovation.

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