Effect of U.S.-China Trade on the Defense Industrial Base

Testimony
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The Commission has asked about the implications of growth of China's high tech industry for the U.S. defense industrial base, and in particular, deficiencies in the U.S. high technology industry that could be detrimental to US defense capabilities; the process for monitoring the effect on the U.S. high tech industrial base, and in turn, on U.S. security when US firms outsource work abroad for defense contracts; and how U.S.-China trade and investment change the U.S. defense industrial base in general and the high tech industry in particular.

The underlying question is whether China's growth and modernization, particulary its growth in the high tech and information technology sectors, is 'hollowing out' the American defense industrial base. This is not the case. While China's manufacturing capabilities play a growing role in supplying consumer products, they are insignificant contributors to U.S. defense technology and this is unlikely to change.

There are new areas of increased risk for the U.S. defense industry. These stem from larger trends where China is a symptom more than a cause. These larger trends are the ongoing international economic integration known as globalization, the related issue of the diffusion of scientific and technological capabilities around the world, and the general decline in demand for advanced conventional weapons. The effect of these trends is that if the United States relies solely on the policies and practices that made it strong in the 1980s and 1990s, it is likely to face increased risk to national security.

Globalization and technological diffusion produce three areas of risk for the defense industrial base. These areas of risk are the changes in research and development efforts that may put the U.S. at a disadvantage; the potential effects of a shift in manufacturing to Asia on U.S. innovation; and finally, possible risks to U.S. security resulting from the globalization of the supply chain for information technology. None of these problems are insurmountable if the United States takes action to address them. The real issue is not China's growth but whether the U.S. can respond in a timely fashion to a new environment for international security and economics. Success is not guaranteed: in the 1970s, the U.S. did not adjust to a new international environment and as a result endured a decade of economic and military weakness.

As in the 1970s, the United States again faces a complex new international environment. It has gone from leading an alliance of Western democracies in a global defense against a superpower foe to a world where alliances are less cohesive and threats are more diffuse. The immediate threat lies with terrorism, weapons of mass destruction, and problematic non-state actors, but the long term strategic challenge lies with the emergence of powerful new states. This strategic competition is not a traditional security problem and it is not fully recognized by the policy community in the United States. The new competitors are a number of large nations, among them China, who see themselves as challenging the U.S. now or in the future for economic power, international influence and regional or global leadership. This is not a military struggle, although military strength is an aspect of the competition and in China's case, military conflict cannot be ruled out.

China is the emerging power of greatest concern, because of its rapid growth, its perceived ambitions and because of the potential for conflict over Taiwan. The hopes that a wealthier, market-oriented China would become a stable democracy have not yet been fulfilled. China's assurances that its intentions are peaceful are undercut by its military growth. Economic interdependence between the U.S. and China continues to grow, but this is not matched by an increase in trust.

The risk of transferring U.S. commercial technology has been a staple of the larger U.S. debate over China policy for many years. Trade with China is routinely viewed through the prism of Chinese military capabilities, but there are now growing concerns that trade and investment with China is eroding the U.S. manufacturing base, creating unemployment and long-term security problems. Public and Congressional attitudes reflect a deep ambivalence about trade with China. However, this ambivalence is not sufficient to overcome the economic forces that will lead to greater integration of the two economies.

To understand the implications of China's economic development for the U.S., it will help to list the elements of a modern defense-industrial base. A mass production/heavy industry defense industrial base is no longer adequate for military superiority - this is not World War II and we are not building Liberty Ships. Many factors determine the strength of a national defense industry, and the connection between the civilian economy and military capabilities is complex and nonlinear.

These include national research and development (R&D) capabilities and, equally important, the ability to turn scientific research into commercially and military useful innovations. A strong defense industry capable of building innovative equipment requires extensive databases with information on testing and past projects and years (if not decades) of experience. It requires strong integration skills – the ability to pull many disparate systems into a coherent and effective weapon. It requires the ability to draw on a broad national and international supply chain for critical components especially for specially designed military components. It requires access to advanced technology for materials, sensors, software, microelectronics, and manufacturing. Finally, a strong defense industrial base requires a skilled science and engineering workforce of adequate size to support both defense production and economic growth.

The key skill for a weapons producer is the ability to design a system (itself a complicated process), assemble subcontractors, and then integrate components and subsystems into a functional weapon. Only a handful of companies around the world can do this. A strong civil manufacturing base, while an asset, does not guarantee success. These skills and information require many years of experience with weapons programs.

For the United States, China's growth affects very few of these factors. The consumer oriented industries where China has gained ground are not crucial for modern defense systems. China is not in a position to supply advanced weapons or the components needed to build them. While Europe, Japan and the U.S. provide industrial technologies to China, the ability of the PLA and China's defense industry to absorb these technologies remains mixed, despite China's general economic progress. China cannot yet depend on its defense industry to produce modern weapons or the components for modern weapons.

Trade brings China access to advanced technologies, but it lacks the information, testing and integration skills that are the most important factors for success in making advanced weaponry. These skills can only be obtained after years of experience with weapons programs. China lacks this experience. Its emphasis from the 1950s until the 1980s on low-tech warfare cost it a generation of weapons experience. Given this, the Chinese appear to be following a three pronged approach: modernize their military now through foreign acquisitions; emphasize research in asymmetric weapons for near term advantage; and pursue long term economic growth to provide an adequate industrial and technological base for a modern arms industry.

Modernization of China's defense industry requires the acquisition of capital goods and technological 'know-how' needed for the industrial base that could support modern weapons programs, along with investment in R&D centers to design indigenous military technologies. In this regard, the most sensitive items that China could acquire from foreign companies is not actual goods but "technology," specifically the information necessary for the development or production of a product. This information takes the form of technical data or technical assistance. Previously, China made technology transfer a key condition for entry into its market, but WTO adherence has reduced these forced technology transfers, especially as more foreign companies open wholly owned facilities rather than entering into partnerships with Chinese firms.

The state of the global arms industry also reduces the importance of China's manufacturing growth for the defense industrial base. With the end of the Cold War, demand for major or advanced weapons fell precipitously. At the same time, the complexity and cost of modern weapons continues to increase. This combination of cost and complexity progressively shrinks the number of nations able to build advanced weaponry. The combination of increased complexity and defense spending cuts persuaded many nations that they could no longer produce modern weapons systems. The most telling affect was on a number of emerging economies that had entered the arms market. Brazil, India, Taiwan, Korea, Israel, Pakistan and South Africa all began major arms programs in the 1970s and 1980s, such as main battle tanks and modern combat aircraft, often complemented by strategic weapons programs. Even when there was substantial foreign assistance, these countries (despite the alarm with which their entry into the market was greeted by western observers), proved unable to sustain their programs.

The result was that a large number of producers exited the industry in the 1990s. They were unable to bear the development costs of next generation systems, or, in those cases where they persevered, the systems they developed tended to be expensive, underpowered variants of modern weaponry. Some countries, such as Israel, adopted a more effective strategy of pursuing excellence in specific niches of the defense industry. At the end of the day, only the U.S., Russia and Europe are capable of producing a range of advanced military equipment. In some instances, such as high performance jet engines, the cost of development is such that the few firms in these areas must work in international partnerships to be able to afford a new program. China would need to break into this inner circle of arms producers and form partnerships with the leaders to gain modern defense-industrial capabilities.

This is particularly true for combat aircraft. The difficulty of sustaining a modern combat aircraft industry drove even advanced economies from the market or led their firms to consolidate. Sweden, for example, exited after producing a fourth generation fighter,[1] the Grypen, but more than a third of Grypen's components (the engines and avionics) were U.S. Other European firms consolidated into a few large defense conglomerates. In China's case, the F-10 fighter program came from this era of failed national programs. Even with substantial foreign help in design, engines, and avionics, the F-10 first entered the arena in the 1990s as an underpowered 1970s fighter. China had to redo the entire program after more than a decade of work and is now producing a middling fourth generation aircraft.

Any dependence by the U.S. defense industrial base on Chinese manufacturing would thus appear only in preliminary stages, involving dual use or commercial components. This alone limits risk. However, as noted earlier, maintaining U.S. defense industrial strength does face three risks where China plays a part. These are the potential effects of a shift in manufacturing to Asia on U.S. innovation; possible risks to U.S. security resulting from the globalization of manufacturing; and most significantly, the risk of decline in research and development. The following sections briefly discuss these topics and possible U.S. responses.

Manufacturing and Innovation

The U.S. and other economies are in transition from an industrial to an information economy. In an information economy, the creation of new ideas and services will generate greater returns than manufacturing or agriculture. From this larger perspective, the increase in manufacturing in Asia is a positive sign of U.S. economic activity moving to areas of higher return. However, there will be an inevitable effect on the U.S. industrial base because of this transition. The risk lies in the relationship between manufacturing and innovation. Those who make a product are more likely to discover ways to improve it. As manufacturing shifts to Asia, research and innovation will follow (particulary if there is a strong scientific workforce to welcome it). Absent compensatory measures, the transition to an information economy and the flow of manufacturing of Asia will decrease U.S. technological strength, particulary in comparison to China.

Innovative new technologies come from several sources. In response to a decline in manufacturing, the U.S. could reinforce other sources for technological innovation. One source is particularly important because it provides the U.S. with comparative advantage. This is the combination of university research programs, entrepreneurs, and financial support (from venture capital, corporations, or governments) provides are a strong source for innovation. The small, new firms created by this combination are often more productive in the creation of new products and services than larger firms. Examples of this 'system' include the research triangle in North Carolina, Silicon Valley and the area

[1] The first generation of jet combat aircraft date from the Korean War. Fourth generation aircraft would include the F-16 or the Su-27.

around MIT. This blend of science and engineering expertise with entrepreneurial skills and capital is a leading source of innovation for the U.S. One sign of its success is the effort by many countries to create similar centers around their own universities.

This model is neither perfect nor widespread, but a strategy to reinforce and expand it could maintain technological leadership. One way to do this is to strengthen advanced graduate level programs in science and engineering. U.S. graduate programs are world leaders. Ensuring that these graduate programs remain strong is an achievable national goal. Despite concern over the decline of U.S. primary education in science and math, primary education or even undergraduate level education will not be the source of technological innovation. New ways to keep U.S. graduate programs strong and to ensure that the ideas they generate flow into economic activity will help maintain technological leadership.

Supply chain risk

Globalization, by giving potential opponents increased access to U.S. critical infrastructure, creates a new set of risks, particularly in information technologies. One set of risks involves the sale of intentionally flawed products for later exploitation. The other set of risks involve a fear of 'dependence' on foreign suppliers. Information technologies deserve special attention because of the central role they play in military transformation.

Assessing the potential risks created by a reliance on a global supply system for advanced technology and determining how to manage those risks is a complex subject that can be dealt with here only in a summary fashion. Neither set of risks are particularly great. Other nations face the same challenges. The question is not how to eliminate risk but how to prudently manage it with minimal economic disruption.

To put this in perspective, it may be useful to consider the recent purchase of IBM's personal computer division by China's Lenovo (formerly known as Legend). Lenovo's purchase of IBM's PC division attracted considerable attention. At first, some observers mistakenly believed that IBM was selling its supercomputer division, but in fact, the transaction involved no sensitive or advanced technologies.

Legend was founded by a researcher from the China Academy of Sciences and CAS still owns shares in the company, which is traded on the Hong Kong Stock Exchange. Legend gained market share rapidly in its first years selling low-end PCs. Some Chinese consumers preferred Legend because it provided local support in Chinese. Several large U.S. firms aided Legend in making its computers by providing assistance in integrating CPUs', motherboards and software.

After becoming the leading PC seller in China, Legend decided to diversify its product line and move into global markets. It changed its name to Lenovo as part of that global strategy, but in 2003, it was forced to retreat. Lenovo's chief weaknesses were its lack of marketing and distribution skills to sustain a global presence. Individuals involved in the transaction say that Lenovo's motives were not to obtain computer technology but to acquire the global marketing and business skills Chinese firms often lack.

One factor often overlooked in the discussion of Lenovo's purchase is that the vast majority of laptops sold in American are already assembled in China from parts imported from the U.S., Taiwan and other Asia-Pacific economies. The production process for computers is distributed throughout the Asia-Pacific region. To the extent there is any risk involved in using laptops assembled in China from components made in three or four other countries, Lenovo's purchase did not increase it.

Intentionally building flaws into hardware or software for later exploitation is a high risk strategy with uncertain payoff. If discovered, the supplier company could be forced from the market. The malicious component may not work as planned once it is integrated with components from other sources. Even if it works when it leaves the factory, it may fail later when it is integrated into a larger network. A cursory assessment suggests that the current threat lies in the use of viruses and spyware that exploit software vulnerabilities rather than in malicious changes to hardware or software.

There is also some concern that new risks to security could result from increased U.S. dependence on an international (rather than national) manufacturing base. Western Europe and Japan have provided core manufacturing capabilities for many years, but the U.S could find itself having to rely on suppliers, like China, who are not allies. 'Foreign dependency' does not make the U.S. innately more vulnerable. U-boats are not going to blockade the Pacific Coast nor cut the global supply chain.

The long-term risk lies in the erosion of the U.S. high tech industrial base as foreign high tech companies enter and compete in the market. U.S. regulations and policies contribute to this erosion. Many aspects of our export control system fail utterly to keep advanced technology out of foreign hands, yet put U.S. companies at a competitive disadvantage. The net effect is to reduce the number of U.S. defense and high tech suppliers.

In aerospace technologies, for example, the U.S. decision to restrict exports of space related technologies in the 1990s led Europe to subsidize the creation of its own satellite component manufacturers. U.S. companies now face new competition that is not hampered by regulation in selling to Europe, or to China for that matter. The effect of the regulatory changes of the 1990s was to shift production outside of the United States and to increase China's access to advanced space technologies.

In other sectors, the U.S. faces erosion because of a number of factors. These include not only ill-advised export regulations, but also the decline of our national research base, the globalization of manufacturing and science and, in some case, foreign government programs to increase their share of manufacturing capabilities. Restrictive policies can damage the country that attempts to implement them, by cutting it off from global flows of ideas, money, and goods. National industries lose access to markets and innovations developed overseas. It compounds the damage if one nation's companies are restricted and their competitors are not. The U.S. finds itself in this situation today.

Industrial policies also will not help deal with the challenge of global manufacturing. Industrial policy substitutes bureaucratic and political processes for private sector decision-making and market disciplines. The U.S. has moved steadily away from industrial policy since the 1980s. Private initiative and market forces provide the impetus and direction for economic growth. U.S. policies emphasize less intrusive government, fewer regulations, privatization, and more reliance on markets and competition among private entities. This stands in contrast to Europe, China, or Japan, where the government plays a prominent role in investment decisions for both government and private sector efforts. The U.S.'s market-oriented approach that emphasizes private investment and decision-making appears to be more effective. Some analysts, in fact, attribute the U.S. success in innovation and economic growth to the absence of explicit growth policies.

Confidence in this laissez-faire approach can be difficult to maintain in the face of the rapid growth of China's tech industries. This growth raises concern that they may displace U.S. manufacturers, leaving U.S. defense industries dependent of Chinese sources of supply. China's growth is the product of government programs of subsidies and incentives aimed at building a high tech economy. These began almost two decades ago with the 863 Program, a national effort to expand high tech research and development in China. The 863 Program and similar efforts have provided China with a large pool of scientific and engineering talent.

The second trend is the decision of many foreign companies to locate in China. The reasons for locating there include lower labor costs, but this is increasingly a tertiary factor. The more important motives are to gain access to both China's expanding domestic market and its increasingly skilled science and engineering workforce. Chinese governments, particulary at the provincial and local levels, have also used subsidies aggressively to attract foreign high tech investment.

The semiconductor industry illustrates many of these trends. China's national policies call for the creation of a domestic semiconductor industry. This appeared as early as the 'Four Modernizations' development program of the 1970s. China has subsidized both indigenous efforts and foreign investors in its effort to end 'foreign dependency' for semiconductors. The Semiconductor Industry Association reports that there are forty fabs (semiconductor fabrication plants) and six semiconductor foundries in China. Seventeen fabs are under construction in China. Four of these fabs, according to press reports and remarks by company officials, will use current generation production technologies. However, eight of the ten largest fabs are owned or operated in partnership with Taiwanese, U.S., Japanese or European companies.

China produced over 10 billion semiconductors in 2003, about 2.5 percent of world production. Most of these semiconductors were at the lower end of technology. Total domestic demand in China for semiconductors is expected to continue to grow at 30 percent a year. China's domestic production met only about 20 percent of its domestic demand, but Beijing hopes to raise China's share to more than 50 percent. The Tenth Five year plan called for twenty five new fabs and a 2000 State Council Directive called for an investment of $10 billion in semiconductors. Since a fab costs between $1 billion to $3 billion to construct, foreign investment will necessarily play a critical part in achieving this goal.

SMIC (Semiconductor Manufacturing International Corp) is China's largest and most advanced semiconductor manufacturer. SMIC is a good example of the semiconductor industry in China: although located in China, its CEO is Taiwanese, its management and R&D staff a blend of European, U.S. and Japanese citizens, and its customer base is international. SMIC's Chairman lived for several decades in the U.S. where he worked for Texas Instruments.

SMIC received long-term leases at concessionary rates, training subsidies and other incentives from the Shanghai government to locate its fab there. It is the only 'Chinese' company in the top twenty five semiconductor manufacturers in terms of capital spending. The companies investing the most in new semiconductor manufacturing equipment are from the U.S., Japan, Korea and Taiwan. This suggests that while fabs in China will increase their share of global production, we are unlikely to see all chip production move entirely to China.

China has succeeded in creating a powerful IT industry through a combination of government planning and market forces, but this approach raises the question as to whether the rapid expansion of the industry and its continued growth are sustainable. Both Korea and Japan saw government policy and political interference drive the misallocation of capital in strategies that, in the short term, produced rapid industrialization but in the last few years have worked to significantly slow economic growth. Concern over the continued expansion of China's manufacturing capabilities should be tempered by consideration as to whether its new industries will also follow the pattern set by Japan and Korea.

Concern should also be tempered by the opening of China's economy, including its WTO commitments. As WTO commitments reduce Beijing's ability to extract concessions from foreign investors or to offer some classes of subsidies, many foreign companies are moving from investing in Chinese-owned firms or from partnerships with Chinese firms to opening wholly owned subsidiaries. This means that the high tech industry in China is not always Chinese-owned.

R&D and Defense

U.S. domestic policies create greater risks for long-term U.S. competitiveness than the rise of China. The most damaging policy involves underinvestment in key research areas: physics, computer sciences, aerospace, engineering. These are the fields that contribute directly to military power and to overall economic growth, but Federal funding for these areas has fallen by half (as a percentage of GDP) since 1970. Corporate R&D spending has changed significantly and focuses on development of new products, in reaction to competitive pressures and the need to show near-term gains to financial markets. While overall U.S. funding for R&D has increased significantly in the last four years, these key areas remain underfunded, particularly for basic research, which is the key to continued technological strength and to the expansion of a skilled science and engineering workforce.

The practice of scientific research (and high tech industries, particularly in IT), are increasingly collaborative and international in nature. While U.S. universities and labs remain among the leaders in many research areas, they now have numerous foreign counterparts of equal, and in some areas, greater capability. The global scientific and technology workforce is increasingly mobile. This works to the U.S.'s advantage as skilled science and technology worked came here, but changes in U.S. immigration policies reinforce the growing attractiveness of research centers outside the United States.

Homeland security regulations, to the extent they undercut foreign graduate attendance U.S. universities or make it more difficult to bring skilled workers to the U.S., also damage our competitiveness. This is not intuitively obvious. A simplistic approach would say that keeping foreigners out of our graduate schools, which are among the best in the world, is good for the United States as 'they' are not learning from us. In fact, the damage accrues mainly to the U.S.

We do not generate enough students in the sciences to fill the empty slots in graduate programs. This means that the effect of restricting foreign attendance is to shrink U.S. research programs. While deep cultural changes and weaknesses in primary education may explain some of this shortage, they are not the primary cause. American students avoid science for sound economic reasons. There are real opportunity costs to studying science. After seven years of difficult and expensive study, a science Ph.D in the US faces another two to three years in low paid and onerous post-doctoral work. Prospects for employment in many fields of research after the post-doc are mixed. Smart people (or rational actors) will, on average, choose to do something else that is more rewarding.

This is an area of considerable long term risk for the United States. While Chinese programs smack of the old Soviet-style emphasis on engineering and science, China is rapidly increasing its technological capabilities as a result of having increased the size of its workforce. China is not the only Asian country to have done this, as the Pacific region has become the centre of the global economy and as Asian countries look at the U.S. success in high tech innovation, and Korea, Taiwan, Japan, India have all begun to expand national research efforts, build a high tech work force and copy aspects of the American system of innovation. To maintain its lead, the US needs to accelerate its own efforts in key scientific areas.

Areas for Response

The issue we face is not primarily the growth of China's industry, but the growth of a global manufacturing and research base and its implications for U.S. technological leadership. The U.S. could respond in several ways to reduce risk. The U.S. will need to develop new strategies and techniques to provide greater assurance in the use of foreign technologies. Policies and regulatory solutions that involve enhancing transparency and setting standards could reduce risk. At a minimum, potential opponents will face a more difficult task if the United States pays additional attention to information security. The most effective response will be to find ways to increase the pace of innovation in the United States, which would make it harder for potential opponents to gain advantage from a global supply chain.

There are two areas where Federal intervention would be useful, as they are areas where the market may not deliver adequate results. The first, as noted above, is in R&, particularly in basic scientific research. Basic research, particularly in physics, is the ultimate source of the innovations that produce economic and military strength. Industry can no longer afford to fund basic research. The U.S. would benefit if it recast decisions on how to fund basic research as a security issue rather than a matter for science policy.

The second is in monitoring foreign involvement in the U.S. economy. There is no central place in the Federal government responsible for assessing technological risk or assuring continued technological vitality. Restoration of a Congressional office to monitor technology would do little to improve the situation – this is an executive branch function. Various Departments and agencies – Defense, Commerce, Energy - have fragmentary responsibilities. The current interagency process, the Committee on Foreign Investment in the United States, was created several decades ago and while it performs its assigned tasks well, it does not have the authority or the resources to monitor the full range of foreign activity in the U.S. economy and the implications of this for security.

In many ways, debate over the rise of China and its implications for the U.S. economy bears striking (if unremarked) parallels with the debate of the 1980s over the rise of Japan. A gravitational pull for manufacturing, American companies in desperate competition, a ballooning trade imbalance and exchange rate difficulties were all part of the Japan trade debate. In that case, U.S. fears proved unwarranted, suggesting that some of the apprehension over China is overstated, but the Japan debate lacked the security and human rights factors that make China's growth more of a challenge than the Japanese precedent. In retrospect, however, it was not Japan's growth that created problems, but the sluggish U.S. response. This is a useful precedent in considering how to respond to the new environment.

The United States remains the world leader in the capabilities of its defense industries, in its investment in R&D, and in the size and skills of its scientific workforce. However, China's growth has raised apprehension over the erosion of the U.S manufacturing base and U.S. technological leadership (upon which much of its military superiority depends). Much of this concern stems from exaggerated or mistaken notions, but the U.S. will need to adjust if it is to preserve current levels of security and economic health. There is now some discussion on how to maintain technological leadership in an era of globalization. This discussion is interesting because it looks at strengthening the U.S. rather than trying to restrict China.