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Overview of U.S. - China Trade in Advanced Technology Products

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Introduction

This volume presents a series of papers prepared by U.S. and Chinese researchers examining the development of trade between the United States and China in advanced technology products (ATPs) at the Joint Symposium on U.S.-China Advanced Technology Trade and Industrial Development, October 23-24, 2009, in Beijing, China. The symposium was organized by the United States International Trade Commission, the School of Public Policy and Management at Tsinghua University, the Institute for International Economic Research at the National Development and Reform Commission, and the Brookings-Tsinghua Center for Public Policy at Tsinghua University. The goal of the research efforts presented at the symposium was to better understand the factors affecting U.S.-China ATP trade and the rapid growth of China as a platform for ATP production and trade.

ATP trade has been a fast-growing segment of U.S.-China bilateral trade relations. This topic is of great interest, given that the United States, an advanced economy, likely has a comparative advantage in ATPs and is well

[1] The views expressed in this paper are those of the authors alone. They do not necessarily reflect the views of the U.S. International Trade Commission or any of its individual Commissioners. The authors would like to thank Dylan Carlson and Caitlyn Carrico for their excellent research assistance.

known for its high levels of innovation and advanced research, as illustrated through its leadership position in global patenting. China, on the other hand, is a fast-growing developing country that has used export-led growth as a major part of its development strategy. China has particularly encouraged large amounts of foreign direct investment (FDI) in export processing zones in an effort to encourage technological spillovers. Based on its export volumes China's strategy has led to an incongruous result: China exports extraordinary large levels of ATP products to the United States relative to its level of development. Research by Dani Rodrik and others has found that the technological sophistication of China's exports more closely resemble those of a developed country than those of a typical developing country, such as Brazil or India.[2] However, research on supply and value chain linkages by Koopman, Wang, and Wei (2008) and Dedrick, Kraemer, and Linden (2008), among others, clearly illustrates that much of the content and value of China's ATP exports originates in third countries such as the United States, Japan, several countries of the European Union (EU), and South Korea, and historically has been exported from foreign-invested enterprises in China's export processing zones.[3]

The papers in this volume cover a wide range of topics and perspectives related to U.S.-China ATP trade, from microfocused papers centered on industry- or product-specific case studies to a discussion of a broad international trade agreement and an assessment of macroeconomic financial flows. Despite this diversity of topics, consistent themes include the importance of the fragmentation of the value chain across Asia and the proactive role of Chinese government efforts supporting ATP-related investment and production. In this introduction, we will first survey these papers, then provide an overview of U.S.-China ATP trade in order to supply a fuller context for understanding the papers' findings.

In the first paper "A Tale of Two Cities: A Comparison of Patent-based Innovative Performance of Domestic and Multinational Companies in China," Zheng Liang and Lan Xue provide a brief history of the evolution of the Chinese patenting system, then compare domestic Chinese innovation with multinational innovation by examining patent behaviors and trends, firm-

[2] In addition to Rodrik (2006), Schott (2008), and Fontagne et al (2007).

[3] See Koopman, Wang, and Wei (2008), Dedrick, Kraemer, and Linden (2008), Ferrantino, Koopman, Wang, & Yinug (2008), Johnson and Noguera (2009), and Daudier et al. (2008).

level innovation, and behavior differences with respect to the U.S. Patent and Trademark Office. They find that Chinese firms innovate through three main pathways: (1) by developing processes in lower levels of global value chains, (2) by competing with low-cost research and development activities, and (3) by catering to the local market.

Huang Xianhai, Yang Gaoju, and Lu Jing, in "China's International Specialization Status in Advanced Technology Industry: A Case Study of Zhejiang Pinghu Opto-mechatronics Industry Cluster," assess the driving forces behind the rise of an opto-mechatronics industry cluster in Pinghu, Zhejiang province, as a case study for the development of China's ATP industry. They find that despite some progress most of Pinghu's enterprises continue to serve as processing and assembly bases for multinational companies; as a result, few incorporate high value-added production activities such as research and development and design.

Yansheng Zhang, Dawei Li, Changyong Yang, and Qiong Du, in "On the Value Chain and International Specialization of China's Pharmaceutical Industry," provide an overview of the pharmaceutical industry value chain and examine China's role in the international specialization of the pharmaceutical industry. The authors use a Trade Competitiveness Index and intra-industry trade analysis to compare China's and India's pharmaceutical industries. They conclude that while India's specialization is at the more technically sophisticated end of the supply chain, China's specialization is at the low end of the non-propriety chain. However, China's domestic value added in pharmaceuticals is relatively larger than other supply chains in which China is at the low end. This is largely due to the small, local nature of raw medicine producers in China compared to the highly vertical MNC-driven production other products.

Michael Anderson and Jacob Mohs, in "The Information Technology Agreement (ITA): An Assessment of World Trade in Information Technology Products," provide a historical perspective on ITA product trade, examining global trade flows and accession of new member countries during the 12 years of the ITA. They find that global IT trade grew by 10.1 percent annually between 1996 and 2008, from $1.2 trillion to $4.0 trillion. A prominent feature of expanding ITA related trade is the broadening participation of Asian countries, led by Singapore, South Korea, Thailand, and particularly China. This growth is the result of fragmentation-based specialization throughout the Asian region. China's growth in ITA exports has made it the largest exporter of technology

goods in the world, supplying $463.7 billion worth (25 percent of global share) in 2008.

Wenkai Sun, Xiuke Yang, and Geng Xiao, in "Understanding China's High Investment Rate and FDI Levels: A Comparative Analysis of the Return to Capital in China, the United States, and Japan," show that FDI inflows to China have increased at an average rate of around 20 percent per year for nearly two decades, expanding from $3.5 billion in 1990 to $92.4 billion in 2008. Investigating the future sustainability of high investment rates and FDI inflow to China, the authors find that the relatively low return to labor and the capital-output ratios in China are the two major factors behind the sustained high returns to capital in China. They see little evidence that the returns have started to decline, though one would expect them to do so in the longer term.

Katherine Linton and Mihir Torsekar, in "Innovation in Biotechnology Seeds: Public and Private Initiatives in India and China," compare and contrast the introduction and development of the biotechnology seed sector in China and India. In a case study of *Bacillus thuringiensis* (Bt) cotton, China evidenced greater government involvement throughout the process, with the result that domestic Bt cotton varieties now hold 80 percent of the market. India showed less direct governmental involvement, allowing a 50-50 joint venture with a U.S. company to take the lead. In both countries the authors found serious problems in three areas vital to biotech seed innovation, including market access issues (with limited access for foreign firms in China, and significant price caps in India); limitations and gaps in IP protection and enforcement; and long delays in regulatory review.

Greg Linden, Jason Dedrick, and Kenneth L. Kraemer, in "Innovation and Job Creation in a Global Economy: The Case of Apple's iPod," analyze the iPod value chain, and in particular the foreign manufacturing process, to demonstrate that the employment and wage effects of this supply chain rely on foreign-made components but U.S. design. The authors conclude that this case shows that innovation can have a positive effect on U.S. employment and wages despite the outsourcing of production jobs, especially if the United States remains a critical base for a highly skilled labor force.

Overview of U.S.–China ATP Trade

U.S. Exports of ATPs to China

This section briefly surveys the magnitude and composition of recent U.S. exports of ATPs to China and examines how such exports differ from U.S. ATP exports to the rest of the world (ROW).[4] Figures 1 and 2[5] illustrate the evolution of U.S. ATP exports to China recent years. U.S. ATP exports to China have grown steadily since 2000, increasing by an estimated annual 13 percent year-over-year and becoming increasingly concentrated in electronic products (e.g., semiconductors).[6]

U.S. ATP exports to China have also outpaced U.S. ATP global exports (figure 1), reflecting the growing prominence of China's market and processing platform and Chinese manufacturers' efforts to integrate ATPs into their supply lines. Electronic products constitute a large and growing share of U.S. ATP exports to China (figure 2). Semiconductors dominate this category, representing about 90 percent of U.S. electronic ATP exports to China in 2009.[7] The information and communication goods category (which consists of machine parts, voice and data imaging machines and parts, and processing and phone parts) have also figured prominently in U.S. ATP exports to China. These products can be broadly considered intermediary goods that the United States ships to China as components for final assembly of other products. This trade phenomenon reflects the trend toward international fragmentation of production, wherein certain developed countries, such as the United States, specialize in producing various segments of global supply chains based on comparative advantage.[8]

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[4] In this discussion ATP simply denotes high-technology goods. For statistical purposes we use the U.S. Census Bureau definition for three reasons: it attempts to capture innovation broadly through a dynamic approach to data classification; it does not appear to be associated with policy objectives; and it lacks a competing international standard. See Ferrantino, Koopman, Wang, and Yinug (2010), for a more in-depth discussion of classification issues for ATP trade between the U.S. and China.

[5] Figures are located after the references.

[6] This is an estimate, since the regular modifications of ATP definitions impede more precise calculations.

[7] Although U.S. aerospace exports, primarily airplanes, accounted for more than a third of U.S. exports to China in 2009, exports of these products tend to be sporadic.

[8] See Dean, Ferrantino, and Wang, "Measuring the Vertical Specialization in Chinese Trade" (2007) for example.

A more detailed review of U.S. ATP exports to China underscores the prominence of several sectors, particularly electronics. As seen in figure 3, electronics accounted for approximately 40 percent of U.S. ATP exports to China in 2009, but less than 20 percent of U.S. exports to the ROW. U.S. electronic exports to China (chiefly semiconductors) have risen from $922 million in 2000 to $5.3 billion in 2009. Figure 4 presents the difference in export shares between U.S. ATP exports to China and to the ROW for three selected years since China's accession to the WTO. In the absence of export specialization, we would expect differences in export shares to be minimal and converge toward zero in time. Unlike any or the other aggregate sectors, the China-ROW difference in the electronics sector has exhibited a substantial change from a large negative (a relative concentration of U.S. exports to ROW) to a large positive (a relative concentration of U.S. exports to China). The export growth described above, combined with the large and rapidly shifting share in the electronics sector, reflects the global value chain fragmentation mentioned above and discussed in a number of articles in this volume.

The information and communication, biotechnology, and aerospace sectors also present unique stories as well.

Information and Communication: Over the past decade the United States has exported relatively more information and communication products to the ROW than to China. This is largely attributable to growing U.S. shipments of computers to the ROW, which have outpaced the growth of such shipments to China. However, more recent surges in U.S. exports of computer components, such as hard drives, to China have more than offset these trends, a development which explains the convergence in U.S. information and communication exports to China and the ROW since 2001.

Biotechnology: The United States also exports far more biotechnology products to the ROW than China, and the gap has been growing. This is primarily attributable to the steady growth in U.S. exports of blood fractions and human vaccines to the ROW, which have remained nominal in China. The diverging export specialization profiles suggest a possible trade opportunity for U.S. exporters. Weak Chinese demand for such products does not appear to explain such trends; German and other European companies are increasingly competitive in China against Chinese domestic producers, and there is growing Chinese demand for U.S. high-technology health care products in the related medical device sector (which is subsumed in the "life sciences" category above).

Aerospace: U.S. aerospace exports to China have also been proportionately smaller than such exports to the ROW. This is largely attributable to lower shares of U.S. airplane exports to China relative to the ROW in this period. Although this may possibly signal an export opportunity for U.S. companies, the irregular nature of airplane sales, along with the fact that the export profile of U.S. airplane sales to China is gradually converging with that of U.S. airplane sales to the ROW, inhibit broader conclusions.

Chinese Exports of ATPs to the United States

This section surveys the size and composition of Chinese exports of ATPs to the United States and illustrates how they differ from Chinese ATP exports to ROW. Chinese ATP exports to the United States have expanded rapidly in recent years, becoming increasingly concentrated in consumer electronics.[9] U.S. ATP imports have been growing steadily in recent years, amounting to $300 billion in 2009. China has been the source behind much of this growth, supplying as much as 30 percent of U.S. ATP imports in 2009, compared with 6 percent in 2000 (figure 5). In addition, these imports from China have been increasingly specialized in ATPs. For example ATPs represented 12 percent of U.S. imports from China in 2000, but 30 percent by 2009 (figure 6).[10] U.S. ATP imports from China consist mostly of informational and communication products, nearly 90 percent in 2009 (figure 7); this category includes mainly consumer electronics such as computers and their parts, telephones, TVs and monitors, printer parts, and cameras. The other large category of U.S. ATP imports from China is opto-electronics (7 percent in 2009), consisting of other consumer electronic products such as flat screen monitors and projectors, printers, and solar panels. The value of U.S. information and communication

[9] For simplicity, assumptions were made to best approximate Chinese ATP trade category values, given the imposition of more precise U.S. ATP definitions on Chinese trade data. Likewise, we disregard well known differences in U.S. and Chinese trade statistics (much of which derives from how Hong Kong trade flows are classified), given anecdotal evidence that such discrepancies are relatively small for ATP products. U.S. ATPs are defined at the HS-10 digit level, which is not directly comparable to the Chinese HS-10 digit level. For simplicity, we have assumed that every Chinese HS-6 digit category (which is comparable to the United States' HS-6 digit category) that included a HS-10 digit product under the U.S. Census definition was an ATP category.

[10] Although annual revisions to the ATP product definitions might qualify some of this growth if ATP selection criteria became progressively restrictive, such revisions would nonetheless be minor compared to overall ATP trade values. Moreover, if such revisions broadened the scope of what was considered an ATP product throughout the considered period, they would not alone account for the clear and systematic trend towards ATP trade specialization in Chinese exports to the United States.

ATP imports from China has grown from $10 billion in 2000 to nearly $80 billion in 2009, while that of opto-electronics imports has grown from $1.5 billion to $6.5 billion over the same period.

Chinese ATP exports to the United States assume a different profile than Chinese ATP exports to the ROW, particularly in the information and communication, and electronics sectors. As seen in figure 8, information and communication exports accounted for approximately 82 percent of China's ATP exports to the United States in 2009, versus 73 percent of those to the ROW. This relatively larger specialization of Chinese ATP information and communication exports to the United States reflects a recent and dynamic change in the sector, as shown in the way the differences between the share of these goods in China's exports to the United States and to the ROW have varied in the past decade (figure 9). As recently as 2001 and 2005, China was more specialized in exports of these products to the ROW than the United States. However, China has since substantially increased the share of these products exported to the United States, such that the market specialization has reversed from ROW to the United States. On the other hand, Chinese exports of opto-electronic goods to the United States, which outpaced those to the ROW in 2001 and 2005, have been converging towards the profile of China's exports to the ROW in recent years. In contrast to both of these developments Chinese electronic ATP exports have been notably concentrated in the ROW relative to the United States, a trend that has become more pronounced since 2001.

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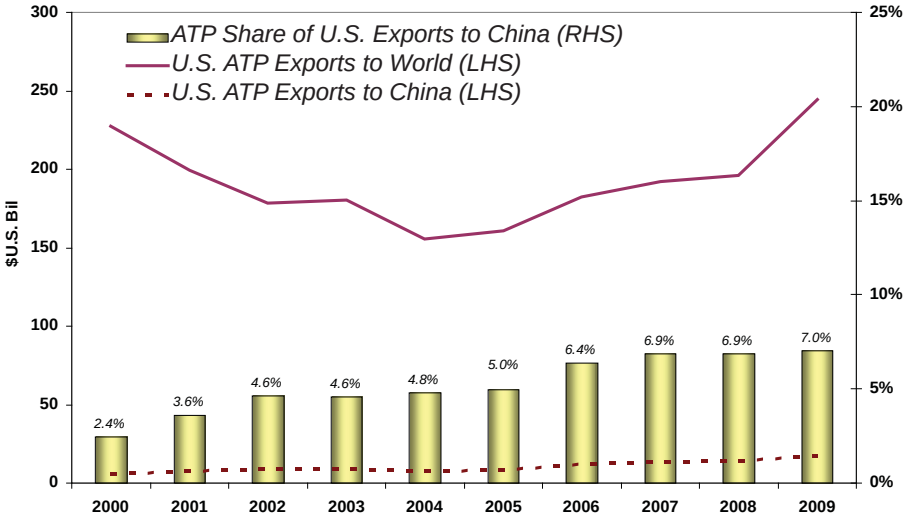
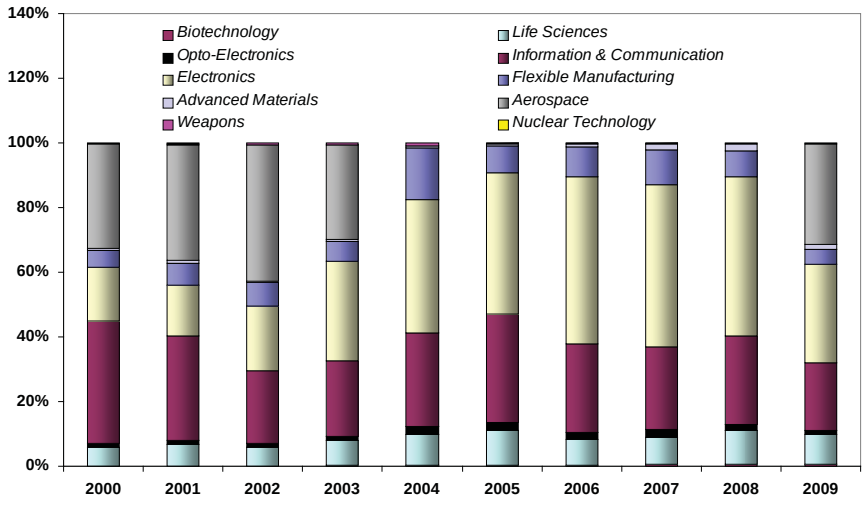
Figure 1: U.S. ATP EXPORTS TO CHINA
(In $U.S. Billions)



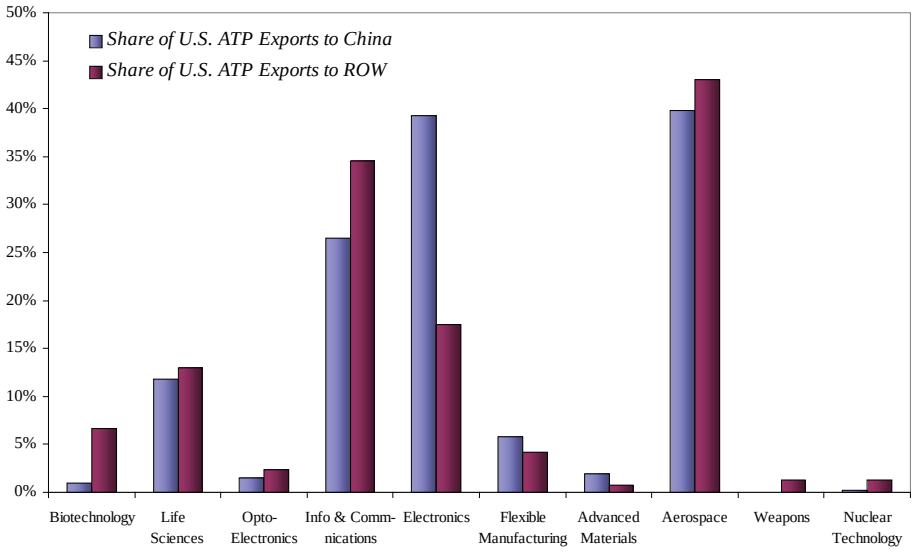
Source: World Trade Atlas

Figure 2: COMPOSITION OF U.S. ATP EXPORTS TO CHINA
(In percent)



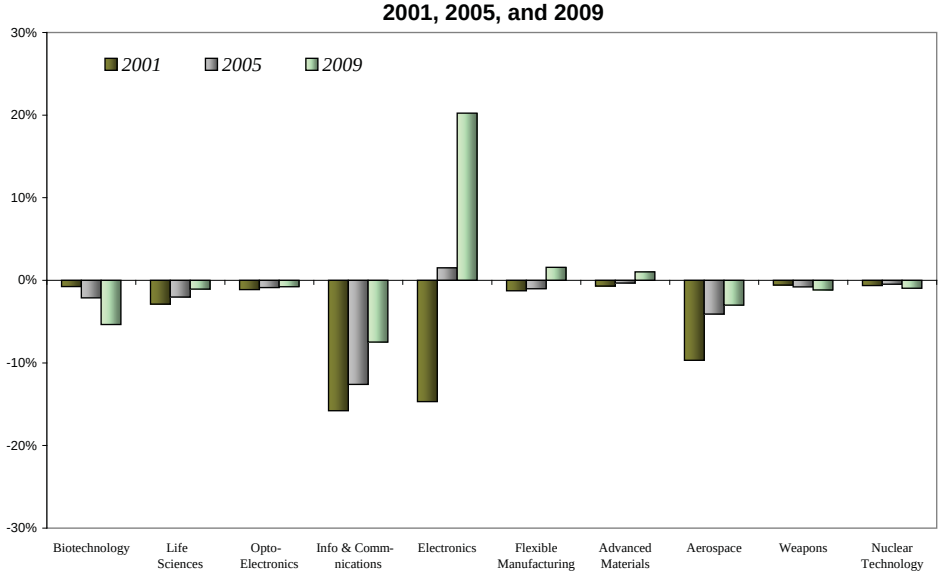
Source: World Trade Atlas

Figure 3: COMPOSITION OF U.S.ATP EXPORTS TO CHINA AND ROW BY SECTOR, 2009



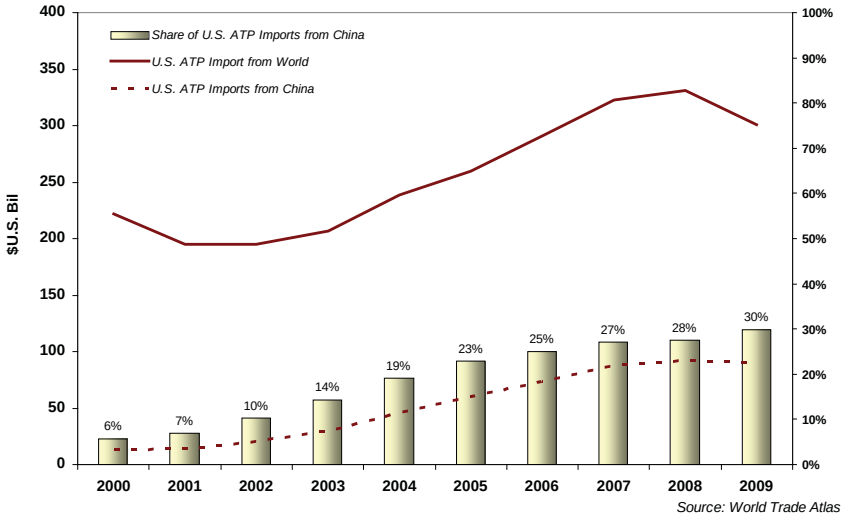
Source: World Trade Atlas

Figure 4: DIFFERENCE BETWEEN U.S. ATP EXPORT SHARE TO CHINA AND ROW, 2001, 2005, and 2009



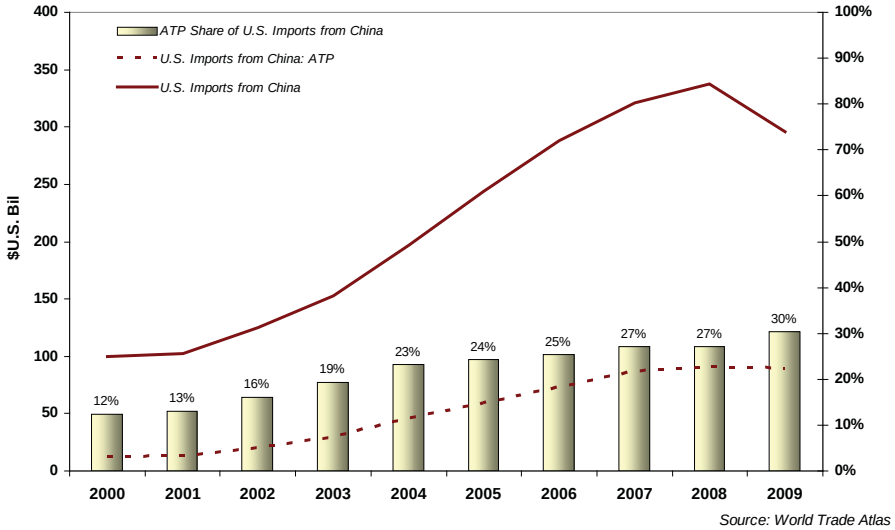
Source: World Trade Atlas

Figure 5: U.S. ATP IMPORTS
(In $US Billions)



Source: World Trade Atlas

Figure 6: U.S. ATP IMPORTS FROM CHINA
(In $US Billions)



Source: World Trade Atlas

Figure 7: U.S. ATP IMPORTS FROM CHINA
(In percent)

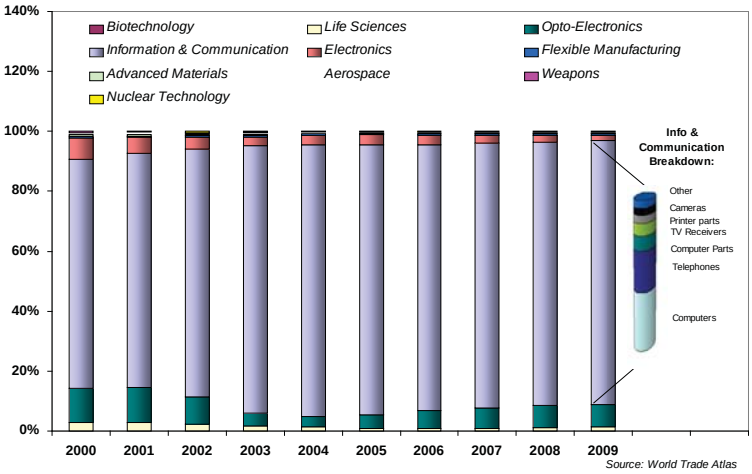


Figure 8: COMPOSITION OF CHINA'S ATP EXPORTS TO THE U.S. AND ROW
(2009)

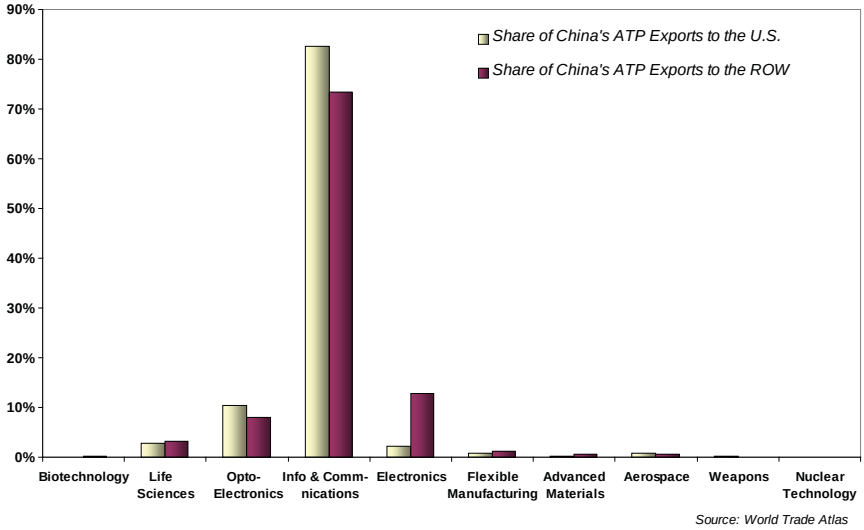
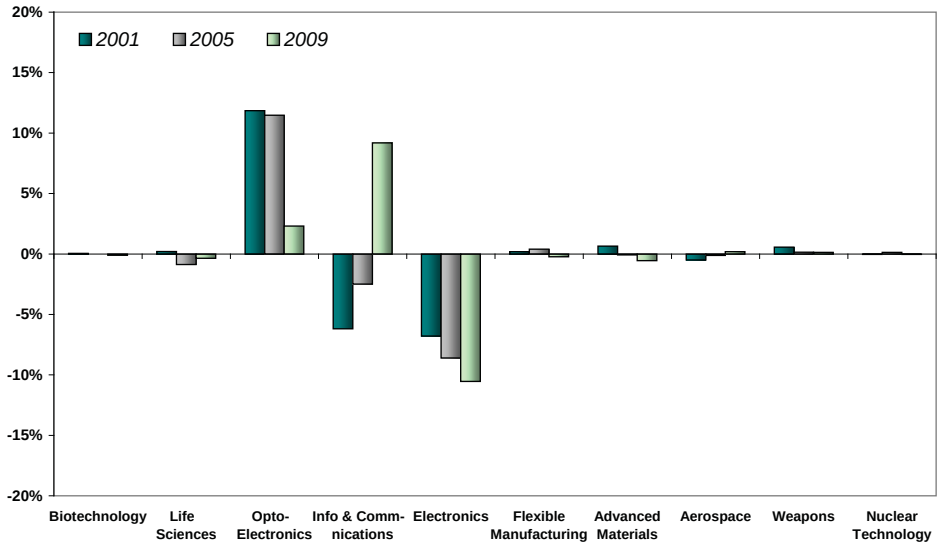


Figure 9: DIFFERENCE BETWEEN CHINA'S ATP EXPORT SHARE TO THE U.S. AND ROW, 2001, 2005, and 2009



Source: World Trade Atlas