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Joint working paper “*Classification of Trade in Advanced Technology Products And its Statistics Reconciliation: The Case of China and the United States*”

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Classification of Trade in Advanced Technology Products and its Statistics Reconciliation: The Case of China and the United States

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Classification and Statistical Reconciliation of Trade in Advanced Technology Products

The Case of China and the United States

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Joint Working Paper on U.S.-China Trade in Advanced Technology Products

Principal Reviewer from USITC: Judith Dean
Principal Reviewer from China: Bin Xu (China Europe International Business School)

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Preface

The rising sophistication of Chinese exports has generated significant interest among policy makers and researchers. Why would China, a country with abundant low skill-labor, but with a relative scarcity of capital and skilled labor, produce and export a bundle of goods that resembles that of developed countries? Does Chinese trade in Advanced Technology Products (ATP) with the US and the rest of the world give us insights about the new complex global production network? Can we identify sources of the rising export sophistication shown in Chinese export statistics?

Researchers in the U.S. and China have been trying to gain insights on these important questions. In the fall of 2006 researchers from the National Bureau of Statistics of China (NBS), Peking University and Tsinghua University, and from Office of Economics at US International Trade Commission (USITC) exchanged ideas on issues relating to U.S.- China trade statistics and patterns in a series of seminars in Beijing and found common interest in examining ATP trade between the two countries. An informal, joint research project was initiated aimed at providing a more thorough understanding of the classification and data issues surrounding U.S.-China ATP trade. The teams bring extensive expertise on each country's trade data and patterns. This expertise may help identify the sources of the rising sophistication in Chinese exports, and allow the teams to conduct detailed assessments through case studies and econometric and other statistical analysis.

The initial research teams include researchers from China, headed by Professor Lan Xue from Tsinghua University and Director Yansheng Zhang from National Development and Reform Commission (NDRC). Members include Professor Qinguo Meng, Dr. Ling Chen, and Dr. Jiangneng Yi, all from Tsinghua; and Professor Jiyao Bi, Dr. Haifeng Wang, Dr. Xu Liu, Dr Jianping Zhang, Mr. Changying Chen, Dr. Fengjie Qu, Dr. Jie Hao, Dr. Yi Zhang, and Dr. Zheren Zhang, all from NDRC; and from the USITC, headed by Dr. Robert Koopman and Karen Laney-Cummings at USITC, and including Dr. Judith Dean, Dr. Michael Ferrantino, Dr Zhi Wang from Office of Economics, Mr. Michael Anderson, Mr. Dennis Fravel, and Mr. Falan Yinug from Office of Industries.

This current joint working paper "**Classification of Trade in Advanced Technology Products And its Statistics Reconciliation: *The Case of China and the United States*"** represents the first step in developing a deeper understanding of the underlying classification schemes and data.

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Executive Summary

This study provides an objective overview of U.S.-China trade in advanced technology products (ATP). It examines the definitions and classification methods of ATP in the United States and China, compares available ATP lists, and investigates some of the pros and cons of both countries' current systems using historical data. It also illustrates a method to reconcile U.S.-China ATP trade data that combines the strengths of both countries' trade statistics. Finally, it presents preliminary explanations for U.S.-China ATP trade patterns from 1996 to 2006, based on one set of reconciled ATP trade statistics.

Major findings from the study are:

- ATP classifications in the two countries, while similar in a number of ways, appear to have been created to serve different purposes. Some Chinese classifications appear to be used to help inform and manage its broad industrial development strategy and often extend to products beyond those considered advanced technology products in the United States. The U.S. ATP classification are mainly for statistical monitoring purposes and do not appear to be tied to specific policy goals.

- The ATP-producing industries are relatively stable, while the ATP product list changes year by year, with dramatic changes taking place when a revision of the HS codes occurs.

- ATP statistics from numerous sources consistently show that the U.S. trade deficit in ATP with the world grew rapidly in recent years, with China as one of the largest contributors.

- The dramatically increasing surplus of China in ATP trade since its WTO accession is concentrated mostly in information and communication technology, while the United States still enjoys sizeable surpluses in electronics and aerospace technology.

- The adjustment of re-exports through Hong Kong has only a modest impact on the discrepancies in U.S.-China ATP trade statistics, which is similar to the findings of Ferrantino and Wang (2007) in U.S.-China general merchandise trade. However, when we make adjustments for differences in classification definitions, and largely purge the Chinese data of "new" products, we get a clearer picture of U.S.-China trade in ATP products.

- More than 90 percent of the rapidly expanding ATP exports from China to the United States is processing trade, which is closely related to foreign direct investment (FDI) and largely carried out by foreign firms. This is in contrast to non-ATP trade, where most of the growth in trade since China WTO accession has been carried out by private Chinese firms, not foreign firms.

- Various special economic zones and areas have largely hosted the rapid expansion of Chinese ATP exports.

- The emergence of China as a major supplier to the U.S. advanced technology products market results from the combination of the fragmentation of global production, China's comparative advantages, and Chinese Government preference policies to processing trade and foreign invested enterprises.

There appears to remain a considerable technological gap between Chinese ATP exports and Chinese imports from the United States. Chinese ATP imports from the United States were dominated by large-scale, sophisticated, high-valued equipment and devices, while Chinese ATP exports to the United States were still mainly small-scale products or components in the low-end of the ATP value-added chain.

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Abbreviations

ATP	Advanced Technology Products
BLS	Bureau of Labor Statistics
DOC	U.S. Department of Commerce
ETDA	Economic and Technology Development Area
FDI	Foreign Direct Investment
FIE	Foreign Investment Enterprise (wholly foreign-owned)
GB	Guo Biao (Chinese Government Standard Chinese Character Encoding Scheme)
HIDA	Hi-Technology Industry Development Area
HNTP	High and New Technology Product
HS	Harmonized Schedule
HTS	Harmonized Tariff Schedule
ICT	Information and Communication Technology
ISIC	International Standard Industry Classification
ITA	International Trade Administration
n.e.c.	Not elsewhere classified
NAICS	North American Industry Classification System
NBS	National Bureau of Statistics of China
OECD	Organization for Economic Co-operation and Development
OTC	OECD Technology Concordance
R&D	Research and Development
SEC	Security Exchange Commission
SEZ	Special Economic Zone
SITC	Standard International Trade Classification
SOE	State Owned Enterprise
USITC	US International Trade Commission
VAT	Value-Added Tax
WTO	World Trade Organization

I. Introduction

Trade in high or advanced technology products (ATP) has received a great deal of attention from policy makers and researchers due to its implications for innovation, productivity, long-term economic growth, international competitiveness, and the creation of well-paid jobs.[1] However, measuring ATP trade is difficult, because different countries and international organizations use different definitions and classifications. As it turns out, measurement in this area is not value-neutral. The concept of "advanced technology" is flexible, and in some cases may reflect underlying ideas about policy which are not always clearly stated. Moreover, while fact-based claims that a country runs a surplus or deficit in ATP can be used to promote various policies, these claims themselves may prove fragile to alternative choices about measurement.

Recent developments in international commerce have made the issue of measuring ATP trade more problematic. The first is the international fragmentation of production, through which production is separated into many stages and carried out in different countries. With such fragmentation, countries are able to specialize in different segments of the vertical production chain based on comparative advantage (Dean, Fung, and Wang, 2007). Thus, it is possible for a country to engage in final assembly of a product that may be considered "high-tech" using essentially "low-tech" labor skills, or to perform a "high-tech" piece of the production process for a product usually thought of as "low-tech." As a result, the existing trade statistics classifying ATP based on final goods alone may not be able to accurately reflect national innovation capacity, technological level, or comparative advantage.

Related to this international fragmentation is the rapid expansion of processing trade in developing economies, especially in China, and the increasing role of China in the global production chain for certain technology-intensive products. Based on China Customs statistics, processing exports accounted for 55 percent of Chinese exports to the world and 65 percent of exports to the United States in 2005. Statistics from the U.S. Census Bureau (Census) indicate that China supplied large shares of U.S. ATP imports in several key technology areas in 2005, including 40 percent ($64.4 billion) of U.S. ATP imports in information and communication technology (ICT) and 22 percent ($4.4 billion) in opto-electronics products.[2] OECD statistics also show that China came close to matching the United States in the value of its global trade in ICT products. From 1996 to 2004, the value of U.S. ICT trade (imports and exports) grew from $230 billion to $375 billion, while China ICT trade soared from $35 billion to $329 billion over the same period. By the end of 2005, ICT goods accounted for 30 percent of Chinese exports to the world, and China surpassed the United States to become the largest supplier of ICT products in the world.

The rapid growth of Chinese exports in ATP has generated a tremendous amount of anxiety in industrial countries, in particular the United States. How can China, a country with relative

[1] In this context, there is a broad and active discussion on the role of FDI and spillovers from foreign investment in ATP and other industrial sectors. See, e.g., Alfaro (2003) and Rodrik (2006).
[2] Opto-electronic products are those that use both optics and electronics. Common examples include laser diodes (common applications include reading DVDs and CDs, and for laser pointers), light-emitting diodes (common applications include for traffic stop lights and instrument panel displays), flat panel devices, optical fiber telecommunications, and detectors and sensors.

abundance in labor, but comparatively less capacity for technological innovation, have such large exports of ATP products to developed countries? Some observers speculate that this is a consequence of the Chinese government's industrial and other policies, arguing that these policies have helped Chinese firms to leapfrog ahead technologically and worrying Chinese advancement poses a major challenge to U.S. commercial and security interests (Preeg 2004). Others believe that the presence of production fragmentation and processing trade causes conventional measures of China ATP exports to present an exaggerated picture of Chinese technological capabilities (Branstetter and Lardy 2006).

This paper provides an objective description of the emerging pattern of China-U.S. ATP trade. The following section evaluates the ATP trade classification in the two countries and their relative strengths and weaknesses. Section III selects a classification system and develops a method that can combine the strength of both nations' data as the basis of ATP trade statistics reconciliation. Section IV describes the emergence of China as a major supplier to the U.S. ATP market and assesses the nature of China ATP exports to the United States during 1996 to 2006 based on the reconciled ATP trade statistics. Section V concludes with a discussion of directions for future research.

II. Definition and Classification of ATP Trade in China and the United States

2.1 The Development of the U.S. Census Classification in ATP trade

Historically, U.S. interest in tracking trade in ATP appears to originate in the shift in global macroeconomic balances that took place in the 1970s. The United States, which regularly ran merchandise trade surpluses in the postwar era through 1970, transitioned to a period of deficit from 1971-75, and has run annual, mostly growing, merchandise trade deficits from 1976 onward. Although part of this transition was attributable to rising oil prices, another part appeared to be associated with the ability of economies in Japan and Western Europe to export an increasingly broad range of manufactures. The shift in the U.S. merchandise balance, combined with high-profile export successes of U.S. trading partners in categories such as electronics and automobiles, raised the concern that the United States was losing its postwar position as the global technological leader. This, in turn, led to calls for industrial policies to maintain the U.S. position in key industries (Wachter and Wachter, eds. 1981; Thurow 1985), and thus an enhanced interest in measuring any possible erosion in that position.

The first U.S. Government tabulations of high-technology trade were conducted by the International Trade Administration (ITA) of the Department of Commerce (Davis 1982). These measures start by defining industries as "high-tech" using R&D intensity as measured by the R&D/sales ratio as a proxy for technology embodied in the product. It takes into account both the direct and indirect R&D intensity embodied in intermediate inputs in an industry by using an input-output model. The top 10 industries with the highest R&D intensity were identified as high-tech industries, and all products within these industries were defined as high-tech products. This high-tech product measure showed a sharp decline in the reported U.S. trade balance in high-technology products, from a $24 billion surplus in 1982 to a $2.6 billion deficit in 1986 (Abbott et al. 1989). A shift in the trade balance to a deficit position might be interpreted as evidence of need for a more activist U.S. industrial policy.[3] U.S. Census researchers began to suspect that the deterioration in the high-technology trade balance as reported by ITA was a statistical artifact caused by an overly broad definition of high-technology products. The use of industry level R&D data, which are significantly more aggregated than trade data, to identify high-technology sectors could easily lead to an overly broad definition of "high-tech" trade.[4]

The U.S. Census introduced a classification system for ATP to measure the trade balance in such products in July 1989. It provided a distinct alternative to the method used by the ITA (Abbott 1991). Instead of using aggregate data at the industry level, the Census method uses more detailed product data. This more disaggregated concept of high-technology trade, for the first time referred to as "ATP" (advanced technology products), relied on product-by-product assessments of technology. It starts from the development of 10 broad technology fields which were commonly considered as advanced technology, and then examines individual products in merchandise trade to determine whether they are significantly associated with one or more of these leading edge technologies. Only products containing one or more of these leading edge technologies can be deemed as ATP. This resulted in a list of ATP at the HTS-10[5] level associated with each of the 10 technology fields.[6] According to this classification, the U.S. trade surplus in ATP had in fact persisted in the 1980s, with estimated surpluses of $24.5 billion in 1982, $15.6 billion in 1986 and $19.4 billion in 1987.

Roughly 700 of the 20,000 HTS-10 codes in use have been identified as ATP. Abbott et al. (1989) states that the Census method provides a more accurate measure of high-tech trade than the ITA method because it requires making judgments about the technology content of finely defined individual products. Since its introduction in 1989 the Census methodology has not changed, although the products within the ATP list have changed annually[7]. Table 1 lists the 10 technology fields, examples of ATP products and the number of HTS-10 codes identified by the Census as ATP in selected years. Examples of ATP products are given in textbox 1.

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[3] This concern is mentioned in particular by Abbott, McGuckin, Herrick and Norfolk (1989) in their discussion of the development of the Census ATP classification.
[4] For example, the industry group described by ITA as "Office and Computing Machines" included scales, balances, cash registers, calculators, dictation records and adding machines as well as computers (Abbott et al p. 4). Arguably, these products are very different from each other in the extent to which they embody innovative or leading-edge technologies.
[5] "HTS" is used here as a contraction for "HTSUSA" (Harmonized Tariff System of the United States of America), the U.S. national implementation of the Harmonized System (HS) of the World Customs Organization. The HS defines internationally comparable products on a six-digit (HS-6) basis. Individual countries can add sub-classifications to this scheme for tariff administration or reporting purposes. The finest available set of categories in the HTSUSA is on a 10-digit (HTS-10) basis.
[6] It is important to note that though advanced technology products (ATP) are classified by 10 digit HTS codes, even at such a detailed level, each 10 digit HTS code does not necessarily represent a single homogenous product. Where several products are classified under one 10 digit HTS code, Census analysts determine whether there are sufficient high tech products to warrant ATP classification for that HTS code.
[7] The annual changes to the ATP list are due to several factors and are not due exclusively to Census analysts adding new ATP product . Often, the ATP codes have been updated to regroup products to reflect broader changes at the statistical level with the list undergoing periodic reviews and revisions.

Box 1: Census's ATP List - Some Commonly Known Products

The U.S. Census' 10 broadly defined technology fields for ATP can lead one to ask what specific products each field contains. Below is a list of commonly known products found in each field.

Field	Products
Biotechnology	Vaccines for human medicine, vaccines for veterinary medicine
Life Sciences	Magnetic resonance imaging apparatus, electrocardiographs, artificial joints
Opto-Electronics	Rangefinders, stereoscopic microscopes, lasers other than laser diodes
Information & Communications	Personal computers, facsimile machines, communications satellites, camcorders
Electronics	Particle accelerators, semiconductors, smart cards
Flexible Manufacturing	Industrial robots, thermostats, semiconductor manufacturing equipment
Advanced Materials	Optical fiber cables
Aerospace	Turbojet aircraft engines, new multi-engine airplanes
Weapons	Guided missiles, self-propelled artillery weapons
Nuclear Technology	Nuclear reactors, uranium compounds enriched in U235

Note: these products are taken from the 2006 Census ATP list, and in most cases the descriptions are the 10-digit HTS product descriptions (some descriptions have been abbreviated).

Box 2: Why are products added to and deleted from the Census ATP List? A Profile of Semiconductors

Since its creation in 1989, the Census ATP list has included semiconductors (HS 8542) consistently (they are included under the "electronics" ATP field). However, many 10-digit codes under HS 8542 have been added to or deleted from the list over the years.

Historically, the majority of 10-digit subheadings for semiconductors have been added to or deleted from 8542 for two reasons:

1. *International code changes*. Periodic 6-digit HS changes at the international level have changed 10-digit codes.
2. *Changes related to product advancement*. The U.S. Government adds or deletes 10-digit codes to keep up to date with technology advances.

Given the fact that Census considers almost all types of semiconductors as ATP, the ATP list has automatically changed whenever 10-digit subheadings have been added to or deleted from 8542.

The table shows certain patterns in the changes to the U.S. ATP list. First, in general the net effect of HTS-10 code additions and removals through the life of the list has been an expansion of products in the list. From 1989 to 2006, the number of HTS-10 codes increased in 6 of the 10 advanced technology fields, and the overall number of HTS-10 in the ATP list increased from 543 in 1989 to 722 in 2006. Second, although the overall number of ATP products has increased incrementally, the number of products in some fields over time has fluctuated while the number of products in other fields has remained relatively stable.[8] For example, the number of products in information and communication technology has fluctuated greatly since 1989, falling from an initial level of 149 products to 118 by 1992, increasing sharply to 173 by 1995 and to 211 by 2001, and falling in 2006 to 205 products. Smaller fields, such as nuclear technology and advanced materials, have seen relatively few changes in the number of products. The largest numbers of net new lines have been in information and communication, flexible manufacturing, life science, electronics, and opto-electronics.

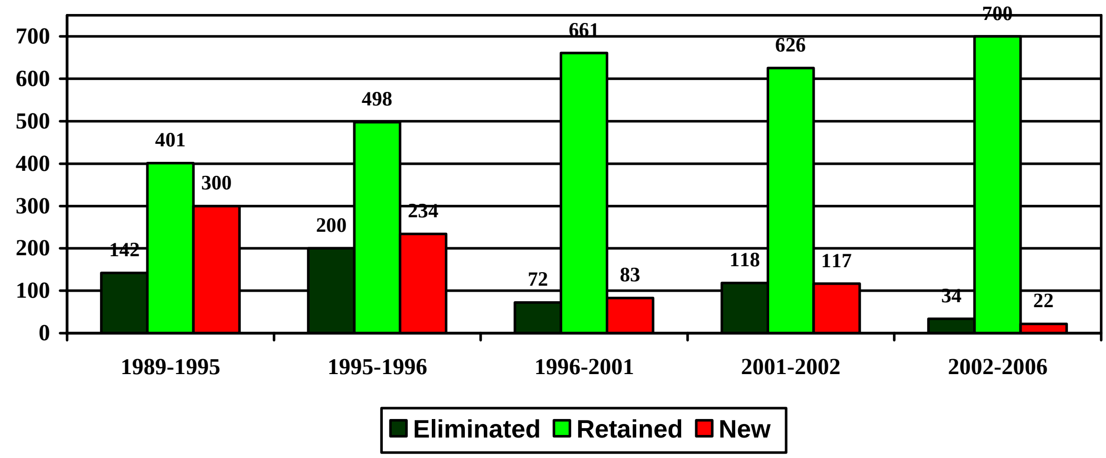
Table 1. The development of the U.S. Census ATP list: Number of HTS-10 codes in each advanced technology field, selected years

Advanced technology fields	1989	1992	1995	1996	2001	2002	2006
Biotechnology	14	14	17	17	17	21	21
Life Sciences	94	113	126	130	135	143	128
Opto-electronics	29	35	45	44	45	45	48
Information and communications	149	118	173	209	211	209	205
Electronics	50	82	85	94	91	76	76
Flexible manufacturing	77	93	132	114	114	117	124
Advanced materials	12	12	12	13	11	11	9
Aerospace	77	75	75	75	84	85	75
Weapons	25	24	24	24	24	24	20
Nuclear technology	16	16	12	12	12	12	16
Total	543	582	701	732	744	743	722

Source: Authors' calculation based on U.S. Census HTS-10 to ATP concordance.
Note: HTS-10 codes classified as ATP include both import and export codes. There are a few HTS-10 codes used for either imports or exports but not both.

[8] The number of HTS-10 codes change from year to year, but this does not necessarily indicate addition or deletion of "products". Rather it could result from the creation of two codes to replace an old one. The trade from the two new codes would equal that of the old single code.

Figure 1. Number of eliminated, retained and new HTS-10 codes in the U.S. ATP list, 1989 - 2006



Source: Authors calculation based on U.S. Census HTS-10 to ATP concordance

Revisions to the Census ATP list may be caused by revisions to the HS by the World Customs Organization, revisions to 10 digit HTS lines by the United States, or revised judgments by analysts as to whether or not a product is “high-tech”. Revisions to the HS, such as those that took place in 1996 and 2002, induce particularly dramatic changes to the ATP list, as illustrated in Figure 1.

Between 1995 and 1996, 200 old HTS-10 codes were eliminated and 234 new codes were added, and between 2001 and 2002, 118 old HTS-10 codes were eliminated and 117 new codes were added. A much smaller number of product code changes occurred between the 1996 and 2001 and between 2002 and 2006. This suggests that the U.S. ATP list is quite stable to each HS version and the lifetime of a particular HTS-10 code in the U.S. ATP list has become longer over time.

Table 2 further breaks down the number of deleted, retained, and new ATP codes during each period into the 10 advanced technology fields. ICT, life sciences and electronics seem the most dynamic technology fields during the sample period. As is apparent, some fields have seen a substantial amount of turnover in terms of both deleted and added codes. This is particularly true in the “information and communications” and “electronics” fields.

Table 2. The development of the U.S. Census ATP list: Number of deleted, retained and new HTS-10 codes in each advanced technology field, selected years

	1989 – 1995			1995 - 1996			1996- 2001			2001- 2002			2002- 2006		
Field	Deleted	Retained	New	Deleted	Retained	New	Deleted	Retained	New	Deleted	Retained	New	Deleted	Retained	New
Biotechnology	4	10	7	3	14	3	0	17	0	12	5	16	0	21	0
Life Science	23	73	53	6	117	13	9	122	13	27	108	35	10	128	0
Opto-Electronics	5	25	20	16	29	15	6	38	7	0	45	0	6	43	5
Information & Communications	53	90	83	84	89	120	38	172	39	6	205	4	4	205	0
Electronics	33	25	60	54	31	63	12	82	9	56	35	41	3	72	4
Flexible Manufacturing	9	68	64	34	98	16	6	108	6	10	104	13	1	116	8
Advanced Materials	2	7	5	1	11	2	1	11	0	0	11	0	2	9	0
Aerospace	8	67	8	2	73	2	0	75	9	1	83	2	6	74	1
Weapons	1	24	0	0	24	0	0	24	0	6	18	6	2	20	0
Nuclear Technology	4	12	0	0	12	0	0	12	0	0	12	0	0	12	4
Total	142	401	300	200	498	234	72	661	83	118	626	117	34	700	22

Source: Authors' calculation based on U.S. Census HTS-10 to ATP concordance.

2.2 The Development of High and New Technology Products (HNTP) Lists in China

Since the mid-1980s, China has employed a number of methods to identify high and new technology industries and screened associated products for various purposes. Chinese classification schemes appear to have been developed with different purpose in mind. Some schemes are focused on collecting data for statistical purposes, while others appear to have been developed explicitly to help support tracking and implementation of Chinese industrialization and development policies. There are five lists of high and new technology products (HNTP) that Chinese national government agencies have issued in recent years. Two of them are related to international trade in high-tech products (table 3) and have some similarities with the U.S. Census ATP classification (identified using italics in the table.).

One is the "High-Technology Product Imports and Exports Statistics Catalogue" jointly issued by the Ministry of Science and Technology and the Ministry of Foreign Trade and Economic Cooperation in 1999.[9] The catalogue was first published in the second issue of China Customs' "Monthly Statistical Report" in 2002, and has since become a part of official China Customs statistics. It divides high and new technology products into nine areas and covers 229 HS-6 codes. A comparison of this classification with the development of the U.S. Census ATP list in the next section suggests that this catalogue is similar to an earlier version of the U.S. Census list at the HS-6 level with minor modifications.

[9] The Ministry of Foreign Trade and Economic Cooperation (MOFTEC) was the predecessor of the Ministry of Commerce (MOFCOM).

Table 3. High and New Technology Products Lists Issued by Chinese Authorities

Name	Issuing Agencies	Version	Characteristics	Intended Purpose
China's High and New Technology Export Products Catalogue	*Ministry of Foreign Trade and Economic Cooperation, Ministry of Science and Technology, Ministry of Finance, State Administration of Taxation and the General Administration of Customs*	*2000*	*8 fields and 1900 products*	*Policy orientation - Basis for export value added tax (VAT) rebate benefits*
		2003	*9 fields and 1875 products*	
		2006	*9 fields and 1601 products*	
China's High and New Technology Product Import and Export Statistics Catalogue	*Ministry of Science and Technology and Ministry of Foreign Trade and Economic Cooperation*	*1999*	*9 fields and 229 HS-6 codes*	*Statistical orientation - used in China Customs' "Monthly Statistical Report" since 2002*
Foreign Investment Promotion High and New Technology Product Catalogue	Ministry of Science and Technology, Ministry of Commerce	2003 A new version is under revision	11 fields and 917 products	Policy orientation - Industrial policy guidance for foreign investors
China's High and New Technology Products Catalogue	Ministry of Science and Technology, Ministry of Finance, State Administration of Taxation	2000	11 fields and 2056 products	Policy orientation - Important basis for high-tech enterprise recognition and granting corporate (income) tax preferential benefits
		2006	11 fields and 1421 products	
China's High-tech Industry Statistics Classification Catalogue	National Bureau of Statistics	2002	8 industries and 4 digit GB/4754-2002 code	Statistical orientation - used in "China High-tech Industry Statistics Yearbook" since 2003

Source: Compiled from various Chinese Government publications. Entries in *italics* are the focus of further discussion and examination in this study.

The other is "High and New Technology Export Products Catalogue". It was jointly issued by the Ministry of Foreign Trade and Economic Cooperation (now the Ministry of Commerce), the Ministry of Science and Technology, the Ministry of Finance, State Administration of Taxation, and the General Administration of Customs to promote Chinese HNTP exports. It was based on the technology fields laid out by the Ministry of Science and Technology in consultation with U.S. and OECD classification standards for high-technology products and was reviewed by industry experts and relevant government departments. The ministries also considered the level of technological and scientific input, value added, inventiveness, breadth of application, and sustainability of a product when defining products within the product list. The first version was published in March 2000 and was broken into 8 technology fields, which encompassed a total of 1900 products. Most products are given HS-8 codes, but some are given HS-10 codes. It was revised in 2003 and 2006, respectively, consistent with the changes in the Harmonized Tariff Schedule and technological advances. The latest version contains 9 technology fields and 1601 products.

Table 4. Comparison of the China HNTP Import and Export Statistics Catalogue and HNTP Export Products Catalogue

<table>
<tr><th colspan="2">HNTP IMPORT AND EXPORT STATISTICS CATALOGUE</th><th colspan="3">HNTP EXPORT PRODUCTS CATALOGUE (2006 VERSION)</th></tr>
<tr><td></td><td>Number of HNT items(in HS 6 digit codes)</td><td></td><td>Number of HNT items (in HS 6 digit codes)</td><td>Number of HNT items (in HS 8 or 10 digit codes)</td></tr>
<tr><td>Total</td><td>229</td><td>Total</td><td>669</td><td>1601</td></tr>
<tr><td>Computers and telecommunications</td><td>37</td><td rowspan="2">Electronics and information</td><td rowspan="2">129</td><td rowspan="2">290</td></tr>
<tr><td>Electronics</td><td>24</td></tr>
<tr><td>Computer integrated manufacturing</td><td>53</td><td rowspan="2">Optical-mechanical-electrical integration</td><td rowspan="2">150</td><td rowspan="2">387</td></tr>
<tr><td>Optoelectronics</td><td>15</td></tr>
<tr><td>Life science</td><td>54</td><td rowspan="2">Biotech, pharmaceuticals and medical devices</td><td rowspan="2">105</td><td rowspan="2">334</td></tr>
<tr><td>Biotech</td><td>7</td></tr>
<tr><td>Aircraft and spacecraft</td><td>24</td><td>Aircraft and spacecraft</td><td>37</td><td>95</td></tr>
<tr><td>Materials</td><td>5</td><td>New materials</td><td>213</td><td>299</td></tr>
<tr><td rowspan="4">Other (energy, nuclear and weapons)</td><td rowspan="4">10</td><td>Software</td><td>2</td><td>9</td></tr>
<tr><td>New energy and energy saving products</td><td>46</td><td>82</td></tr>
<tr><td>Environmental protection</td><td>9</td><td>96</td></tr>
<tr><td>Modern agriculture</td><td>8</td><td>9</td></tr>
</table>

Source: Authors' calculation.

The other is "High and New Technology Export Products Catalogue". It was jointly issued by the Ministry of Foreign Trade and Economic Cooperation (now the Ministry of Commerce), the Ministry of Science and Technology, the Ministry of Finance, State Administration of Taxation, and the General Administration of Customs to promote Chinese HNTP exports. It was based on the technology fields laid out by the Ministry of Science and Technology in consultation with U.S. and OECD classification standards for high-technology products and was reviewed by industry experts and relevant government departments. The ministries also considered the level of technological and scientific input, value added, inventiveness, breadth of application, and sustainability of a product when defining products within the product list. The first version was published in March 2000 and was broken into 8 technology fields, which encompassed a total of 1900 products. Most products are given HS-8 codes, but some are given HS-10 codes. It was revised in 2003 and 2006, respectively, consistent with the changes in the Harmonized Tariff Schedule and technological advances. The latest version contains 9 technology fields and 1601 products.

Table 4 presents a comparison of the definitions and classifications used by the two lists. Although the HNTP Imports and Exports Statistics Catalogue was designed for trade data collection, the Customs' HNTP statistics without product level identification most likely over-estimate Chinese high-tech trade. By contrast, the HNTP Export Catalogue is policy oriented, and is used in the Chinese Government export promotion policies, specifically for VAT rebates. It makes much finer product-level distinctions (HS-8 or HS-10) than the HNTP Imports and Exports Statistics Catalogue (HS-6), and is more closely aligned to the U.S. Census' ATP classification system than any of the other four high-tech product classification systems currently used in China.

Table 5 gives a picture of the fairly extensive changes in the HNTP Export Products Catalogue over time. 29.1 percent of the HS-8 codes in the 2003 list was dropped from the 2006 list, and 28 percent of the HS-8 codes in the 2006 list is new. Table 6 lists the corresponding changes for each of the 9 technology fields between the 2003 and 2006 versions. As can been seen, there are substantial numbers of added and deleted codes in all of the technology fields relative to the size of each field, with the exception of software. Such changes may be explained in two ways.

The first explanation is associated with the rapid economic growth and technological progress in China during past decade. This technological progress is driven partly by domestic innovation and creation, and partly by imported technologies associated mainly with FDI inflows. The dramatic influence of FDI and multinational firms can be seen in most manufacturing sectors, both through direct technological transfer and spillovers to domestic enterprises.[10] Technological progress in China appears to have taken place more rapidly than in many developed economies due to the contribution of catch up and spillovers from high levels of FDI. Rodrik (2006a) argues that there are economy-wide productivity and growth advantages to developing a broad set of manufacturing industries, not only ATP sectors. Thus Chinese interest in encouraging and tracking "new" product sectors in addition to ATP products, may reflect this broader manufacturing diversification approach. The inclusion of new products in the statistics and the rapid evolution of manufacturing industries in China may lead to the relatively large number of changes observed in the Chinese HNTP catalogue.

The second possibility is that the changes are largely administrative in nature. The items in the HNTP Export Products Catalogue are first proposed by enterprises and then recommended by local governments and industrial sectors. Finally, they are screened jointly by the Ministry of Science and Technology and three other ministries. This process may contain several selection stages and is largely determined by the judgments of different groups of experts at each stage. This raises the possibility that changes in the list are more policy driven than technology driven.

[10] The empirical evidence on spillovers from FDI to domestic firms is mixed. See Smarzynska (2002) for a good summary of the literature and Rodrik (2006b) and Xu and Wang (2007) for China specific discussions.

Table 5. Development of the HNTP Export Products Catalogue

Version of HNT list	Number of sectors	Number of items	Number ofHS-8 CODES			
			Total	Deleted	Remaining	New
2000	8	1900	--	--	--	--
2003	9	1875	876	255	621	--
2006	9	1601	862	--	--	241

Source: Authors' calculation
Note: A single HS-8 line may contain more than one HNTP product. It may also contain non-HNTP products.

Table 6. Changes in the HNTP Export Products Catalogue by technology field

TECHNOLOGY FIELD	Number of items in 2006	Number of HS-8 codes				
		2003*	2006	Deleted	Remaining	New
Electronics and information	290	184(326)	211	37	147	64
Optical-mechanical-electrical integration	387	163(387)	186	32	131	55
Biotech, pharmaceuticals and medical devices	334	184(481)	142	73	111	31
Aircraft and spacecraft	95	43(100)	51	8	35	16
New materials	299	245(357)	224	104	141	83
Software	9	4(7)	4	0	4	0
New energy and energy saving products	82	82(103)	64	31	51	13
Environmental Protection	96	33(111)	29	10	23	6
Modern agriculture	9	9(10)	9	6	3	6

Source: Authors' calculation
Note: The figures in brackets are the number in the 2003 list.

2.3 Comparison of the U.S. Census ATP List with China's Two Trade-Related HNTP Lists

Table 7 lists the results of a line by line comparison between China's "HNTP Imports and Exports Statistics Catalogue" (which appears to be used mainly for statistical purposes) and the 2000 version of U.S. Census ATP list. It suggests that China followed an early version of the U.S. Census ATP list in making this catalogue. The 9 high-technology fields correspond to the 10 fields in the U.S. Census list with the last two ATP fields, "weapons" and "nuclear technology", merged into one area called "others" in the Chinese version. The HS-6 codes in each advanced technology field are very closely matched with the Census ATP list. China's own adjustments were mainly deletions of 19 HS-6 categories and insignificant in most fields except weapons. However, as noted earlier, because the HS-6 is still too aggregated to identify ATP products, this classification most likely results in an over estimate of Chinese ATP trade.

Table 7. A comparison between the U.S. Census 2000 version ATP list and China HNTP Import and Export Statistics Catalogue

Technology field	Common code	US-only code	China-only code
Biotechnology	7	0	0
Life Science	62	6	0
Opto-Electronics	15	1	0
Information & Communications	37	1	0
Electronics	22	0	0
Flexible Manufacturing	54	1	0
Advanced Materials	4	0	0
Aerospace	17	2	0
Weapons	5	7	0
Nuclear Technology	6	1	0
Total	229	19	0

Source: Authors' calculation.

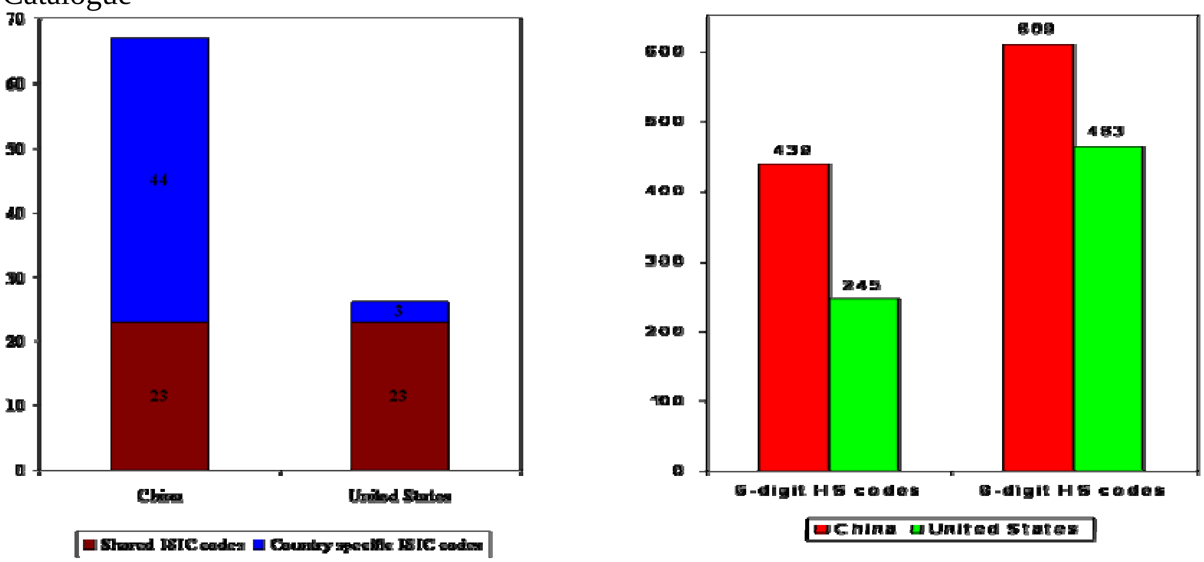
Now we turn to a comparison between the "HNTP Export Catalogue" (which is policy oriented, being used for determining VAT rebate benefits) and the U.S. Census' ATP list. The results of a line by line comparison are listed in table 8 and summarized in figure 2. For presentation purposes, we grouped the HS codes in each list according to International Standard Industry Classification (ISIC, revision 3) at the 4-digit level. This aggregation will also facilitate the synthesis of results from product and output based ATP classification methods used for these two lists with widely used sector and input based ATP classification methods,[11] provide a basis for linking identified ATP products in the list to production data, and facilitate comparison with other standards, such as the OECD ATP classification.

The detailed line by line comparison demonstrates that the HTNP Export Catalogue contains a number of products that are not considered "high-tech" in the U.S. list. This may be because some products that are "low-tech" or "medium-tech" by the U.S. standards are still "new" to China due to its current stage of technological development, and the list reflects the Chinese Government's interest in developing a diversified manufacturing base as part of its development policy. The U.S. list is concentrated in 26 ISIC-4 sectors and has not been changed in almost two decades. It corresponds fairly well with popular notions of what is meant by "high-tech". Three of these 26 sectors have no counterpart in the Chinese list (nuclear fuel processing, steam boilers, and weapons and ammunition). China's HTNP Export Products

[11] A detailed comparison of different ATP classification methods is given in appendix A.

Catalogue includes 67 ISIC-4 sectors, of which 44 do not appear in the U.S. list (left panel of figure 2). These 44 sectors range widely over all types of manufactures. They include sectors such as food, textiles, and furniture which many would consider to be "low-tech," as well as a number of sectors associated with capital goods, such as basic iron and steel, various types of machinery, and motor vehicles and parts. Even within the 23 ISIC-4 sectors in common between the two lists, Chinese coverage is broader. The Chinese list includes 439 HS-6 lines as compared to only 245 in the United States (right panel of figure 2).

Figure 2: Comparison between U.S. Census ATP list and China HNTP Export Product Catalogue



Source: Authors calculation.

These differences appear to reflect a fundamental conceptual difference in the two classification systems. The U.S. system covers only manufacture and focuses on products considered to be "high-tech" and is focused on providing statistical insights on trade-related developments in various advanced technology fields. The Chinese system also includes products which are considered "new" to China, as well as some agricultural sectors and one service sector (software consultancy and supply), reflecting the fact that its system is designed to play a role in providing statistical support to one of its development policies. The much larger number of HS-6 lines in the overlapping sectors may also be attributed to "new" products. It may also be the case that the use of the HNTP Export Products Catalogue for purposes of administering VAT rebates leads to the designation of some products as "new" which might not otherwise be so identified, so that they can qualify for the rebate. In any event, the combination of "high-tech" and "new" products on the same list complicates attempts to make international comparisons with lists from countries such as the United States that focus on a more narrow set of high-tech only products.

To empirically assess whether China's HNTP classification system overestimates Chinese ATP trade, we calculate the value of China-U.S. ATP trade as a share of China-U.S. total trade, essentially purging the effect of "new" products from the Chinese data. The share for China is computed from HS-8 China Customs statistics based on the Chinese HNTP Export Product

Catalogue, while the share for the United States is computed from HTS-10 statistics from the US International Trade Commission (USITC) Data Web and based on U.S. Census ATP classification. Table 7 reports the results of this calculation for 2005.[12] The results clearly show that in most cases, ATP trade shares based on Chinese data and classification are consistently higher than ATP trade shares based on U.S. data and classification, especially in Chinese ATP exports to the United States.

In the aggregate, the difference is larger for eastbound trade. 38.3 percent of China reported exports to the United States falls under the definition of the HNTP Export Catalogue, as compared to 24.3 percent of U.S. reported imports from China using the U.S. classification. For westbound trade the counts are much closer, with 31.8 percent of Chinese imports from the United States counted as ATP under the Chinese definition, while 29.4 percent of U.S. exports to China counted as ATP under the U.S. classification. It is not possible to directly decompose these differences, in part due to differences in product classifications and in part due to discrepancies in trade statistics, because the comparisons must be made at a finer level than HS-6. However, an examination of the sector-by-sector patterns in table 7, as well as the considerations discussed above about the conceptual differences in the classification schemes, suggest that the differences in product classification are probably driving the results.

In the case of Chinese exports to the United States (U.S. imports from China), most of the 23 ISIC-4 sectors gives a higher share using Chinese statistics and classification. At the aggregate level, the sectors overstate Chinese ATP exports to the U.S. by 57.6 percent. In the case of U.S. exports to China (Chinese imports from the United States), 18 sectors give a higher share for Chinese statistics and classifications, while 5 sectors give a higher share using U.S. statistics and classification. These latter 5 sectors are for U.S. exports to China under the categories "publishing of recorded media," "office, accounting, and computing machinery," "electronic valves and tubes and other electronic components," "industrial process control equipment," and "aircraft and spacecraft."

[12] We have performed this calculation for all years from 2002 through 2006. The results are available from the authors upon request.

Table 8. Comparison between the U.S. Census ATP list and China HNTP Export Catalogue, by ISIC rev.3

ISIC	Industry description	2006 U.S. Census ATP list			2006 China HTNP export Catalogue	
Common Industries		No. of HTS-6 codes	No. of HTS-8 codes	No. of HTS-10 codes	No. of HS-6 codes	No. of HS-8 codes
2213	Publishing of recorded media	5	7	9	2	2
2411	Basic chemicals, except fertilizers and nitrogen compounds	26	40	45	79	91
2423	Pharmaceuticals, medicinal chemicals and botanical products	19	25	32	47	57
2429	Other chemical products n.e.c.	1	1	3	14	17
2911	Engines and turbines, except aircraft, vehicle and cycle engines	3	4	9	6	9
2914	Ovens, furnaces and furnace burners	1	1	1	1	1
2915	Lifting and handling equipment	2	2	3	3	3
2919	Other general purpose machinery	1	2	2	17	23
2922	Machine-tools	39	62	86	29	42
2929	Other special purpose machinery	4	4	7	13	17
3000	Office, accounting and computing machinery	12	47	69	15	42
3110	Electric motors, generators and transformers	1	2	2	16	24
3120	Electricity distribution and control apparatus	1	1	3	12	14
3130	Insulated wire and cable	1	1	1	5	5
3190	Other electrical equipment n.e.c.	4	5	5	14	19
3210	Electronic valves and tubes and other electronic components	16	20	72	31	37
3220	Television and radio transmitters and apparatus for line telephony and telegraph	8	37	52	10	38
3230	Television and radio receivers, sound or video recording or reproducing apparatus	7	54	69	16	29
3311	Medical and surgical equipment and orthopedic appliances	22	40	45	27	38
3312	Instruments and appliances for measuring, checking, testing, navigating and other	34	62	78	45	58
3313	Industrial process control equipment	3	4	14	2	2
3320	Optical instruments and photographic equipment	16	21	27	19	20
3530	Aircraft and spacecraft	17	19	54	15	20
	Unclassified	2	2	2	1	1
	Subtotal	245	463	690	439	609
US only Industries						
2330	Processing of nuclear fuel	4	5	15		
2813	Steam generators, except central heating hot water boilers	2	2	2		
2927	Weapons and ammunition	9	10	14		
	Subtotal	15	17	31		
	U.S. total	260	480	721		

Table 8–cont. China-only ISIC Industries

ISIC	Industries description	No. of 6-digit HS code	No. of 8-digit HS code
0111	Growing of cereal and other crops n.e.c.	1	1
0200	Forestry, logging and related service activities	2	2
1532	Starches and starch products	2	2
1549	Other food products n.e.c.	1	1
1711	Preparation and spinning of textile fibers; weaving of textiles	3	3
1721	Made-up textile articles, except apparel	1	1
1729	Other textiles n.e.c.	1	1
2010	Sawmilling and planting of wood	1	1
2101	Pulp, paper and paperboard	1	1
2310	Coke oven products	1	1
2320	Refined petroleum products	1	1
2412	Fertilizers and nitrogen compounds	3	3
2413	Plastic in primary and forms and of synthetic rubber	10	10
2421	Pesticides and other agro-chemical products	2	2
2422	Paints, varnishes and similar coatings, printing ink and mastics	2	2
2511	Rubber tires and tubes; rethreading and rebuilding of rubber tires	2	2
2519	Other rubber products	1	1
2520	Plastic products	5	5
2610	Glass and glass products	11	11
2691	Non-structural non-refractory ceramic ware	1	1
2692	Refractory ceramic products	4	4
2699	Other non-metallic mineral products n.e.c.	3	3
2710	Basic iron and steel	19	19
2720	Basic precious and non-ferrous metals	46	50
2893	Cutlery, hand tools and general hardware	5	5
2899	Other fabricated metal products n.e.c.	9	9
2912	Pumps, compressors, taps and valves	12	16
2913	Bearings, gears, gearing and driving elements	4	4
2921	Agricultural and forestry machinery	1	1
2923	Machinery for metallurgy	2	2
2924	Machinery for mining , quarrying and construction	3	3
2926	Machinery for textile, apparel and leather production	5	6
2930	Domestic appliances n.e.c.	2	2
3140	Accumulators, primary cells and primary batteries	5	6
3150	Electric lamps and lighting equipment	1	1
3410	Motor vehicles	2	3
3420	Bodies (coachwork) for motor vehicles: trailers and semi-trailers	1	1
3430	Parts and accessories for motor vehicles and their engines	4	4
3511	Building and repairing of ships	2	2
3610	Furniture	1	1
3691	Jewelry and related articles	1	1
3693	Sports goods	2	2
3699	Other manufacturing n.e.c.	3	3
7220	Software consultancy and supply	1	4
	Subtotal	190	204
	China total	629	813

Source: Authors' calculation.

2.4 The relative advantages and disadvantages of the US and Chinese classifications

Chinese experts generally rationalize the use of the broader definition of high and new technologies because of China's broad industrialization policy. One exception is the definition of high-technology that has been used by the NBS to collect and publish Chinese high-tech industry statistics. Clearly, there is a distinction between the concepts of "high-tech" and "new-tech", though some people frequently misuse the term "high-tech" to refer to both high-tech and new-tech simultaneously. As a result, the current classification of high and new technology products in China tends to inflate high-tech related statistics and makes useful cross country comparisons of Chinese high-tech statistics very difficult. The mix of high and new tech products together needs to be understood and carefully considered when making cross country comparisons. China may find it useful to separate high-tech products, to ensure consistency with standards in the advanced industrial countries, while also having a separate list of "new products" that may be in medium or even in some low tech industries, but still "new" to China given its current stage of technological development. Mixing the two types of very different products makes construction, evaluation and implementation of the ATP classification systems more difficult.

Another potential disadvantage is the use of too many different classification systems for statistics collection and for policy incentives. This may not only increase confusion and administrative costs, but it also may make revisions difficult. For example, products on the HNTP Export Products catalogue receive higher VAT rebates, which may make any modification of the HNTP list sensitive to vested interests.

In addition, some existing high and new technology product classifications are too detailed to be assigned unique codes. For example, most products in the export HNTP Export Products catalogue can not be fully identified even at the HS-10 level, and an 8-digit HS code is frequently shared by other similar HNT products, even non-HNT products. It may be useful to assign distinct HS codes to each high-tech product as the United States does, both for statistics collection and policy incentive administration purposes.

The U.S. Census ATP list has its advantages and disadvantages as well. The U.S. list benefits from identifying specific, individual products at the most disaggregated HTS-10 level. The discretion provided by doing analysis at the HTS-10 level corrects the problems of more blunt methods of measuring ATP, which defined ATP by industry even if a major portion of the individual products within the industry clearly not an advanced technology products. Thus, the Census list reflects more detailed analysis of an individual product's potential for being an advanced technology product and results in a list that is more disaggregated than many other lists in the world.

Another advantage of the Census ATP list is its flexibility. As products become more sophisticated or other products become more mature, the analysts who revise the list have the discretion to change it so that it reflects as accurately as possible those products that should be considered advanced technology products in a given year.[13]

Table 9. Comparison of share of ATP trade in total trade by industries based on statistics and classification from China and the United States, 2005

ISIC	*Industry Name*	*China Exports to U.S.*	*U.S. imports from China*	*China imports from U.S.*	*U.S. exports to China*
2213	Publishing of recorded media	0.1	93.8	6.8	98.9
2411	Basic chemicals, except fertilizers and nitrogen compounds	49.4	1.6	20.9	0.2
2423	Pharmaceuticals, medicinal chemicals and botanical products	72.9	5.4	73	12.1
2429	Other chemical products n.e.c.	72.8	1.9	32.7	2.5
2911	Engines and turbines, except aircraft, vehicle and cycle engines	18.3	4.8	52.5	4.2
2914	Ovens, furnaces and furnace burners	14	0.2	14.1	5.4
2915	Lifting and handling equipment	4.5	0.1	5.7	3.9
2919	Other general purpose machinery	12.7	0	39.1	0.9
2922	Machine-tools	5.1	1.1	62	32.8
2929	Other special purpose machinery	71.7	1.0	59.1	24.8
3000	Office, accounting and computing machinery	97.2	82.9	90.8	93.8
3110	Electric motors, generators and transformers	52.8	0.9	57.3	0
3120	Electricity distribution and control apparatus	58.7	6.7	52.3	7.5
3130	Insulated wire and cable	18.9	3.5	40.6	6.3
3190	Other electrical equipment n.e.c.	59.6	0.2	59.3	23.8
3210	Electronic valves and tubes and other electronic components	49.5	75.2	44.9	94.2
3220	Television and radio transmitters and apparatus for line telephony and telegraph	100.0	86.1	99.8	90.5
3230	Television and radio receivers, sound or video recording or reproducing apparatus	58.9	43.0	50.8	19.3
3311	Medical and surgical equipment and orthopaedic appliances	63.3	33.1	94.9	69.4
3312	Instruments and appliances for measuring, checking, testing, navigating and other	76.2	27.8	90.8	60.2
3313	Industrial process control equipment	38.7	66.1	76.0	48.3
3320	Optical instruments and photographic equipment	28.1	5.9	59.0	18.0
3530	Aircraft and spacecraft	97.1	96.5	26.6	95.8
	Total	38.3	24.3	31.8	29.4

Source: Authors' calculation. U.S. share based on Census ATP list and USITC Oracle database; China's share based China's HNTP Exports Catalogue and trade statistics from China Customs.

However, the Census list does not appear to fully use available quantitative criteria to supplement analysts' judgment in creating the list. As will be described in the next section, there are certain quantitative checks that can be created from trade statistics and used to complement analysts' judgment in creating a more accurate list.

[13] Some may consider the flexibility of the ATP list to be a disadvantage in the sense that analysts' discretion in influencing the list is a less scientific method of arriving at the list and thus detracts from the value of the list.

The U.S. Census ATP list has its advantages and disadvantages as well. The U.S. list benefits from identifying specific, individual products at the most disaggregated HTS-10 level. The discretion provided by doing analysis at the HTS-10 level corrects the problems of more blunt methods of measuring ATP, which defined ATP by industry even if a major portion of the individual products within the industry clearly not an advanced technology products. Thus, the Census list reflects more detailed analysis of an individual product's potential for being an advanced technology product and results in a list that is more disaggregated than many other lists in the world.

Another advantage of the Census ATP list is its flexibility. As products become more sophisticated or other products become more mature, the analysts who revise the list have the discretion to change it so that it reflects as accurately as possible those products that should be considered advanced technology products in a given year.[14]

However, the Census list does not appear to fully use available quantitative criteria to supplement analysts' judgment in creating the list. As will be described in the next section, there are certain quantitative checks that can be created from trade statistics and used to complement analysts' judgment in creating a more accurate list.

2.5 Some final remarks on ATP classification

This section has described and compared the different ATP classification methods currently employed by the United States and China, especially these classifications related to ATP trade. Detailed historical data comparison shows that the China HNTP Exports and Imports Statistical Catalogue is essentially a duplication of the 2000 version of the U.S. Census ATP list at aggregate HS-6 level. It also appears that the Chinese HNTP Export Catalogue may be too broad to allow for direct comparison with U.S. Census ATP list. The Chinese HNTP Export Catalogue includes many "new" products that are clearly not high-tech. We further computed the share of ATP trade in total trade by ISIC group using both countries' classification and official trade statistics, and found Chinese classification and data resulted in a much higher ATP share in total trade than that based on U.S classification and data. However, problems also exist in current U.S. Census classification method.

One tool that does not yet appear to have been applied in either country's ATP classification methodology is an analysis of "high-tech" products based on general trade statistics. Quantitative measures developed from more general trade statistics might potentially complement the current criteria the United States and China have used in forming their ATP lists. Examples of potential quantitative measures that may help refine ATP classification schemes include trade weighted unit value index, ATP value share and number of product share in product group or industries.

[14] Some may consider the flexibility of the ATP list to be a disadvantage in the sense that analysts' discretion in influencing the list is a less scientific method of arriving at the list and thus detracts from the value of the list.

Using the ratio of trade weighted unit values between ATP products and all products may help analysts pinpoint potential areas of focus within product classifications. Theoretically, the ratio of the trade-weighted unit value of ATP products in a given sector to the trade weighted unit value of all products in that sector should be more than one, if one is to assume that the unit value of ATP products is greater than the unit value of ATP plus non-ATP products.[15] Regarding ATP value shares, theoretically, sectors that have a majority of their products defined as ATP should also have a majority of their value attributed to ATP products. Attention should be paid when a sector has a high percentage of its products defined as ATP but a low percentage of its value captured from actual trade statistics as ATP.[16]

These two measures simply illustrate that using quantitative measures based on general trade statistics has the potential for being a useful tool to help define ATP. Researchers should bear in mind that the applicability and accuracy of any ATP classification should be testable. International trade statistics may be the best data available for conducting such tests. However, it is beyond the focus of this current study to determine how to accurately define and implement these kinds of tools, and this topic will be addressed in a related, later report as part of this joint research project. Appendix tables A1-A3 provide a possible point of departure for such future research.

III. Reconciliation of ATP Trade Statistics between China and the United States

3.1 Methodological Considerations

Based on the above comparison of U.S. and Chinese ATP trade classification schemes, we can see that the China HNTP Exports and Imports Statistical Catalogue is essentially a duplication of the 2000 version of the U.S. Census ATP list at aggregate HS-6 level. It also appears that Chinese HNTP Export Catalogue includes many "new" products that would generally not be considered "high-tech." We further computed the share of ATP trade in total trade by ISIC group using both countries' classification and official trade statistics, and found Chinese classification and data resulted in a much higher ATP share in total trade than that based on U.S classification and data. The major strength of U.S. Census ATP list is that it identifies specific, individual products at the most disaggregated HTS-10 level. The discretion provided by doing analysis at the HTS-10 level corrects the problems of more blunt methods of measuring ATP, which defined ATP by industry even if a major portion of the individual products within the industry are clearly not advanced technology products. Thus, the U.S. Census list reflects more detailed analysis of an individual product's potential for being an advanced technology product

[15] It must be emphasized that in some industries with highly heterogeneous physical units, the trade weighted unit value may not be a sufficient tool for measuring ATP, because it may not represent the actual relative value for the industry in the aggregate. For example, in the auto industry, a car may not be classified as ATP, but a GPS or some other small electronic device that is a part of a car could be defined as ATP, therefore, the trade weighted unit value of ATP at the industry level may be much lower than the industry average trade weighted value. Therefore, great care must be exercised in using this tool, and it certainly should not be the only tool used to measure ATP.

[16] This example occurs consistently from 1996 to 2006 for U.S. exports to the world of ISIC sector code 3313 (industrial process control equipment) where the number of ATP products in the sector is almost 80 percent yet the value attributed by ATP products vary between 28 and 54 percent (see appendix table 2).

and results in a list that is more disaggregated than Chinese classification. It appears to correspond more closely to conventional ideas of "high-tech," while two of current Chinese HNTP classifications relating to trade are likely to overstate Chinese ATP trade. Therefore, we decide to use the current U.S. ATP classification as a basis to conduct a reconciliation of U.S.-China ATP trade statistics. This is done for practical reasons, rather than to rule out the possibility that a better classification may emerge in the future. By using a single classification, we can focus on differences in the measured trade arising from differences in U.S. and China trade data.

To make U.S. and China ATP data comparable, we first calculate the ATP value share in both U.S. imports from and exports to China at the HS-6 level based on U.S. trade statistics, bearing in mind that within each HS-6 heading, some of the U.S. HTS-10 lines are considered to be ATP and some are not. We then apply these same shares to the China Customs data at the HS-6 level.[17] In order to compare U.S.-reported ATP trade with the implied values of ATP trade in China Customs data using the U.S. definition, we aggregate the data both into ISIC industries and the 10 U.S. technology fields, and then examine variation by the type of firm trading (SOE, FIE etc.), the type of customs regime in China (normal, processing, etc), and the type of incentive scheme (special economic zones, economic and technology development zones, etc). The advantage of this approach is that we blend the information available in the Chinese data on firm types, customs regimes, and incentive zones with the information in the U.S. data on the finely disaggregated definition of ATP, and thus obtain more detailed structural information on U.S.-China ATP trade. Of course, more precise and specific assumptions (e.g. all exports from export processing zones are assumed to be processing exports) could be made, but this simple assumption is a good starting point to test the proposed method.

Table 10 reports the value share of ATP in total U.S.-China merchandise trade by ATP-producing industries, aggregated from the detailed HS-6 to ISIC-4, as found in the U.S. data. It shows that the share of ATP in U.S. exports to China is significantly higher than U.S. imports from China; however, the ATP share of U.S. imports from China rises quickly after 2001. Within the ISIC-4 categories containing at least some ATP, the shares of ATP trade in 1996 were 26.4 percent for U.S. exports to China and 7.4 percent for U.S. imports from China, rising to 31.9 percent of U.S. exports to China and 25.3 percent of U.S. imports from China in 2006.
Another important adjustment that must be made in U.S.-China ATP statistics reconciliation relates to re-exports of ATP by Hong Kong. It is well known that a large share of Chinese trade with the United States passes through Hong Kong, while current statistics reporting practices in both countries do not fully reflect this fact. This creates a systemic bias in official trade statistics in both countries, leading to conflicting officially reported bilateral trade balances. To solve this problem, we treat data reported by China and Hong Kong as one side and data

[17] This assumption is not as dangerous as it may appear at first. One may well be concerned that the composition of production and trade at a finer level than HS-6 varies a lot across countries. But we actually have two measures of the same trade flow (U.S. exports to China = China's imports from the United States), and vice versa. Thus, the actual maintained assumption is simply that the degree of over or under reporting in Chinese data relative to U.S. data is constant for each HTS-10 code within an HS-6 code. Since the identification of certain HTS-10 codes as ATP is only observable in the U.S. data, this assumption is necessary.

reported by the United Sates as the other side. This method avoids the necessity of accounting explicitly for Hong Kong re-export markup.[18]

The calculation of exports and imports from both sides is conducted as follows: in eastbound trade, the exports side of the mirror equals China's reported exports to the United States, plus Hong Kong domestic exports and Hong Kong reported re-exports for China to the United States, while the import side of the mirror equals the sum of U.S. reported total imports from China and Hong Kong. Similarly, in westbound trade, the export side of the mirror equals U.S. reported exports to China, plus U.S. reported total exports to Hong Kong minus Hong Kong re-exports of goods to third countries other than China with U.S. origin, while the import side of the mirror equals the sum of China and Hong Kong reported imports originated from the United States after fob/cif adjustment, subtracting Hong Kong re-exports from the U.S. to China in order to avoid double-counting. This method of constructing the mirror data makes it unnecessary to consider the Hong Kong re-export markup first, as in Feenstra and Hanson (2004), because both sides of the mirror include the markup. ATP trade flows via Hong Kong are estimated in a similar way to China reported ATP trade, ATP value share of exports to and import from Hong Kong at the 6-digit HS level calculated from U.S. reported data were applied to Hong Kong reported total imports and domestic exports, while ATP value share of imports from China at the 6-digit HS level calculated from U.S. reported data was applied to Hong Kong reported re-exports of China-originated goods to the United States.

[18] See Ferrantino and Wang (2007) for a fuller treatment of issues involving trade data reconciliation among China, Hong Kong, and the United States.

Table 10. ATP value share in total US-China merchandise trade by ATP-producing sectors, selected years, in percent

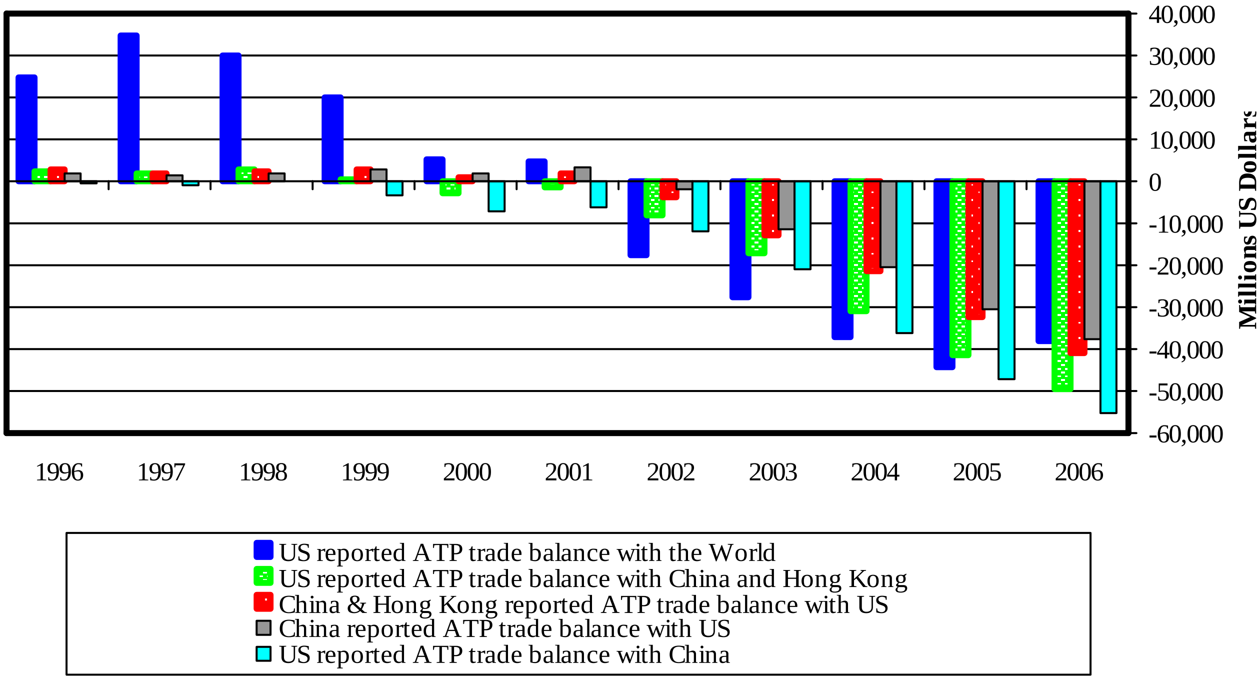
ISIC	Industry Name	U.S. exports OF ATP to China %			U.S. imports OF ATP from China %		
		1996	2001	2006	1996	2001	2006
2213	Publishing of recorded media	79.6	93.2	99.2	57.0	69.9	90.4
2330	Processing of nuclear fuel	100.0	99.0	87.4	100.0	100.0	100.0
2411	Basic chemicals, except fertilizers and nitrogen compounds	1.6	0.1	0.2	1.1	1.0	3.2
2423	Pharmaceuticals, medicinal chemicals and botanical products	4.7	9.2	12.1	4.0	3.7	5.1
2429	Other chemical products n.e.c.	1.5	2.0	7.1	1.7	1.5	2.2
2813	Steam generators, except central heating hot water boilers	0.0	7.9	0.0	0.0	0.0	0.3
2911	Engines and turbines, except aircraft, vehicle and cycle engines	6.2	10.1	8.6	3.2	7.3	4.9
2914	Ovens, furnaces and furnace burners	5.2	6.2	0.8	0.0	0.1	0.0
2915	Lifting and handling equipment	0.0	1.4	3.0	0.0	0.0	0.0
2919	Other general purpose machinery	0.7	0.7	0.7	0.0	0.1	0.0
2922	Machine-tools	28.1	44.6	43.9	0.5	0.7	1.9
2927	Weapons and ammunition	99.3	8.0	5.4	21.9	40.4	34.6
2929	Other special purpose machinery	19.7	33.9	29.7	2.0	0.4	1.3
3000	Office, accounting and computing machinery	92.6	96.8	93.9	62.7	69.8	84.7
3110	Electric motors, generators and transformers	0.0	0.0	0.0	0.5	0.7	0.8
3120	Electricity distribution and control apparatus	5.0	4.7	10.0	9.8	6.8	6.2
3130	Insulated wire and cable	17.2	13.3	5.2	0.1	1.9	4.1
3190	Other electrical equipment n.e.c.	14.2	10.4	26.6	0.2	0.1	0.1
3210	Electronic valves and tubes and other electronic components	79.4	90.3	95.4	58.8	72.1	74.7
3220	Television and radio transmitters and apparatus for line telephony and telegraph	91.0	91.0	93.9	25.9	48.3	87.6
3230	Television and radio receivers, sound or video recording or reproducing apparatus	4.5	7.4	11.3	20.9	40.5	47.9
3311	Medical and surgical equipment and orthopedic appliances	72.7	73.2	65.9	54.9	68.2	37.6
3312	Instruments and appliances for measuring, checking, testing, navigating and others	63.6	65.8	59.9	17.8	21.9	40.2
3313	Industrial process control equipment	66.1	57.9	53.8	17.8	9.7	62.9
3320	Optical instruments and photographic equipment	75.5	60.6	19.2	8.7	7.1	6.1
3530	Aircraft and spacecraft	98.9	98.7	94.9	98.5	98.5	95.9
	Total	26.4	37.7	31.9	7.4	13.1	25.3

Source: Authors' calculation based on U.S. Census HTS-10 to ATP concordance and USITC Oracle database.

3.2 Results: Balance of China-U.S. ATP trade

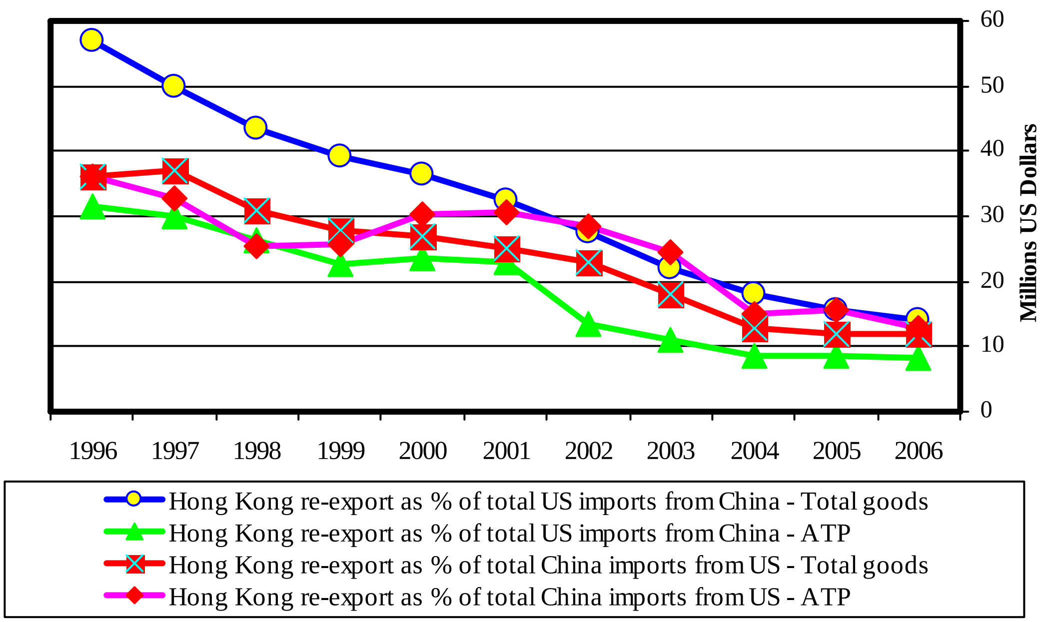
Figure 3 shows the China-U.S. trade balance in ATP reported by the United States, by China, and by the United States and China and Hong Kong. U.S. net exports to the world are also provided as a benchmark. Although statistical discrepancies still exist even after adjustments for re-exports via Hong Kong, the data from all sources consistently show a similar pattern. The United States as a leading technological nation had enjoyed a large surplus in ATP with the world until the end of the 1990s. However, the surplus shrunk quickly in the turn of the century and became a deficit unambiguously in 2002. Since then the U.S. trade deficit for ATP has grown rapidly, with China as one of the largest contributors. The adjustment of re-exports through Hong Kong only has a modest impact on the discrepancies in China-U.S. ATP trade statistics, a similar finding to Ferrantino and Wang (2007) on general merchandise trade data.

Figure 3: U.S. net exports in ATP to China and the world, 1996-2006



There is an interesting pattern regarding re-exports of ATP. Hong Kong re-exports play a more important role in U.S. exports of ATP to China than in U.S. imports of ATP from China. Figure 4 shows that while the role of Hong Kong as a "middleman" between China and the United States has declined in the last decade, the share of Hong Kong re-exports of China originated ATP as the share of U.S. reported ATP imports from China is significantly lower than such shares in general merchandise, and also it is consistently lower than Hong Kong re-exports of U.S.-originated ATP to China as a share of the total China ATP imports from the United States.

Figure 4: The role of Hong Kong re-exports in US-China ATP trade, 1996-2006



Tables 11 and 12 decompose the aggregated ATP trade balance for the 10 advanced technology fields and the 26 ISIC ATP producing industries, respectively. If the data were perfectly consistent, we would expect to see the same numbers with the opposite sign.

Table 11. Trade balance in ATP reported by the United States and China & Hong Kong in major technology fields, selected years, in millions of U.S. dollars

Advanced technology fields	**U.S. reported**			**China & Hong Kong reported**		
	1998	2002	2006	1998	2002	2006
Biotechnology	3	5	5	10	31	20
Life Science	196	269	617	-173	-419	-867
Opto-Electronics	-512	-3,316	-12,794	313	1,888	11,800
Information & Communications	-1,600	-12,024	-50,705	1,215	7,848	43,104
Electronics	511	2,693	6,514	-1,150	-2,267	-5,946
Flexible Manufacturing	223	544	795	-200	-642	-1,404
Advanced Materials	123	60	42	-227	-320	-151
Aerospace	3,932	3,616	6,326	-2,077	-2,332	-5,833
Weapons	-10	2	-98	-6	-18	70
Nuclear Technology	14	-82	-29	-6	78	29
Total	2,881	-8,233	-49,327	-2,301	3,847	40,822

Source: Authors' calculation. U.S. reported data based on U.S. Census HTS-10 to ATP concordance and USITC Oracle database; China & Hong Kong reported data are computed by applying U.S. ATP trade share at HS-6 to official trade statistics from China Custom Administration and Hong Kong Census and Statistics Department.

Although discrepancies remain between U.S. reported and China & Hong Kong reported ATP trade balances, the pattern of net ATP trade flows are rather consistent (opposite sign) in nine of the 10 advanced technology fields, except biotechnology. The Chinese surplus is mostly concentrated in information and communications technology and opto-electronics, while the U.S. surplus is concentrated in electronics, aerospace, flexible manufacturing and life sciences.

When aggregated according to the 26 ISIC-4 ATP-producing industries, the net trade pattern is also generally consistent in U.S. and China & Hong Kong reported data, matching in 22 of 26 cases in 2006. Chinese ATP surplus was concentrated in office, accounting and computing machinery (3000); television and radio transmitters (3220) and television and radio receivers (3230). These categories are relatively likely to be consumer goods, though many computers are also capital goods. The U.S. surpluses are concentrated in capital-goods sectors such as electronic components (3210), instruments (3313), and aircraft and spacecraft (3530), which earned the United States the largest surplus from China. The four ISIC-4 industries for which both sides reported surpluses (2432 pharmaceuticals, 3320 optical instruments) or deficits (3120 electricity distribution and control apparatus, 3313 industrial process control equipment) in 2006 played a relatively small role in the overall ATP trade balance.

Table 13 shows the bilateral trade in ATP products using the U.S. Census classification and decomposes the aggregated US-China ATP trade balance in figure 3 into the10 advanced technology fields. The overall amount of discrepancy is larger in the eastbound direction than in the westbound direction, consistent with Ferrantino and Wang (2007). The eastbound trade as reported in U.S. data is about 14 percent larger than in China/Hong Kong data, while the westbound trade is about 3 percent larger. The distribution of trade among the advanced technology fields is similar regardless of which side data are used. China-Hong Kong exports to the United States are dominated by the “Information and Communications” category, which also accounts for most of the discrepancy. U.S. exports to China and Hong Kong are more diversified with “Electronics,” “Aerospace,” and “Information and Communications” taking the top three places and accounting for over 80 percent of the total.

The pattern of net ATP flows is consistent regardless of whether U.S. data or China-Hong Kong data are used as the base. The identification of one side or the other as being in surplus is consistent in nine of the 10 advanced technology fields, bearing in mind that a surplus reported by one side corresponds to a deficit reported by the other, so we should expect the sign to be opposite. Biotechnology is the one exception. The Chinese surplus is mostly concentrated in information and communications technology and opto-electronics, while the U.S. surplus is concentrated in electronics, aerospace, flexible manufacturing and life sciences.

Disaggregated eastbound and westbound trade at ISIC-4 industries reported by the two sources is listed in appendix tables A4 and A5. Under such an aggregation, the largest categories of China-Hong Kong reported exports to the United States are ISIC 3000, “Office, accounting and computing machinery,” ISIC 3220, “Television and radio transmitters and apparatus for line telephony and telegraph,” and ISIC 3230, “Television and radio receivers, sound or video recording or reproducing apparatus.” These three categories account for over 90 percent of China-Hong Kong ATP exports to the United States (U.S. ATP imports from China-Hong Kong), and are consistent regardless of which side data are used. While the statistics for U.S. exports of ATP goods to China and Hong Kong (China/Hong Kong imports of ATP goods from the United States) match fairly well regardless of which side data are used. At the ISIC-4 level, the bilateral specialization in ATP becomes clearer. A majority of U.S. exports are either in ISIC 3210, which includes semiconductors and integrated circuits, and ISIC 3530, "Aircraft and Spacecraft." It can be argued that the main U.S. export categories require a higher degree of technological capacity than the main China/Hong Kong export categories. Final assembly of computers and radio/TV equipment, which include a high share of consumer goods, is comparatively labor-intensive and migrates easily from country to country, while the technology for producing semiconductors and aircraft diffuses more slowly and remains relatively more concentrated near the location of R&D.

Table 12. Trade balance in ATP trade reported by the United States and China & Hong Kong in ISIC sectors, selected years, in millions of U.S. dollars

ISIC	INDUSTRY NAME	U.S. reported			China & Hong Kong reported		
		1998	2002	2006	1998	2002	2006
2213	Publishing of recorded media	65	-22	61	-19	-38	-220
2330	Processing of nuclear fuel	1	-92	-47	-2	90	36
2411	Basic chemicals, except fertilizers and nitrogen compounds	-10	-9	-84	8	8	70
2423	Pharmaceuticals, medicinal chemicals and botanical products	5	0	2	16	38	26
2429	Other chemical products n.e.c.	6	9	61	-151	-285	-196
2813	Steam generators, except central heating hot water boilers	0	0	0	-3	-9	0
2911	Engines and turbines, except aircraft, vehicle and cycle engines	25	28	159	-11	-5	-44
2914	Ovens, furnaces and furnace burners	2	4	3	-2	-3	-2
2915	Lifting and handling equipment	5	9	8	-1	-5	-9
2919	Other general purpose machinery	0	6	4	0	-10	-7
2922	Machine-tools	83	192	304	-51	-177	-433
2927	Weapons and ammunition	-1	-5	-39	1	1	9
2929	Other special purpose machinery	47	204	283	-80	-259	-545
3000	Office, accounting and computing machinery	-1,881	-9,301	-37,462	1,454	5,072	30,754
3110	Electric motors, generators and transformers	-8	-17	-38	6	16	37
3120	Electricity distribution and control apparatus	-42	-41	-58	-10	4	-45
3130	Insulated wire and cable	22	7	-55	-6	-7	29
3190	Other electrical equipment n.e.c.	13	77	155	-8	-91	-271
3210	Electronic valves and tubes and other electronic components	524	2,713	6,434	-1,095	-2,188	-5,634
3220	Television and radio transmitters and apparatus for line telephony and telegraph	520	-1,951	-14,316	-651	1,351	12,820
3230	Television and radio receivers, sound or video recording or reproducing apparatus	-1,066	-4,138	-11,553	685	3,349	11,369
3311	Medical and surgical equipment and orthopaedic appliances	34	9	137	-39	-100	-387
3312	Instruments and appliances for measuring, checking, testing, navigating and others	351	495	627	-192	-560	-823
3313	Industrial process control equipment	34	-10	-105	-45	-26	-45
3320	Optical instruments and photographic equipment	56	15	23	-43	-11	109
3530	Aircraft and spacecraft	4,096	3,586	6,169	-2,067	-2,325	-5,792
	Total	2,881	-8,233	-49,327	-2,306	3,830	40,806

Source: Authors' calculation. U.S. reported data based on U.S. Census HTS-10 to ATP concordance and USITC Oracle database; China & Hong Kong reported data are computed by applying U.S. ATP trade share at HS-6 to official trade statistics from China Custom Administration and Hong Kong Census and Statistics Department.

Table 13. Trade in ATP reported by the United States and China & Hong Kong in major technology fields, selected years, in millions of U.S. dollars

Advanced technology fields	1996	1998	2000	2002	2004	2006	1996	1998	2000	2002	2004	2006
East bound trade	**U.S. Reported ATP Imports From China & Hong Kong**						**China & Hong Kong Reported ATP Exports to the U.S**					
Biotechnology	10	13	10	15	25	47	14	17	33	48	71	67
Life Science	176	250	364	461	602	632	120	203	314	340	437	408
Opto-Electronics	537	924	2,377	3,894	8,263	13,611	323	612	1,475	2,521	7,401	12,443
Information & Communications	3,273	4,599	9,094	15,230	35,613	55,798	3,020	3,895	6,547	11,225	27,957	47,578
Electronics	1,345	1,678	2,114	1,314	1,735	2,529	843	1,080	1,680	995	1,484	2,886
Flexible Manufacturing	22	36	58	120	224	369	20	34	50	97	150	240
Advanced Materials	25	12	61	23	66	119	28	15	66	62	65	98
Aerospace	74	65	66	98	162	242	36	86	57	80	155	393
Weapons	30	31	50	37	58	99	24	30	49	24	45	70
Nuclear Technology	0	1	0	95	74	48	0	0	0	92	72	40
Total	5,491	7,609	14,194	21,286	46,821	73,494	4,428	5,972	10,271	15,484	37,838	64,223
West bound trade	**U.S. Reported ATP Exports to China & Hong Kong**						**China & Hong Kong Reported ATP Imports from the U.S.**					
Biotechnology	10	16	17	20	21	52	5	7	14	17	30	47
Life Science	349	446	556	730	1,025	1,249	303	376	549	758	1,096	1,275
Opto-Electronics	345	412	648	578	620	816	207	299	834	634	555	642
Information & Communications	2,116	2,999	3,908	3,206	3,476	5,093	2,111	2,681	4,369	3,378	3,523	4,474
Electronics	2,117	2,189	3,756	4,007	6,970	9,043	2,026	2,230	2,631	3,261	6,285	8,832
Flexible Manufacturing	303	259	377	664	1,294	1,163	432	234	548	739	1,822	1,644
Advanced Materials	85	136	129	84	98	161	75	242	289	382	348	249
Aerospace	2,389	3,998	2,037	3,714	2,199	6,568	1,950	2,163	1,715	2,412	2,661	6,226
Weapons	37	20	16	39	54	1	12	36	33	42	64	0
Nuclear Technology	7	15	12	13	13	19	3	6	65	14	7	11
Total	7,760	10,490	11,456	13,053	15,772	24,167	7,140	8,307	11,099	11,646	16,389	23,404

Source: Authors' calculation. U.S. reported data based on U.S. Census HTS-10 to ATP concordance and USITC Oracle database; China & Hong Kong reported data are computed by applying U.S. ATP trade share at HS-6 to official trade statistics from China Custom Administration and Hong Kong Census and Statistics Department.

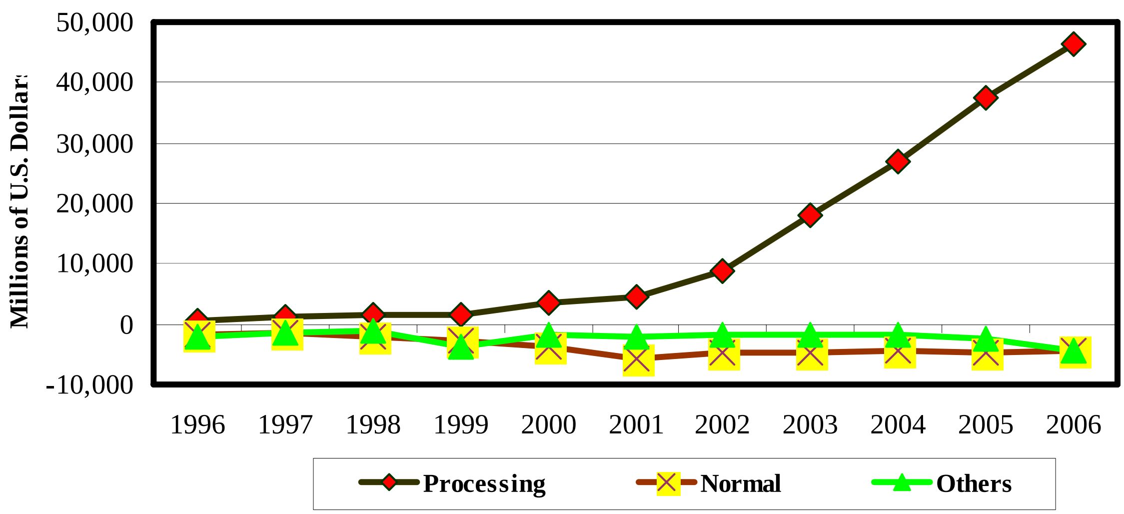
IV. The Structural Pattern of China-U.S. ATP Trade

4.1 The role of processing trade and different type of firms in China-U.S. ATP trade

The increasing imbalance of China-U.S. ATP trade puzzles many observers. Some people speculate that China has risen as a technologically leading economy in the world. This image is likely reinforced by the increasing quantity of Chinese electronic products and other ATP goods in the U.S. and European markets. Scrutinizing major structural information in Chinese ATP exports and trade surplus with the United States based on our reconciled ATP trade statistics may provide some explanations on what factors drive the aggregate data.

First, micro data indicates that the processing trade ATP surplus is large enough to account for the entire Chinese ATP trade surplus with the United States. Figure 5 indicates this surplus surged rapidly from 2002, which was a turning point in the U.S. ATP trade balance. In contrast, non-processing ATP trade maintained consistent deficits from 1996 to 2006. Table 14 shows that processing exports of ATP account for more than 92 percent of Chinese ATP exports every year since 1996, and over 95.5 percent every year since 2002. This compares to the 65 percent share of processing exports in total exports to the United States mentioned earlier. Clearly, processing trade and the fragmentation of global production underlying it is the major contributing factor to the dramatic increase in the U.S. ATP trade deficit with China in recent years.

Figure 5: China's ATP trade surplus with the U.S. was due solely to processing exports



Data Source: China Custom Statistics, U.S. Census ATP definition.

Table 14. Chinese ATP exports to and imports from the United States by trade regime, 1996-2006

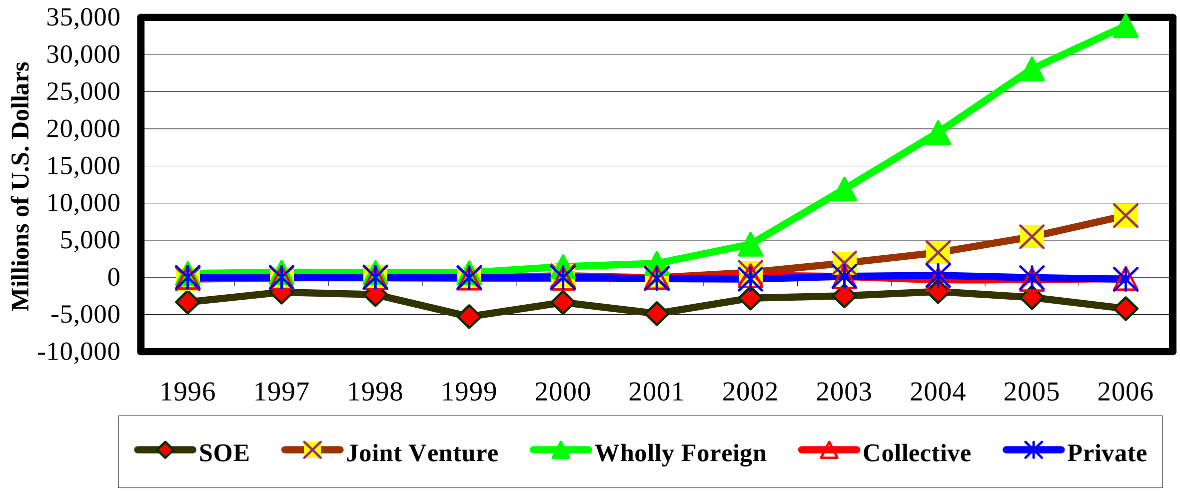
Year	*Exports (%)*			*Imports (%)*			
	Processing exports	Normal exports	Other exports	Processing imports	FIE equipment imports	Normal imports	Other imports
1996	92.87	3.52	3.61	11.47	8.41	33.86	46.26
1997	93.16	3.48	3.36	17.34	10.04	36.69	35.92
1998	92.71	3.42	3.87	23.38	4.89	43.95	27.78
1999	92.07	4.44	3.49	19.09	3.07	34.74	43.11
2000	93.43	5.00	1.57	18.15	6.99	52.00	22.86
2001	94.56	3.77	1.67	16.97	5.72	56.62	20.69
2002	95.79	2.46	1.75	24.08	7.11	49.97	18.85
2003	96.52	1.91	1.57	24.06	7.96	47.91	20.07
2004	96.43	1.69	1.88	29.73	13.5	37.81	18.96
2005	96.61	1.66	1.73	32.95	7.02	37.84	22.19
2006	95.81	2.06	2.13	35.51	8.83	28.36	27.30

Source: Authors' calculation. Shares are computed by applying U.S. ATP trade share at HS-6 to official trade statistics from China Custom Administration.

Second, the reconciled data also indicate that China's ATP trade surplus with U.S. was mainly generated by foreign-invested enterprises (FIEs) in China. Figure 6 illustrates the contributions to the ATP trade surplus from wholly foreign owned and joint venture firms. Clearly, FIE firms are the largest contributors to Chinese ATP trade surplus with the United States, which has grown rapidly since 2002, the year after China formally entered the World Trade Organization (WTO). In contrast, state owned enterprises (SOE) have an ATP trade deficit with the United States, while collective enterprises and private firms contributed very little to the ATP trade surplus during the period. This sharply contrasts the fact that private firms in China have expanded net exports to the world dramatically since China's WTO accession as shown by figure 7. Clearly, Chinese private firms have generated the largest portion of the country's total merchandise trade surplus with the world in 2006 (figure 7), indicating domestic firm in China are still mainly engage in labour-intensive, usually "low tech" productions. Further breakdown of the net exports of Chinese private firm into major HS sections in Figure 8 confirms that most of the surplus in 2006 generated by Chinese private firms came from traditional labor-intensive sectors such as apparel and footwear. There is still a large technology gap for those firms to move up the technological ladder.

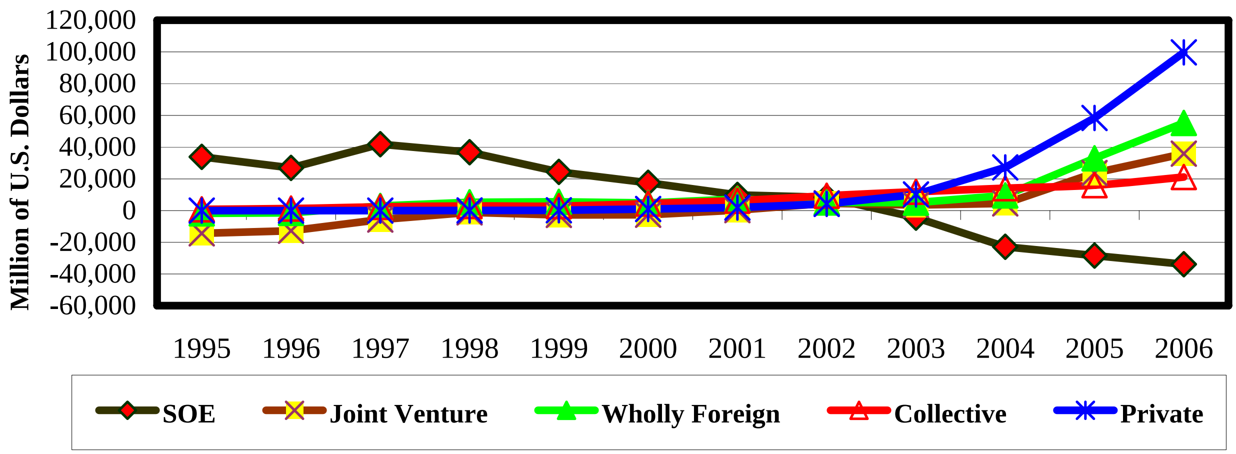
Figure 9 further shows the contributions of different types of enterprises to China's ATP exports to the United States. Clearly, FIEs played a dominant role and produced most China's ATP exports. There is a shift of export share from joint ventures to wholly foreign owned firms in recent years. Taken together the export shares of FIEs are over 92 percent of ATP exports since 1996. In contrast, the ATP export share of SOEs has continuously decreased, accounting for less than 5 percent of ATP exports to the United States in 2006. The boost of ATP exports since 2002 in China is associated with China's accession to the WTO in late 2001, which helped to stimulate the FIE boom in many manufacturing industries.

Figure 6: China's ATP trade surplus with U.S. was mainly generated by foreign-invested enterprises since China's WTO accession



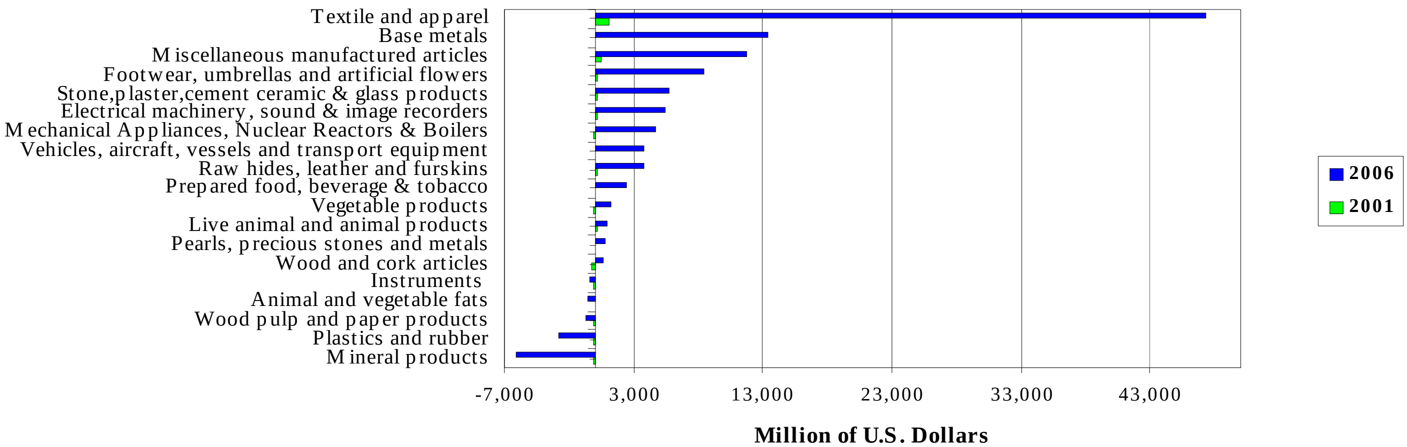
Data Source: China Custom Statistics, U.S. Census ATP definition.

Figure 7: Since China's WTO accession, private firms have generated the largest part of the trade surplus for all commodities



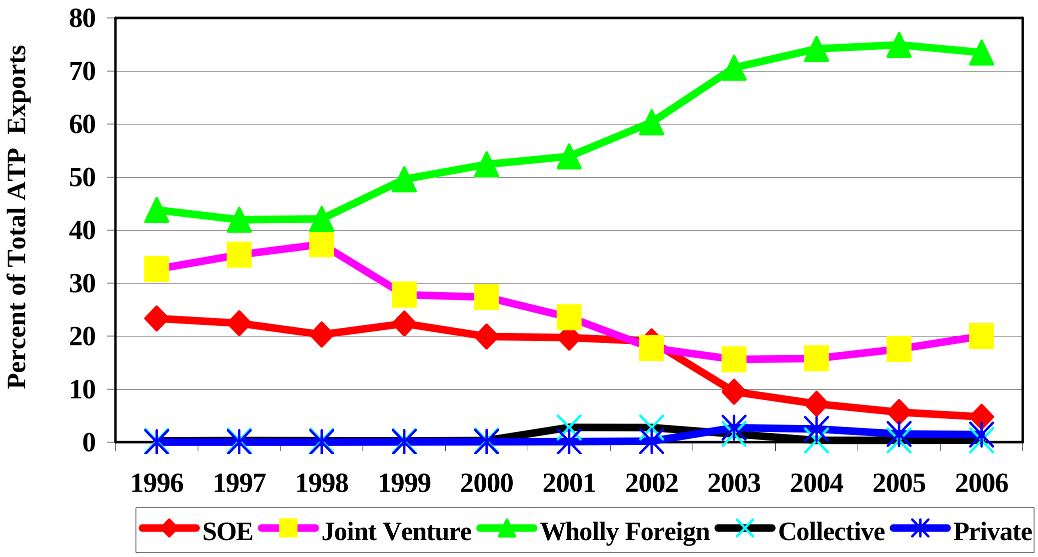
Data Source: China Custom Statistics.

Figure 8: Net general merchandise exports to the world by private Chinese firms by sector, 2001 and 2006



Data Source: China Custom Statistics.

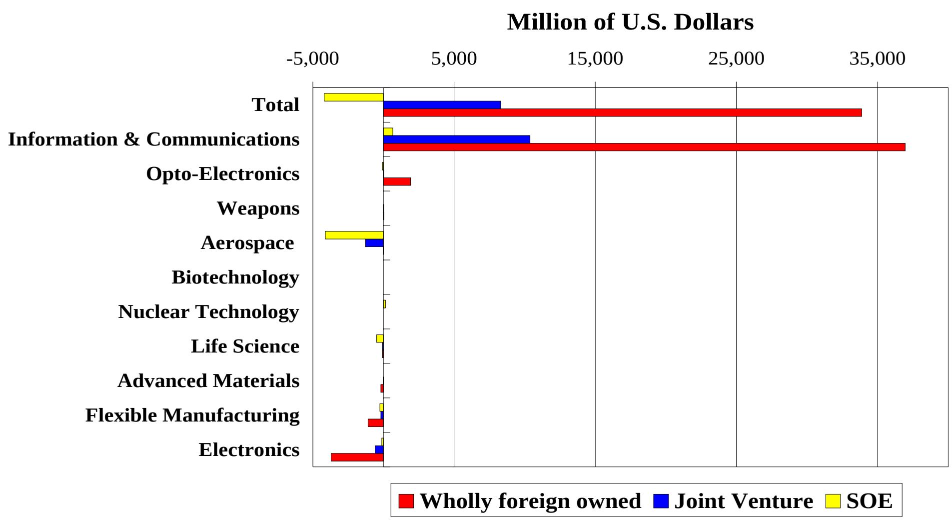
Figure 9: Since 2003, about 90% of Chinese ATP exports to U.S. were produced by FIEs



Data Source: China Custom Statistics, U.S. Census ATP definition.

Finally, a further examination of different enterprises in each high-tech field in Figure 10 shows that FIE (both wholly foreign owned and joint venture) contribute the most of net ATP exports to the U.S. in information and communication, and opto-electronics fields. Production in these two fields is mostly well fragmented with technology-intensive components produced in advanced countries and labour-intensive parts, and especially final assembly carried out in developing countries (FIE run the largest net imports from the U.S. in electronics at the same time, which is a key intermediate input for production in these two high-tech fields). This arrangement exploits the comparative advantages of different countries, and leads to benefits for foreign investors, multinational companies, and consumers. The net export structure of SOEs is very different. SOEs experience net ATP imports, with the largest net imports from the U.S. consisting of aerospace products.

Figure 10: Breakdown of Chinese net ATP exports to the U.S. associated with the types of enterprises in 2006



Data Source: China Custom Statistics, U.S. Census ATP definition.

4.2 The role of various special economic zones in China-U.S. ATP trade

Chinese authorities, including provincial, city, and county governments, have been actively promoting diversification and quality upgrading of their industrial and product structures through taxation and other policy incentives. A particular manifestation of these incentives is the proliferation of economic and technological development zones, high-tech industrial zones, and export processing zones around the country. The collective share of these zones in Chinese exports has risen from less than 6 percent in 1995 to about 25 percent in 2005. These policy incentives, combined with the incentives for processing trade and FIEs already mentioned, have likely raised the level of Chinese ATP exports to developed countries. The extent of these incentives is unlikely to be fully justified on efficiency grounds. Our impression is that the incentives cause a bigger impact on the pattern of trade than would be justified by specific positive externalities associated with ATP products, such as learning-by-doing or technical spillovers.

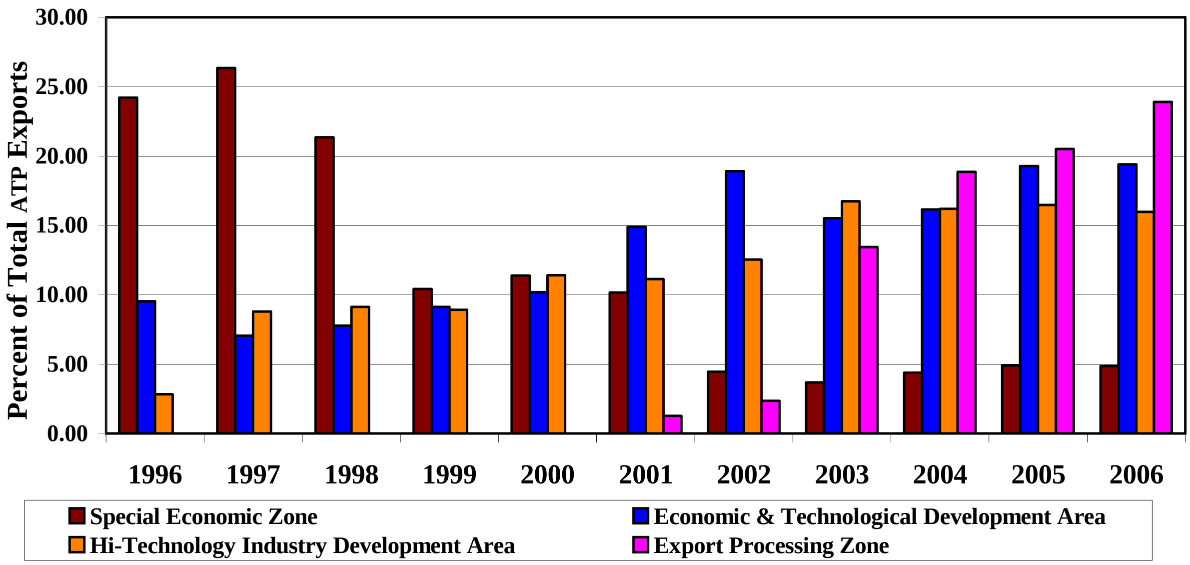
China has established a number of special economic zones where more incentive policies are applied as parts of its development strategy since 1979. Five special economic zones (SEZs) are distinguished from other special economic areas. They include the entire Hainan Province, three cities (Shenzhen, Zhuhai, and Shantou) in Guangdong Province, and a city (Xiamen) in Fujian Province. Other special economic areas are much smaller geographically and classified as Economic and Technological Development Areas (ETDAs), Hi-Technology Industry Development Areas (HITDA), Export Processing Zones (EPZs), etc. Some of these special economic zones and areas are within the five SEZs. A number of incentive policies have been introduced in these zones and they also enjoy greater flexibility in utilizing foreign capital, introducing foreign technology, and conducting economic cooperation overseas. For example, during the period covered by our data, FIEs were usually entitled to a preferable 15% corporate income tax rate versus the normal rate of 33%,[19] and foreign banks and service companies benefit from different corporate income tax rates. Among these policy zones, ETDAs and HTIDAs are tax-favored enclaves established by central or local governments (and often approved by the central government) to promote development of sectors that could be "high and new tech".

Figure 11 shows Chinese ATP exports to the United States from different government policy zones. In 1996, SEZs accounted for 24 percent of Chinese ATP exports; the share quickly decreased to less than 4.5 percent in 2002, and then slightly increased to nearly 5 percent. In contrast, EPZs accounted for only 1.3 percent of Chinese ATP exports in 2001; the share rapidly increased to almost 24 percent in 2006. ETDA and HTIDA accounted for 9.5 and 2.8 percent of total ATP exports in 1996 and their shares increased respectively to 19.4 and 16 percent in 2006. On aggregate, the four major types of government policy zones accounted for about 65 percent of Chinese ATP exports to the United States by 2006, much higher than the 25 percent number in China's general merchandise exports to the world from these policy zones.

As demonstrated by the structural information from our reconciled US-China ATP trade statistics presented above, it is indisputable that processing trade and FDI have played a major role in the dramatic increase of Chinese surplus in ATP trade with the United States. The underlying driver appears to be the fragmentation of global production. However, the Chinese Government preferential treatments of processing trade over normal trade and foreign firms over domestic firms have also provided important incentives for such a trade pattern to emerge. Unless there is an incentive change, such patterns are likely to continue. A detailed discussion of the various policy incentives impacting ATP trade is beyond the scope of this study and will be the focus in another report of this joint project.

[19] The new Chinese corporate income tax law, which becomes effective in 2008, equalizes the standard rate applied to FIEs and domestic enterprises. China has also recently removed some products from eligibility for processing trade benefits. These steps may reflects a recognition by the Chinese authorities that the previous pattern of incentives had a net distorting effect, and may presage further moves to at least partially reduce the benefits associated with special economic zones.

Figure 11: About 65% of China's ATP exports to U.S. came from various government policy zones in 2006



Data Source: China Custom Statistics, U.S. Census ATP definition.

4.3. Relative prices in China–U.S. ATP trade

Economic theory suggests that prices are a good indicator for quality differences when products possess attributes that all consumers are willing to pay more for. In trade, unit values are often proxies for the prices of traded products. For goods which are measured with units (e.g. kilograms, square kilometers, barrels, number of computers, etc) trade statistics often report both a value and a quantity. Dividing the value by the quantity generates a value per unit, or unit value, which can be interpreted like a price. However, physical units usually vary by products within industries, so industry level unit values usually cannot be computed (Schott 2007). In order to examine the relative prices of ATP in China-US trade, we compute unit values for products exported to China from the US, and products the US imports from China and the world, with defined units of measurement at the HTS-10 level. We then aggregate these unit values weighted by their corresponding shares in total US ATP exports to, or imports from, China (and the world). We then derive a trade weighted unit value index for each of the 10 high-tech fields and ISIC industries. Next we evaluate whether these indexes correctly summarize similar information on quality, and other product attributes regarding the relative values of China-U.S. trade.[20] The trade weighted unit value index UVI is defined as:

$$UVI_{kt}^{sr} = \sum_i w_{it}^{sr} \frac{V_{it}^{sr}}{Q_{it}^{sr}} \qquad w_{it}^{sr} = \frac{V_{it}^{sr}}{\sum_i V_{it}^{sr}} \tag{1}$$

[20] Please note the aggregated unit value index reflects not only the quality but also the composition of China-US ATP trade.

where V is the value of trade flows(exports or imports), Q is the measured physical quantity of the same trade flows. Superscript s represents the source country, r represents the destination country; subscript k represents the high-tech field or ISIC industry, i represents HTS-10 code, t represents years, and w is the share of the value of HTS-10 product i in total exports/imports of group k.

Table 15 summarizes the results of the unit value calculations for U.S. ATP exports to and imports from China, as well as U.S. ATP imports from the world and China, at the HTS-10 level for two-way traded products (that is for HTS-10 level products that both U.S. and China export to and import from each other). The numbers in the table are the ratios of two unit values. We use the concept of measuring quality by relative unit value based on consumer willingness to pay more for the same product if they perceive it to be of higher quality (Fabrizio, Igan and Mody (2007).)The unit value ratios between U.S. exports to and imports from China are listed in the left panel in four broad groupings. These values show a great deal of product differentiation even within each of the HTS-10 codes, with the U.S. made products' ratios greater than 1 reflecting more high-quality, or technologically-advanced products than Chinese made products. These values suggest that even though China exports high-tech products under the same product headings as the United States it appears likely that the varieties exported by China and the United States are not in direct competition because their prices are very different.

Table 15. Detailed ATP products unit value comparison at HTS-10 codes, two-way traded products, 1996-2006

		Ratios between U.S. exports to and imports from China				Ratios between U.S. imports from the world and imports from China			
Opto-electronics	No. of HS-10[a]	Less than 1	Between 1 - 10	Between 10 - 100	Over 100	Less than 1	Between 1 – 5	Between 5 - 10	Over 10
1996	7		2	2	3		2	2	3
1997	8	1	4	2	1	2	4	1	1
1998	9		1	2	6	1	5	2	1
1999	8	1	3	3	1	3	4	1	
2000	9	1	4	3	1	1	5	2	1
2001	9	1	3	5		2	5		2
2002	10		5	4	1	2	4	3	1
2003	10		4	4	2	2	6	1	1
2004	10	2	4	4		2	7	1	
2005	13	1	2	8	2	1	10		2
2006	13		4	8	1	1	9	1	2
Information & communications									
1996	43	3	12	22	6	7	23	6	7
1997	53	5	19	22	7	9	32	8	4
1998	51	2	10	32	7	3	33	11	4
1999	55	1	12	28	14	7	35	7	6
2000	60	4	10	34	12	8	42	6	4
2001	56	2	10	31	13	7	38	6	5
2002	65	7	15	33	10	12	40	11	2
2003	64	2	20	32	10	10	48	5	1
2004	64	3	21	31	9	12	46	5	1
2005	69	5	27	28	9	16	49	1	3
2006	69	1	35	28	5	16	51	1	1
Total ATP									
1996	134	16	49	42	27	29	69	14	22
1997	151	25	65	42	19	42	76	18	15
1998	146	20	50	49	27	28	84	19	15
1999	151	18	62	49	22	41	81	16	13
2000	159	23	51	63	22	33	92	19	15
2001	165	30	58	56	21	38	95	14	18
2002	167	28	61	57	21	42	87	21	17
2003	167	26	65	55	21	42	97	13	15
2004	174	30	68	57	19	45	94	18	17
2005	189	28	75	62	24	40	116	13	20
2006	193	19	88	68	18	45	113	14	21

Source: US Census and USITC Oracle database.
Note: HS-10 products that US both exports to and imports from China and associated with a physical unit so unit value of the products can be calculated.

As can be seen from the table during 1996 to 2006, about 40 percent of the unit value ratios between US made products and China made products is between 1 and 10 (692 out of 1,796 HS-10 products), one-third of US ATP products had a unit value of 10 to 100 times that of the Chinese products (600 out of 1,796), and more than 13 percent (241 out of 1796) had a unit value greater than 100 times over Chinese products. Only 263 lines, or less than 15 percent, were Chinese products with higher unit values than the U.S. products. In high-tech fields, opto-electronics and ICT, where China has a significant trade surplus with the United States, the price difference between U.S. and Chinese made HTS-10 products are even more significant. About 95 percent of U.S. made products have higher unit values, and more than 60 percent of them at least 10 times higher, than similarly coded Chinese products.

Examining the same ratios for U.S. ATP imports from the world and from China (right panel of table 15) we see that over 75 percent of Chinese ATP exports to the United States are also lower than the average unit price of ATP made by other countries in the world.

Table 16 presents unit values of one-way ATP traded products between US and China. There were 1,305 HTS-10 products that the United States exported to China but China did not export to the US and 1,809 HTS-10 products that China exported to the United States but the United States did not export to China during 1996 to 2006. Because this trade is one-way, no unit value ratios could be calculated at HTS-10 level. However unit values reported in current U.S. dollars reveal a similar pattern as shown by the unit value ratios in table 11. ATP exports from the United States to China were generally far more expensive than ATP exports from China to the US. This suggests that U.S. made products were likely of higher quality or more technologically advanced than Chinese made products shipped to the US. In the 1,809 HTS-10 products China exported to the United States, more than 60 percent (1,108 products) had unit values less than 100 dollars, 23 percent had unit values between 100-1,000 dollars, and less than 8 percent had unit values greater than $10,000. On the other hand about 40 percent of the 1,305 HTS-10 products the United States exported to China were worth more than 10,000 dollars and only 19 percent of these products were worth less than 100 dollars. The example of microscopes is used to illustrate the nature of ATP quality differences in U.S.-China trade (table 17). Even though the U.S. and Chinese classifications differ at the HS-10 level, it is clearly the case that the products exported from the United States are one or two orders of magnitude more expensive than the Chinese products, and are unlikely to be identical from the standpoint of features or use.

Table 16. Detailed ATP products unit value comparison at HTS-10 codes, one-way traded products, in current US dollars, 1996-2006

	Products U.S. only imports from China					**Products U.S. only exports to China**				
Opto-Electronics										
Year	No. of HS-10[a]	Less 100	Between 100-1,000	Between 1,000 – 10,000	Over 10,000	No. of HS-10[b]	Less 100	Between 100-1,000	Between 1,000 – 10,000	Over 10,000
1996	14	7	6	1		3		1		2
1997	16	8	7	1		2				2
1998	15	7	6	2		2				2
1999	17	6	6	4	1	2				2
2000	18	5	7	4	2	2				2
2001	19	6	9	3	1	2				2
2002	19	5	10	2	2	2				2
2003	19	7	9	1	2	2				2
2004	21	8	8	1	4	2				2
2005	22	6	12		4	5		1	3	1
2006	21	4	14		3	5		1	1	3
Information & communications										
1996	45	22	20	3		33	4	4	21	4
1997	36	18	16	1	1	26	2	7	12	5
1998	45	29	13	2	1	27	3	6	15	3
1999	38	27	9	2		26	3	6	14	3
2000	44	24	12	7	1	21	3	8	8	2
2001	50	27	17	6		25	3	7	12	3
2002	47	26	15	5	1	18	1	6	9	2
2003	47	28	12	6	1	20		7	9	4
2004	52	29	17	5	1	20	2	6	10	2
2005	47	24	19	4		16	2	4	9	1
2006	52	24	21	7		17	3	3	8	3
Total ATP										
1996	134	87	34	8	5	132	28	15	44	45
1997	125	80	32	8	5	116	27	14	33	42
1998	159	109	32	10	8	119	24	19	33	43
1999	156	101	28	14	13	118	20	21	32	45
2000	168	100	34	22	12	117	23	22	28	44
2001	167	99	41	17	10	121	22	29	25	45
2002	171	107	39	12	13	118	17	22	24	55
2003	174	112	36	14	12	128	22	22	22	62
2004	186	114	37	16	19	115	23	20	27	45
2005	179	100	41	17	21	110	23	19	27	41
2006	190	99	55	14	22	111	20	22	22	47

Source: US Census and USITC Oracle database.
Note: [a]. HS-10 products that US imports from China but does not export to China and associated with a physical unit so unit value of the products can be calculated.
[b]. HTS-10 products that US exports to China but does not import from China and associated with a physical unit so unit value of the products can be calculated.

Table 17. Unit Value example: U.S. exports to China and China exports to U.S. HS 9011, 2006

HTS number	*HTS Product*	*Total exports U.S. Dollars*	*Unit value U.S. Dollars*
U.S. exports to China			
9011100000	Stereoscopic microscopes	487,179	3,431
9011200000	Microscopes, for microphotography & cinema	693,491	11,754
China exports to U.S.			
9011104000	Stereoscopic microscopes with means to photo image	1,592,944	251
9011108000	Stereoscopic microscopes	3,647,098	115
9011204000	Microscopes with means to photograph the image	1,459,958	215
9011208000	Microscopes, exc with means to photograph the image	1,864,786	61

Source: US Census and USITC Oracle database.

Table 18 provides trade-weighted unit value indexes for the 10 major high-tech fields in the year 1996, 2001 and 2006, computed based on equation (1) and the detailed HTS-10 unit value information underlying tables 16 and 17. As can be seen, the unit value indexes of U.S. exports to China in nine of the 10 high-tech fields are consistently and significantly higher than that of U.S. imports from China, with advanced materials the only exception. The trade-weighted unit value indexes seem to retain similar relative price patterns from the unit value comparisons conducted at the detailed HS-10 level.[21] For example, the big differences in unit value indexes for the opto-electronics and ICT fields clearly indicate that Chinese exports to the US were probably consumer electronics at the low-end of these industries' value-added chains, while Chinese imports from the US appear to be mainly sophisticated equipment at the high-end of these industries' value-added chains.

[21] Careful examination of the number of HTS-10 products included in the calculation of trade weighted unit value index confirms that it contains exactly the same number of unit value HTS-10 products included in tables 15 and 16. For example, table 15 shows there are 193 two-way traded HTS-10 ATP in 2006 that have unit values and table 16 shows there are 111 HTS-10 products US exports to China that have a unit values. The sum of these two numbers exactly matches the 304 unit values used to compute the 2006 unit value index for US exports to China in table 18. This is because any HTS-10 products without a unit value in the total 383 HTS-10 products that the United States exported to China in 2006 will count as zero and thus have no impact on the resulting index. Similar logic applies to the Chinese calculations.

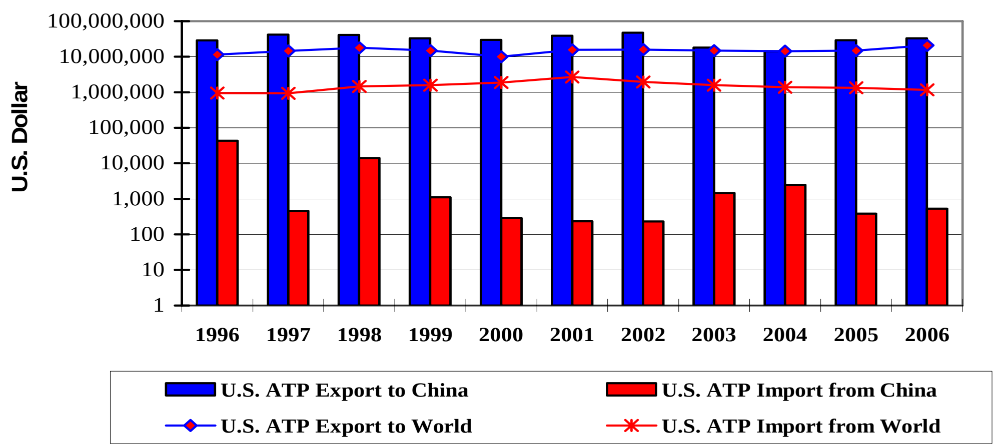
Table 18. Trade weighted unit value index of US export to and import from China, current US dollars

	US exports to China			**US imports from China**		
	Total HS-10 code[a]	HS-10 with unit[b]	Unit value index	Total HS-10 code[a]	HS-10 with unit[b]	Unit value index
1996						
Biotechnology	7	7	1,336	6	6	23
Life science	64	27	4,489	57	33	876
Opto-electronics	12	10	21,713	29	21	87
Information & communications	95	76	13,945,862	129	88	109
Electronics	64	61	34,213	76	71	3
Flexible manufacturing	59	50	303,749	27	21	1,565
Advanced materials	5	5	5	9	7	59
Aerospace	27	22	42,435,697	21	13	1,957,647
Weapons	7	5	1,258	9	7	16
Nuclear technology	4	3	8,779	1	1	4
Trade weighted average	344	266	28,829,153	364	268	43,391
2001						
Biotechnology	7	7	46	11	11	28
Life science	72	32	7,451	75	48	547
Opto-electronics	13	11	17,544	35	28	483
Information & communications	100	81	3,646	151	106	124
Electronics	68	65	1,385	78	73	3
Flexible manufacturing	62	54	203,530	43	37	16,537
Advanced materials	3	3	8	9	7	16
Aerospace	28	23	85,228,162	20	12	66
Weapons	8	5	941	10	8	10
Nuclear technology	6	5	11,370	3	2	567
Trade weighted average	367	286	39,284,103	435	332	235
2006						
Biotechnology	7	7	100	15	15	15
Life science	72	35	13,613	81	49	1,658
Opto-electronics	22	18	16,002	38	34	429
Information & communications	106	87	1,985	171	121	298
Electronics	52	48	2,174	68	62	12
Flexible manufacturing	78	70	250,560	74	68	33,073
Advanced materials	3	3	105	7	6	237
Aerospace	32	28	81,310,101	21	17	21,346
Weapons	5	4	142	13	8	27
Nuclear technology	6	4	3,242	4	3	482
Trade weighted average	383	304	32,886,860	492	383	536

Source: US Census and USITC Oracle database.
Note: [a]. HS-10 products that include both one-way and two-way US-China ATP trade
[b]. A physical unit can be measured in the trade flow so unit value of the products can be calculated.

Figure 12 provides trade-weighted ATP unit value index at the aggregated level from 1996 to 2006, computed based on equation (1) and the detailed HTS-10 unit value information underlying tables 16 and 17 The UVI seem to retain similar relative price patterns from the unit value comparisons conducted at the detailed HS-10 level.[22] It shows that the United States and China trade significantly different products with each other, and this phenomenon has largely remained unchanged from 1996 to 2006. It shows that the aggregated trade-weighted unit value index of U.S. ATP exports to China is slightly above what it exports to the world, and it is in the range of 1 million U.S. dollars. However, the trade-weighted unit value index of U.S. ATP imports from China is largely below that of its imports from the world, and it lies mostly below $1,000 ($536 in 2006). It appears that ATP exports from the United States to China are dominated by large scale, sophisticated, high-valued equipment and devices at the high-end of these industries' value-added chains, while ATP exports from China to the United States are mainly small scale final products or components in the low-end of the ATP value-added chain. A careful analysis of the role and position of China in the world ATP supply chain based on more disaggregated product level data and case studies is an interesting topic but beyond the scope of this paper.

Figure 12: Trade- weighted unit value of Sino-U.S. ATP trade, 1996-2006



Source: Authors calculation.

[22] Careful examination of the number of HTS-10 products included in the calculation of trade weighted unit value index confirms that it contains exactly the same number of unit value HTS-10 products included in tables 16 and 17. For example, table 16 shows there are 193 two-way traded HTS-10 ATP in 2006 that have unit values and table 17 shows there are 111 HTS-10 products US exports to China that have a unit values. The sum of these two numbers exactly matches the 304 unit values used to compute the 2006 aggregate unit value index for US exports to China in figure 12. This is because any HTS-10 products without a unit value in the total 383 HTS-10 products that the United States exported to China in 2006 will count as zero and thus have no impact on the resulting index. Similar logic applies to other UVI calculations.

V. Conclusions

In this paper, we first evaluated the classification of ATP trade in both China and the United States, investigated the strengths and weaknesses of both sides' current systems based on historical data; we then developed a method to reconcile both nations' ATP trade statistics from 1996 to 2006, combining the information available in the Chinese data on firm types, customs regimes, and incentive zones with the information in the U.S. data on the finely disaggregated definition of ATP, and thus obtain more detailed structural information on U.S.-China ATP trade; and finally, we provided s a preliminary description on the nature of the emerging China-U.S. ATP trade in recent years based on the reconciled ATP trade statistics.

The basic message we learned from the changes in the U.S. Census ATP list since 1989 is that the ATP producing industries are relatively stable, while the ATP product list changes year by year, with dramatic changes taking place when a revision of HS codes occurs. Therefore, it may be useful to apply input and sector based quantitative measures such as R&D intensity and percent of highly skilled workers in total labor force as well as input-output techniques to select high-tech industries. Then from the set of HS products that fall into these industries, one can further select particular products based on expert judgments complemented by quantitative measures calculated from trade statistics. The process is not unlike that used to fill a skilled job position in which common criteria (which can be quantified into overall scores) are first used to narrow the applicant pool to a small group of candidates, then interviewing and subjective judgment can be used to select the finalists from the small group.

ATP statistics from various sources consistently show that the U.S. trade deficit in ATP with the world grew rapidly in recent years, with China as one of the largest contributors. The dramatically increasing surplus of China since its WTO accession is concentrated mainly in information and communication technology, while the United States still enjoys sizeable surpluses in electronics and aerospace technology. We also find that the adjustment of re-exports through Hong Kong only has a modest impact on the discrepancies in China-U.S. ATP trade statistics, which is similar to what Ferrantino and Wang (2007) found in general China-U.S. merchandise trade. However, we found purging "new products" from the Chinese trade data has a more important effect on ATP trade statistics reconciliation.

Further investigation into the structural details of China-U.S. ATP trade statistics found that more than 95 percent of the rapidly expanding ATP exports from China to U.S. are processing trade, which is closely related to FDI and largely carried out by foreign firms. Various government policy zones have largely hosted the rapid expansion of Chinese ATP exports to the U.S. The rapid emergence of China as a large supplier to the U.S. advanced technology products market is closely associated with a combination of three major factors: the fragmentation of global production, China's comparative advantages, and the Chinese Government preference policies to processing trade and FIE firms. Unfortunately, data limitations prevent us from further identifying the origins of these FIEs in China to understand the relative role of FDI from Western developed countries and newly industrialized countries in East Asia.[23] In addition, the reconciled U.S.-China ATP statistics also show that within China, there is still a considerable technological gap between Chinese domestic firms and foreign firms, which is reflected by the distinct export structures of these firms in recent years.

An analysis of unit value also adds important insights. Chinese ATP imports from U.S. were dominated by large-scale, sophisticated, high-valued equipment and devices, while Chinese ATP exports to the United States were still mainly small-scale products or components in the low-end of the ATP value-added chain. Even though China has begun to export a set of ATP products similar to those exported by the U.S. in recent years, there appears to remain a considerable quality and technological gap between Chinese ATP exports and U.S. ATP exports.

Our study also reveals the necessity to refine and improve current definition of classification of ATP. Even at 10 digit HS level, such as US Census fine disaggregated ATP list, some products are hard believe to be high-tech, exampled by the low value microscopes imported from China in our paper. Researchers should bear in mind that the applicability and accuracy of any ATP classification should be testable. International trade statistics may be the best data available for conducting such tests. However, it is beyond the focus of this study to determine how to accurately define what should be advanced technology products. Such a topic has fundamental importance to our profession and will be addressed in our future work.

[23] There is extensive literature documenting the difference between these two types of FDI firms in China. For example, Xu and Lu (2007) report differences between firms from Hong Kong, Macao and Taiwan and those from other source countries.

Appendix A. An Alternative Method of ATP Classification: Sector or products? Input-based or Output-based?

Various methods for classifying advanced technology products have been developed in recent years. This section addresses four particular methods: the International Trade Administration method, the U.S. Census Bureau method, the OECD method, and the Bureau of Labor Statistics method. The section concludes with a comparison and critique of each method.

1. U.S. Department of Commerce ITA Method: R&D intensity by industry

The ITA DOC3 methodology for measuring high-technology trade uses research and development (R&D) intensity of an industry as the principal criterion for determining whether an industry is considered high-tech. Import and export products are first classified by 3-digit Standard Industrial Classification (SIC) industry groups. Once groups are created, they are defined as either high-tech or low-tech. Determining whether a SIC group is high-tech or low-tech is based on the ratio of R&D spending to sales by domestic producers. This formula is used as a proxy to measure the degree of technology contained in the products in the industry (Abbott 19).

More specifically, the ITA accounts for R&D in intermediate inputs of an industry by using an input-output table to decide what amount of the R&D value in the intermediate goods should be included as part of the direct R&D used in developing the final goods (Abbott 19). The 10 industries with the highest embodied R&D to sales ratio are then defined as high-tech. Implicit in this methodology is the notion that all products within each of the 10 high-tech industries are considered high tech-products.

Thus, the ITA method creates major technology sectors using R&D intensity as the main criteria. The sectors are broad and if the sector is considered high-tech, then all individual products produced by the sector are automatically defined as high-tech.

2. U.S. Census Bureau Method: Identify leading edge technology associated with individual products by HTS

The Census approach to constructing a list of high-technology products relies on expert knowledge and judgment rather than on a standard formula. When the U.S. Census set out to construct its list in 1989, the first step it took was to develop 10 broad fields or categories of products that were considered as high technology. Once these 10 fields were identified, the next step in determining which products were considered high-tech was for analysts to examine all individual products traded by the United States to determine if any of the leading-edge technologies embodied in the 10 fields were contained in the product. If they were, the product was categorized as an advanced technology product (Abbott et al 7-8).

The main criterion used in this method to determine whether a product is part of the ATP list or not is the particular knowledge and judgment of individual Census analysts. This approach differs drastically from the ITA criterion that relies on a formula based on a ratio between R&D spending and sales.

The different methods result in different lists. The Census ATP method drills down to the product level to identify individual products by HTS-10 code as high tech.[24] Because this method allows for very precise measurement, the Census list is smaller than the ITA list. On the other hand, the ITA list is industry and input based, using industry categories that are as a whole defined as high or low tech.

3. OECD Method: Both sector and product approach by ISIC and SITC

A third approach to classification of high-technology products has been proposed by the Organization for Economic Co-operation and Development (OECD). The OECD approach combines both a sector-based approach and a product-based approach, thereby attempting to combine the benefits of a quantitative sector and subjective product approach. Like the ITA method, the sector method of the OECD is broad. It relies on quantitative data for R&D intensity by targeting 22 ISIC 2 digit manufacturing sectors. Besides taking into account direct R&D expenditures by a sector, the method also attempts to calculate indirect R&D embodied in intermediate and capital goods. Therefore, using the OECD approach, total R&D intensity of a sector is the sum of its direct and indirect intensities. The result is the placing of industries into one of four groups: high technology, medium-high technology, medium-low technology, and low technology (Hatzichronoglou 5).

In its overall methodology, the OECD adds a product approach to the sector approach. The product approach examines products at a more disaggregated level compared to the 2 digit ISIC level of the sector approach: it uses 3-digit SITC product groups. An initial list of these groups was compiled that was characterized by high R&D intensity in a sample of six OECD countries. This list was further narrowed by the subjective selection of products at the 5-digit level (Peneder 8-9).

4. BLS Method: Using high-technology employment as a gauge

A fourth approach for classification of high-technology products has been created by the Bureau of Labor Statistics (BLS). BLS created a method for identifying and ranking high-technology industries and then conducted an interagency seminar to create more detailed criteria to test the rankings. BLS methodology uses high-technology employment as the principal gauge for defining an industry as high-tech or not. First, BLS collects data on occupational employment by 4-digit North American Industry Classification (NAICS) code. It then applies the following criteria to that data: if employment in technology-oriented occupations in an industry accounts for at least twice the 4.9-percent average for all industries combined, then the industry is defined as high-tech (Hecker 58). From this group of NAICS numbers, three levels are further specified: level I, which includes industries where high-tech occupations account for a proportion that is at least 5 times the average or greater and constitute 24.7 percent or more of industry employment; level II, which includes industries where high-tech occupations account for a proportion that is 3 to 4.9 times the

[24] Note that not all HTS 10 codes contain single products; often they may contain several products, in which case it is left to Census analysts to determine whether there are sufficient high tech products in the code to warrant ATP classification.

average and constitute 14.8 to 24.7 percent of industry employment; and level II, which includes industries where high-tech occupations account for a proportion that is 2 to 2.9 times the average and constitute 9.8 to 14.7 percent of industry employment.

Besides this measure, BLS also obtained other selection criteria from an interagency group it convened to study the issue. The group recommended the following additional criteria: proportion of R&D employment, production of high-tech products, use of "high-tech" production methods, and growth in output per hour. These criteria were applied to the initial list of NAICS industries.

5. Comparison of the methods

These four different methodologies for defining and measuring high-technology products provide an opportunity for comparison. Arguments have been made for the advantages and disadvantages of each methodology, and this section attempts to summarize the arguments.

Much has been written about the differences between the ITA and Census methodologies, and the differences have been summarized by one author into three categories:(1) the level of product aggregation, (2) the use of direct versus indirect measures of technology content, and (3) the use of subjective versus objective criteria (Abbott 21).

First, the level of product aggregation between the two methods differs greatly. Under the ITA method, once an industry is defined as "high-tech" (using the ratio of R&D expenditures to sales), then all products within that industry are considered as high-tech. On the other hand, the Census approach relies on individual analysts to examine all products traded between the United States and the rest of the world to decide which one is high-tech. Clearly, the Census approach examines products on a much more disaggregated level than the ITA approach. The ITA approach groups products and determines whether a group of products is high-tech or not, while the Census approach determines whether individual products are high-tech or not.

Second, the two methods differ in how they measure the amount of technology incorporated in the product. The ITA method uses the ratio of R&D expenditures to sales by domestic producers to determine whether an industry (and therefore the products it produces) is high-tech. The Census, on the other hand, uses a more direct approach to determining whether a product is high-tech. The Census first developed a list of technological fields that were deemed to be high-tech in nature. It then defined the leading edge technologies in these fields. Finally, Census analysts examined all HTS 10 codes to determine if the product(s) within them contained any of these leading edge technologies and then categorized them accordingly (Abbott 20).

Finally, one of the most obvious differences between the ITA and Census methodologies is the degree to which the criteria are objective versus subjective. The use of a ratio to determine whether a product is high-tech or not by ITA is a more objective measure compared to the Census method of relying on analysts' knowledge and judgment to determine high-tech status for a product, which is clearly a subjective measure.

The OECD method can be viewed as a middle ground between the ITA and Census methods, because it incorporates both sector and product approaches. The criteria used for the sector approach, in fact, rely on the same main criteria as the ITA sector approach: R&D intensity. The OECD takes the R&D intensity approach one step further and measures both direct and indirect R&D intensity (Hatzichronoglou 5). Using this method, four groups of industries were created: high-technology, medium-high-technology, medium-low-technology, and low-technology.

The OECD supplements its sector approach with a product approach in order to allow more detailed analysis (Hatzichronoglou 7). It focuses on the products in the high-technology group and uses a subjective evaluation to disaggregate the products further, thus reflecting the Census approach in its subjectivity and desire to reach greater levels of product disaggregation.

The BLS method differs from the other three in its emphasis on the level of high-tech employment in defining whether an industry is high-tech or not. It applies this criteria to all sectors at the 4-digit NAICS level, but it does not drill down to more product-specific levels. In this sense, it is similar to the ITA method. It is also similar to the ITA method in that the criterion is an objective benchmark (though the criterion is different from that used by the ITA).

Though BLS relies on employment data as its main measure of high-tech, some of the other selection criteria recommended by the study group reflect similarities to some of the other methods. For example, R&D is used in the ITA and OECD methods, though not in the same way as it is used by BLS. Also, in BLS production of high-tech products criterion, direct reference is made to the Census classification system, and effort is made to apply the Census criterion to the BLS list of NAICS codes.

6. Critique of each method

The ITA Methodology

Some believe the ratio of R&D expenditures to sales is not an appropriate measure of high-tech status for products (Abbott 19). Abbott believes it is a biased measure of technology. He also believes that it is an inexact method because it does not make a distinction between R&D expenditures for product development and process development. For example, R&D spent to improve a production process may not necessarily result in a more advanced product.

Linked to the first criticism of the ITA methodology is the view that the resulting aggregated industry-level classifications, which are then considered high-tech or not, are too broad. It leads to industries being classified as high-tech when a large portion of the products within them are not high-tech products (Abbott et al 4).

The Census Methodology

The clear criticism of the Census methodology for measuring high-tech products is its subjectivity. By relying on the knowledge and judgment of Census industry analysts to determine whether a product (or products) within a 10 digit HTS code is considered high-tech or not, it is possible that a completely different list would be arrived upon by a different set of analysts. Ironically, it was the desire to overcome the perceived shortcomings of the ITA methodology that the Census methodology was created, with its own shortcomings.

OECD Methodology

Because the OECD method shares qualities of both the ITA and Census methods, it also shares in their criticism. As with the criticism of the ITA methodology, the OECD sector approach is limited by the criteria used (R&D intensity) and the lack of sufficiently disaggregated data it results in. The limitation of the OECD product approach is its use of subjective expert opinion to create a more disaggregated list of high-technology products (OECD 8-9).

BLS Methodology

The BLS employment approach is by definition limited to employment as its main criterion. The additional selection criteria recommended by the working group help to broaden the scope of the criterion, but that criterion is only applied to the list of 4-digit NAICS codes that was arrived at using the original employment based criteria. Also, the criticism of the ITA methodology is that it leads to categories that are too broad can also apply to the BLS methodology. 4-digit NAICS categories are broad categories, which, when disaggregated may include products that are high-tech and other that are not.

Table A1. Changes in the number of ATP 10-digit HS codes in ATP-producing industries, 1989-2006

ISIC	INDUSTRY NAME	1989 – 1995			1996- 2001			2002-2006		
		dead	retained	new	dead	retained	New	dead	retained	New
2213	Publishing of recorded media	0	0	7	2	8	3	0	10	0
2330	Processing of nuclear fuel	4	14	0	0	11	0	0	11	4
2411	Basic chemicals, except fertilizers and nitrogen compounds	13	10	26	0	39	0	1	45	0
2423	Pharmaceuticals, medicinal chemicals and botanical products	8	12	15	0	28	0	0	32	0
2429	Other chemical products n.e.c.	0	0	3	0	3	0	0	3	0
2813	Steam generators, except central heating hot water boilers	0	2	0	0	2	0	0	2	0
2911	Engines and turbines, except aircraft, vehicle and cycle engines	0	9	0	0	9	0	0	9	0
2914	Ovens, furnaces and furnace burners	0	0	2	0	1	0	0	1	0
2915	Lifting and handling equipment	0	1	1	0	2	1	0	3	0
2919	Other general purpose machinery	0	0	2	0	1	0	0	1	1
2922	Machine-tools	6	51	35	3	76	6	1	79	7
2927	Weapons and ammunition	1	16	0	0	16	0	0	14	0
2929	Other special purpose machinery	3	4	13	3	8	0	0	7	0
3000	Office, accounting and computing machinery	13	40	19	12	63	6	0	69	0
3110	Electric motors, generators and transformers	NA	NA	NA	0	2	0	0	2	0
3120	Electricity distribution and control apparatus	2	0	3	0	3	0	0	3	0
3130	Insulated wire and cable	0	1	0	0	1	0	0	1	0
3190	Other electrical equipment n.e.c.	1	1	4	0	3	0	0	5	0
3210	Electronic valves and tubes and other electronic components	34	27	52	11	79	7	3	68	4
3220	Television and radio transmitters and apparatus for line telephony and telegraph	24	29	19	5	44	8	0	52	0
3230	Television and radio receivers, sound or video recording or reproducing apparatus	15	10	46	24	49	24	4	69	0
3311	Medical and surgical equipment and orthopaedic appliances	3	30	17	4	47	8	9	45	0
3312	Instruments and appliances for measuring, checking, testing, navigating and others	10	67	28	8	80	11	9	77	1
3313	Industrial process control equipment	0	11	0	0	11	0	0	14	0
3320	Optical instruments and photographic equipment	1	22	7	0	30	0	7	23	4
3530	Aircraft and spacecraft	4	43	0	0	43	9	0	53	1
	Total	142	400	299	70	651	80	34	688	22

Source: Authors calculation based on U.S. Census HTS-10 to ATP concordance.

Table A2. Ratio of average trade weighted unit value between ATP and total merchandise, ATP share of value and number of products in total U.S. exports to the world by ATP-producing industries, selected years

		1996			*2001*			*2006*		
ISIC	***Industry Name***	***Value share***	***Share of Product No.***	***Unit Value ratio***	***Value share***	***Share of Product No.***	***Unit Value ratio***	***Value share***	***Share of Product No.***	***Unit Value ratio***
2213	Publishing of recorded media	86.9	30.0	1.1	87.6	27.8	1.1	90.8	38.1	1.1
2330	Processing of nuclear fuel	94.8	66.7	1.1	87.9	64.7	1.2	74.7	68.8	1.2
2411	Basic chemicals, except fertilizers and nitrogen compounds	1.2	2.1	21.8	2.1	2.2	9.3	0.7	2.6	33.4
2423	Pharmaceuticals, medicinal chemicals and botanical products	14.8	7.7	1.3	9.7	7.7	0.4	16.8	8.3	0.6
2429	Other chemical products n.e.c.	4.0	0.7	2.2	3.4	0.7	3.2	3.5	0.6	7.1
2813	Steam generators, except central heating hot water boilers	14.9	16.7	2.1	26.0	16.7	2.3	8.9	16.7	3.6
2911	Engines and turbines, except aircraft, vehicle and cycle engines	14.3	15.0	0.5	23.4	15.0	0.7	29.3	15.0	0.8
2914	Ovens, furnaces and furnace burners	5.8	7.1	1.3	10.4	7.1	1.2	2.9	5.9	1.1
2915	Lifting and handling equipment	0.5	3.2	0.7	0.6	3.2	0.6	2.8	3.2	1.0
2919	Other general purpose machinery	0.1	0.7	2.4	0.7	0.7	5.2	0.8	0.7	2.0
2922	Machine-tools	28.4	16.9	2.4	28.8	17.1	2.4	36.8	17.7	2.0
2927	Weapons and ammunition	35.0	20.0	0.1	55.6	20.0	0.6	49.0	15.7	0.4
2929	Other special purpose machinery	35.6	9.0	2.4	29.0	8.0	2.3	28.5	7.0	2.2
3000	Office, accounting and computing machinery	88.8	45.8	1.1	89.4	45.8	1.1	90.8	46.3	1.0
3120	Electricity distribution and control apparatus	2.3	3.3	13.6	2.0	3.3	19.1	7.4	4.9	5.1
3130	Insulated wire and cable	12.4	6.7	0.1	15.7	6.7	0.1	8.7	6.7	0.1
3190	Other electrical equipment n.e.c.	6.2	4.1	7.1	5.1	4.2	8.4	14.8	6.8	2.9
3210	Electronic valves and tubes and other electronic components	86.9	48.6	0.7	85.7	48.3	0.7	90.5	40.8	0.8
3220	Television and radio transmitters and apparatus for line telephony and telegraph	82.7	52.5	1.1	86.4	53.7	1.3	87.8	58.5	0.9
3230	Television and radio receivers, sound or video recording or reproducing apparatus	10.9	14.1	3.4	13.2	17.3	2.0	17.8	14.8	1.1
3311	Medical and surgical equipment and orthopaedic appliances	51.9	50.0	0.6	50.5	50.8	1.8	47.4	49.2	1.6
3312	Instruments and appliances for measuring, checking, testing, navigating and others	58.0	46.5	1.5	60.4	46.5	1.5	58.7	44.1	1.5
3313	Industrial process control equipment	35.9	78.6	0.6	31.4	78.6	0.6	53.9	78.6	0.7
3320	Optical instruments and photographic equipment	26.6	20.8	1.7	44.5	20.8	2.0	27.4	19.4	2.6
3530	Aircraft and spacecraft	93.2	52.1	1.1	93.3	50.7	1.1	93.9	52.1	1.1
	Total	24.9	5.2	4.2	27.4	5.2	3.6	24.4	4.9	4.1

Table A3. Ratio of average trade weighted unit value between ATP and total merchandise, ATP share of value and number of products in total U.S. imports from the world by ATP producing industries, selected years

		1996			*2001*			*2006*		
ISIC	***Industry Name***	***Value share***	***Share of Product No.***	***Unit Value ratio***	***Value share***	***Share of Product No.***	***Unit Value ratio***	***Value share***	***Share of Product No.***	***Unit Value ratio***
2213	Publishing of recorded media	67.6	28.6	1.2	60.7	31.8	1.3	76.4	36.4	1.0
2330	Processing of nuclear fuel	51.6	47.1	2.0	75.9	43.8	1.4	78.6	61.5	1.3
2411	Basic chemicals, except fertilizers and nitrogen compounds	13.5	2.9	4.8	25.4	2.7	1.3	33.7	2.9	2.2
2423	Pharmaceuticals, medicinal chemicals and botanical products	18.3	8.6	0.3	26.5	8.7	1.0	17.5	9.6	1.2
2429	Other chemical products n.e.c.	9.4	0.8	7.9	10.1	0.8	7.3	9.7	0.8	6.0
2813	Steam generators, except central heating hot water boilers	11.5	9.1	1.4	1.3	16.7	1.3	15.3	16.7	3.0
2911	Engines and turbines, except aircraft, vehicle and cycle engines	11.5	5.3	1.1	6.6	5.4	1.4	9.7	4.9	4.9
2914	Ovens, furnaces and furnace burners	13.5	7.1	3.1	8.4	6.7	1.6	11.2	5.6	2.0
2915	Lifting and handling equipment	3.4	3.2	1.1	2.5	3.2	0.6	4.9	3.2	0.6
2919	Other general purpose machinery	0.4	0.6	0.1	0.1	0.6	0.0	0.2	1.1	0.3
2922	Machine-tools	36.7	16.7	1.8	31.9	16.7	1.6	31.7	18.3	2.5
2927	Weapons and ammunition	22.3	21.7	0.8	23.6	23.0	0.2	24.0	21.9	0.6
2929	Other special purpose machinery	9.8	7.4	1.1	12.3	5.2	2.5	8.8	5.1	3.7
3000	Office, accounting and computing machinery	74.0	46.8	1.0	82.4	45.5	1.3	86.9	46.2	1.3
3110	Electric motors, generators and transformers	0.7	1.6	0.0	0.6	1.6	0.0	0.9	1.6	0.0
3120	Electricity distribution and control apparatus	7.3	4.3	4.2	8.9	4.2	0.6	9.5	4.2	0.7
3130	Insulated wire and cable	1.5	6.3	0.1	17.4	5.3	0.1	7.2	5.3	0.1
3190	Other electrical equipment n.e.c.	0.9	3.5	34.1	1.0	3.2	2.8	1.2	5.0	5.7
3210	Electronic valves and tubes and other electronic components	87.6	43.4	0.8	85.0	42.6	1.1	83.4	38.0	1.0
3220	Television and radio transmitters and apparatus for line telephony and telegraph	54.0	54.5	2.2	73.7	56.3	1.4	89.7	56.3	1.3
3230	Television and radio receivers, sound or video recording or reproducing apparatus	34.1	27.2	1.7	40.5	27.1	1.6	57.7	25.7	1.5
3311	Medical and surgical equipment and orthopaedic appliances	62.4	49.4	1.7	65.3	52.9	1.5	60.0	43.7	3.3
3312	Instruments and appliances for measuring, checking, testing, navigating and others	27.6	28.1	1.5	34.5	28.1	2.3	36.3	26.0	0.3
3313	Industrial process control equipment	28.0	29.2	0.8	23.4	29.2	1.1	37.0	41.7	0.6
3320	Optical instruments and photographic equipment	18.5	20.0	5.7	25.2	19.0	4.0	25.0	18.5	4.1
3530	Aircraft and spacecraft	92.3	44.3	1.4	93.2	45.9	1.2	92.4	45.2	1.4
	Total	16.5	3.6	6.1	17.1	3.6	5.6	15.7	3.4	6.4

Source: Authors calculation based on U.S. Census HTS-10 to ATP concordance from USITC Oracle database.

Table A4. Trade in ATP reported by the United States and China & Hong Kong in ISIC producing industries - Eastbound, selected years, in millions of U.S. dollars

ISIC	Industry Name	1998	2000	2002	2004	2006	1998	2000	2002	2004	2006
		U.S. Reported Imports					**China & Hong Kong Reported Exports**				
2213	Publishing of recorded media	40	150	148	231	159	31	120	132	173	89
2330	Processing of nuclear fuel	1	1	96	75	50	0	1	93	72	40
2411	Basic chemicals, except fertilizers and nitrogen compounds	16	14	13	17	89	9	15	10	11	73
2423	Pharmaceuticals, medicinal chemicals and botanical products	11	11	20	33	52	23	38	54	82	75
2429	Other chemical products n.e.c.	2	11	5	32	40	6	27	47	43	41
2813	Steam generators, except central heating hot water boilers	0	0	0	0	0	0	0	0	0	0
2911	Engines and turbines, except aircraft, vehicle and cycle engines	0	3	4	6	9	0	1	2	1	3
2914	Ovens, furnaces and furnace burners	0	0	0	0	0	0	0	0	0	0
2915	Lifting and handling equipment	0	0	0	0	0	0	0	0	0	0
2919	Other general purpose machinery	0	0	0	0	1	0	0	0	0	1
2922	Machine-tools	9	10	3	11	44	4	6	3	9	51
2927	Weapons and ammunition	1	3	5	10	39	1	2	1	1	9
2929	Other special purpose machinery	1	0	11	4	11	0	2	3	1	6
3000	Office, accounting and computing machinery	3,994	7,674	11,661	28,366	41,225	3,269	4,734	7,497	21,159	33,989
3110	Electric motors, generators and transformers	8	15	17	31	38	6	9	16	20	37
3120	Electricity distribution and control apparatus	55	70	56	79	143	6	29	21	30	40
3130	Insulated wire and cable	5	11	11	28	72	1	7	6	12	40
3190	Other electrical equipment n.e.c.	2	6	1	3	4	1	0	1	2	4
3210	Electronic valves and tubes and other electronic components	1,629	2,066	1,261	1,653	2,441	1,075	1,661	971	1,450	2,885
3220	Television and radio transmitters and apparatus for line telephony and telegraph	332	1,206	2,880	7,650	15,628	363	1,119	2,566	6,492	13,729
3230	Television and radio receivers, sound or video recording or reproducing apparatus	1,102	2,308	4,246	7,360	11,704	709	1,861	3,411	7,317	11,627
3311	Medical and surgical equipment and orthopaedic appliances	214	307	406	529	486	169	267	296	368	273
3312	Instruments and appliances for measuring, checking, testing, navigating and others	50	106	182	280	708	138	124	119	229	511
3313	Industrial process control equipment	6	10	81	147	205	13	23	77	97	120
3320	Optical instruments and photographic equipment	64	148	87	123	113	61	170	81	116	194
3530	Aircraft and spacecraft	65	61	92	151	232	86	55	78	154	389
	Total	7,609	14,194	21,286	46,821	73,494	5,972	10,271	15,484	37,838	64,223

Source: Authors calculation. U.S. reported data based on U.S. Census HTS-10 to ATP concordance and USITC Oracle database; China & Hong Kong reported data are computed by applying U.S. ATP trade share at HS-6 to official trade statistics from China Custom Administration and Hong Kong Census and Statistics Department.

Table A5. Trade in ATP reported by the United States and China & Hong Kong in ISIC-producing industries -westbound, selected years, in millions of U.S. dollars

ISIC	Industry Name	1998	2000	2002	2004	2006	1998	2000	2002	2004	2006
		U.S. Reported Exports					**China & Hong Kong Reported Imports**				
2213	Publishing of recorded media	105	130	126	162	220	51	153	170	215	309
2330	Processing of nuclear fuel	2	3	5	3	3	2	2	3	4	4
2411	Basic chemicals, except fertilizers and nitrogen compounds	6	11	4	4	5	1	5	1	2	3
2423	Pharmaceuticals, medicinal chemicals and botanical products	16	17	20	22	55	7	15	17	30	49
2429	Other chemical products n.e.c.	8	17	14	43	101	157	157	332	291	237
2813	Steam generators, except central heating hot water boilers	1	3	0	0	0	3	67	9	0	0
2911	Engines and turbines, except aircraft, vehicle and cycle engines	25	13	32	26	167	11	6	7	7	47
2914	Ovens, furnaces and furnace burners	2	3	4	8	3	2	3	3	10	2
2915	Lifting and handling equipment	5	1	9	4	8	1	1	5	5	9
2919	Other general purpose machinery	0	2	6	6	5	0	4	10	11	8
2922	Machine-tools	92	104	195	318	348	55	107	180	387	485
2927	Weapons and ammunition	0	1	0	5	0	0	0	0	0	0
2929	Other special purpose machinery	48	114	215	417	294	80	185	262	740	551
3000	Office, accounting and computing machinery	2,112	3,308	2,360	2,431	3,763	1,815	3,044	2,425	2,572	3,235
3110	Electric motors, generators and transformers	0	0	0	0	0	0	0	0	0	0
3120	Electricity distribution and control apparatus	13	9	15	23	85	16	10	17	25	85
3130	Insulated wire and cable	26	14	19	11	17	7	7	13	9	11
3190	Other electrical equipment n.e.c.	16	29	79	273	159	8	20	93	244	276
3210	Electronic valves and tubes and other electronic components	2,153	3,738	3,974	6,880	8,875	2,169	2,568	3,159	6,110	8,519
3220	Television and radio transmitters and apparatus for line telephony and telegraph	852	901	929	937	1,312	1,014	1,865	1,215	784	909
3230	Television and radio receivers, sound or video recording or reproducing apparatus	36	40	108	208	151	23	28	62	199	258
3311	Medical and surgical equipment and orthopaedic appliances	248	320	414	524	623	208	281	396	547	660
3312	Instruments and appliances for measuring, checking, testing, navigating and others	401	467	677	1,121	1,335	331	617	679	1,189	1,334
3313	Industrial process control equipment	40	49	71	77	100	57	70	103	147	164
3320	Optical instruments and photographic equipment	120	143	102	104	136	104	183	92	197	86
3530	Aircraft and spacecraft	4,161	2,017	3,678	2,164	6,401	2,153	1,707	2,403	2,650	6,181
	Total	10,490	11,456	13,053	15,772	24,167	8,307	11,099	11,646	16,389	23,404

Source: Authors calculation. U.S. reported data based on U.S. Census HTS-10 to ATP concordance and USITC Oracle database; China & Hong Kong reported data are computed by applying U.S. ATP trade share at HS-6 to official trade statistics from China Custom Administration and Hong Kong Census and Statistics Department.

Table A6. Unit value Index of Sino-U.S. ATP trade in ISIC sectors (U.S. dollars)

ISIC	Industry Name		US Export to China			US Import from China	
		1996	2001	2006	1996	2001	2006
2213	Publishing of recorded media	162.7	202.7	357.2	0.4	1.4	2.9
2330	Processing of nuclear fuel	3.3	15.0	34.0	26.4	500.4	463.4
2411	Basic chemicals, except fertilizers and nitrogen compounds	4,485.3	107.7	255.0	178.3	231.9	236.6
2423	Pharmaceuticals, medicinal chemicals and botanical products	1,108.5	48.7	94.7	24.2	40.6	16.4
2429	Other chemical products n.e.c.	35.6	60.9	135.9	305.5	165.6	684.9
2813	Steam generators, except central heating hot water boilers	4,866.0	35,667.4	6,263.0			10,277.2
2911	Engines and turbines, except aircraft, vehicle and cycle engines	305,222.5	200,300.0	731,085.5			
2914	Ovens, furnaces and furnace burners	45,102.0	19,870.5	15,315.0		5,000.0	25.0
2915	Lifting and handling equipment	14,180.0	12,788.9	22,718.7		16,148.5	393.3
2919	Other general purpose machinery	155,189.4	30,518.9	4,049.4		160,994.0	74.5
2922	Machine-tools	345,701.2	250,773.4	389,153.2	16,518.0	45,986.9	92,111.3
2927	Weapons and ammunition				10.2	11.1	12.0
2929	Other special purpose machinery	375,532.5	203,356.8	232,644.5	5,564.8	42,730.8	900,064.1
3000	Office, accounting and computing machinery	6,204.4	3,900.2	2,388.6	87.1	292.7	418.4
3110	Electric motors, generators and transformers				0.9	8.2	4.2
3120	Electricity distribution and control apparatus	6,547.1	7,873.7	1,878.9	5.6	20.0	54.1
3130	Insulated wire and cable	0.4	0.4	0.4	2.7	0.4	0.3
3190	Other electrical equipment n.e.c. (X1000)	593.6	61.9	172.0	0.0	0.0	1.7
3210	Electronic valves and tubes and other electronic components	315.0	6.4	7.0	2.7	1.6	10.5
3220	Television and radio transmitters and apparatus for line telephony and telegraph	10,351.8	3,383.6	1,742.5	143.7	85.5	101.2
3230	Television and radio receivers, sound or video recording or reproducing apparatus	1,541.6	2,225.5	375.8	104.6	102.5	215.7
3311	Medical and surgical equipment and orthopaedic appliances	3,917.7	13,213.6	28,221.8	2,029.6	605.4	3,675.1
3312	Instruments and appliances for measuring, checking, testing, navigating and others	6,371.0	41,804.0	49,333.5	614.0	684.2	1,664.9
3313	Industrial process control equipment	34,711.1	25,554.9	5,378.6	22.6	32.4	8.2
3320	Optical instruments and photographic equipment	212.7	196.8	12,054.9	7.2	8.8	43.1
3530	Aircraft and spacecraft (X1000)	43,931.1	85,645.1	81,607.5	2,029.4	0.1	24.1
	Average (X1000)	28,829.1	39,284.1	32,886.6	43.4	0.2	0.5

Source: US Census and USITC Oracle database.
Note: Aggregated from HS-10 products that include both one-way and two-way US-China ATP trade and a physical unit can be measured in the trade flow so unit value of the products can be calculated.

Appendix B High-Tech Industry and Product Definition and Classification Methods in China

I. High-Tech Industry Definition:

The State Development and Reform Commission (previously the State Development Planning Commission) has divided high-tech industries into eight categories:

1. Information chemical products,
2. Medical and pharmaceutical products (chemical pharmaceutical products, Chinese medicine processing, and biological and biochemical products),
3. Aircraft and spacecraft (manufacture and repair of aircraft and spacecraft),
4. Electronic and telecommunications equipment (telecommunication equipment, radar and peripheral equipment, broadcast and television equipment, electronic apparatus, electronic components, household audiovisual equipment, and other electronic equipment),
5. Computer and office equipment (computers, computer network equipment, peripheral equipment of computers, and office equipment),
6. Medical equipment and meters,
7. Public software service,
8. Other (includes nuclear fuel processing).

The State Development and Reform Commission and the National Bureau of Statistics both use these categories. China introduced a high-tech research and development plan called “Plan 863” in 1986. Although this was not an industry plan, the high-tech research and development content of the plan focused on industrialization. The high-tech research in these plans extended downstream, forming high-tech industries. However, “Plan 863” researched technology, not products. “Plan 863” originally focused on seven research areas with two more added in the 1990s for a total of nine research areas. These research areas were space flight, biotechnology, information technology, lasers, automation, new energy resources, new materials, aeronautics, and marine technology.

China launched the “Torchlight Plan” in 1988 to promote the commercialization and industrialization of high-tech research. The “Torchlight Plan” primarily focused on supporting projects researching new materials, biotechnology, telecommunications, mechatronics, new energy resources, high efficiency and conservation environmental technologies, and other cutting edge technological research with commercial value. The “Torchlight Plan” was implemented across the entire country in over 100 national and province level high-tech industrial development areas. These areas have developed rapidly and there are now 53 national level high-tech zones with economic activity exceeding 2 trillion RMB.

In 1991 the State Science and Technology Commission issued the “National High-Technology Industrial Development Zone High-Tech Industry Rules and Regulations”. The regulation contained 11 high-tech areas, including microelectronics and electronic information technology. The regulation did not classify high-tech products.

The former State Science and Technology Commission classification system for high-tech industry was based on four criteria:

1. High-tech industries are knowledge-intensive and technology-intensive economic entities.

2. University graduates consist of 30 percent or more of the company work force. 10 percent or more of the company work force is engaged in research or developing technology.
3. Research and development costs for high-tech products equals 3 percent or more of total revenue.
4. High-tech products and technology related income make up 50 percent or more of total revenue.

In summary, there are three high-tech industry concepts used by government agencies in China: the State Development and Reform Commission document covering eight industries, “Plan 863” involving nine technology areas and designed to encourage industrialization, and the “Torchlight Plan” for use in high-tech development zones. These three concepts are based on separate documents and used in separate statistics.

II. Classification Methods of High-Tech Industry

“The Issuance of High-Technology Industry Statistical Classification Catalogue” (NUC [2002] 33) was released by the National Bureau of Statistics of China in July 2002. According to this document the “National High-Tech Products Catalogue” is based on the OECD classification method. The document also stipulates that R&D investment intensity in manufacturing sectors be used to indicate technological intensity. China uses U.S. Department of Labor statistics on the ratio of R&D scientists and engineers in industries as a supplementary index in determining technology intensity.

The classification criteria used in the catalogue are fairly standard. It uses a hierarchical approach in its calculations. All domestic industries are ranked and those meeting the criteria below are classified as high-tech industries. The classification process is based on relative standards:

1. High-tech industries should have around twice the average manufacturing sector level of technology intensity at division levels. If the division reaches the standard, then all sub-groups in this division are classified as high-tech sectors.
2. Given that R&D investment is not distributed equally in industry sectors, sub-groups failing to meet the first-level criteria may be included if their level of technology intensity is three times the manufacturing sector average at group level. If the sub-group reaches the standard, then all classes in this sub-group are classified as high-tech sectors.
3. Specific industries in a sub group failing to meet the second-level criteria may be included if their level of technology intensity is four times the manufacturing sector average at detailed class level.

The above process is used to generate a first draft of high-tech industries. The draft list of high-tech industries is then reviewed and adjusted as necessary. First, chemical synthesis material industries are removed from the list. Technology intensity in this sector level is not high and it is not comparable with similar industries in foreign countries. However, manufacture of information equipment and energy equipment are included even though they are closely connected to synthetic material industries.

Second, industries are adjusted and added to the draft list to increase international comparability when there are conflicts between ISIC classification and China's "National Economic Industry Classification" system (GB/T4754-2002). For example, computer repair is removed from the electronic telecommunications equipment sub group (in ISIC computer repair is part of computer services). Airplane repair is assigned to the aircraft and spacecraft sub group (ISIC assigns airplane repair to airplane manufacturing). The entire pharmaceutical manufacturing industry is counted as high-tech to make international comparison easier.

Third, equipment, instruments and cultural items and office machinery are not counted as high-tech industries. This is because while the quality of technical personnel in these industries is twice or more than the manufacturing industry average, these industries fail to meet the required input intensity standards. Only the relatively technology-intensive copying machine portion of office machinery is classified as a high-tech industry. Software development is classified as a high-tech industry due to its knowledge intensity and its important role in information technology. (The OECD classification does not include the software industry). Nuclear fuel processing is a new area in material manufacturing and it is particularly technology intensive. It has its own sub group in China national industry classification and is categorized as a high-tech industry. Information chemical manufacturing is classified as a high-tech industry because it is vital to the development of the electronic and telecommunications equipment sector, a key link in the information manufacturing chain, and closely connected to the supply of important electronic telecommunication materials. (The OECD high-tech classification does not include material manufacturing.)

Finally, the National Bureau of Statistics of China issued the "Catalogue of High-technology Industry Classification" based on the new "National Economic Industry Classification" (GD/T4754-2002) to make high-tech industry statistics from different regional offices more comparable. The report requires nationally unified standards on "The scope of high-tech industry statistical index calculation" and "high-tech industry statistical data reporting formats." "China's High-Technology Industrial Statistical Yearbook" has referenced the "Catalogue of High-Technology Industry Classification" since 2003. The National Bureau of Statistics of China also issued "The New Classification System and its Corresponding Historical Format" and "The OECD Classification System and China's High-Technology Industry Classification" to enable international comparisons to be made for previous years. The four steps listed above are the basis for the China high-tech industry statistical classification method.

III China's High-Technology Product Definition and Classification

The core of China's current high-tech product definition is built on one high-tech industry classification and four product catalogues mentioned in section II and discussed the two related with ATP trade in some details. Here we briefly discuss the remaining two product catalogues that are not directly related to ATP trade. They are: "China's High-Technology Product Catalogue" and the "Foreign Investment Promotion High-Technology Product Catalogue."

1 "China's High and New Technology Product Catalogue."

The Ministry of Science and Technology, Ministry of Finance, and the State Administration of Taxation jointly prepared and issued "China's High and New Technology Product Catalogue" to speed up development of high-tech industries, encourage production of high-tech products, and increase the market competitiveness of China's high-tech products. In 1997, the State Science and Technology Commission issued the "National High-Technology Product Catalogue," dividing high-tech products into nine areas, 58 general categories, and 327 specific categories. In September 2000, the Ministry of Science and Technology, Ministry of Finance, and the State Administration of Taxation jointly issued "China's High and New Technology Product Catalogue," containing 11 technology areas and 2,056 products designated as high-tech.[25] The principles for product selection were as follows:

1. The product core technology belongs to one of the 11 high-tech areas.
2. The product core technology is innovative, technology-intensive, and patented. The product should have strong market potential, be in a growth and maturation period, be economically profitable, and be beneficial to society and the environment. The product should also be appropriate for sustainable development and the economic and social condition in China.
3. The product should be internationally competitive and have the ability to replace imports or increase exports.

In 2006, the Ministry of Science and Technology, Ministry of Finance, and the State Administration of Taxation revised the selection process for products in the high and new tech product catalogue after soliciting public input and expert advice. The new and high-tech product classification criteria were:

1. Products designated as new and high-tech should belong to one of 11 set high-tech areas: telecommunications, advanced manufacturing, aerospace, modern transportation, biotechnology and pharmaceuticals, new materials, new energy resources and energy conservation, environmental protection, earth space and ocean, nuclear technology, and modern agriculture.
2. Products designated as new and high-tech should be technology-intensive, advanced and innovative, require advanced production methods, conserve energy, be nonpolluting, and have market potential.

The "National Medium and Long-term Science and Technology Development Plan Draft (2006-2020)" emphasized 1,421 products from the 11 technology areas contained in the "National New and High-Technology Product Catalogue."[26]

The high and new tech product catalogue management code contains eight digits (i.e. XX XX XX XX), covering all technology areas and product types. The management code is primarily for looking up products and facilitating future adjustments. The first two digits

[25] The 11 technology categories in the 2000 catalogue were: telecommunications, software, aerospace, optical-mechanical-electrical integration, biotechnology, pharmaceuticals and medical equipment, new materials, new energy resources and high efficiency technologies, environmental protection, earth, space and ocean, nuclear technology, and agriculture.

[26] The 11 technology categories in the 2006 catalogue were: telecommunications, advanced manufacturing, aerospace, modern transportation, biopharmaceuticals and medical devices, new materials, new energy resources, environmental protection, earth space and ocean, nuclear technology, and agriculture. The new catalogue included software in the telecommunications category and created new categories for advanced manufacturing and modern transportation.

designate the technology area.[27] The third and fourth digits represent product categories within the technology areas. The fifth and sixth digits represent product types. The seventh and eighth digits represent specific products. The catalogue separates products into high, medium, and low rankings based on the level of technology and the level of preferential treatment. Asterisks "*" are used to designate levels, with "***" being the highest.

2. "Foreign Investment Promotion High-Technology and New Product Catalogue."

In 2003, the Ministry of Science and Technology and the Ministry of Commerce created the "High and New Technology Product Catalogue for Encouraging Foreign Investment" based on the "National High and New Technology Products Catalogue." The list contained 721 products from the "National High and New Technology Products Catalogue" as well as adding 196 other technology products urgently needed in China, all together covering 11 product areas and 917 product types. The 11 product areas are: telecommunication, software, aerospace, optical-mechanical-electrical integration, biology, pharmaceuticals and medical devices, new materials, new energy resources and energy conservation, environmental protection, earth, space and ocean, nuclear technology, and modern agriculture.

Compared to the "Industry Foreign Investment Indices Catalogue", the "High and New Tech Product Catalogue for Encouraging Foreign Investment" has more detailed categories, clearer indices, and is easier to use. China's technological development needs, comparative technological backwardness, national security, and environment were all considered in creating the "High and New Tech Product Catalogue for Encouraging Foreign Investment".

Some provinces and cities, such as Jiangsu Province, have created their own catalogue of high-tech products based on industry reports and research carried out by relevant departments. In addition, other places like Beijing allow companies to apply directly to the local government for a review on whether the company products can be classified as high-tech. Although these local policies increase flexibility, they require large numbers of experts to carry out individual local reviews of these products. In addition, some provinces such as Guangdong, Zhejiang, Shanghai, and Tianjin make every high-tech product designation valid for five years.

[27] (1) Telecommunications, (2) software, (3) aerospace, (4) optical-mechanical-electrical integration, (5) biology, pharmaceuticals and medical devices, (6) new materials, (7) new energy resources and energy conservation, (8) environmental protection, (9) earth, space and ocean, (10) nuclear technology, (11) modern agriculture.

Table B1. Statistics Catalogue of High-technology Industry Classifications

Industry code	Industry name
2530	Nuclear Fuel Processing
2665	Manufacture of Information Chemical Products
27	Manufacture of Medical and Pharmaceutical Products
2710	Manufacture of Primary Chemical Pharmaceutical Products
2720	Manufacture of Preparatory Chemical Pharmaceutical Products
2730	Chinese Medicine Processing
2740	Chinese Medicine Pharmaceutical Processing
2750	Manufacture of Veterinary Pharmaceuticals
2760	Manufacture of Biological and Biochemical products
2770	Manufacture of Health and Medical Supplies
368	Manufacture of Medical Equipment and Instruments
3681	Manufacture of Medical Diagnosis, Monitoring and Treatment Equipment
3682	Manufacture of Dental Instruments and Equipment
3683	Manufacture of Laboratory and Medical Sterilization Equipment
3684	Manufacture of Medical, Surgical and Veterinary Equipment
3685	Manufacture of Mechanical Treatment and Care Ward Equipment
3686	Manufacture of Prostheses, Artificial Organs and Implantation Equipment
3689	Manufacture of Other Medical Equipment and Devices
376	Manufacture of Aircraft and Spacecraft
3761	Manufacture and Repair of Aircraft
3762	Manufacture of Spacecraft
3769	Other Aeronautic Manufacturing
40	Manufacture of Telecommunications Equipment, Computers, and Other Electronic Equipment
401	Manufacture of Telecommunication Equipment
4011	Manufacture of Telecommunication Transmission Unit
4012	Telecommunication Exchange Unit
4013	Telecommunication Terminal Unit
4014	Manufacture of Mobile Communications and Terminal Equipment
4019	Manufacture of Other Telecommunication Equipment
402	Manufacture of Radar and Peripheral Equipment
403	Manufacture of Broadcast and Television Equipment
4031	Manufacture of Broadcast and Television Program Production and Transmission Equipment
4032	Manufacture of Broadcast and Television Receiving Equipment
4039	Manufacture of Applied Television Equipment and other Broadcasting Equipment
404	Manufacture of Computer Hardware
4041	Manufacture of Computers
4042	Manufacture of Computer Network Equipment
4043	Manufacture of Peripheral Equipment of Computers

405	Manufacture of Electronic Apparatus
4051	Manufacture of Electronic Vacuum Apparatus
4052	Manufacture of Semiconductor Separated Parts
4053	Manufacture of Integrated Circuits
4059	Manufacture of Optoelectronics and Other Electronic Devices
406	Manufacture of Electronic Components
4061	Manufacture of Electronic Components and modules
4062	Manufacture of Printed Circuit Board (PCB)
407	Manufacture of Household Audiovisual Equipment
4071	Manufacture of Household Television and Film Equipment
4072	Manufacture of Household Audio Equipment
409	Manufacture of Other Electronic Equipment
411	Manufacture of General Instruments and Meters
4111	Manufacture of Industrial Automatic Control Devices
4112	Manufacture of Electric Instruments and Meters
4113	Manufacture of Drawing, Calculating and Measuring Equipment
4114	Manufacture of Experimental Analysis Equipment
4115	Manufacture of Test Equipment
4119	Manufacture of Supply Meters and Other General Devices
412	Manufacture of Professional Meters and Devices
4121	Manufacture of Environmental Monitoring Devices and Meters
4122	Manufacture of Vehicles and Other Counting Devices
4123	Manufacture of Navigation, Meteorology and Marine device
4124	Manufacture of Agricultural, Forestry, Animal Husbandry and Fishery Devices and Meters
4125	Manufacture of Seismic and Geological Exploration Equipment
4126	Manufacture of Educational Equipment and Devices
4127	Manufacture of Nuclear and Radiation Measurement Equipment
4128	Manufacture of Electronic Measuring Instruments
4129	Manufacture of Other Professional Devices
4141	Manufacture of Optical Equipment
4154	Manufacture of Copying and Offset Printing Equipment
4155	Manufacture of Calculators and Currency Equipment
4190	Manufacture and Repairs of Other Instruments and Meters
621	Software Industry
6211	Basic Software Services
6212	Applied Software Services

Source: China Statistical Yearbook on Science and Technology, 2005.

Table B2. High-Technology Industry Statistical Data Format

Industry	**Corresponding Code** (GB/T4754-2002）
I. Nuclear Fuel Processing	253
II. Information Chemical Products	2665
III. Medical and Pharmaceutical Products	27
Chemical Pharmaceutical Products	271+272
Chinese Medicine Processing	274
Biological and Biochemical Products	276
IV. Aircraft and Spacecraft	376
1．Manufacture and Repair of Aircraft	3761
2．Spacecraft	3762
3．Other Aeronautic Manufacturing	3769
V. Electronic and Telecommunications Equipment	40-404
1．Telecommunication Equipment	401
Telecommunication Transmission Units	4011
Telecommunication Exchange Units	4012
Telecommunication Terminal Units	4013
Mobile Communications and Terminal Equipment	4014
2．Radar and Peripheral Equipment	402
3．Broadcast and Television Equipment	403
4．Electronic Apparatus	405
Electronic Vacuum Apparatus	4051
Semiconductor Separated Parts	4052
Integrated Circuits	4053
Optoelectronics and other electronic devices	4059
5．Electronic Components	406
6．Household Audiovisual Equipment	407
7．Other Electronic Equipment	409
VI. Computer and Office Equipment	404+4154+4155
1．Computers	4041
2．Computer Network Equipment	4042
3．Peripheral Equipment of Computers	4043
4．Office Equipment	4154+4155
VII. Medical Equipment and Meters	368+411+412+4141+419
1．Medical Equipment and Devices	368
2．Instruments and Meters	411+412+4141+419
VIII. Public Software Service	6211+6212

Source: China Statistical Yearbook on Science and Technology, 2005.

Table B3. New Industry Classification System (GB/T4754-2002 and the Corresponding Historical Format

Industry	**Corresponding Code** （GB/T4754-94）
I. Medical and Pharmaceutical Products	27
Chemical Pharmaceutical Products	271+272
Chinese Medicine Processing	273
Biological and Biochemical Products	275
II. Aircraft and Spacecraft	377
1．Manufacture and Repair of Aircraft	3771+3786
2．Other Aeronautic Manufacturing	3779
III. Electronic and Telecommunications Equipment	41-414-418-4173
1．Telecommunication Equipment	411
Telecommunication Transmission Units	4111
Telecommunication Exchange Units	4112
Telecommunication Terminal Units	4113
2．Radar and Peripheral Equipment	412
3．Broadcast and Television Equipment	413
4．Electronic Apparatus	415
Electronic Vacuum Apparatus	4151
Semiconductor Separated Parts	4153
Integrated Circuits	4155
5．Electronic Components	416
6．Household Audiovisual Equipment	4171+4172
7．Other Electronic Equipment	419
IV. Computer and Office Equipment	414+4256+4173
1．Computers	4141
3．Peripheral Equipment of Computers	4143
4．Office Equipment	4256+4173
V. Medical Equipment and Instruments	365+421+422+423+429
1．Medical Equipment and Devices	365
2．Instruments and Meters	421+422+423+429

Source: China Statistical Yearbook on Science and Technology, 2005.

Table B4. OECD Classification System & China's High-technology Industry Classification Categories

Industry	Corresponding Code
New Industry Classification	**（GB/T4754-2002）**
I. Medical and Pharmaceutical Products	27
II. Aircraft and Spacecraft	376
III. Electronic and Telecommunications Equipment	40-404
IV. Computers and Office Equipment	404+4154+4155
V. Medical Equipment and Instruments, Optical Devices, and Instruments and Meters	368+411+412+4141+419
Original Industry Classification	**（GB/T4754-94）**
I. Medical and Pharmaceutical Products	27
II. Aircraft and Spacecraft	377
III. Electronic and Telecommunications Equipment	41-414-418-4173
IV. Computers and Office Equipment	414+4256+4173
V. Medical Equipment and Instruments, Optical Devices, and Instruments and Meters	365+421+422+423+429

Source: China Statistical Yearbook on Science and Technology, 2005.

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