Journal of Economic and Social Measurement 17 (1991) 17–44
IOS Press

MEASURING HIGH TECHNOLOGY TRADE: CONTRASTING INTERNATIONAL TRADE ADMINISTRATION AND BUREAU OF CENSUS METHODOLOGIES AND RESULTS*

Thomas A. ABBOTT III
Graduate School of Management, Rutgers University, Newark, NJ 07102, USA

1. Overview

The proper classification of high technology trade is an important issue for evaluating the competitiveness of the United States in the world market. Popular press reports have claimed that the United States is falling behind the Japanese and Europeans in such critical areas as computers, electronics, and biotechnology. Such reports are, in large part, based on data published by the International Trade Administration (ITA). These reports usually conclude with a call for government intervention to protect and defend what is viewed as the slipping U.S. comparative advantage in high technology products.

The necessity of such intervention has recently been questioned by Abbott et al. (1989). After constructing a new "Advanced Technology Products" (ATP) measure in conjunction with the Bureau of the Census, the authors found that the United States had maintained a healthy trade surplus in high technology products throughout the 1980s. This differs from results obtained using the ITA data because of differences in the classification of individual products. Many products included in the ITA measure were excluded from the ATP measure because they were not considered high-tech by Census analysts. Determining which measure, ATP or ITA, is best for any specific question entails a careful examination of the competing methods and results.

Prior to 1989, international trade data was collected under two distinct clas-

* This paper is based upon activities supported by the Economic Analysis Studies Group, National Science Foundation under contract #C29819X-00-0 and reported in "The Classification of High Technology Trade: A Comparison of International Trade Administration and Bureau of the Census Methodologies and Results". The author gratefully acknowledges the many insights gained through discussions with Paul Herrick and Leroy Norfolk of the Foreign Trade Division, Bureau of the Census; and Robert H. McGuckin and Mark Doms of the Center for Economic Studies, Bureau of the Census. All opinions and conclusions are those of the author, and do not necessarily reflect those of the National Science Foundation or the Bureau of the Census.

sification systems.[1] The Tariff Schedule USA (TSUSA) classification was used to collect import trade data; and the Schedule B classification was used to collect the export trade data. Although both classification systems use 7 digit codes to represent individual products and attempts were made to maintain comparability at a 3 or 4 digit level, individual products often have different 7 digit codes depending on whether they were entering or leaving the country.[2] It is therefore difficult to match import and export data at a product level and aggregation is necessary for obtaining accurate measures of the trade balance.

Both the ITA and ATP measures of high technology trade are based on foreign trade data collected using TSUSA and Schedule B codes. ITA first classifies the individual export or import product in terms of 3 digit Standard Industrial Classification (SIC) industry groups and then defines the entire industry as high-tech or low-tech on the basis of the R&D to sales ratio for that industry. The ATP approach classifies individual products (7-digit TSUSA and Schedule B codes) as high-tech or low-tech on the basis of technological content of the product as determined by Census Bureau analysts. With such striking differences in methodologies it is not surprising to find different conclusions.

This paper is a preliminary examination of the key differences between these two measures. The next section provides a deeper comparison of the two methodologies used for the classification of high technology products. Three key differences are found: 1) the level of aggregation used, 2) the use of indirect versus direct measures of embodied technology, and 3) the use of "objective" versus "subjective" criteria.

The third section provides statistical analysis, by industry, of the differences between the two measures using 1988 trade data. These results suggest that the difference between the two measures are the result of products which are included by the ITA measure but excluded by the ATP measure. Specifically, major differences are found in the "Communications Equipment and Electronics", "Professional and Scientific Instruments" and "Plastics and Resins" industries where significant portions were excluded from the ATP measure.

The final section provides concluding remarks on measuring the high technology trade balance. A clearer definition of what is meant by high technology in a particular context is needed before the appropriateness of either measure can be determined.

[1] In January 1989, the United States officially switched to using the Harmonized Classification System which maintains a level of comparability between imports and exports at a 6 digit level (there are a total of 10 digits). Although increased comparability of imports and exports is a benefit of this change, the primary objective of the Harmonized System was comparability across nations at the 6 digit level and differences between imports and exports remain at the 8 and 10 digit levels.

[2] These differences are due to different objectives of the classification systems. Import codes (TSUSA) must reflect differences in tariffs on individual products whereas the export codes (Schedule B) are used more for statistical (and trade restriction) purposes and therefore correspond more closely to the Standard Industrial Classification product definitions.

2. Alternative Methods of Classification

This section compares two methods of measuring the trade balance of high technology products: The International Trade Administrations (ITA) DOC3 measure of high technology trade, and the Bureau of the Census Advanced Technology Products (ATP) measure of high technology trade introduced in July 1989. The two methods of classifying products are very different in their approaches: ITA uses aggregate data and a quantifiable measure of embodied technology (the R&D to sales ratio) while ATP used disaggregate data and qualitative measures of embodied technology.

The methodology used to construct the ITA DOC3 measure of High Tech Trade is discussed in *U.S. High Technology Trade and Competitiveness*, published by the International Trade Administration, and was developed in Davis (1982). The ITA measure starts by defining industries as "High-Tech" using the ratio of research and development expenditures to sales of domestic producers as a proxy for the technology embodied in the products.

In determining the high technology industries Davis took into account the research and development embodied in the intermediate inputs of an industry by using an input-output table to determine how much of the value of R&D embodied in the intermediate products should be included with the direct R&D used to develop the final products.[3] Davis then defined the "High-Tech" industries as the 10 Standard International Trade Classification (SITC) industries with the highest embodied R&D to sales ratio.

The final step was to define all products within these industries as being "high technology" products. Implicitly, this assumes that all of the products from a single industry contain the same embodied technology, and ignores the product heterogeneity which exists in most industries.

This methodology suffers from several major flaws. First, the ITA methodology assumes that the ratio of research and development expenditures to sales is the appropriate measure of "embodied technology" for an industry. R&D, however, is not an unbiased measure of technology.[4] Moreover, in constructing the ITA measure, no distinction was made between R&D expenditures used for product development and those used for process development.[5]

[3] International Trade Administration, *U.S. High Technology Trade and Competitiveness*. Staff Report # DIE-01-85. February 1985.

[4] Research and Development expenditures are reported (or not reported) by the company for a variety of reasons. These reasons include: differential tax treatments of R&D and other expenditures, because it conveys information to stock holders and potential purchasers, and because government agencies request this information (NSF, SEC). The rules for determining what expenditures are R&D, or which employees are doing research, are determined by the purpose of the reporting and may have little to do with determining which products are on the leading edge of new technologies. Moreover, R&D is typically reported, when it is reported, at a company level. Most of the large R&D companies are involved in many different lines of business and industries, and the allocation of R&D to these areas is at best suspect.

[5] The distinction between product and process R&D is important for the evaluation of advanced

Second, the methodology assumes that all of the products within an existing industry are either high-tech or low-tech. As we will show in the next section, this is clearly not the case.[6] Third, the ITA methodology assumes that the U.S. R&D to sales ratios are appropriate for defining high technology world-wide. Research and development in the United States is more heavily skewed towards military applicaitons than throughout the rest of the world.[7] Moreover, there are important research areas which the United States lags behind the rest of the world.[8] Thus, the ITA measure of high technology is biased towards those industries in which the United States has a comparative advantage or emphasis in research and development.

Starting with the premise that the use of aggregate data represents a major flaw in current measures of the high technology trade balance, the Census Bureau developed its measure of Advanced Technology Products trade balance using more detailed product data. Census Bureau analysts examined all products traded between the United States and the rest of the world, almost 20,000 individual products, to determine which were high-tech and which were not. The methodology used in making this determination is described in by Abbott et al. (1989).

The approach used by the Census Bureau was to first examine the literature and develop a list of the technological fields which are considered to be "high technology." Next, analysts attempted to identify the breakthroughs which defined the leading edge of these fields. Finally, armed with this information, industry analysts examined individual products to determine if they contained a significant amount of one or more of these leading edge technologies. If the product contained a significant amount of one or more of the technologies, it was deemed an "Advanced Technology Product" (ATP).[9] Finally, data on

technology products. Process R&D, by definition, is aimed at improving the production efficiency of a company or industry, and does not result in products which are of necessarily higher quality or sophistication. For example, the development of new methods of petroleum cracking have resulted in much higher efficiency in obtaining gasoline from crude oil, but one would not want to consider gasoline to be a high-tech product. Likewise, the auto industry spends a great deal of resources on the development of new models; but that does not necessarily imply that they will be high-tech cars.

[6] Many industries which are classified as High Tech contain a great deal of products which would not be considered on the leading edge of their technological fields. For example, the "Office and Computing Machines" industry (SIC 357) includes such products as scales, balances, cash registers, calculators, dictation records, adding machines, and computers. Without even going into the details of which computers are on the leading edge (Is the IBM PC still a high technology good?) it is clear that there are a large number of products in this industry which most people would not consider high technology.

[7] See for example "SPECIAL REPORT: THE HIGH-TECH RACE: What the U.S. Can Do", *Fortune*. October 13, 1986, p. 39.

[8] Magnetic-levitation trains, logical inference computers, and high definition television are just three examples of technologies in which the United States lags other countries in research and development efforts.

[9] The term Advanced Technology Product was introduced to avoid confusion between those

imports and exports of Advanced Technology Products was aggregated to construct the overall Advanced Technology Products (ATP) trade balance.

Clearly the Census methodology also suffers from several major flaws. In particular, it relies entirely upon the judgement of industry analysts to evaluate and determine whether a product is high-tech. At this level of detail, there are no quantifiable measures (like R&D to sales) which can be used to determine (however imprecisely) whether a product is high-tech. This implies that another group of analysts would undoubtedly arrive at a different list of ATP products based on their own experiences, attitudes, and prejudices. We cannot, in good conscience, minimize this point. All we can do is to try to mitigate the impact of these subjective decisions and make the users aware of the potential problems.[10]

In conclusion, there are three key differences between the methodologies used to construct the ITA and Census measures of high technology trade. These differences are: 1) the level of aggregation (industries versus products), 2) the use of indirect (R&D to sales) versus direct measures of embodied technology, and 3) the use of objective versus subjective criteria.

These differences are, in part, dictated by the approach used to measure embodied technology. ITA's use of R&D as an indirect measure of technology restricted their analysis to industries because of data availability but permitted the use of "objective" criteria. The Census Bureau's use of product data dictated the use of subjective criteria but permitted direct examination of the individual products. It is up to individual researchers and policy makers to determine which (if either) measure is appropriate for their particular application.

3. Detailed Comparison of Census and ITA Statistics

To facilitate comparisons between the ATP, ITA, other possible measures of high technology trade, data on over 2700 individual products (either export or import) for the period from 1985 to 1988 have been assembled in a database

products found to contain high technology using the Census approach and those products which are produced in the "high technology" industries as determined by ITA's DOC3 definition.

[10] There are several ways that the Census Bureau has tried to minimize the impact of the subjective decisions. First, the judgments of the analysts were reviewed by people inside the Census Bureau as well as outsiders. The analysts were pushed to justify the inclusion or exclusion of individual products, and in some cases, changes were made. Such reviews will be carried out on a regular basis so that new products can be added to the list, and products which become dated can be removed from the list. Second, this paper provides review of the procedures used, and identifies key areas where differences exist between the "objective" and "subjective" approach. Those areas will be reviewed and subsequent changes will be made in the list of products if it is deemed necessary. And finally, the appendices at the end of the paper, provide a detailed breakdown of the individual products which differ between the ITA and Census measures, and data on the imports and exports of those products. With this data, users are free to adjust the respective measures to compensate for any bias they find in the Census or ITA methodology. It is hoped that these procedures of review, sensitivity analysis, and data publication will lead users to have the same confidence in the ATP measure of trade balance as they have in other Census Bureau publications.

Table 1

	Total	ATP	ITA	Both
Exports	924	255	855	186
Imports	1724	256	1709	189
Total	2700	511	2564	375

structure which is described in more detail in Abbott (1990). This section reports results of a comparison between the ITA and ATP measures using data for 1988. Comparisons for other years, or for alternative measures, can be easily made using the database and associated software and have been discussed in Abbott et al. (1989).

Table 1 shows the breakdown between imports/exports of the 2700 products in the database for each classification.[11] As expected, the ITA approach of defining entire industries to be high technology results in many products being included in their measure (of the 2700 products in the database, 2564 are included in the ITA measure). By comparison, the ATP measure, being more selective, has many fewer products (only 511 of the 2700 products are included in the ATP measure). In addition, there is considerable overlap between the two measures, with a total of 375 products being included in both measures.

It is frequently useful to divide the products in the database into three groups:

Group 1 – products which are included in both measures
Group 2 – products which are included by ATP only
Group 3 – products which are included by ITA only

Table 2 provides an examination of these three groups over the period 1982 to 1988. As can readily be seen, the common component (Group 1) tends to dominate both measures, providing a $ 14–23 billion dollar surplus during the period from 1982 to 87. In 1988, the surplus of these products was almost $ 24 billion. Group 2 products, those unique to the ATP measure, play only a minor role in the overall high technology trade balance, accounting for only about $ 2 billion dollars in surplus to ATP through 1987, before rising to a $ 3.5 billion surplus in 1988. In contrast to this, the Group 3 products (those only included in the ITA measure) had significant impact on the trade balance in most years. Starting out in 1982 with a $ 845 million dollar surplus, these products rapidly lost ground and by 1984 the had an $ 11 billion dollar deficit. Over the period from 1985 to 1988 these products had a deficit of nearly $ 17 billion dollars. The differences between the ATP and ITA measures are determined by the products which make up the Group 2 and 3 categories, that is, products which are included in one measure but not the other.

[11] Note, the number of products presented here differs from earlier publications (which focused on the 82–88 period) of the ATP measure because of revisions in the product definitions (TSUSA and Schedule B codes) themselves. The longer focus necessitated keeping some definitions, used prior to 1985, in the data set.

Table 2
Comparison of trade data using the ATP and ITA definitions of high technology
(millions of dollars)

	ATP	ITA	Common to Both (Group 1)	ATP Only (Group 2)	ITA Only (Group 3)
1982					
Exports	39718	58112	37150	2568	20962
Imports	15170	34521	14404	766	20117
Balance	24548	23591	22746	1802	845
1983					
Exports	42536	60158	39992	2544	20166
Imports	18890	41397	18304	586	23093
Balance	23646	18761	21688	1958	−2927
1984					
Exports	46868	65510	43723	3145	21787
Imports	26648	59464	25705	943	33759
Balance	20220	6046	18018	2202	−11972
1985					
Exports	51497	68425	48442	3055	19983
Imports	27552	64778	26373	1179	38405
Balance	23945	3647	22069	1876	−18422
1986					
Exports	53501	72517	50309	3192	22208
Imports	37861	75107	36348	1513	38759
Balance	15640	−2590	13961	1679	−16551
1987					
Exports	62087	84071	58587	3500	25484
Imports	42662	83481	41274	1388	42207
Balance	19425	590	17313	2112	−16723
1988					
Exports	76952	104566	70378	6574	34188
Imports	49711	97732	46642	3069	51090
Balance	27241	6834	23736	3505	−16901

Source: Abbott et al. (1989) and current analysis.

3.1. Products Included in ATP but Not Included in ITA

In their evaluation of individual products, Census Bureau analysts included many products from industries which were not included in the ITA DOC3 definition of high technology industries. These products are produced by industries which include: Fabricated Structural Metals (344), Miscellaneous Fabricated Metals (349), Construction Machinery (353), Metalworking Machinery (354), General Industrial Machinery (356), Electrical Industrial Apparatus (362), and

Miscellaneous Electrical Machinery (369). In ranking the R&D to sales ratios, these industries were not among the top ten and thus were not included in the ITA measure of high technology. Tables A1 and A2 list the products which were included in the ATP measure but excluded from the ITA measure.

These products were judged by the Census Bureau analysts to contain significant amounts of the leading edge technologies. For example, the leading export in Group 2, Semiconductor Production Machinery, contain sophisticated control systems needed for the manufacture of semiconductor chips used in computers and other sophisticated electronic devices. These machines accounted for over $ 1 billion dollars in exports, more than 16 percent of the export value in Group 2. Other high value exports in Group 2 include: "Electro-Medical Apparatus" ($ 778 million), "Jet and Gas Turbine Engines" ($ 773 million), and "Combination Electrical Charge Measuring Equipment" ($ 754 million). On the import side, we find that the Census Bureau analysts included "Medical and Other X-ray Equipment" ($ 545 million), and "Other Electrical-Medical Apparatus and Parts" ($ 687 million combined) as high technology products.

Overall, these Group 2 products had a trade surplus of over $ 3.5 billion dollars. Thus, it would appear that the ITA measure of high technology misses a number of important products which should be included in the measure of high technology trade if one wants an accurate picture of the current U.S. trade posture in the high technological arena.

3.2. Products Included in ITA but Not Included in ATP

The second, and numerically more important, source of differences between the Census and ITA measures of high technology trade are products included in the ITA measure but excluded from the Census. These are the so-called "low-tech" products manufactured in the "High Tech" industries. From the analysis in the proceeding section, we know that most of the differences between the ITA and Census measures are due to trade of these products. Although it would be nice to list all of the products which fall into the Group 3 category, those included in the ITA measure but excluded from the ATP measure, such a list would contain 2189 products and would be about 42 pages long. For current purposes, however, it is sufficient to examine the differences between the ITA and ATP measures using the existing ITA industry definitions. Table 3 provides a breakdown of the trade balance for each measure, using the ITA industry definitions (where all products in that industry are included in the ITA measure). The three most striking differences between the two measures are in "Communications Equipment and Electronics", where ITA reports a $ 18.6 billion dollar trade deficit and ATP reports a $ 2.6 billion dollar deficit; "Professional and Scientific Instruments", where ITA reports a $ 2.5 billion dollar deficit and ATP reports a $ 3.7 billion dollar surplus; and "Plastics and Resins", where ITA reports a $ 5.3 billion dollar surplus and ATP reports 0 surplus (none of the products in this industry were included in the ATP meas-

Table 3
Trade balance by ITA industry groups comparison of ITA and ATP classifications.
(Millions of dollars)

ITA industry group	ITA	ATP	Difference
Guided missiles, spacecraft			
Exports	1,062	1,062	0
Imports	52	52	0
Balance	1,010	1,010	0
Communications equip. & electronics			
Exports	23,569	15,928	7,641
Imports	42,205	18,502	23,703
Balance	−18,636	−2,574	−16,061
Aircraft and parts			
Exports	25,078	23,599	1,119
Imports	6,272	5,210	1,062
Balance	18,805	18,748	56
Office, computing & accounting machines			
Exports	24,499	23,530	969
Imports	21,971	18,709	3,262
Balance	2,527	4,821	−2,294
Ordnance and accessories			
Exports	723	92	631
Imports	440	124	315
Balance	284	−32	316
Drugs and medicines			
Exports	4,042	375	3,667
Imports	3,723	443	3,279
Balance	319	−67	387
Industrial inorganic chemicals			
Exports	4,143	752	3,392
Imports	3,455	865	2,590
Balance	689	−113	802
Prof. & scientific instruments			
Exports	10,206	4,679	5,527
Imports	12,713	923	11,791
Balance	−2,508	3,756	−6,263
Engines, turbines and parts			
Exports	3,818	0	3,818
Imports	4,816	1,813	3,002
Balance	−998	−1,813	815
Plastics and resins			
Exports	7,424	0	7,424
Imports	2,083	0	2,084
Balance	5,341	0	5,341

Table 3 (cont.)

ITA industry group	ITA	ATP	Difference
Other industries			
Exports	0	6,575	– 6,575
Imports	0	3,069	– 3,069
Balance	0	3,505	– 3,505
Total trade balance			
Exports	104,566	76,953	27,613
Imports	97,732	49,711	48,021
Balance	6,834	27,241	– 20,407

ure). A fourth feature is the Other Industry category which includes all of those products included in ATP but fall outside of the 10 ITA high technology industries, as discussed above.

We will now individually discuss each of these industries.

3.3. Guided Missiles and Spacecraft (SIC 376)

Guided Missiles and Spacecraft is the only industry in which there was complete agreement between ATP and ITA. There are a total of 4 export product codes (with $ 1.1 billion in value) and 3 import product codes (with $ 52 million in value) resulting in a $ 1 billion dollar trade surplus for the industry.

3.4. Communications Equipment and Electronics (SIC 365, 366, 367)

As mentioned above, there are major differences between the ATP measure and the ITA measure for this industry. Census Bureau analysts felt that most of the products in this industry were not high-tech products. Of the 196 export product codes (representing $ 23.5 billion), only 66 ($ 15.9 billion) were included in the ATP measure. Of the 392 import product codes ($ 31.1 billion) only 84 ($ 13.7 billion) were included in the ATP measure. Thus, it is not surprising to find that there are major differences in the reported trade balances of each measure.

Table B1 in the appendix provides a list of the top 15 export and import product codes which were excluded by the ATP measure. ''Printed Circuit Boards'' ($ 862 million) and ''Sound Recordings, Not Specifically Provided For'' ($ 591 million) lead the list of exports excluded from the ATP measure. Although one might argue that some printed circuit boards are high technology, most are fairly simple etched boards having only one layer of circuitry; and clearly sound recordings are not one of this countries leading technologies.

The leading import products to be excluded from the ATP measure were ''Radio-Tape Combinations for Vehicles'' ($ 1.75 billion dollars) and ''Other Radio Combinations'' ($ 1.44 billion). Appropriately, Census analysts felt that car stereos and "boom boxes" did not represent the leading edge of this industry.

Although one might quibble with individual product classifications, most people would agree that much of the communications and electronics equipment included in the ITA measure should not be considered "high technology". Eliminating these products, as in the ATP measure, provides a dramatically different conclusion as to the United States' market position. The conclusion from the ATP measure is that the United States remains a strong competitor in high technology electronics ($ 2.6 billion deficit on $ 34 billion dollars of trade) but is much weaker at the low technology end of the industry ($ 16 billion deficit on only $ 31 billion dollars of trade).

3.5. *Aircraft and Parts (SIC 372)*

Within the Aircraft and Parts Industry, most products are included in both measures. On the export side, 27 of the 33 product codes are included in the ATP measure. These products represent $ 24.0 billion dollars of the total $ 25.1 billion dollar industry exports. On the import side, 14 of the 27 import product codes were included in the ATP measure, representing $ 5.2 billion of the $ 6.3 billion dollars of imports for this industry. With such complete coverage, it is not surprising that there is little difference in the trade balance of this industry as reported by the ITA measure or the ATP measure.

A complete list of all of the products in this industry excluded from the ATP measure is provided in Table B2. "Used and Rebuilt, Nonmilitary Aircraft" heads the list of exports (with $ 727 million), while "Aircraft Parts, NSPF" ($ 900 million) heads the list of imports. Again, although some of the specific items included in these product categories may be considered high technology, most are not.

3.6. *Office, Computing and Accounting Machinery (SIC 357)*

When one thinks about high technology products, the first thing that comes to mind is computers and other information processing products. Thus, industry 357 plays an important role in the development of any high technology trade measure. Unfortunately, at the aggregate level, computers are not separated from the other types of office and accounting machines (typewriters, calculators, copy machines, etc.). Thus, using the trade balance of the industry as a whole may introduce substantial errors in measuring the high technology trade balance. Specifically, of the 47 export product codes, only 14 were judged "high-tech" by Census Bureau analysts. Of the 103 import product codes, only 43 were judged high-tech. Interestingly, although there were many product codes excluded from the ATP measure, those products excluded had relatively low value. The ATP measure captures about 96 percent of the value of exports, ($ 23.5 billion out of $ 24.5 billion) and 85 percent of the value of imports

($ 18.7 billion out of $ 22.0 billion). Thus, the balance of trade for this industry differs by only $ 2.3 billion depending on which measure is used.

As suggested above, products excluded by the ATP measure have relatively low value and are associated with more general office equipment. As seen in Table B3, the leading export product excluded from the ATP is "Parts of Other Office Machines" ($ 157 million), and the leading import product excluded is "Parts of Electrostatic Copy Machines" ($ 831 million). Other products excluded from the ATP measure include telephone answering machines, typewriters, calculators, and cash registers. Clearly these products should not be included in a measure of high technology trade.

3.7. *Ordnance and Accessories* (*SIC 348*)

For the Ordnance and Accessories industry, the overall trade surplus was $ 284 million, while the trade deficit in Advanced Technology Products was $ 32 million. This is somewhat surprising because of the widely held belief that the United States is a major supplier of arms to the world and that these weapons are sophisticated. This apparent contradiction is because most of the sophisticated weapons that the United States ships abroad are included in other industries, specifically in the Aircraft and Parts industry (372) and Guided Missiles and Spacecraft industry (376). The products found in the Ordnance and Accessories industry are priliminary small arms, ammunition, bombs and bomb parts that are not very sophisticated. As a result, only 2 of the 33 export product codes and 3 of the 45 import product codes are included in the ATP measure.

A list of high value exports and imports excluded from the ATP measure supports these exclusions (Table B4). The leading export excluded from the ATP measure is "Ammunition for Military Weapons of more than 30 MM Bore" ($ 117 million) while the leading import excluded from the ATP measure is "Pistols and Revolvers of more than $ 8 Value" ($ 80 million).

3.8. *Drugs and Medicines* (*SIC 283*)

Drugs and Medicines are another industry where there are differences between the overall trade balance and Advanced Technology Products trade balance. The overall trade surplus for the drug industry was $ 319 million in 1988, but for the ATP products the United States ran a trade deficit of $ 68 million, resulting in an overall difference of $ 387 million dollars between the ITA and Census measures.

Many of the products in this industry were judged to be not high-tech by Census Bureau analysts. Of the 104 export product codes, only 12 were included in the ATP measure, while of the 255 import product codes only 5 were included. For the Drug industry, the distinction between product and process development was the key in explaining ITA's inclusion and ATP's exclusion of many of these products. Although the Drug industry is a major R&D performing industry, most of the research and development expenditures are spent on developing manufacturing processes for producing large quantities of the drug and/or developing new delivery systems (i.e. a drug is currently delivered through vaccination and the manufacturer is attempting to develop an oral version). A relatively small percentage of the R&D expenses go towards the development of new drugs.

As a result, ATP classifies only $ 375 million of the $ 4.0 billion dollars of exports and only $ 443 million of the $ 3.7 billion dollars of imports as high tech, providing the differences in the trade balance discussed above. Some of the high value products excluded from the ATP are listed in Table B5. Heading up the list of exports excluded is "Antibiotics, NSPF" ($ 690 million) and "Bulk Cardiovascular Drugs" ($ 442 million). Heading up the list of imports excluded from ATP are "Cardiovascular Drugs, excluding Alkaloids" ($ 275 million) and again "Antibiotics, NSPF" ($ 263 million).

3.9. *Industrial Inorganic Chemicals (SIC 281)*

Most of the products in the Industrial Inorganic Chemicals industry are not high-tech. They are chemical compounds, like aluminium oxide which are relatively simple and can be produced using several different technologies. Only 8 traded products from this industry were chosen to be included in the Advanced Technology Products list by the Census Bureau analysts (4 export and 4 import). These products are "Nuclear Reactor Fuel Rods", "Uranium Compounds", and "Radio Active Isotopes" used in medical and experimental applications.

This industry shows up in the ITA definition of high technology because of the high research and development expenditures; however, most of these expenditures are for the development of new and more efficient production processes, rather than for the development of new products. In accordance with the criteria that technology must be embodied in the product in order to be an Advanced Technology Product, most of this industry was not included in the ATP list.

Not surprisingly, there is a large difference between the ITA trade balance and the ATP trade balance. In 1988, the ITA trade balance was $ 689 million while the advanced technology products ran a deficit of $ 113 million. Thus, the Industrial Inorganic Chemicals industry explains $ 802 million dollars of the difference between the ITA and ATP measures for 1988.

A listing of the top 15 product codes excluded from the ATP measure is provided in Table B6. These products confirm the Census characterization of the industry (high technology process but simple products) and justify their exclusion from the high technology trade balance.

3.10. Professional and Scientific Instruments (SIC 38 × 3825)

The Professional and Scientific Instruments industry is the only industry in which the ITA definitions differ from a simple aggregation of 3 digit SIC codes. In an attempt to maintain comparability to the Standard International Trade Classification (SITC), ITA excluded SIC 3825, "Electrical Measuring Equipment" from the definition of the industry. In examining this industry, Census Bureau analysts found that only a narrow portion of the industry contained high technology products. Of the 188 export product codes, only 61 were included in the ATP measure, and of the 458 import product codes (many of these are various kinds of watches which separated by type of material and number of jewels) only 29 were included in the ATP measure.

On the whole, ATP products accounted for almost half of the exports ($ 4.7 billion out of $ 10.2 billion) but for less than 8 percent of the imports ($ 923 million out of $ 12.7 billion). Not surprisingly, the Professional and Scientific Instruments industry accounted for substantial differences between the ATP and ITA high technology trade balances. The 15 highest value export and import products which were excluded from the ATP measure are listed in Table B7. These products include miscellaneous medical equipment, photographic film, and other such products. Clearly, these products should be excluded from even the broadest definition of high technology products, as done by the ATP measure.

3.11. Engines, Turbines and Parts (SIC 351)

The Engines, Turbines and Parts industry is also a source of major differences between the ATP and ITA measures. None of the 37 export products were included by Census Bureau analysts in the ATP measure, and only 2 of the 52 import products were included.[12] On the whole, the industry had total exports of $ 3.8 billion, and imports of $ 4.8 billion, with $ 1.8 billion in high-tech products. Thus ITA reports a $ 1.0 billion dollar trade deficit while ATP reports a $ 1.8 billion dollar deficit. A listing of the highest valued products is provided in Table B8. These products, mainly diesel and other engine parts, clearly should not be included in a measure of high technology trade.

3.12. Plastic Materials and Synthetic Resins (SIC 282)

The Plastic Materials and Synthetic Resins industry is another example where there is a great deal of process research and development but very little product R&D. As a result, the ATP measure of advanced technology does not

[12] The two import products included in the ATP measure are: Parts of Non-Piston Aircraft Engines, and Parts of Non-Piston Civilian Aircraft Engines.

include any of this industry's products while the ITA measure included the entire industry. This leads to a significant difference in the measured trade balance. In 1988, the industry had a trade surplus of over $ 5.34 billion. Including this industry in the Census measure would have, however, increased the overall difference between the ITA and ATP measure.

The highest valued exports and imports are listed in Table B9. These products confirm the Census Bureau's analysts characterization of the industry, and justify the exclusion of this industry from the ATP measure. Polypropylene and polyethylene resins are not high technology products, although their manufacture may require sophisticated equipment.

4. Concluding Remarks

This paper compares two alternative methods of classifying high technology trade. The first method, developed by the International Trade Administration (ITA) uses industry R&D to sales ratio as a proxy for embodied technology, and defines the top 10 R&D industries as "High Technology Industries". It then classifies all traded products which correspond to these industries as being high technology products. The second method, developed by the Bureau of the Census (ATP), focuses on the individual products and attempts to classify them on the basis of analysts' judgments. As expected, two very different methodologies arrive at very different conclusions.

The usefulness of either measure depends, of course, on the particular application. In most cases, the ITA measure provides a broad notion of the high technology industries and U.S. trade performance in these areas. In contrast, the Census Bureau approach takes a much narrower view and attempts to essentially define high technology through an enumeration of the products. This results in a classification more closely aligned to what the public and policy makers have in mind when they discuss high technology. This, however, is achieved at the cost of clear, objective, criteria for establishing which products are to be considered high technology.

Given the jugdmental nature of the ATP classification, it is important to provide users with an environment for examining and modifying the high technology classification to suit the needs of a particular application. The database and associated software which this study is based on is a step in this direction. Efforts are needed to improve the quality and extend the time frame of the database before this task can be called complete.

Moreover, this report raises the important issues of what is high technology? How can we measure it? The use of R&D to sales ratios is one approach. The Bureau of Labor Statistics has developed similar measures using the ratio of engineers and scientific personnel to regular employees as a second alternative. The Census Bureau's "I know it when I see it" approach is yet a third alternative. A clearer understanding of the term high technology and the context in which it is used, is needed before we can really answer whether the United States is winning or losing the high technology trade war.

References

Abbott, T., R. McGuckin, P. Herrick and L. Norfolk (1989). Measuring the Trade Balance in Advanced Technology Products. Center for Economic Studies Discussion Paper: CES 89-1. Bureau of the Census.

Abbott, T. (January 1990). *High Technology Data Base: Users Guide and Technical Documentation* (available from the author).

Abbott, T. (February 1990). *The Classification of High Technology Trade: A Comparison of International Trade Administration and Bureau of Census Methodologies and Results.* Report to the National Science Foundation, Economic Analysis Studies Group.

Bylinsky, G. (1986). Special Report: The High Tech Race, Who's Ahead? *Fortune*, October 13, 26–38.

Bylinsky, G. (1986). What Tomorrow Holds. *Fortune,* October 13, 42–46.

Bartel, A.P. and F.R. Lichtenberg (May 1985). Technology, Trade and Employment. Unpublished mimeo. Columbia University.

Davis, L. (July 1982). Technology Intensity of U.S. Output and Trade. Unpublished paper. Department of Commerce, International Trade Administration.

Davis, L. (September 1983). Staff Report: The Indirect Influence of R&D on Trade Performance. International Trade Administration.

CorpTech. (1986). *The CorpTech High Technology Classification System.* As published in CorpTech Directory, U.S. Edition.

International Trade Administration (February 1985). Staff Report: U.S. High Technology Trade and Competitiveness, DIE-01-85.

International Trade Administration. Final Report: The Status of Emerging Technologies: An Economic/Technological Assessment to the Year 2000.

Landau, R. and D.W. Jorgenson, eds. (1986). *Technology and Economic Policy.* Cambridge, MA.

McGuckin, R.H. and J.L. Monahan (1987). High Technology Goods and the U.S. Trade Deficit. Unpublished paper. Center for Economic Studies, Bureau of the Census.

Nasar, S. (1985). America's War on Imports. *Fortune.* August, 19, 26–29.

National Academy of Science (1987). *Balancing the National Interest: U.S. National Security Export Controls and Global Economic Competition.* Washington, DC: National Academy Press.

Ramo, S. (1988). How to Revive U.S. High Tech. *Fortune.* May 9, 124–133.

Ramo, S. (1988). *The Business of Science: Winning and Losing in the High-Tech Age.* New York, NY: Hill and Wang.

Richie, R.W., D.E. Hecker and J.U. Burgan (november 1983). High Technology Today and Tomorrow: a Small Slice of the Employment Pie. *Monthly Labor Review*, 50–58.

Smith, L. 1986. What the U.S. Can Do. *Fortune.* October 13, 39–41.

Sveikauskas, L. (September 1983). Science and Technology in United States Foreign Trade. *The Economic Journal*, 542–554.

Worden, G. (1986). Problems in Defining High-Technology Industries, presented at Informal Workshop on Industrial Statistics, Organization for Economic Cooperation and Development, Paris, France, November 4.

Appendix A. Products included in ATP but not included in ITA

Table A1. Exports

Product	SIC	Description	1988 Value
6785065	356	SEMICONDUCTOR PRODUCTION MACH	1081723000
7091670	369	ELECTRO-MEDICAL APPARAT NSPF	777799120
6604935	920	JET & GAS TURBINES, NONMILITARY	772813074
7125040	382	COMBNTN ELEC CHARC MEAS EQP	753598895
7091690	369	PTS NSPF ELEC-MED & THER APP	458608105
7125035	382	WAVE FORM MEAS EQ & PTS NSPF	319467906
7125045	382	EQUIP NSPF TEST ELEC CIRCUIT	303666953
7096320	369	MED/DEN X-RAY EQP & PTS NSPF	247861862
7125020	382	VOLT CURRENT RESIST TEST EQP	216172763
7091620	369	ELEC-MED THERAPTC DEVCE NSPF	208226599
7125032	382	OSCILLSCPES OSCILLGRPH & PTS	183203914
6884010	382	SIGNAL GENERATORS	126852252
7091665	369	PATIENT MONITORING SYSTEMS	107804166
7125025	382	FREQ TEST APPARATUS & PARTS	106636780
6601006	349	FUEL ROD ASSEMBLIES	102828176
7091605	369	PACEMAKERS	93416448
7125005	382	ELEC TEST EQ INTNL COMBUS EN	90684319
6601008	344	NUCLEAR REACTORS AND PARTS	59483457
7096120	369	X-RAY TUBES	57346627
7096620	369	RADIATN APPARA & PTS MED/DEN	57138708
7096340	369	X-RAY EQP & PTS EXC MED/DEN	55870209
7096640	369	RADIATN MEASMNT EQ ETC & PTS	54704320
6743528	354	DEBURRING,GRINDING ETC., N/C	38862134
6743538	354	FLAT SURF PRECISION GRIND MCH,NSPF	36653359
7091655	369	ELECTROCARDIOGRAPHS	29628149
7096660	369	RADIATION APPARA & PTS NSPF	21077580
6604925	920	JET & GAS TURBINES, MILITARY	20061658
6743571	354	SHEARING & PUNCHING MACH, N/C	16987921
6743503	354	HORZ LATHES,MULTI SPINDLE,N/C	13864986
6743216	354	SINGLE & MULTI STA TRANSFER MACH	12565054
7091615	369	ULTRASONIC THERAPEUTIC DEVCE	12043445
6743505	354	HORZ LATHES,SINGLE SPIN,UN 25HP,N/C	11539378
6743544	354	PRECISION GRIND MACH, NSPF	11023071
6743209	354	MACH CTR,HORZ,W/O INDEX TURRET	10581600
6743211	354	MACH CTR,HORZ,WITH INDEX TURRET	10376320
6743204	354	MACH CTR,VERT,Y-AXIS NOT OV 26 IN	9038764
6743264	354	MILLING MACH,N/C	8281007
6743559	354	METAL REMOVING MACH, NSPF, N/C	7766407
6743578	354	BENDING & FORMING MACH, N/C	7472743
6743542	354	PRECISION GRIND MCH,INTERNAL,CYLND	6576024
7096140	369	PARTS FOR X-RAY TUBES	6040264
6743553	354	CHIPLESS SPARK EROSION MACH	4887416
6743549	354	ELECTRIC DISCHARGE MACH,NSPF	4800596
7091660	369	ELECTROENCEPHALOGRAPHS	4587490
6743507	354	HORZ LATHES,SINGLE SPIN,25-50HP,N/C	4451548
6743541	354	PRECISION GRIND,EXTERNAL,CYLINDRICL	4188065
6743254	354	DRILLING MACH,N/C	3636437
6743509	354	HORZ LATHES,SINGLE SPIN,OV 50HP,N/C	3390953

Table A1 (cont.)

Product	SIC	Description	1988 Value
6743206	354	MACH CTR,VERT,Y-AXIS OV 26 IN.	2922338
6743533	354	FLAT SURF PRECISION GRIND MCH,TABLE	2619785
6743247	354	BORE,DRILL,MILL MACH,N/C,VERT	2173575
6743246	354	BORE,DRILL,MILL MCH,N/C,HORZ,NSPF	1956240
6743225	354	WAY TYPE MACHINES	1511123
6743547	354	TRAVELING WIRE MACH	1491434
6743276	354	VERT BORE MACH & TURRET LATHES,N/C	1424274
6743245	354	BORE,DRILL,MILL MCH,N/C,HORZ,TABLE	1041814
6743523	354	VERT LATHES,SINGLE SPINDLE, N/C	927123
6743551	354	SPARK EROSION MACH, N/C	921055
6743521	354	VERT LATHES,MULTI SPINDLE, N/C	611998
7091610	369	DIATHERMY UNITS	472914
6743281	354	BORING MACHINES, N/C	387031

		Total	6574750726

Table A2. Imports

Product	SIC	Description	1988 Value
7096320	369	MEDICAL ETC X-RAY EQIP & PT	545389059
7091770	369	ELEC-MED APPARATUS, NSPF	395612781
7091790	369	ELEC-MED APPARATUS PTS NSPF	291751766
6743506	354	HOR LATHE,SINGLE SPIN,UN 25 HP,N/C	221504845
6784800	356	FLIGHT SIMULATING MACH	110003020
7091720	369	ELEC-MED THERAP DEVICS NPSF	99653163
7096340	369	X-RAY APPARATUS NSPF & PTS	99633457
6743562	354	TRAVELING WIRE MACH	78073596
6785086	356	INDUSTRIAL ROBOTS, NSPF	71170416
6743404	354	MACH CTR,VERT,Y-AXIS NOT OV 26 IN.	70603489
6743508	354	HOR LATHE,SGL SPIN,25-50 HP,N/C	68730241
6743412	354	SINGLE & MULTI STA TRANSFER MACH	68728198
6743409	354	MACH CTR,HORIZ,WITH AUTO TOOL CHNGR	60618988
7096120	369	X-RAY TUBES	54923842
7096620	369	MEDICAL ETC RADIO EQIP & PT	54789683
6743593	354	METAL FORM MACH TOOL,NSPF, N/C	51549948
6745310	362	NUMERICAL CONTROLS FOR MACH. TOOLS	44960006
6839005	362	INDUSTRIAL ROBOTS, WELDING	43551462
7091540	369	ELECT-SURG APPTUS NSPF PTS	41839425
6785087	356	PARTS FOR INDUST ROBOTS,NSPF	41576565
6743584	354	PUNCHING & SHEARING MACH, N/C	33010839
6743464	354	MILLING MACH,N/C	32709530
7091715	369	ULTRASONIC THERAPUT DEVICES	29679264
6743546	354	GRIND MACH,AXIS .01MM, N/C	28667884
7091765	369	ELEC-MED MONITOR SYSTEMS	28361050
6743543	354	GRIND MACH(FLAT) .01 MM	25240590
6743411	354	MACH CTR WITH INDEX TURRETS	24001091
8541000	369	APP USING RADIOACTIVE SUBS.	23309990
6743588	354	BENDING & FORMING MACH, N/C	21003624
6743504	354	MULTI-SPINDLE LATHES, HORIZ, N/C	20456995

Table A2 (cont.)

Product	SIC	Description	1988 Value
6641005	353	INDUST ROBOTS,LIFT & HANDLING	19932274
6743576	354	METAL CUT MACH TOOL,NSPF, N/C	18886113
7091705	369	PACEMAKERS	17421474
6743571	354	MACH TOOL, CHIPLESS,NSPF	16903842
6743519	354	LATHE,EXC HORIZONTAL, N/C	16701887
6743564	354	EDM'S, EXCEPT TRAVELING WIRE TYPE	16464855
6743567	354	MACH TOOL,CHIPLESS, N/C	14849806
6743554	354	GRIND MACH,EXTERNAL,CYLINDRICAL	13436722
6743419	354	COMB. BORE,DRILL,MILL,MACH. NC,NSPF	13317032
6743541	354	RECIP TABLE TYPE FLAT SURF GRIND	12540080
6743328	354	DRILLING MACH,N/C	12525721
7096660	369	RADIATION EQUIP NSPF & PTS	11836977
7096140	369	X-RAY TUBE PARTS	11327738
7091520	369	ELECT-SURG THERAPEUT APPTUS	10156958
6743418	354	COMB BOR,DRILL MCH,N/C,HORIZ	8757608
6743539	354	GRIND MCH,FLAT SUR,AXIS .01MM, N/C	8458705
6743505	354	MULTI-SPINDLE LATHES, HORIZ,NSPF NC	8370034
6743528	354	SHARPEN MCH,TOOL & CUTTER GRIND,N/C	7416947
7091750	369	ELECTROCARDIAGRAPHS	6940560
7096640	369	RAD CONTROL ETC EQUIP & PTS	6925336
7091760	369	ELECTROENCEPHALOGRAPHS	6272363
6743406	354	MACH CTR,VERT,Y-AXIS OV 26 IN.	6181062
6743558	354	GRIND MACH(AXIS .01MM) NSPF	6090273
6743556	354	GRIND MACH,INTERNAL,CYLINDRICAL	4298334
6743510	354	HOR LATHE,SGL SPIN,OV 50 HP,N/C	4268148
6743481	354	BOR MCH EXC VERT, N/C	3571007
6743476	354	VERT BOR MCH & TURRET LATHES, N/C	2594139
6743417	354	COMB BOR,DRILL,MILL MACH, N/C	1563354
7091710	369	DIATHERMY UNITS	305058

		Total	3069419214

Appendix B. Products included in ATP but not in ITA

Table B1. Communications Equipment and Electronics
High Value Exports Excluded by ATP Measure

Product	SIC	Description	1988 Value
6859055	367	PRINTED CIRCUIT BOARDS	862827492
7244440	365	SOUND RECORDINGS, NSPF	591409028
6852085	367	TV APPARATUS & PARTS, NSPF	446257941
6852017	365	TELEVISION RECEIVERS, COLOR	404556654
6859054	367	CONNECTORS, NSPF	356360532
6859068	367	TERMINALS & ELECT SPLICERS	260611915
6859038	367	ELECTRICAL SWITCHES & RELAYS, NSPF	242670340
7244535	367	MAGNETIC VIDEO TAPE, NOT RECORDED	239226567
6846220	366	TELEPHONE INSTRUMENTS	201552667
6852610	365	RADIO RECIEVERS, AUTO (AM AM/FM)	179436330
6847020	365	LOUDSPEAKERS	150381566
7244565	367	MAGNETIC COMPUTER TAPE, NOT RECRD	144729654
6846444	366	TELEGRAPH APPARATUS, NSPF & PARTS	133410006
6852001	365	TELEVISION RECEIVERS, UNFINISHED	113524436
6854075	367	TAPE RECORDERS ETC & PARTS, NSPF	111804689

		Total	7641467424

High Value Imports Excluded by ATP Measure

Product	SIC	Description	1988 Value
6785012	365	RADIO-TAPE COMBO, NSPF, FOR VEHICLE	1748411789
6854974	365	OTHER RADIO COMBOINATION CASSETTE	1438804615
6884280	367	ELECTRICAL ARTS & PARTS, NSPF	1234900525
6785075	365	COMBOS WITH TAPE PLAYER, NSPF	824169431
6826051	367	POWER SUPPLIES, < 500 W	642703741
6853300	366	RADIO APPARATUS & PARTS, NSPF	590090121
6859038	367	ELECTRICAL SWITCHES & RELAYS, NSPF	571387463
6849252	365	TV, COLOR, 13"	553305446
6850804	366	TV APPARATUS FOR CABLE TV & PARTS	495620402
6845815	366	FEATURE TELEPHONES, SINGLE LINE	474148469
6859059	367	PRINTED CIRCUIT BOARDS, NSPF	472760364
6826053	367	POWER SUPPLIES, 500 W & OVER	414790919
6850860	366	TV APPARATUS NSPF & PARTS NSPF	405596593
6859054	367	CONNECTORS, NSPF	391622934
6849864	367	PC BD W/SPEC COMP W/CHAS FR	375239416

		Total	23703435295
			===========
		Balance	-16061967871

Table B2. Aircraft and Parts
High Value Exports Excluded by ATP Measure

Product	SIC	Description	1988 Value
6944020	372	AIRPLANES, NONMILT, USED OR REBUILT	726907493
6605252	372	PARTS, NSPF, AIRCFT, PIST, CIVILN	245325980
6605254	372	PARTS, NSPF, AIRCFT, PISTON	93786238
6604826	372	AIRCFT ENGINE, PIST, N MIL, >500 HP	24855456
6604824	372	AIRCFT ENGINE, PIST, N MIL, <500 HP	17993146
6604822	372	AIRCRAFT ENGINES, PISTON, MILITARY	9813491

		Total	1118681804

High Value Imports Excluded by ATP Measure

Product	SIC	Description	1988 Value
6946110	372	AIRCRAFT PARTS NSPF, FOR CVL AIRCFT	900442424
6944120	372	AIRPLANES, NONMILT, USED/REBUILT	93133597
6946120	372	AIRCRAFT PARTS, NSPF	51086599
6941600	372	BALLOONS & AIRSHIPS FOR CVL USE	11058917
6605610	372	PISTON ENGINES FOR AIRCRAFT	2964745
6605614	372	PISTON ENGINES, FOR CIVIL AIRCRAFT	2580249
6942100	372	GLIDERS, FOR CIVIL USE	506094
6946500	372	KITES & PARTS, FOR MILITARY USE	190663
6605616	372	PISTON ENGINES FOR AIRCFT X CIVIL	174505
6946300	372	BALLOON & AIRSHIP, MILITARY USE	109845
6946400	372	GLIDERS, MILITARY USE	109160
6943100	372	KITES & PARTS, FOR CIVIL USE	39203

		Total	1062396001
			==========
		Balance	56285803

Table B3. Office, Computing and Accounting Machinery
High Value Exports Excluded by ATP Measure

Product	SIC	Description	1988 Value
6765590	357	PARTS, OTHER OFFICE MACHINES	157521841
6763050	357	OFFICE MACHINES, NSPF	123606795
6765000	357	TYPEWRITER PARTS, NSPF	105652404
6760570	357	TYPEWRITERS, N-PORT, NSPF, N-AUTO	100462702
6765570	357	PARTS, ELECTROSTATIC COPY MACHNS	81320122
6765540	357	PARTS, NSPF, OFC MACH W CALC MECH	68393882
6763034	357	OFFICE COPY MACHINES, NSPF	53016646
6763040	357	AUTOMATIC TYPWRTS & WORDPRC UNITS	50883908
6682015	357	DUPLICATING MACHINES, OFFSET-TYPE	49607521
6762520	357	OFFICE MACHINES, W CALC, NSPF	39347676
6685040	357	PARTS, NSPF, DUPLICATING MACHS	16204714
6682020	357	BLUEPRINTING ETC MACHINERY, X PARTS	15678418
6762019	357	CALCULATORS, NSPF	15126135
7155520	357	TIME RECORDING & STAMPING MACH.	13327526
6762200	357	CASH REGIST, W CALCULATING MECH.	10966171

		Total	968731918

High Value Imports Excluded by ATP Measure

Product	SIC	Description	1988 Value
6765645	357	PARTS, ELECTROSTATIC COPY MACH, IND	830758657
6763090	357	OFFICE MACHINES, NSPF	356497915
6853905	357	TELEPHONE ANNOUNCE & RECORD MACHINE	344776016
6760700	357	TYPEWRITERS, NSPF	222452591
6762017	357	CALCULATORS, ELECTRNC, NSPF	215290869
6765695	357	PARTS, OFFICE MACHINES NSPF	180189422
6762011	357	CALCULATORS, ELECTRNC, HANDHELD	173170980
6762500	357	MACHINES NSPF, W CALCULATING MECH	137473478
6765630	357	OFFICE CALC MACH PARTS, NSPF	110638156
6762200	357	CASH REGIST, W CALCULATING MECH.	97663795
6760510	357	TYPEWRITERS, PORTABLE ELECTRIC	92453273
6765030	357	TYPEWRITER PARTS	86992027
6763019	357	OFFICE COPYING, OTHER	57977507
6682315	357	DUPLICATING MACH, OFFSET TYPE	55507984
6765440	357	INK FAB RIBBON, CART, CASS FOR ADP	43183425

		Total	3262430146
			===========
		Balance	-2293698228

Table B4. Ordinance and Accessories
High Value Exports Excluded by ATP Measure

Product	SIC	Description	1988 Value
7309610	348	AMMUNITION FOR MILT WEAP > 30 MM	116976807
7308225	348	MILITARY WEAPON, SELF PROP, > 30 MM	114224365
7309540	348	PARTS FOR BOMBS, GRENADES ETC	60735686
7309520	348	BOMBS, GRENADES, TORPEDOS ETC	44503193
7301400	348	PISTOLS & REVOLVERS	30460140
7308240	348	PARTS, MILT WEAPONS, < 30 MM	27793479
7308210	348	MILITARY WEAPON, NOT PROP, > 30 MM	26553775
7309660	348	PARTS FOR MILT AMMO > 30 MM	24728998
7309620	348	AMMUNITION FOR MILT WEAP < 30 MM	19030147
7308440	348	PARTS FOR OTHER ARMS	18038526
7309640	348	HUNTING & SPORTING MUNITIONS, NSPF	17214471
7308230	348	MILT WEAP < 30MM, MACHINE GUNS	13956230
7309605	348	AMMUNITION FOR PISTOLS & REVOLVERS	13843993
7304700	348	SHOTGUNS	13508575
7302240	348	NONMILTARY RIFLES, CENTERFIRE	11902633
		Total	631470973

High Value Imports Excluded by ATP Measure

Product	SIC	Description	1988 Value
7301900	348	PISTOLS & REVOLVERS, > $8	80402296
7303180	348	RIFLES, CENTERFIRE, NSPF	26035381
7309400	348	RIFLE & PISTOL AMMO, NSPF	21705551
7307500	348	SHOTGUN PARTS	18610590
7304525	348	SHOTGUNS, OVER UNDER	17928586
7303120	348	RIFLES, AUTOLOAD CENTERFIRE	15149453
7307400	348	SHOTGUN BARRELS	14573224
7306100	348	PISTOL & REVOLVER PARTS	14189812
7303140	348	RIFLES, BOLT ACTION CENTERFIRE	12725148
7301020	348	MUSKETS & FIREARMS, NOT CARTRIGE	12569953
7308100	348	FIREARMS NSPF	11812974
7300500	348	SWORDS, BAYONETS ETC	7710531
7304530	348	SHOTGUNS, NSPF	7707055
7303190	348	RIFLES, RIM FIRE	7593905
7309560	348	SHELLS LOADED, NSPF	6539808
		Total	315006994
		Balance	316463979

Table B5. Drugs and Medicines
High Value Exports Excluded by ATP Measure

Product	SIC	Description	1988 Value
4352400	283	ANTIBIOTICS, NSPF	690436166
4357700	283	CARDIOVASCULAR DRUGS, BULK	442317168
4386000	283	DIAGNOSITCS REAGENTS, NSPF	341324266
4428500	283	PHARMACEUTICAL PREPS, NSPF, DOSES	167946002
4381030	283	HUMAN BLOOD PLASMA	153550053
4419000	283	OTHER ARTIFICIAL MIXES	116650311
4359500	283	DRUGS, NSPF, BULK	103654038
4381050	283	NORMAL HUMAN SERUM	103619972
4420900	283	SINGLE ANTIBIOTICS, SYSTEMIC, NSPF	91664308
4357300	283	ANTI-INFECTIVE AGENTS, NSPF	85251245
4351100	283	ERYTHROMYCIN & DERIVATIVES	84264169
4353500	283	STEROID HORMONES & SUBS, NSPF	77359088
4422500	283	CARDIOVASCULAR PREPS FOR HUMAN USE	77321774
4353300	283	CORTICOSTEROIDS, BULK, NSPF	71304283
4427200	283	SINGLE VITAMINS & MINERALS, DOSES	59285590

		Total	3666871992

High Value Imports Excluded by ATP Measure

Product	SIC	Description	1988 Value
4121100	283	CARDIOVASCULAR DRUGS, X ALKALOIDS	274688314
4373250	283	ANTIBIOTICS, NSPF	262615034
4122250	283	ANALGESICS ETC, NSPF	254936493
4377600	283	VIRUSES, SERUM TOXINS & BIO PRODUCT	234385205
4120300	283	AUTONOMIC DRUGS, NSPF	183747760
4117600	283	ANTICIOTICS, NSPF	176430837
4119500	283	ANTI-INFECT AGENTS, NSPF	141521357
4380200	283	DRUGS & RLTD PRODUCTS IN CAPS, NSPF	105668677
4400000	283	MEDICAL PREPS IN CAPS ETC, NSPF	99740318
4250455	283	AMINO ACIDS, NSPF	86537862
4250620	283	L-LYSINE MONOHYDROCHLORIDE	80901612
4378236	283	VITAMIN A & PROVIT. A, SYNTHETIC	64594820
4119800	283	CROMOLYN, SODIUM AUTONOMIC DRUGS	59471037
4378240	283	VITAMIN C, ASCORIBIC ACID, SYN	57910605
4375780	283	SYNTHETIC NONSTEROID HORMONES	51493911

		Total	3279799710
			==========
		Balance	387072282

Table B6. Industrial Inorganic Chemicals
High Value Exports Excluded by ATP Measure

Product	SIC	Description	1988 Value
4331035	281	COMPOUND CATALYSTS, NSPF	328995273
4210830	281	SODIUM HYDROXIDE, LIQUID	304644763
4208400	281	SODIUM CARBONATE (SODA ASH)	287150709
4216200	281	SODIUM COMPOUNDS, NSPF	275623863
4331056	281	LABORATORY REAGENT PREPS	245205497
4725000	281	TITANIUM DIOXIDE	219528949
4231090	281	INORGANIC COMPOUNDS, NSPF	211478452
4171240	281	ALUMINUM OXIDE (ALUMINA)	208194282
4925750	281	RADIOACTIVE CHEM ELEM & COMP, NSPF	89717279
4182900	281	CALCIUM PHOSPHATES	78439271
4171900	281	ALUMINUM COMPOUNDS, NSPF	57659471
4152900	281	CHEMICAL ELEMENTS, NSPF	54781840
4726500	281	PIGMENT MIXS, UNLEADED, NSPF	47518441
4210200	281	SODIUM CYANIDE	44750510
4152400	281	HELIUM	43219749

		Total	3391626404

High Value Imports Excluded by ATP Measure

Product	SIC	Description	1988 Value
4171240	281	ALUMINUM OXIDE (ALUMINA)	796360982
4737000	281	TITANIUM DIOXIDE	288257396
4210800	281	SODIUM HYDROXIDE	147084398
4162000	281	HYDROFLUORIC ACID	101174201
4737600	281	ZINC OXIDE, DRY, NO LEAD	65007325
4171800	281	ALUMINUM COMPOUNDS, NSPF	57597897
4208800	281	SODIUM CHLORATE	57419308
4738820	281	PIGMENTS, NSPF CONT LEAD	46480037
4152700	281	IODINE RESUBLIMED	31246610
4932620	281	ACTIVATED CARBON	31196299
4163500	281	SULFURIC ACID, INCD OLEUM	30537403
4152000	281	CHLORINE	30183342
4203665	281	POTASSIUM COMPOUNDS, NSPF	28370223
4216280	281	SODIUM COMPOUNDS, NSPF	28260880
4235096	281	INORGANIC COMPOUNDS, NSPF	26251131

		Total	2590075228
			==========
		Balance	801551176

Table B7. Professional and Scientific Instruments
High Value Exports Excluded by ATP Measure

Product	SIC	Description	1988 Value
7093000	384	MED, DEN, SURG INST & PARTS, NSPF	445756506
7090900	384	BOUGIES, CATHETERS ETC, NSPF	338334013
7231590	386	STILL PHOTO FILM NSPF, NOT DIAZO	303187197
6765580	386	PARTS, NSPF, PHOTOCOPY MACHS	265042056
7233009	386	SILVER HALIDE PAPER, NSPF	233734622
7095600	384	BONE & JOINT PROTHESIS ETC	217689253
7223640	386	STILL CAMERA PARTS, NSPF	180076838
7231550	386	STILL PHOTO FILM PACKG FOR RETAIL	172088128
7229540	386	PHOTOFINISHING EQUIP FOR STILL FILM	158742346
7231507	386	STILL X-RAY FILM, MEDICAL NOT DENT	146732279
4871000	386	PHOTO CHEM & PREPS, NSPF	119414654
4961000	384	SURGICAL SUTURES, ETC	114294520
7231537	386	GRAPHIC ARTS FILM, NSPF	110723551
7092540	384	DENTAL INSTRUMENTS, NSPF, INC POWR	108159705
7230700	386	MOTION PICTURE FILM, 35 MM & >	105441968

		Total	5527593340

High Value Imports Excluded by ATP Measure

Product	SIC	Description	1988 Value
6763012	386	ELECTROSTATIC PHOTOCOPY, INDIRECT	1108141874
7124975	382	ELECTRICAL MEASURING INST, NSPF	900583426
7150509	387	WATCHES, NOT SELFWIND, 0-1 JWL	432673620
7084720	385	FRAMES & MOUNTINGS FOR EYEGLASSES	395861934
7150510	387	WATCHES, NOT SELFWIND, 0-1 JWL	395065137
7233030	386	SILVER HALIDE PHOTO PAP, NEG COLOR	325413562
7221625	386	CAMERAS, STILL 35 MM	310328891
7221630	386	CAMERAS, STILL 35 MM W FLASH	293627038
7124950	382	ELECT PRESSURE GAUGES ETC	291826525
7124960	382	ELEC POLARIMETERS, GAS ANALYSIS ETC	289892009
7084520	385	SUNGLASSES & SUNGOGGLES > $2.50	286384510
6765650	386	PARTS, PHOTOCOPY EQUIP	274268427
7117820	382	GAUGES, REGULATORS ETC, NSPF	265518344
7231590	386	STILL PHOTO FILM NSPF, NOT DIAZO	248883965
7229400	386	PHOTOFINISHING EQUIT, NSPF, STILL	213613546

		Total	11790856325
			===========
		Balance	-6263262985

Table B8. Engines, Turbines and Parts
High Value Exports Excluded by ATP Measure

Product	SIC	Description	1988 Value
6605410	351	PARTS, NSPF, DIESEL AUTO, TRK & BUS	617345543
6605460	351	PARTS, NSPF, INDSTL GAS TURBINES	385952049
6605445	351	PARTS OF COMPRESS IGN ENG, NSPF	384110841
6604110	351	DIESEL ENGINES, AUTO, TRUCK, BUS	353433950
6604965	351	GAS TURBINES FOR MECHANICAL DRIVES	323112602
6605440	351	PRATS, NSPF, DIESEL ENG, TRACTORS	265048774
6604872	351	GASOLINE ENGINES, NSPF, < 6 HP	173477449
6605220	351	PARTS, NSPF, GAS ENGINES, MARINE	162788597
6603040	351	STEAM TURBINES, PARTS, NSPF	149075229
6604840	351	GASOLINE ENGINES, MARINE, OUTBOARD	130442015
6604133	351	DIESEL ENGINES, NSPF, 201-500 HP	87430881
6604131	351	DIESEL ENGINES, NSPF, < 200 HP	83452223
6605270	351	PARTS, NSPF, GAS PISTON, NSPF	79753874
6604139	351	DIESEL ENGINES, NSPF, > 1500 HP	75060725
6604125	351	DIESEL ENGINES, MARINE, 301-500 HP	63752480

		Total	3817563245

High Value Imports Excluded by ATP Measure

Product	SIC	Description	1988 Value
6604260	351	DIESEL ENGINES, OTHER	366834800
6607150	351	PARTS NSPF, DIESEL ENGINES NSPF	344925377
6604220	351	DIESEL ENGINES FOR AUTO, TRK & BUS	234705010
6609200	351	FUEL INJECTN PUMPS, COMP-IGNIT ENGS	220995385
6606752	351	PARTS NSPF, NSPF ENGINES, X DIESEL	200185584
6607119	351	PARTS, NSPF, AUTO DIESEL ENGINES	187416549
6605624	351	PISTON OUTBOARD MARINE ENGINE, >30	145337199
6826048	351	GENERATOR SETS, NSPF	145193873
6606732	351	PARTS NSPF, MARINE ENGINS, X DIESEL	136063313
6605640	351	PISTON ENGINES, X DIESEL, 1-25 HP	114536259
6607165	351	PARTS, GAS TURBINE X AIRCRAFT	102949177
6605622	351	PISTON OUTBOARD MARINE ENGINE, < 30	90870284
6605655	351	PISTON ENGINES, X DIESEL, 1-25 HP	79512194
6607147	351	CRANKSHFT, DIESEL ENGINES NSPF	64508509
6603040	351	STEAM TURBINES, PARTS, NSPF	61842746

		Total	3002490211
			==========
		Balance	815073034

Table B9. Plastics and Resins
High Value Exports Excluded by ATP Measure

Product	SIC	Description	1988 Value
4441700	282	POLYPROPYLENE RESINS	855039373
4441620	282	POLYETHYLENE RESINS, HIGH DENSITY	419801844
3093270	282	OTH GRPD FIL. & STRIP, NSPF	350462292
4441606	282	LOW DENSITY POLYETHYLENE RESINS	340973726
4461561	282	SYNTHETIC RUBBER, NSPF	328478514
4442525	282	POLY-TYPE THERMOPLASTIC RESIN, NSPF	321911865
4441400	282	POLYCARBONATE RESINS	237846819
4442310	282	POLYVINYL CHLORIDE RESINS, UNCMPD	191373552
4442010	282	ACRYLONITRILE-BUTADINE-STYRENE RESN	180308563
4441608	282	MEDIUM DENSITY POLYETHYLENE RESINS	167589781
4445410	282	EPOXY MOLDING COMPOUNDS	158863858
4446600	282	SILICON RESINS	150963148
4442050	282	STYRENE RESINS, NSPF	149067198
4440520	282	ACRYLIC & METHACRYLIC RESINS, NSPF	148569776
4441210	282	NYLON POLYAMIDE RESINS	140910422

		Total	7424477206

High Value Imports Excluded by ATP Measure

Product	SIC	Description	1988 Value
4453010	282	POLYETHULENE RESINS, LOW/MED DENSTY	290915095
4461558	282	SYNTHETIIC RUBBER, NOT CONT FILLERS	103713672
4461516	282	POLYBUTADIENE RUBBER	85129022
4455630	282	THERMOPLASTIC RESINS, NSPF	62211033
3093200	282	NYLON GRP-FIL > $.80 LB	60078952
4086100	282	POLYAMIDE RESINS, NYLON TYPE	57252483
4454200	282	POLYVINYL ALCOHOL RESINS	54795795
4454600	282	POLYVINYL CHLORIDE RESINS	53060950
4455400	282	POLYTETRAFLUOROETHYLENE	49305052
4461539	282	STYRENE-BUTADIENE NSPF, > 50% STY	48822986
4453020	282	POLYETHYLENE RESINS, HIGH DENSITY	47394858
3093350	282	ACRYLIC GRP-FIL, > $.80 LB	43906332
3094361	282	OTHER POLY FILAMENT, N-CONT N-CELL	42397588
4087200	282	ACRYLONITRILE-BUTADINE-STYRENE RESN	37225832
4088450	282	POLYSTYRENE RESINS, TERPOLYMERS	36358916

		Total	2083721727
			==========
		Balance	5340755479