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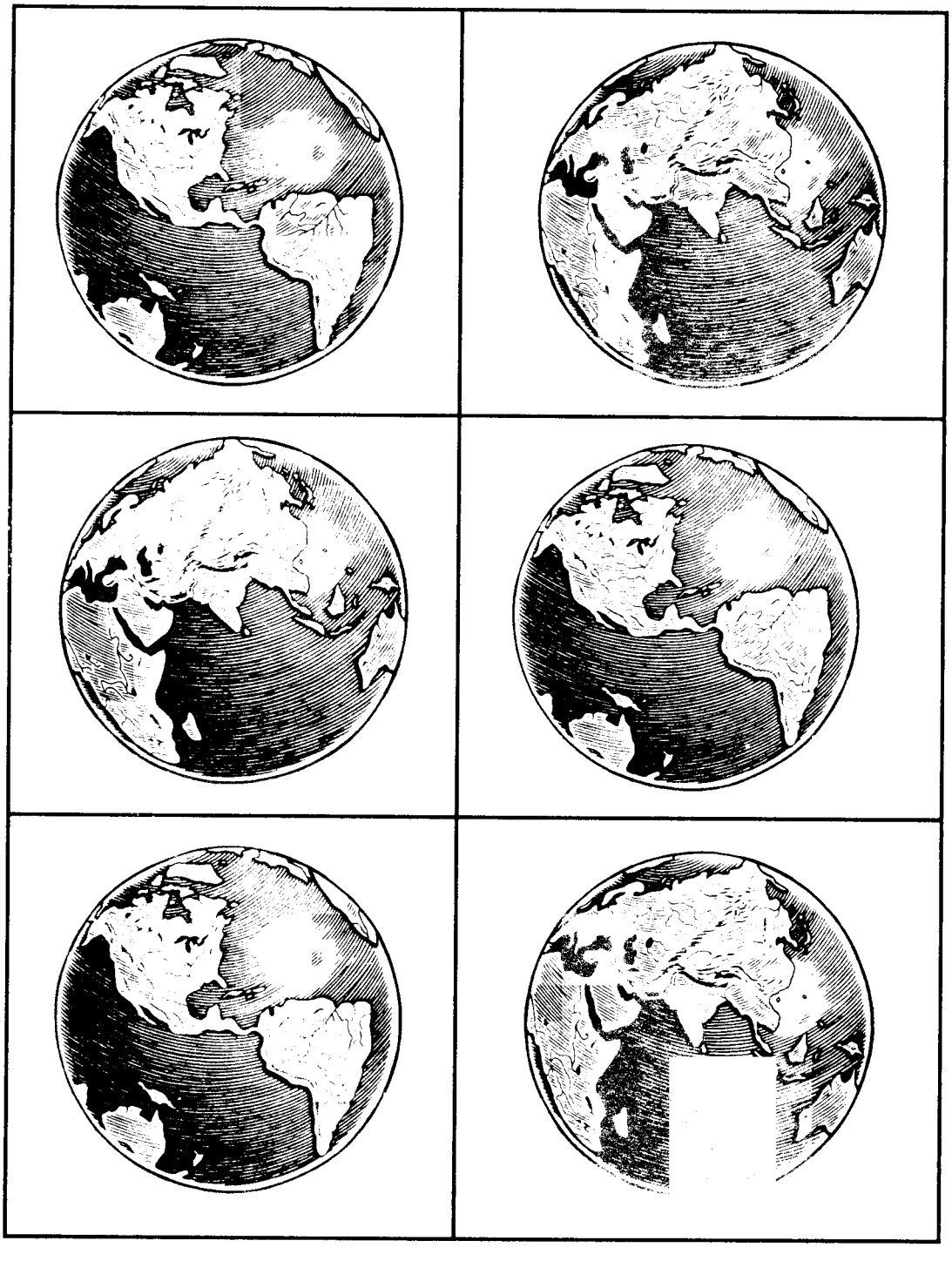
International Trade In Environmental Protection Equipment

An Assessment Of Existing Data



INTERNATIONAL TRADE IN

ENVIRONMENTAL PROTECTION EQUIPMENT:

An Assessment of Existing Data

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SUMMARY

This study estimates total U.S. imports, exports, and trade balances for environmental protection (EP) equipment between 1980-1991. The levels of trade in EP equipment are disaggregated by environmental medium (i.e., air, water, and other). Bilateral trade flows between the United States and selected U.S. trading partners also are presented for 1980-1991. Finally, this study describes trade in pollution abatement equipment from the perspective of selected U.S. trading partners. Data on their imports, exports, and trade balances for 1988-1991 are reported.

The conceptual framework used to estimate levels of international trade in EP equipment is based primarily upon the existing system for collecting and classifying international trade data, the harmonized system. Because the harmonized system is extensively documented, this framework for estimating international EP trade has the advantage of being well-defined and reproducible. However, it shares the same limitations as the data from which it is derived. In short, the definition of EP trade used in this study is constrained because the data either are not gathered and published, or they are published at an insufficiently disaggregated level. Data on patent rights for EP technology, direct foreign investment in EP equipment, and pollution prevention processes are not published; data on trade in services are not sufficiently disaggregated to isolate EP services. Due to data limitations, it is not possible to estimate these components.

The data compiled in this report show that the United States is a major exporter of EP equipment in general and air pollution control equipment in particular. Only 21 percent of the air pollution control equipment sold in the United States is supplied by imports. The United States enjoyed a surplus of trade in environmental protection equipment of $1.1 billion in 1991, and this surplus has been increasing steadily since 1989. Between 1989 and 1991, U.S. exports increased approximately 70 percent, while imports increased approximately 45 percent.

Although the United States is a major exporter of EP equipment, trade in EP equipment constitutes a relatively small percentage of total U.S. trade. In 1990, U.S. exports of EP equipment were less than one-half of one percent of all U.S. merchandise exports. The U.S. trade surplus in EP equipment was dwarfed by the overall U.S. trade deficit of more than $100 billion in 1990.

Furthermore, data compiled in this study cast doubt on other claims regarding patterns of international trade in EP equipment. Contrary to views on German leadership in this market, the data show that in 1990 the United States led Germany in exports of air pollution control equipment by about $63 million. This lead grew to $362 million by 1991, when the United States supplanted Germany as the country with the largest trade surplus in environmental protection equipment. The trade estimates compiled in this study also differ dramatically from those presented by OECD.

Finally, the data show that levels of trade in EP equipment are highly volatile. One reason for this volatility could be that the levels of trade in EP equipment are relatively small. Consequently, a single sale of EP equipment could case a country's total exports of EP equipment to rise sharply. In addition, definitions for the commodity trade codes are under constant revision. These two factors make any trend analysis difficult, and they suggest that any projections of exports and imports of EP equipment will be uncertain.

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1. OVERVIEW

1.1. *Purpose of the Study*

This study examines trends in the international trade of environmental protection (EP) equipment. It was undertaken because the ongoing public debate about the economic impacts of environmental regulation, especially the international trade impacts, has been impeded by a lack of consistent, well-documented data describing the pattern of international trade in EP equipment.

It has been asserted, for example, that the United States imports as much as 70 percent of its air pollution control equipment, and that Germany has the largest share of the global market for air pollution control and other environmental technologies (see Porter, 1991 and Wirth, 1992). The Organization for Economic Co-operation and Development (OECD) paints a more positive picture for the United States, estimating the U.S. trade surplus in pollution control equipment at $4 billion in 1990 alone (OECD, 1992). At the same time, however, the OECD reports a $8 billion trade surplus for all of Europe. According to the OECD, Germany enjoyed a trade surplus of $10 billion, the United Kingdom and France each had a surplus of $500 million, while Japan had a trade surplus of $3 billion.[1] It is unclear from these data which countries, if any, ran a trade deficit in EP equipment.

These claims, as well as others like them, cannot be verified or reconciled without better supporting data. This study attempts to fill this need by estimating levels of international trade in EP equipment using a conceptual framework based primarily upon the existing system for collecting and classifying international trade data. This harmonized system, used by most U.S. trading partners, is similar to the Standard Industrial Classification (SIC) scheme. Because the harmonized system is extensively documented, this framework for estimating international EP trade has the advantage of being well-defined and reproducible. However, it shares the same limitations as the data from which it is derived. As discussed below, data on a number of EP components either are not gathered and published or are published at an insufficiently disaggregated level. Yet the framework is flexible enough to allow modification if additional EP trade data become available.

This study estimates total U.S. imports, exports, and trade balances for EP equipment between 1980-1991. The levels of trade in EP equipment are disaggregated by environmental medium (i.e., air, water, and other). Bilateral trade flows between the United States and selected

U.S. trading partners also are presented for 1980-1991. Finally, this study describes trade in pollution abatement equipment from the perspective of selected U.S. trading partners. Data on their imports, exports, and trade balances for 1988-1991 are reported.

It should be emphasized that this study estimates international product flows, not the potential size of foreign markets for EP equipment. Product flows are measured in dollars. This study draws no conclusions about the benefits accruing from the use of the EP equipment.

1.2. *Principle Findings*

Despite their limitations, these data provide insight into the U.S. competitive position in the EP industry vis-a-vis the rest of the world. An assessment of the importance of trade in EP equipment relative to the total volume of U.S. trade is also possible. Further, the data allow the verification or refutation of common claims regarding levels and trends in EP trade. Finally, the study gives some indication of the feasibility of predicting future trends in EP trade.

The data compiled in this report show that the United States is a major exporter of EP equipment in general and air pollution control equipment in particular. Only 21 percent of the air pollution control equipment sold in the United States is supplied by imports. The United States enjoyed a surplus of trade in environmental protection equipment of $1.1 billion in 1991, and this surplus has been increasing steadily since 1989. Between 1989 and 1991, U.S. exports increased approximately 70 percent, while imports increased approximately 45 percent.

Although the United States is a major exporter of EP equipment, trade in EP equipment constitutes a relatively small percentage of total U.S. trade. In 1990, U.S. exports of EP equipment were less than one-half of one percent of all U.S. merchandise exports. The U.S. trade surplus in EP equipment was dwarfed by the overall U.S. trade deficit of more than $100 billion in 1990.

Furthermore, data compiled in this study cast doubt on other claims regarding patterns of international trade in EP equipment. Contrary to views on German leadership in this market, the data show that in 1990 the United States led Germany in exports of air pollution control equipment by about $63 million. This lead grew to $362 million by 1991, when the United States supplanted Germany as the country with the largest trade surplus in environmental protection equipment. The trade estimates compiled in this study also differ dramatically from those presented by OECD. For 1990, OECD estimates the U.S. trade surplus for EP equipment at $4 billion, more than four times the value estimated in this study.[2]

Finally, the data show that levels of trade in EP equipment are highly volatile. One reason for this volatility could be that the levels of trade in EP equipment are relatively small. Consequently, a single sale of EP equipment could case a country's total exports of EP equipment to rise sharply. In addition, definitions for the commodity trade codes are under

constant revision. These two factors make any trend analysis difficult, and they suggest that any projections of exports and imports of EP equipment will be uncertain.

1.3. *Outline of the Report*

This report consists of six additional sections and three appendices. In Section 2, the traded products that constitute EP equipment are defined. Section 2 also provides information on the statistical reports which served as data sources and discusses the limitations of the published data.

Section 3 presents estimates for U.S. trade in EP equipment for 1980-1988, while Section 4 presents estimates for 1989-1991. In both Sections 3 and 4, estimates for U.S. exports, imports, and trade balances are provided. These estimates are disaggregated first by environmental medium and then by major importing and exporting countries. The 1989-1991 are presented separately because traded commodity classifications were changed in 1989, thus limiting the comparability of the 1980-1988 data to the 1989-1991 data. Section 5 examines exports, imports, and trade balances from the perspective of eight U.S. trading partners: Canada, France, Germany, Japan, Mexico, the Republic of China, the Republic of Korea, and the United Kingdom.

Section 6 places U.S. trade in EP equipment in the context of overall U.S. international trade by comparing EP exports and imports to total U.S. exports and imports. Examples of industries with similar levels of exports and trade balances are given. The U.S. data and the data from other countries are compared to estimates of international trade in EP equipment from other studies in Section 7.

Appendix A presents data on the number of instances of exports and imports which involve the licensing of EP technology for Japan. The products and product codes that are used to estimate EP trade for the United States and selected U.S. trading partners are listed in Appendix B. Finally, Appendix C presents data on the inputs purchased for pollution abatement in Germany. These data are used to discuss the OECD methodology for estimating EP trade.

2. DEFINING ENVIRONMENTAL PROTECTION EQUIPMENT, DATA SOURCES, AND DATA LIMITATIONS

2.1. *Defining EP Equipment*

2.1.1. Method

In order to estimate trade in EP equipment, the products that constitute EP equipment must be defined. The definition of EP equipment used in this study is largely a function of existing sources of published trade data.

International trade data are published as a series of commodity codes, much like the Standard Industrial Classification (SIC) scheme. To develop a definition for EP equipment, all commodity trade codes were reviewed, and those that consisted predominantly of EP equipment were identified. The products and their respective trade code numbers were taken from the Tariff Schedule of the United States Annotated (TSUSA) classification system for imports, schedule B for exports, and the harmonized system for both imports and exports. The products and product codes are listed in Appendix B.[3]

The United States switched to the harmonized system for classifying traded commodities in 1989. This affects the definition of EP trade and comparability of yearly trade flows, because the old and new systems are not easily compared. Since most U.S. trading partners switched to the harmonized system in 1988, it is now possible to develop a reasonable concordance of trade classification codes among countries. Thus, trade in EP equipment for U.S. trading partners was measured using the trade codes that correspond roughly to the harmonized EP commodity codes for the United States. Prior to 1988, trade product classification schemes varied across countries, making it virtually impossible to determine which products constituted EP equipment. The harmonized codes used to measure exports, imports, and trade balances from the perspective of major U.S. trading partners also are presented in Appendix B. The sources of data for other countries are discussed in greater detail in Section 3.

2.1.2. Types of Equipment Included

The trade codes selected for inclusion in the definition of EP equipment data fell roughly into three categories: air pollution control equipment, water pollution control equipment, and other types of pollution control equipment. The air pollution control equipment includes, but is not limited to: incinerators, electrostatic precipitators, and dust collection and air purification equipment. The water pollution control equipment component is comprised of machinery for purifying water and other liquids. The third category ("other") contains EP products that do not fit neatly into either the air or water pollution control equipment components (e.g., ion exchange resins).[4]

2.1.3. Components of EP Trade Not Captured

Ideally, the definition of EP trade would include elements besides pollution equipment, such as patent rights and the large body of equipment and devices that prevent pollution rather than control it. Unfortunately, the analysis of EP trade at this time is limited to the components for which data are available. The omission of certain components from this study does not imply that they do not constitute a significant portion of EP trade. In fact, it is possible that the omitted components form a larger share of EP trade than the measured components. Yet, without more detailed data, it is not possible to assess the importance of the unmeasured components to total EP trade. However, if data on the unmeasured components of EP trade were to become available, it would be fairly easy to incorporate the data into the framework for measuring EP trade used in this study.

The definition of EP trade, for example, should include the amounts paid for patent rights for the use of EP technology. Payments for patent rights would appear as an entry for royalties and license fees in the current account of the balance of payments. This component of EP trade is of particular interest, because inclusion of information on imports and exports of EP patent rights by country would allow testing for correlations between stringency of environmental regulations and leadership in the development of technology. One hypothesis that could be tested is whether stringent environmental regulations on one country give that country a comparative advantage in producing these products and selling them in the international market (Porter, 1991).

Direct foreign investment by U.S. or foreign firms in the EP equipment industry also should be included. Direct foreign investment would appear in the capital account of the balance of payments. To the extent that capital flows substitute for commodity flows, estimates of international trade based on physical commodity flows understate actual international activity in the EP equipment sector.

Similarly, the definition of EP trade used in this study does not include trade in environmental protection services. The U.S. Department of Commerce, Bureau of the Census (1992, pp. 40 and 57) reported that of the $17.1 billion of current account costs of pollution abatement incurred by manufacturing sectors in 1990, $5.4 billion were for services and equipment leasing. Given that services potentially form an important component of EP expenditures, estimates of trade that do not include trade in EP services understate export and import levels.

Finally, the data do not include the potential for trade in inputs that reduce environmental emissions via changes in production processes (pollution prevention). As pollution prevention supplants traditional end-of-the pipe measures for protecting the environment, it is likely that production process changes will begin to represent a larger share of EP trade. Without data on pollution prevention, EP trade may be significantly understated, and trends in EP trade may be

misleading. Similarly, the data do not include pollution control devices that are "embodied" in traded products. For example, catalytic converters installed in automobiles traded internationally are not captured.

In short, the definition of EP trade used in this study is constrained because the data either are not gathered and published, or they are published at an insufficiently disaggregated level. Data on patent rights for EP technology, direct foreign investment in EP equipment, and pollution prevention processes are not published; data on trade in services are not sufficiently disaggregated to isolate EP services. Due to data limitations, it is not possible to estimate these components. However, if the data limitations were overcome, it would be relatively easy to incorporate these components into this study's framework for estimating EP trade.

2.2. *Data Sources*

To analyze trade in pollution abatement equipment, this study aggregates data for each of the commodity trade codes classified as EP equipment. A variety of statistical reports published by the United States as well as its major trading partners served as sources of data.

For the United States, the following reports published by the Department of Commerce (Bureau of the Census) were used:

- *U.S. Exports: Schedule B Commodity by Country* (FT 446).
- *U.S. Exports: Harmonized Schedule B Commodity by Country* (FT 447).
- *U.S. Imports for Consumption and General Imports: Tariff Schedule of the United States Annotated (TSUSA) Commodity by Country of Origin* (FT 246).
- *U.S. Imports for Consumption: Harmonized Tariff Schedule of the United States Annotated (TSUSA) Commodity by Country of Origin* (FT 247).

For U.S. trading partners, the data sources included:

- **Canada**: *Exports: Merchandise Trade*, (Catalogue 65-202) and *Imports: Merchandise Trade*, (Catalogue 65-203), published by Statistics Canada (International Trade Division).
- **Japan**: *Japan Exports & Imports: Commodity by Country*, published by the Tariff Association.

- **France, Germany, and the United Kingdom**: *External Trade* and *Internal Trade*, published by the Statistical Office of the European Community.

- **Mexico**: *Annuario Estadistico del Commercio Exterior de los Estados Unidos Mexicanos*, published by the United States of Mexico, Instituto Nacional de Estadistica, Geografia e Informatica.

- **Republic of China**: *Monthly Statistics of Exports* and *Monthly Statistics of Imports*, published by the Republic of China Statistical Department (Directorate General of Customs, Ministry of Finance).

- **Republic of Korea**: *Statistical Yearbook of Foreign Trade*, published by Korean Customs Administration (Korea Customs Research Institute)

2.3 *Data Limitations*

For the United States, even though data are gathered at a finer level of disaggregation than for most nations, some products of the U.S. EP industry cannot be isolated from the broader categories of equipment not generally classified as EP equipment. For example, trade in "sewer pipes" ideally would be classified as EP trade. It is not possible, however, to isolate trade in "sewer pipes" from the broader category "pipes," which may or may not represent EP trade. Further, some types of equipment and products (e.g., fans and chemicals) can be used for both EP and non-EP activities. To correct for this difficulty, the reported data would need to be disaggregated by end use, not product type as is currently the case.

As mentioned above, the United States adopted the harmonized system for trade classification in 1989. Consequently, despite attempts at reconciliation, the data from the old (pre-1989) and the new (1989 and beyond) trade classifications are not comparable.[5] The harmonized system allows for greater detail in measuring imports and exports and comparing them across different countries. Thus, in this study, the pre-1989 and the post-1988 data are presented separately.

Also due to the limited detail of the data, classifying the trade codes by environmental medium is difficult. In some instances, a trade code may include data for two or more media. In this case, a judgement has been made regarding the predominant type of equipment represented by the trade code category. If this judgment could not be made with any degree of confidence, then the code was placed in the "other" EP equipment category.

In some cases, published U.S. data estimating bilateral trade flows understates export and import values for some nations. This occurs because "small" values for exports and imports of a specific commodity classification are aggregated into an "other countries" category. Consequently, even though a U.S. trading partner is not listed separately under an EP product

code, its trade in the EP commodity is not necessarily zero. However, because it is not possible to determine which countries are included in the "other country" category, this situation is treated as a zero trade case in this study.

When comparing U.S. data with data from other countries, it is important to keep in mind that the harmonized system is comparable across countries only up to the 6-digit level of disaggregation. The United States publishes data at the 10-digit level of disaggregation, and identifying the trade codes that constitute EP equipment requires utilizing the full 10-digit specification. To define EP trade for other countries, trade codes which correspond roughly to the 10-digit U.S. codes were used. Even if a country publishes data at a similar level of disaggregation, there is no guarantee that its 10-digit trade code represents the same class of commodities as in the United States. Thus, the U.S. data may not be fully comparable to the data for other countries.

3. ESTIMATES FOR U.S. TRADE IN ENVIRONMENTAL PROTECTION EQUIPMENT: 1980-1988

3.1. *U.S. Exports, Imports, and Trade Balances*

U.S. exports, imports, and trade balances are presented for the period 1980-1988 in Table 1, while Figure 1 illustrates the historical trend.[6] The trade statistics are reported in thousands of current U.S. dollars.

After an initial increase from 1980-1981, U.S. exports declined through 1986. Exports of EP equipment increased sharply from 1986 to 1988, nearly doubling in size from $445 million in 1986 to $859 million in 1988. U.S. imports of EP equipment, which totaled $113 million in 1980, tended to increase throughout the 1980s. By 1988, U.S. imports totaled $426 million.

The United States carried a surplus in trade for EP equipment from 1980-1988, even though from 1980 to 1985 the surplus was declining. Between 1985 and 1986, it stopped declining and began to rise steadily from 1986 to 1988. The balance of trade remained positive ever since. Beyond 1986, a sharp increase in exports more than offset the effect of a steady increase in imports on the U.S. balance of trade in EP equipment.

3.2. *Composition of U.S. Trade in Pollution Control Equipment*

The trends in trade for each component of EP equipment helps explain the factors that have influenced fluctuations in trade. Table 2 and Figures 2 and 3 present data on exports and imports for air, water, and other pollution control equipment. Table 2 shows only exports for water pollution control equipment since, prior to the adoption of the harmonized system for

Table 1

U.S. Exports, Imports, and Trade Surpluses for Environmental Protection Equipment--1980-1988

(thousands of current dollars)

Year	Exports	Imports	Balance
1980	655,573	113,257	542,316
1981	725,509	145,650	579,859
1982	696,054	178,960	517,094
1983	657,979	145,633	272,346
1984	558,523	173,317	385,206
1985	458,465	233,570	224,895
1986	445,226	268,246	203,980
1987	559,796	355,610	204,186
1988	858,746	425,894	432,852

Note:

Data were compiled from the following U.S. Department of Commerce (Bureau of the Census) reports: *U.S. Exports: Schedule B Commodity by Country* (FT 446) and *U.S. Imports for Consumption and General Imports: TSUSA Commodity by Country of Origin* (FT 246).

Table 2

U.S. Exports and Imports for in Environmental Protection Equipment by Media--1980-1988

(thousands of current dollars)

	Exports			Imports		
Year	Air	Water	Other	Air	Water	Other
1980	163,601	144,985	346,987	21,806	*	91,451
1981	158,023	190,802	376,684	22,980	*	122,670
1982	146,074	177,580	372,400	27,194	*	151,766
1983	115,938	188,915	353,126	31,736	*	113,897
1984	105,789	149,471	303,263	32,716	*	140,601
1985	101,697	131,883	224,885	50,619	*	182,951
1986	88,012	130,651	226,563	61,489	*	206,757
1987	99,332	137,010	323,454	78,403	*	277,207
1988	160,791	203,477	494,478	97,108	*	328,786

Note:

*Prior to the adoption of the harmonized system for trade classification, data for imports were not detailed enough to isolate imports of water pollution control equipment.
Imports of water pollution control equipment are captured in the "other" category.

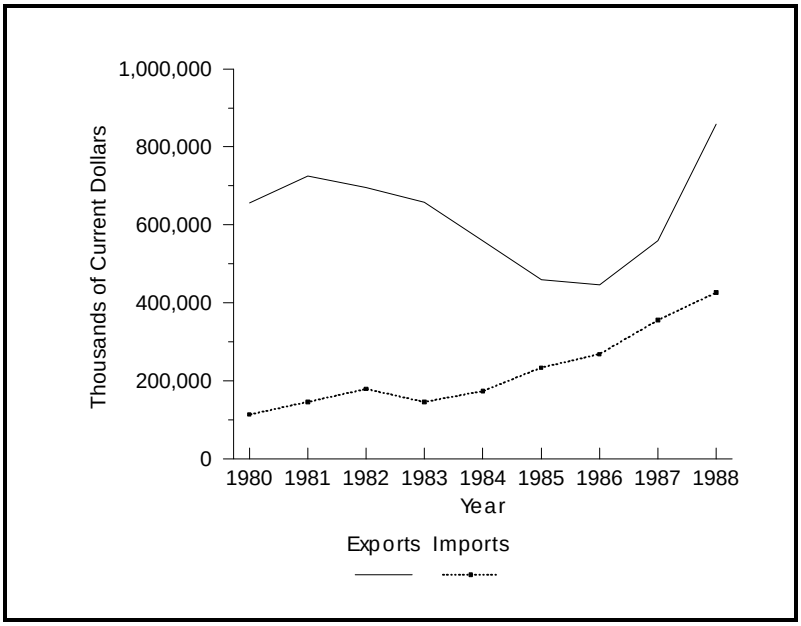

Figure 1: Exports and Imports of Environmental Protection Equipment (1980-1988)

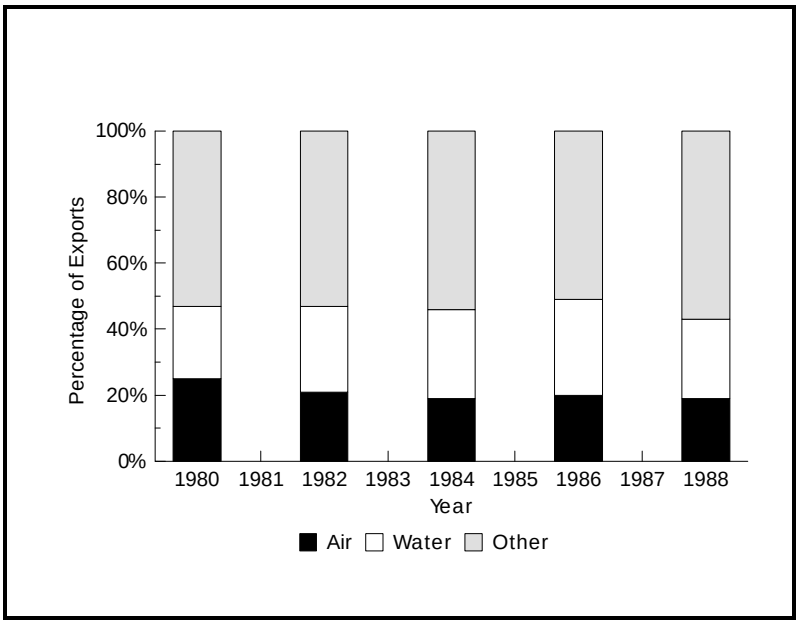

Figure 2: Exports of Environmental Protection Equipment By Medium

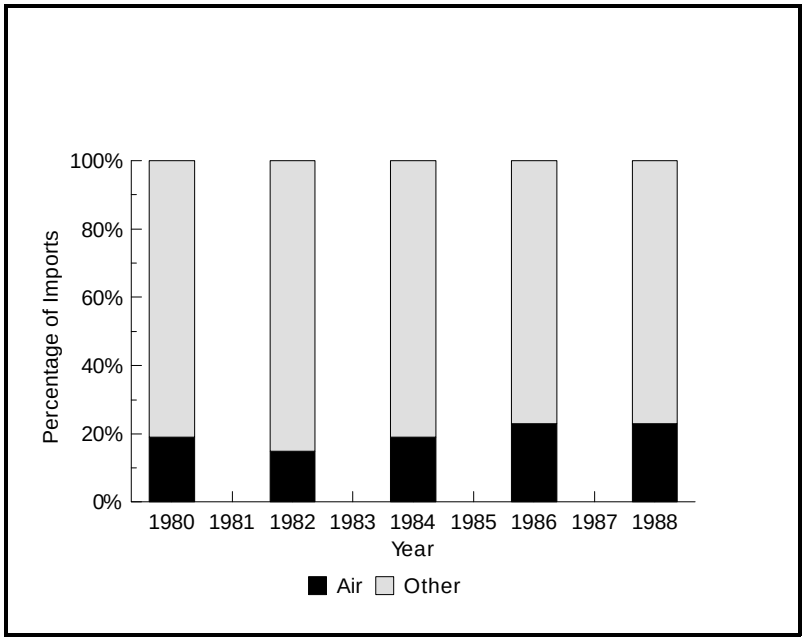

Figure 3: Imports of Environmental Protection Equipment By Medium

trade classification, data for imports were not detailed enough to isolate imports of water pollution control equipment. Imports for water pollution control equipment are captured in the "other" category.

The composition of EP exports shifted little from 1980 through 1988. The values reported in Table 2 indicate that the share of air pollution control equipment in total exports declined from about 25 percent in 1980 to about 19 percent in 1988, fluctuating around 20 percent during most of the period. As can be seen in Table 2, the share of water pollution control equipment in total exports of EP equipment ranged from 22 percent to 29 percent between 1980-1988. Throughout the 1980s, the largest component of EP equipment was "other," which accounted for approximately 50 percent of all EP exports.

The composition of EP imports showed a slightly greater variation. One reason may be that data on air pollution control equipment was sufficiently detailed to allow for separate reporting of this component. Water and other pollution control equipment were combined. The share of air pollution control equipment in total EP imports declined from 19 percent in 1980 to 15 percent in 1982. From 1983 to 1988, imports of air pollution control equipment ranged from 19 percent to 23 percent. The share of water plus other pollution control equipment increased

from 1980 to 1985, peaking at 85 percent in 1982. From 1983 to 1988, water and other pollution control equipment ranged from 77 percent to 81 percent of total EP imports.

3.2.1. Air Pollution Control Equipment

Figure 4 illustrates imports, exports, and trade balances for air pollution control equipment in the United States. Between 1980 and 1988, the pattern of trade for air pollution control equipment was quite similar to the overall trend for EP equipment. Exports of air pollution control equipment fell nearly 50 percent between 1980 and 1986, from $164 million to $88 million. After 1986, exports of air pollution control equipment rose sharply to $161 million. Between 1980 and 1988, imports increased steadily from $22 million in 1980 to $97 million in 1988. During this period, exports of air pollution control equipment always exceeded imports, as shown in Figure 4.

3.2.2. Water Pollution Control Equipment

Figure 5 shows the trend for exports of water pollution control equipment from 1980-1988. As mentioned above, the published data are not detailed enough to allow for separate reporting of water pollution control equipment imports, which are combined with other pollution control equipment imports. From 1980 to 1981, water pollution control exports increased about 32 percent. With the exception of 1983, exports of water pollution control equipment then declined until 1986. Water pollution control equipment exports increased to $203 million in 1988, well above the 1980 level of $145 million.

3.2.3. Other Pollution Control Equipment

Exports and imports of the combined categories of water and other pollution equipment are shown in Figure 6. Because imports of water pollution control equipment were combined with imports of other pollution control equipment, the values for exports and imports of other pollution equipment as reported in Table 2 are not directly comparable. Exports of water and other pollution control equipment were combined in Figure 6 in order to present a useful comparison.

Imports of water and other pollution abatement equipment, with the exception of 1983, rose from 1980 through 1988. The trade balance was positive each year, although the surplus declined through 1986. After 1986, the trade surplus rose sharply due to a large increase in exports in 1987 (29 percent over the 1986 level) and 1988 (95 percent over the 1986 level).

Figure 4: Exports and Imports of Air Pollution Control Equipment

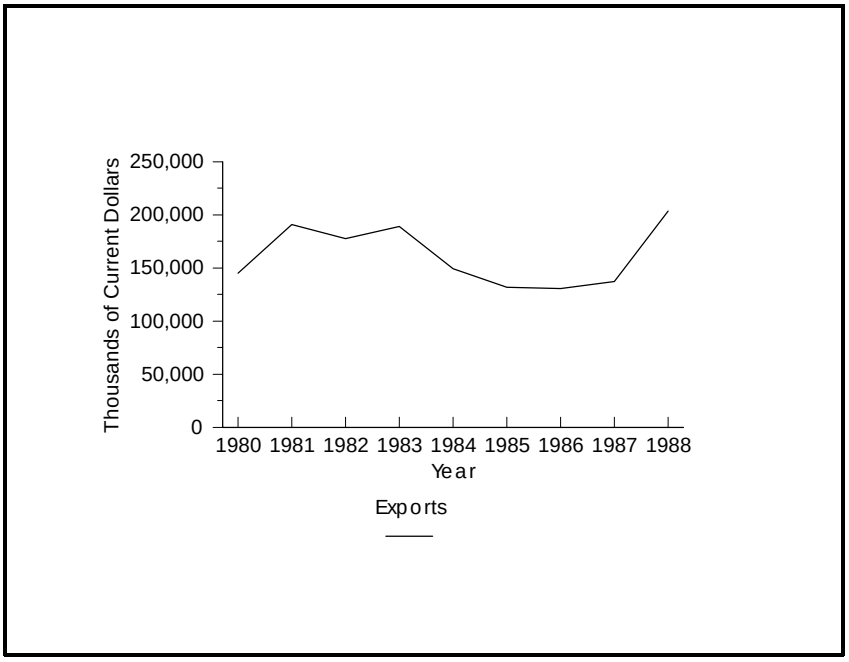

Figure 5: Exports of Water Pollution Control Equipment

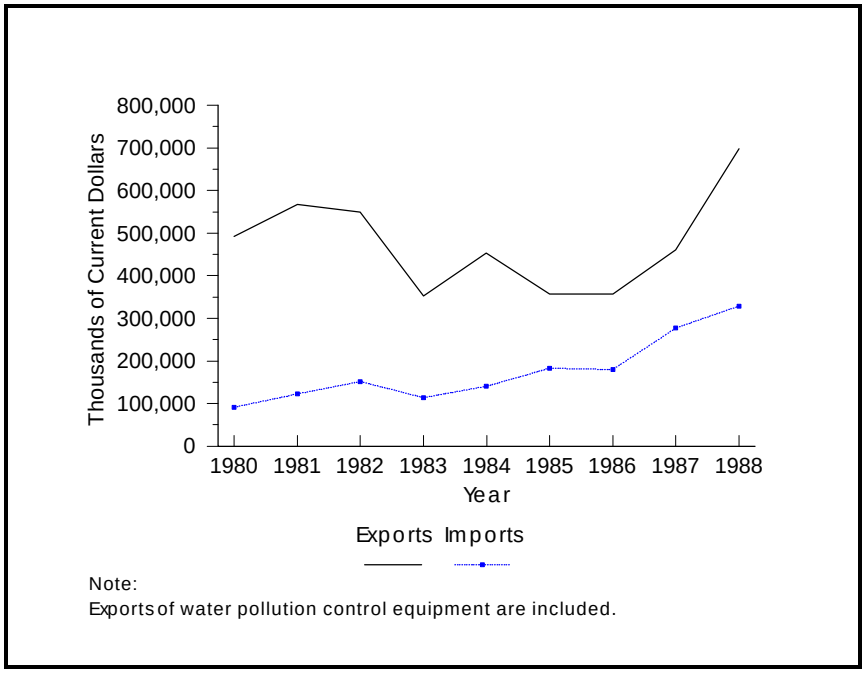

Figure 6: Exports and Imports of "Other" Pollution Control Equipment

3.3. *Bilateral Trade Flows*

The published U.S. data also allow for disaggregation of U.S. exports (imports) by country of destination (origin). Tables 3 through 5 provide bilateral trade flows as well trade balances for selected U.S. trading partners for 1980-1988. These trading partners accounted for over one-half of total U.S. EP exports and about three-fourths of all U.S. EP imports.

3.3.1. Exports

As can be seen in Table 3, Canada typically has been the largest U.S. export market for EP equipment. In 1980, exports to Canada totaled $138 million, 21 percent of total U.S. EP exports. The level of exports to Canada in 1980 was more than double the amount of exports to Japan, the second largest U.S. export market for EP equipment. From 1980-1984, Canada accounted for at least one-fifth of U.S. EP exports, and in 1983, nearly one-half of U.S. exports of EP equipment went to Canada. Even though U.S. EP exports to Canada fell below pre-1984 levels from 1985-1987, Canada still remained the largest export market for U.S. EP equipment.

Table 3

U.S. Exports of Environmental Protection Equipment for Selected Trading Partners--1980-1988

(thousands of current dollars)

Year	Canada	France	Germany	Japan	Mexico	Republic of Korea	Republic of China	UK
1980	138,358	22,627	23,301	65,319	59,051	8,333	12,141	23,858
1981	159,080	19,856	25,682	61,129	56,391	25,465	14,035	24,965
1982	144,736	25,348	27,406	56,716	30,300	26,050	10,444	27,763
1983	315,681	21,551	20,399	53,144	27,070	14,464	10,880	28,289
1984	154,487	19,669	15,941	44,426	17,177	20,802	10,448	30,006
1985	77,977	19,219	17,061	45,399	16,169	14,230	5,958	26,634
1986	65,843	25,155	20,833	47,837	19,848	10,445	10,620	29,760
1987	83,323	25,889	22,621	64,903	68,257	18,049	15,885	36,685
1988	113,751	40,190	26,335	105,331	121,129	23,894	29,243	46,962

Table 4

U.S. Imports of Environmental Protection Equipment for Selected Trading Partners--1980-1988

(thousands of current dollars)

Year	Canada	France	Germany	Japan	Mexico	Republic of Korea	Republic of China	UK
1980	25,690	8,958	26,001	10,320	1,604	0	61	18,453
1981	32,335	12,065	26,169	21,168	1,659	0	98	17,993
1982	38,393	10,883	26,430	27,809	1,426	89	9,,344	20,856
1983	27,991	7,404	21,132	21,063	769	75	5,402	15,332
1984	38,278	15,719	32,735	17,389	496	206	1,514	19,780
1985	48,299	19,089	40,619	30,896	1,136	772	2,804	28,537
1986	44,571	22,836	56,512	38,585	3,143	2,242	4,389	29,785
1987	61,970	19597	54,462	61,042	7,149	4,404	9,592	42,208
1988	82,428	33,437	52,519	59,825	7,409	6,212	15,981	48686

Table 5

U.S. Balances of Trade in Environmental Protection Equipment for Selected Trading Partners--1980-1988

(thousands of current dollars)

Year	Canada	France	Germany	Japan	Mexico	Republic of Korea	Republic of China	UK
1980	112,668	13,669	(2700)	54,999	57,447	8,333	12,080	5,405
1981	126,745	7,791	(487)	39,961	54,732	25,465	13,937	6,972
1982	106,343	14,465	976	28,907	28,874	25,961	1,100	6,907
1983	287,690	14,147	(733)	32,081	26,301	14,389	5,478	12,957
1984	116,209	3,950	(16,794)	27,037	16,681	20,596	8,934	10,226
1985	29,678	130	(23,558)	14,503	15,033	13,458	3,154	(1,903)
1986	21,272	2,319	(35,679)	9,252	16,705	8203	6,231	(25)
1987	21,353	6,292	(31,841)	3,861	61,108	13,645	6,293	(5,523)
1988	31,323	6,753	(26,184)	45,506	113,720	17,682	13,262	(1,724)

Mexico also has been an important export market for U.S. EP equipment. From 1980-1983, Mexico was the third largest importer of U.S. EP equipment. Mexico was the fastest growing U.S. EP export market during 1986-1988, with exports to Mexico increasing from $20 million in 1986 to $121 million in 1988. In 1988, Mexico was the largest importer of U.S. EP equipment, surpassing Canada for the first time. Together, Mexico and Canada purchase a significant portion of U.S. EP exports, accounting for an average of 23 percent of the total for 1980-1988.

Interestingly, Japan was the second largest importer of U.S. EP equipment throughout the 1980s. Although in 1987 and 1988 Japan fell into third place behind Canada and Mexico, U.S. exports of EP equipment to Japan were rising sharply, from $48 million in 1986 to $65 million in 1987 to $105 million in 1988. By 1988, Japan had become almost as large an export market as Mexico ($121 million) and Canada ($114 million).

European countries have tended to account for relatively smaller shares of U.S. EP exports. Individual shares for France, Germany, and the United Kingdom have ranged from three to seven percent of total U.S. EP exports. France, Germany, and the United Kingdom together accounted for $70 million of U.S. EP exports, roughly 11 percent of the total. In 1987 and 1988, U.S. exports of EP equipment to these three countries amounted to $85 million and $113 million, approximately the amount of exports to Canada.

3.3.2. Imports

With the exception of 1980 and 1986, the largest exporter of EP equipment to the United States was Canada. Between 1980-1988, the share of Canadian imports in total U.S. EP imports ranged from 17 percent to 23 percent. In contrast to exports, U.S. imports of EP equipment from Mexico were relatively small ($7 million), only two percent of the total in 1988.

Typically, Germany and Japan have been the second or third largest exporter of EP equipment to the United States. Two exceptions were 1980 and 1986, when Germany passed Canada as the largest exporter of EP equipment to the United States The three European countries (France, Germany, and the United Kingdom) together account for a substantial share of U.S. EP imports. In 1981 and 1984-1986, France, Germany, and the United Kingdom accounted for about 40 percent of U.S. EP imports. In 1980, the United States imported $53 million of EP equipment from these three countries, or about 47 percent of total EP imports.

3.3.3. Trade Balances

The United States historically has run a surplus with all of these countries, except for Germany and the United Kingdom. The only year between 1980 and 1988 that the United States ran a surplus with Germany was 1982. Further, the deficit with Germany appears to have followed an upward trend during this time, as exports to Germany remained essentially constant

while imports from Germany were increasing steadily. The United States ran a fairly small surplus with the United Kingdom between 1980 and 1984. This surplus became a small deficit in 1985. Overall, during 1985-1987, surpluses became smaller while deficits became larger. By 1988, however, surpluses rose substantially above pre-1988 levels while deficits became smaller. This is due primarily to an across-the-board increase in EP exports.

4. ESTIMATES FOR U.S. TRADE IN ENVIRONMENTAL PROTECTION EQUIPMENT: 1989-1991

4.1. *U.S. Exports, Imports, and Trade Balances*

As discussed in Section 4 above, the switch to the harmonized system for trade classification in 1989 limits the comparability of pre-1989 and post-1988 data. Thus, the pre-1989 and the post-1988 data are presented and discussed here separately. Because the switch represents a definitional change, the two series should not be combined or compared.

Estimates for exports, imports, and trade balances for 1989-1991 are presented in Table 6. During this three-year time period, U.S. exports increased from $975 million to 1,680 million or about 72 percent. Imports of EP equipment rose more slowly, from $410 million in 1989 to $567 million in 1991, an increase of 38 percent. Thus, the trade surplus grew from $565 million in 1989 to $1.1 billion in 1991.

4.2. *Composition of U.S. Trade in Pollution Control Equipment*

The switch to the harmonized system for trade classification in 1989 allows for more accurate disaggregation of imports and exports of EP equipment. The disaggregation, however, is still far from perfect. As with the pre-1989 system, some trade codes still include data for two or more media, and assigning them to a specific medium can introduce inaccuracies. Table 7 reports exports and imports for air, water, and other EP equipment, while Figures 7 and 8 show the composition of imports and exports under the harmonized system for 1989-1991.

Table 6

U.S. Exports, Imports, and Trade Surpluses for
Environmental Protection Equipment--1989-1991

(thousands of current dollars)

Year	Exports	Imports	Balance
1989	975,158	409,667	565,491
1990	1,310,254	501,391	808,863
1991	1,680,021	566,921	1,113,100

Notes:

1989-1991 are not comparable to preceding years due to the switch to the harmonized system for trade product classification. The values in Table 6 should not be combined with the values in Table 1.

Data were compiled from the following U.S. Department of Commerce (Bureau of the Census) reports: *U.S. Exports: Harmonized Schedule B Commodity by Country* (FT 447) and *U.S. Imports for Consumption: Harmonized TSUSA Commodity by Country of Origin* (FT 247).

Table 7

U.S. Exports and Imports in Environmental Protection Equipment by Media--1989-1991

(thousands of current dollars)

	Exports			Imports		
Year	Air	Water	Other	Air	Water	Other
1989	377,395	363,110	234,653	122,790	141,690	145,187
1990	543,553	409,161	357,540	123,397	187,785	190,209
1991	885,620	449,798	344,603	127,995	216,060	222,866

Notes:

1989-1991 are not comparable to preceding years due to the switch to the harmonized system for trade product classification. The values in Table 7 should not be combined with the values in Table 2.

Data were compiled from the following U.S. Department of Commerce (Bureau of the Census) reports: *U.S. Exports: Harmonized Schedule B Commodity by Country* (FT 447) and *U.S. Imports for Consumption: Harmonized TSUSA Commodity by Country of Origin* (FT 247).

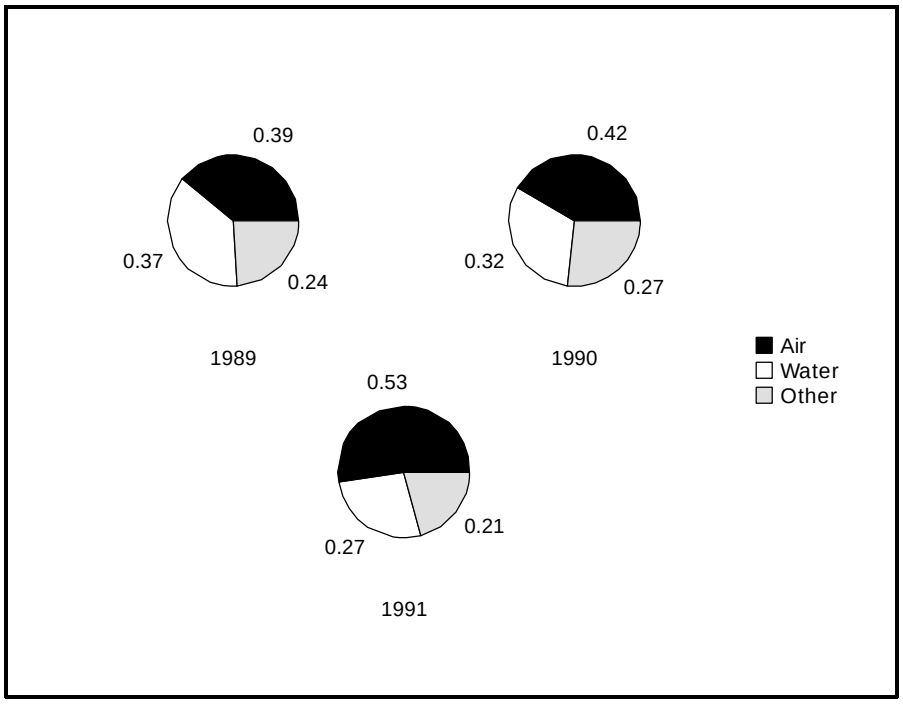

Figure 7: Exports of Environmental Protection Equipment By Medium (1989-1991)

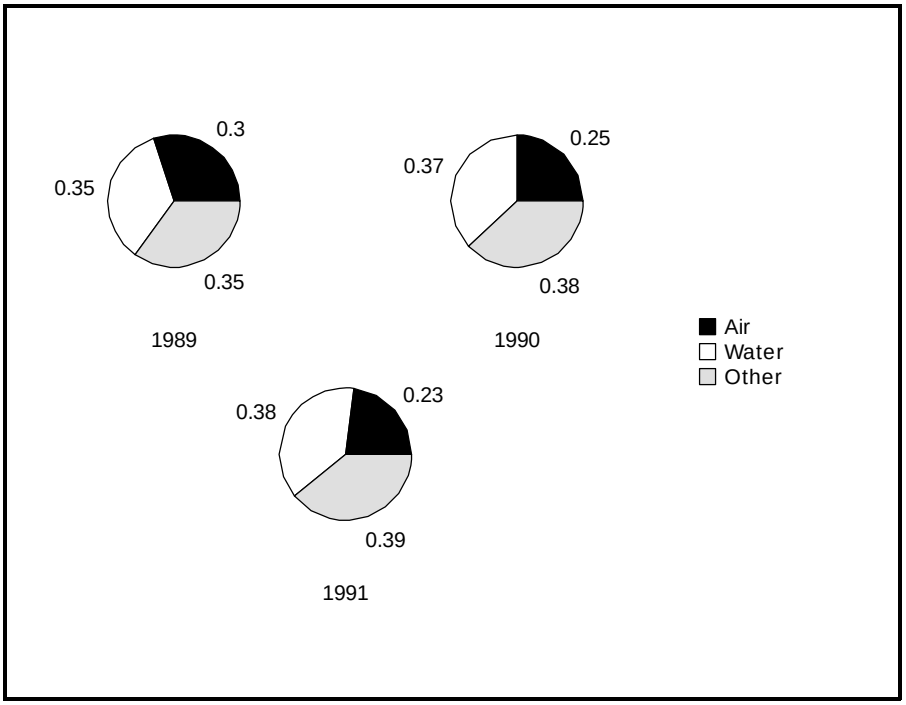

Figure 8: Imports of Environmental Protection Equipment By Medium (1989-1991)

4.2.1. Air Pollution Control Equipment

The largest component of exports is air pollution control equipment, which accounts for over one-half of total U.S. EP exports. This suggests that some air pollution control equipment may have been captured in the "other" category under the pre-1989 system of classification. Air pollution control equipment is a growing share of EP exports. Exports of air pollution control equipment more than doubled between 1989 and 1991, from $377 million to $866 million.[7] In 1989, 39 percent of U.S. EP exports were air pollution control equipment, and by 1991 air pollution control equipment accounted for 53 percent of total U.S. EP exports. In contrast, imports of air pollution control equipment remained virtually constant during 1989-1991. Thus, the share of air pollution control equipment in total U.S. EP imports declined from 1989 to 1991 (from 30 to 23 percent).

4.2.2. Water Pollution Control Equipment

Exports of water pollution control equipment increased substantially during 1989-1991, from $363 million to $450 million, a 24 percent increase. As a share of total U.S. EP exports, exports of water pollution control equipment declined from 37 percent in 1989 to 27 percent in 1991. Although exports of water pollution control equipment were rising, the growth in air pollution control equipment exports was much higher, causing the share of water pollution control equipment in total U.S. EP exports to decline.

The harmonized system for trade classification allows for separate reporting of water pollution control equipment imports. Imports of water pollution control equipment increased 52 percent from 1989 to 1991, from $142 million to $216 million. The share of water pollution control equipment in total U.S. EP imports increased from 35 percent in 1989 to 38 percent in 1991.

4.2.3. Other Pollution Control Equipment

Exports of other pollution control equipment increased 47 percent from 1989 to 1991, from $235 million to $345 million. However, exports of other pollution control equipment decreased slightly between 1990 and 1991, from $358 million to $345 million. The share of other pollution abatement equipment in total U.S. EP exports has remained fairly constant, with a slight rise from 24 percent in 1989 to 28 percent in 1991. Imports of other pollution control equipment increased from $145 million in 1989 to $225 million in 1991. Imports of other pollution control equipment, then, are roughly the size of imports of water pollution control equipment. The share of other pollution control equipment in total U.S. EP imports increased from 35 percent in 1989 to 39 percent in 1991.

4.3. *Bilateral Trade Flows*

Table 8 shows bilateral trade flows as well trade balances for selected U.S. trading partners for 1989-1991. Trade with these countries constituted more than 60 percent of total U.S. EP exports and about three-fourths of all U.S. EP imports.

4.3.1. Exports

Except for 1989, Canada was this country's largest export market during 1989-1991. In 1989, Japan was the largest export market, and in both 1990 and 1991 Japan was the second largest export market. Together, Canada and Japan accounted for 40 percent or more of U.S. EP exports in 1990 and 1991. Following Japan and Canada, the United Kingdom was the third largest export market in 1989 and 1991, while Mexico was the third largest in 1990. During 1989-1991, exports to Mexico comprised approximately five percent of total U.S. EP exports. Exports to Canada, Mexico, and Japan represented about one-third of U.S. EP exports. Exports to France, Germany, and the United Kingdom represented about 16 percent of U.S. EP exports. While it is difficult to infer trends from three years of data, it is interesting to note that in 1991 export levels were substantially higher than 1989 and 1990 levels for each of the U.S. trading partners.

4.3.2. Imports

During 1989-1991, the United States purchased a considerable portion of its imports from three countries: Canada, Japan, and Germany. Imports from these three countries accounted for over one-half of total U.S. EP imports.

4.3.3. Trade Balances

During 1989-1991, the United States carried a surplus with all of these trading partners, except Germany and the United Kingdom. In 1989 and 1990, the United States ran a small deficit with Germany, but this deficit became a small surplus in 1991. Only in 1990 did the United States run a deficit with the United Kingdom. The largest surplus in 1991 was with Canada and Japan, due to a large increase in exports to these two countries.

5. COMPARISON OF TRADE IN POLLUTION CONTROL EQUIPMENT TO OVERALL U.S. TRADE

By way of context, it is useful to compare the values for trade in EP equipment presented in this study to U.S. international trade in general. Table 9 shows total U.S. merchandise exports and imports from 1980 through 1991. Exports of EP products constituted *less than one-half of one percent* of U.S. merchandise exports in 1991. Imports of EP equipment accounted for approximately one-tenth of one percent of U.S. merchandise imports in 1991. For years

Table 8

U.S. Exports, Imports, and Trade Balance of Environmental Protection Equipment for Selected Trading Partners--1989-1991

(thousands of current dollars)

	Exports			Imports			Trade Balance		
Country	1989	1990	1991	1989	1990	1991	1989	1990	1991
Canada	126,945	383,331	420, 399	94,391	117,410	102,901	32,554	265,921	317,498
France	43,482	57,261	71,104	19,692	19,781	24,253	23,790	37,480	46,851
Germany	33,674	40,588	97,161	52,524	61,910	88,057	(18,850)	(21,322)	9,104
Japan	142,239	138,133	319,789	71,556	92,140	118,102	70,683	45,993	201,687
Mexico	53,512	69,699	94,720	11,268	16,634	18,561	42,244	53,065	76,159
Republic of Korea	50,162	49,152	57,959	1,589	3,073	4,680	48,573	46,079	53,279
Republic of China	66,586	59,707	72,427	13,848	21,943	18,863	52,738	37,764	45,726
United Kingdom	74,291	38,227	98,282	28,565	63,320	45,532	45,726	(25,093)	52,750

Notes:

1989-1991 are not comparable to preceding years due to the switch to the harmonized system for trade product classification. The values in Table 8 should not be combined with the values in Tables 3-5.

Data were compiled from the following U.S. Department of Commerce (Bureau of the Census) reports: *U.S. Exports: Harmonized Schedule B Commodity by Country* (FT 447) and *U.S. Imports for Consumption: Harmonized TSUSA Commodity by Country of Origin* (FT 247).

Table 9

Comparison of Environmental Protection (EP) Equipment Imports and Exports to Total U.S. Merchandise Exports and Imports 1980-1990

(Millions of current dollars)

Year	EP Exports	Total U.S. Exports	EP Exports as a Percent of Total Exports	EP Imports	Total U.S. Imports	EP Imports as a Percent of Total Imports
1980	656	224,300	0.29	113	249,800	0.05
1981	726	237,100	0.31	146	265,100	0.05
1982	696	211,000	0.33	179	247,600	0.07
1983	658	201,800	0.21	146	268,900	0.05
1984	559	219,900	0.25	173	332,400	0.05
1985	458	215,900	0.21	234	338,100	0.07
1986	445	223,300	0.20	268	368,400	0.07
1987	560	250,200	0.22	356	409,800	0.09
1988	859	320,200	0.27	426	447,200	0.10
1989	975	361,700	0.37	409	477,400	0.09
1990	1,310	388,700	0.34	501	497,600	0.10
1991	1,680	416,000	0.40	567	489,400	0.12

Total U.S. imports and exports are taken from *Economic Report of the President* (U.S. President, 1993, p. 464). EP imports and exports are taken from Tables 1 and 6. Data for 1989-1991 are included with pre-1989 data to give a frame of reference. Data on EP trade for 1989-1991 are not comparable to the pre-1989 data.

preceding 1991, the percentage of EP equipment in total U.S. imports and exports was even smaller. Hence, it is apparent that EP equipment does not constitute a major component of U.S. merchandise trade.

The comparisons of trade in EP equipment to overall trade, while useful for placing EP trade in context, should not be interpreted as evidence that EP trade is trivial. For most kinds of traded goods, the share in total U.S. trade is likely to be small. It is more meaningful to compare EP trade to trade in other sectors of the economy. According to the *Statistical Abstract 1991* (U.S. Department of Commerce, 1991), two 2-digit SIC industries had levels of exports in 1990 comparable to, or less than, the level of exports for EP equipment (in millions of dollars). These two industries were furniture and fixtures (SIC 25) with exports of $1.6 billion, and leather and leather products (SIC 31) with exports of $1.4 billion.

Table 10 shows data for selected 3- and 4-digit SIC industries that had levels of exports in 1990 comparable to, or less than, the level of exports of EP products. According to Table 10, the level of exports for EP equipment was roughly twice the level for fabricated textile products (SIC 239) in 1990. Exports of EP equipment were approximately the same as exports for book publishing (SIC 2731). Table 11 gives data for selected industries with trade surpluses in the general range of the trade surplus for environmental protection products. The trade surplus for EP equipment was larger than the trade surplus for pulp mills (SIC 2611) and roughly the same size as the surpluses for farm machinery and equipment (SIC 3523), space vehicle equipment, nec (SIC 3769), and radio and TV communications equipment (SIC 3663).

6. TRADE IN POLLUTION CONTROL EQUIPMENT FOR OTHER COUNTRIES

Prior to 1988, trade product classification schemes varied across countries, making it virtually impossible to determine which products constituted EP equipment. The adoption of the harmonized system for trade classification in 1988 by all countries allows for the development of a reasonable concordance of trade classification codes among countries.[8] Table 12 provides data on exports, imports, and trade balances for Canada, France, Germany, Japan, the Republic of Korea, Mexico, the Republic of China, and the United Kingdom.

The harmonized system is comparable across countries only up to the six-digit level of aggregation. In many instances, identifying the trade codes that constitute EP equipment requires a finer level of aggregation. Thus, the U.S. data may not be fully comparable to the data for other countries. In fact, except for data from European countries (France, Germany, and the United Kingdom), the data may not be comparable across any of the other countries. The European data are comparable because they are from the same source.

To illustrate the difficulties with the data, refer to Mexico in Table 12. In 1990, using

Table 10

Selected Industries with Export Levels Comparable to Export of Environmental Protection Equipment in 1990

(Millions of current dollars)

Industry	SIC	Exports
Machine Tools	3541,-2	1,640
Book Publishing	2731	1,428
Fabricated Textile Products	239	630
Household Appliances	363	1,778
Sporting & Athletic Goods	3949	1,023
Environmental Protection Equipment	--	1,310

Source: U.S. Department of Commerce, International Trade Administration, 1992 (Environmental Protection Equipment Figures are taken from Table 1).

Table 11

Selected Industries with Trade Balances Comparable to the Trade Balance for Environmental Protection Equipment in 1990

(Millions of current dollars)

Industry	SIC	Exports	Imports	Trade Balance
Pulp Mills	2611	3,288	2,851	437
Farm Machinery and Equipment	3523	3,165	2,551	614
Space Vehicle Equipment, NEC	3769	724	79	615
Radio and TV Communications Equipment	3663	3,728	3,042	686
Environmental Protection Equipment	--	1,310	501	565

Source: U.S. Department of Commerce, International Trade Administration, 1992 (Environmental Protection Equipment Figures are taken from Table 1).

Table 12

Exports, Imports, and Trade Balances
for Selected Other Countries
(Thousands of U.S. Dollars)

a. Exports

Country	1988	1989	1990	1991
Canada	111,269	143,821	194,240	197,858
France	248,182	326,413	476,734	488,716
Germany	933,329	1,089,792	1,506,968	1,491,798
Japan	546,934	577,643	563,030	695,354
Republic of Korea	2,053	3,227	4,440	551
Mexico	115	233	355	N/A
Republic of China	*	20,306	29,887	28,065
UK	342,156	507,434	666,880	659,059
US	*	975,158	1,310,254	1,680,021

b. Imports

Country	1988	1989	1990	1991
Canada	436,951	478,121	458,870	481,725
France	242,318	285,089	419,708	474,632
Germany	422,052	482,796	681,003	771,812
Japan	139,086	149,708	210,903	216,969
Republic of Korea	25,499	49,708	47,298	7,503
Mexico	5,532	11,599	16,551	N/A
Republic of China	*	107,014	102,067	118,678
UK	239,573	283,016	343,699	372,067
US	*	409,667	501,391	566,921

Table 12 (continued)

c. Trade Balances

Country	1988	1989	1990	1991
Canada	(325,682)	(334,300)	(264,630)	(283,867)
France	5,864	41,324	57,026	14,084
Germany	511,277	606,996	825,965	719,986
Japan	407,848	427,935	361,127	478,385
Republic of Korea	(23,446)	(46,481)	(42,858)	(6,952)
Mexico	(5,417)	(11,326)	(16,196)	N/A
Republic of China	*	(86,708)	(72,180)	(90,613)
UK	102,583	224,418	323,181	286,992
US	*	565,491	808,863	1,113,100

Notes:

Canada's data are compiled from Canada, Statistics Canada, International Trade Division, various issues; European community data are compiled from Statistical Office of the European Community, various issues; Japan's data are compiled from Japan Tariff Association, various issues; The Republic of Korea's data are Republic of Korea, Korean Customs Administration, Korea Customs Research Institute, various issues; Mexico's data are compiled from United States of Mexico, Instituto Nacional de Estadistica, Geografia e Informatica, various issues; the Republic of China's data are compile from The Republic of China, Statistical Department, Directorate General of Customs, Ministry of Finance, various issues.

To convert to U.S dollars, exchange rates for Canada and Japan were taken from U.S. President, 1992; exchange rates for the European community were taken from Commission of the European Community, Directorate General for Economic and Financial Affairs, 1992; exchange rates for the Republic of China were taken from Federal Reserve System, Board of Governors, 1991 and 1993.

*The Republic of China and the United States did not switch to the harmonized system for trade classification until 1989 so that data for 1988 are not available.

N/A = not available

data reported by Instituto Nacional de Estadistica, the estimated level of Mexican exports to all countries was only $355,000. Table 8 shows that, using data published by the U.S. Department of Commerce, Mexico exported $16.6 million to the United States alone. These types of inconsistencies stem from reporting requirements that vary across countries and the fact that the harmonized system is comparable across countries only up to the six-digit level of aggregation.

6.1. *Canada*

Table 12 shows that Canada's exports of EP equipment grew from 1988-1991. In 1991, Canadian exports were $198 million, up 78 percent over 1988 levels of $111 million. Imports also rose, but not as fast. In 1991, Canadian imports were $482 million, up from $437 million in 1988, or 10 percent. The data also show that Canada ran a deficit in EP trade for all four years. This deficit is slowly declining.

6.2. *France*

According to Table 12, France's exports of EP equipment were growing during 1988-1991. In 1988, France's exports totaled $248 million. By 1991, France's exports were $489 million, up almost 100 percent. France's imports, on the other hand, increased from $242 million to $475 million, about 96 percent, during these four years. France thus ran a surplus in EP trade during 1988-1991. During 1988-1990, the surplus rose rapidly, from about $6 million to $57 million. Between 1990 and 1991, the surplus declined to $14 million, about 75 percent.

6.3. *Germany*

From 1988-1991, German EP exports grew from $933 million to $1.5 billion, or roughly 60 percent. German EP imports nearly doubled, rising from $422 million in 1988 to $772 million in 1991. Germany also ran a trade surplus during this time, a surplus which rose from $511 million in 1988 to $826 million in 1990. In 1991, the surplus fell to $720 million.

6.4. *Japan*

Except for 1990, Japan's exports of EP equipment rose steadily between 1988-1991. By 1991, exports were $695 million, 27 percent above the 1988 level of $547 million. Japan's EP imports also increased during this time, from $139 million in 1988 to $217 million in 1991, about 56 percent. Thus, Japan carried a trade surplus in EP equipment during 1988-1992. This surplus remained fairly stable, ranging from a low of $361 million in 1990 to a high of $478 million in 1991.

6.5. *Republic of Korea*

The Republic of Korea imports substantially more EP equipment than it exports. Table 12 shows that EP exports from the Republic of Korea were relatively low during 1988-1991, ranging from about one-half million dollars in 1991 to over four million dollars in 1990. In 1988, the Republic of Korea imported $25 million. EP imports rose to about $50 million in 1989, then declined to $47 million in 1990. In 1991, imports declined even further to less than $8 million. These widely fluctuating patterns of exports and imports for the Republic of Korea are reflected in its trade deficit, which ranged from about $46 million in 1989 to $7 million in 1991.

6.6. *Mexico*

The data for Mexico were available only for 1988-1990. In all three of these years Mexico's EP exports were relatively small, well below one-half million dollars. Mexican imports were larger, ranging from less than $6 million in 1988 to about $17 million in 1990. During 1988-1990, Mexico ran a deficit in EP trade, ranging from $5 million in 1988 to $16 million in 1990.

6.7. *Republic of China*

Like the United States, the Republic of China did not switch to the harmonized system for trade classification until 1989. Thus, data on EP trade for the Republic of China are available only for 1989-1991. EP exports from the Republic of China rose from $20 million in 1989 to $28 million in 1991, or 40 percent. EP imports also rose during this time, from $107 million to $119 million, around 11 percent. During 1989-1991, the Republic of China ran a deficit in EP trade that grew from $87 million to $91 million.

6.8. *United Kingdom*

The United Kingdom's exports of EP equipment increased dramatically from 1988 to 1991, almost doubling from $342 million to $659 million. The increase in EP imports was not as large, from $240 million in 1988 to $372 million in 1991. During this time, the United Kingdom carried a surplus in EP trade that more than doubled from $103 million in 1988 to $287 million in 1991.

7. COMPARISON OF ENVIRONMENTAL TRADE ESTIMATES

Several other studies have made claims regarding the nature of the patterns in EP trade between the United States and other countries. In this section, the results from this study are compared to estimates generated in other studies as well as to some common public perceptions. First, the estimates are discussed in the context of public perception. The OECD estimates then

are reviewed and the large discrepancies between the estimates of EP trade generated in this study and OECD's are discussed. Finally, this study's estimates for EP trade are compared to estimates reported by the U.S. Department of Commerce and the Japan External Trade Organization (JETRO). The estimates of EP trade presented in this study are relatively close to the values reported by the U.S. Department of Commerce and JETRO.

7.1. *Comparison to Public Perceptions*

Several claims regarding the nature of EP trade have appeared in the popular press. It has been asserted that the United States imports as much as 70 percent of its air pollution control equipment and that Germany leads the in global market for air pollution control and other environmental technologies (see, for example, Porter, 1991 and Wirth, 1992).

To analyze the accuracy of claims regarding the percentage of air pollution control equipment that the U.S. imports, it was necessary to estimate both total U.S. demand for air pollution control equipment and the amount of that demand satisfied by imports. Total U.S. demand for air pollution control equipment is equal to total shipments of domestically produced air pollution control equipment plus imports of air pollution control equipment less exports. To measure shipments of air pollution control equipment, data for industrial air pollution control equipment (SIC 35646) were used.[9] Because SIC 35646 compares to the trade code corresponding to stationary source air pollution control equipment (Trade Code 8421.39), estimates of exports and imports for air pollution control equipment were generated using only Trade Code 8421.39. In Table 7 above, the component of EP trade classified as air pollution control equipment included more trade codes (see Appendix C) so that the air pollution control equipment values reported in Table 7 are larger. This larger value is not comparable to SIC 35646.

Table 13 provides data on total U.S. shipments, exports, and imports of stationary source air pollution control equipment for 1989-1991. For each year, these data were used to compute the percentage of total U.S. demand for stationary source air pollution control equipment satisfied by imports. Between 1989 and 1991, this percentage ranged from 20 percent to 35 percent, substantially lower than the 70 percent commonly claimed.

To analyze the accuracy of claims regarding German leadership in air pollution and other environmental technologies, this study again used the trade code corresponding to stationary source air pollution control equipment (Trade Code 8421.39). Exports and imports of stationary source air pollution control equipment are reported for France, Germany, Japan, the United Kingdom, and the United States in Table 14.

Table 14 shows that, in all three years, the United States lead Germany in exports of stationary source air pollution control equipment, although in 1989 and 1990 Germany was a

Table 13

Shipments, Exports, and Imports of Stationary Source Air Pollution Control Equipment

	1989	1990	1991
Shipments*	710,942	825,311	936,680
Exports**	292,723	437,560	738,564
Inports**	104,883	121,136	108,421
Domestic Consumption (Shipments + Imports - Exports)	523,102	598,887	306,537
Imports as a Percentage of Shipments	15	15	12
Imports as a Percentage of Domestic Consumption	20	24	35
Exports as a Percentage of Shipments	41	53	79

*U.S. shipments of stationary source air pollution control equipment is measured using data for SIC 35646 (see U.S. Department of Commerce, U.S. Bureau of the Census, "Selected Industrial Air Pollution Control Equipment," *Current Industrial Reports*, MA35J).

**Trade in stationary source air pollution control equipment is measured using trade code 8421.39, as this is comparable to SIC 35646.

Note: The large increase in exports of air pollution control equipment for the U.S. between 1990 and 1991 can be traced to trade code 8421.39.00.90. In 1989 and 1990, the published trade data reported no exports for this commodity code. In 1991, however, exports of $562 million were reported for trade code 8421.39.00.90.

Table 14

Trade in Stationary Source Air Pollution Control Equipment for 1989-1991 (Commodity Code 8421.39)

(Thousands of Current U.S. Dollars)

	1989		1990		1991	
Country	Exports	Imports	Exports	Imports	Exports	Imports
France	54,959	74,998	96,543	122,046	95,213	149,160
Germany	246,234	142,637	375,318	237,499	376,863	251,691
Japan	101,860	26,810	76,459	48,126	116,670	85,085
UK	84,806	57,149	106,342	94,883	112,942	93,030
US	292,723	104,883	437,560	121,136	738,564	108,421

close second. In 1991, however, U.S. exports were amost double the size of Germany's. In 1990, the U.S. led Germany in exports of air pollution control equipment by about $63 million. This lead grew to $362 million by 1991. Furthermore, in 1991, the United States supplanted Germany as the country with the largest trade surplus in EP equipment (see Table 12). Thus, while Germany appears to be a major exporter of air pollution control equipment as well as EP equipment in general, the data compiled in this study suggest that it does not hold the lead often claimed in the popular press.

7.2. *Comparison to OECD Estimates*

The OECD gathers and compiles statistics on EP trade from member countries. In a 1992 report, the OECD lists values for EP trade for selected countries in 1990. According to the report, each of the following enjoyed a surplus in EP trade in 1990: United States ($4 billion), Europe ($8 billion), and Japan ($3 billion). Within Europe, Germany enjoyed a trade surplus of $10 billion, while the United Kingdom and France each had a surplus of $500 million. This yields a combined trade *surplus* of $15 billion dollars. The OECD did not indicate which countries are importing this quantity of environmental protection goods.

OECD estimates for the 1990 U.S. and Japanese trade surpluses for pollution control equipment are more than four times the value estimated in this study. For Germany, the OECD estimates are more than 10 times this study's estimates (see Table 12). Since OECD did not identify the specific trade codes classified as EP equipment, there is no way to fully reconcile the values estimated in this study and those reported by OECD. However, there are two possible explanations for these large discrepancies.

One potential explanation is the OECD methodology for obtaining its estimates. Briefly, OECD gathers data on the estimated level of total domestic production of EP products and the size of the trade balance for the United States, Germany, France, the United Kingdom, and Japan. Exports are reported as a share of domestic EP equipment production. Table 15 summarizes OECD's data for 1990 (1992, p. 21). The Production, Export Share, and Trade Balance columns are taken directly from OECD (1992, p.21). From these values, it is easy to determine the implied level of exports and imports for each of the countries. Exports are derived by multiplying Production by Export Share. Imports are derived by subtracting the Trade Balance from Exports.

The most obvious problem with the OECD data is the inconsistency in the Japanese data. Since the implied level of exports is less than the trade surplus assigned to it by the OECD, Japan must have *negative* imports, which is not possible.[10] These types of inconsistencies highlight the need for better data collection procedures and a consistent framework for integrating the data.

Another possible explanation for the discrepancy between the EP trade estimates

Table 15

Summary of OECD Trade Estimates for the Environmental Protection Industry

Country	Production (Billions of U.S. Dollars)	Export Share (Percentage of Production Exported)	Trade Balance (Billions of U.S. Dollars)	Exports (Billions of U.S. Dollars)	Imports (Billions of U.S. Dollars)
	(1)	(2)	(3)	(4)	(5)
United States	80.0	10.0	4.0	8.0	4
Germany	27.0	40.0	10.0	10.8	.8
France	12.0	14.0	0.5	1.7	1.2
United Kingdom	9.0	17.0	0.5	1.5	1.0
Japan	30.0	6.0	3.0	1.8	-1.2

Note:

The Production, Export Share, and Trade Balance columns are taken directly from OECD (1992, p.21). Exports are derived by multiplying Production by Export Share. Imports are derived by subtracting the Trade Balance from Exports.

reported in this study and by OECD is the share of domestic EP production that is exported. Using information from additional sources, it is possible to examine the accuracy of OECD's reported values for export share. For Germany in 1980, Schäfer and Stahmer (1989) estimated the value of purchases for all goods and services used in pollution abatement. In addition, they provided information on the exports and output of each of these goods and services.

Table 16 provides the Schäfer and Stahmer data for each of the goods and services purchased for purposes of pollution abatement in Germany.[11] Total purchases as well as exports and total production are included. For each product and service, it is possible to calculate the share of exports in total production and the percent it accounts for in total EP expenditures.

Table 16

Total Output and Export Levels for Products Purchased for Environmental Protection in Germany

(10^6 DM)

Product/Service	Amount of Domestic Production Purchased for EP	Exports	Total Domestic Production	Exports as a Percent of Production	Percent of Product/Service in Total EP Expenditures
Agricultural, forestry and fishing products	5	2,564	68,951	3.7	0.0
Electricity, gas, water, mining products	1,649	6,675	112,589	5.9	5.4
Chemicals, chem. products	699	43,094	131,322	32.8	2.3
Petroleum products	183	4,954	81,565	6.1	0.6
Plastic and non-metallic products	0	14,720	92,711	15.9	0.0
Basic metal products	5	29,555	174,918	16.9	0.0
Machinery (except electrical), transport equipment	2,289	109,015	299,921	36.3	7.5
Electrical machinery, fabricated metal products, n.e.c.	609	48,375	163,921	29.5	2.0
Textiles, leather, wood, paper and products	13	24,125	163,343	14.8	0.0
Food, beverages, tobacco	0	14,181	172,050	8.2	0.0

Table 16 (continued)

Product/Service	Amount of Domestic Production Purchased for EP	Exports	Total Domestic Production	Exports as a Percent of Production	Percent of Product/Service in Total EP Expenditures
Environmental protection services	6,658	0	18,874	0.0	21.9
Non-market services except environmental protection services	571	536	368,324	0.1	1.9
Construction	407	7,207	197,578	3.6	1.3
Trade, transport, and communication services	11,461	40,312	343,736	11.7	37.7
Other market services except environmental protection services	0	10,785	508,510	2.1	0.0
TOTAL INTERMEDIATE INPUTS	24,549	356,098	2,898,313	12.3	80.8
Imported products	751	---	---	---	2.5
Non-deductible value added tax	1,036	---	---	---	3.4
Consumption of fixed capital	2,246	---	---	---	7.3
Compensation of employees	1,795	---	---	---	5.9
Property and entrepreneurial income	0	---	---	---	0.0
GRAND TOTAL	30,377	356,098	2,898,313	12.3	100.0

Source: Schäfer and Stahmer (1989)

Although it is not obvious which EP products are included in the OECD data, several insights can be drawn from Schäfer and Stahmer. First, purchases for environmental protection services and trade, transport, and communication services represent the largest components of total EP expenditures for goods and services. These two sectors combined represent almost 60 percent of total EP expenditures for goods and services. However, in the German economy in 1980, zero percent of environmental protection services was exported, and only about 12 percent of trade, transport, and communication services was exported. It appears that the major EP products produced in the German economy were purchased predominantly for domestic use.

Hence, it is unclear how OECD justifies the assumption that 40 percent of all output of the environmental protection industry in Germany is exported. One possibility is that Germany exported a substantially larger percentage of its EP output in 1990 than in 1980. However, other sources suggest that the share of EP equipment that is exported may be small (see JETRO 1989/90, p.55 and 1992, pp. 20-21). The reasons are: (1) the cost of transporting the equipment, (2) the "low-tech" nature of hardware components, (3) the differences in regulations among nations, and (4) the service/maintenance requirements of purchasers. It also may be possible that there has been a dramatic change in the types of products that are purchased for environmental protection (i.e., there has been a shift in purchases from nontraded goods and services to traded goods and services). At this point, data to support or refute this possibility are unavailable.

7.3. *Comparison to Estimates Reported in Other Studies*

Other studies have generated estimates of EP trade that are closer to the values reported in this study. Two examples are the U.S. Department of Commerce (1991) and data published by the Japan Export Trade Organization (JETRO).[12,13]

The U.S. Department of Commerce (1991, p. 29) has used data for SIC 35646 (industrial air pollution control equipment) to estimate the size of the world export market for air pollution control equipment. The DOC reports that, in 1986, the size of this market was $142 million. Of the total world export market for air pollution control equipment, the DOC study found that the United States supplied roughly 30 percent. Germany supplied approximately 18 percent of the market. The United Kingdom, Japan, and Sweden all controlled less than 10 percent of the world export market for air pollution control equipment.

According to the DOC report, the United States had exports of $67.5 million in 1987 and $119 million in 1989. This study, on the other hand, estimates U.S. exports of air pollution control equipment in 1987 at $99 million (see Table 2). In Table 7, this study reports U.S. exports of air pollution control equipment at $377 million in 1989. The values estimated in this study are larger because they are based upon a broader definition of the trade codes that constitute air pollution control equipment than in the DOC report. However, the estimated

levels of U.S. air pollution control exports for 1987 and 1989 reported in this study are of the same order of magnitude as in the DOC report.

As a second source of comparison, JETRO has published data on Japanese exports of EP equipment. In Table 17, the data reported by JETRO (Uno, 1991 for 1988) are converted to thousands of U.S. dollars.[14] The Japanese values are about 64 percent to 76 percent smaller than values compiled in this study and reported in Table 12. However, the differences are not by orders of magnitude as is the case with the OECD figures.

Table 17

Japan Export Trade Organization (JETRO) Estimates of Japan's Exports of Pollution Abatement Equipment

(Thousands of U.S. Dollars)

	1988	1989	1990
Air Pollution	89,990	104,997	145,379
Water Pollution	48,490	28,833	37,034
Waste Disposal	24,694	710	17,738
Noise and Vibration	148	1,456	593
TOTAL	163,322	135,997	200,744

Source: JETRO (1989/90) for 1988 and 1990 and Uno (1991) for 1989.

To convert to U.S dollars, exchange rates for Japan were taken from U.S. President, 1992.

NOTES

1. The OECD also states that "Japanese firms are large exporters and licensors of air pollution control equipment...." (OECD, 1992, p. 22). At present, there are few data regarding licensing agreements for EP technology. The Japanese External Trade Organization, however, publishes information of the number of instances of exports and imports which involve the licensing of EP technology (e.g., licensing technology for construction of an incinerator). This information, which is presented in Appendix A, provides a basis for assessing the validity of this claim.

2. It is possible that the OECD included components of EP trade not captured in this study in its measure (see discussion in Section 2 below). However, it is not possible to fully reconcile the values estimated in this study and those reported by OECD since the OECD did not identify the specific trade codes classified as EP products or identify its data sources.

3. See the following Department of Commerce (Bureau of the Census) reports: *U.S. Exports: Schedule B Commodity by Country* (FT 446) and *U.S. Imports for Consumption and General Imports: Tariff Schedule of the United States Annotated (TSUSA) Commodity by Country of Origin* (FT 246) for the pre-1989 system for trade classification; *U.S. Exports: Harmonized Schedule B Commodity by Country* (FT 447) and *U.S. Imports for Consumption: Harmonized Tariff Schedule of the United States Annotated (TSUSA) Commodity by Country of Origin* (FT 247) for the post-1988 system for trade classification.

4. Due to data limitations, equipment for solid waste pollution abatement could not be reported separately.

5. For a discussion of the harmonized system, see U.S. Department of Commerce, International Trade Administration (1990, pp. 3-8).

6. The *trade balance* is defined as exports minus imports. When the trade balance is *positive*, there is a trade *surplus*. When the trade balance is *negative*, there is a trade *deficit*.

7. This large increase in exports of air pollution control equipment can be traced to trade code 8421.39.00.90. In 1989 and 1990, the published trade data reported no exports for this commodity code. In 1991, however, exports of $562 million were reported for trade code 8421.39.00.90.

8. The U.S. and the Republic of China did not adopt the harmonized system until 1989.

9. See U.S. Department of Commerce, U.S. Bureau of the Census, "Selected Industrial Air Pollution Control Equipment," *Current Industrial Reports*, MA35J.

10. This insight is from Heskett, 1992, p.7.

11. The full set of Schäfer-Stahmer numbers is reported in Appendix C.

12. As a third source, Heskett (1992, p.16) also used the harmonized trade classification to determine U.S. exports of various categories of environmental protection equipment. In contrast to this study, Heskett defined trade in pollution abatement equipment as consisting of: Dust Collection and Air Purification Equipment (trade code 8421.39.00.10), Filtering and Purifying Machinery for Gas (trade code 8421.39.00.50), Industrial Gas Cleaning Equipment (trade code 8421.39.00.90), and Incinerators and Laboratory Furnances (trade code 8417.80.00.00).

Heskett also used the harmonized system to determine German exports of environmental protection equipment.

13. The data published by the Japan Export Trade Organization (JETRO) are compiled by the Japan Society of Industrial Machinery Manufacturers.

14. These data are further disaggregated into 7 categories of air pollution control equipment and 6 categories of water pollution control equipment. The 1988 export figures are from JETRO (1990/92, pp. 56). The 1989 export data are from Uno (1991, p. 19). The 1990 export data are from JETRO (1992, pp. 7, 12, 18, 20).

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APPENDIX A

INTERNATIONAL TRADE IN ENVIRONMENTAL TECHNOLOGY FOR JAPAN

International Trade in Environmental Technology for Japan

At present, there are few data regarding the trade in environmental protection technology. The Japan External Trade Organization (JETRO) however, publishes some data on Japanese trade in EP technology. The data are not reported as monetary values. Rather, Japanese firms provide the number of "cases" of exports and imports of technology. These typically appear to involve the licensing of environmental protection technology (e.g., licensing technology for construction of an incinerator).

JETRO (1989/90, pp. 70-71) contains detailed information on Japanese exports and imports of environmental protection technology for fiscal years 1984-1988. Table A-1 lists the total number of cases for exports, while Table A-2 lists the total number of cases for imports.

Between 1984 and 1988 Japan had one case of exports of air pollution control technology to the United States each year (except for 1987 when there was no case). Japan recorded 7 cases of air pollution technology imports from the United States in 1985 and 1987, 6 cases in 1984 and 1986, and 3 cases in 1988. The United States was the leading exporter of air pollution control technology to Japan in all five years.

The United States was also the leading exporter of water pollution control technology and waste disposal technology to Japan from 1984 through 1987. The United Kingdom was the leading exporter of each of these technologies in 1988. Overall, the United States was also the leading exporter of technology to Japan in all five years: 1984 (18 cases), 1985 (19 cases), 1986 (17 cases), 1987 (16 cases), 1988 (6 cases - tied with the United Kingdom). The Federal Republic of Germany was the second leading exporter of technology to Japan in 1984 (8 cases) and 1985 (9 cases). The United Kingdom was the second leading technology exporter to Japan in 1986 (7 cases) and 1987 (7 cases).

In 1990, (see JETRO, 1992, p. 22), there were 10 cases of Japanese exports and 23 cases of Japanese imports of environmental protection technology. Of these, 4 cases were exports to Europe, 1 case of exporting technology to Mexico, and 1 case of exporting technology to North America (i.e. Canada and the United States). On the other hand, Europe (7 cases) and North America (15 cases) account for 22 of the cases of Japanese imports of environmental protection technology. Given that JETRO (1989/90, pp. 70-71) showed no exports or imports of technology to Canada for 1984 through 1988 (inclusive), the United States probably accounts for virtually all of the trade in technology assigned to North America in 1990.

These data appear to indicate that, although the gap has narrowed during the later 1980s, Japan remains a net importer of environmental protection technology. Most of Japan's exports of technology are to other Asian nations, while most of its imports of technology are from Europe and the United States. Contrary to the OECD (1992, p. 22) statement that "Japanese firms are large

exporters and licensors of air pollution control equipment. . . .," theUnited States was a net exporter of environmental protection technology to Japan during the entire period.

Table A-1

Japanese Exports of Environmental Protection Technology

(Number of Cases)

Components	1984	1985	1986	1987	1988
Air Pollution	8	15	12	8	8
Water Pollution	7	6	2	4	5
Waste Disposal	2	4	3	1	3
Noise and Vibration	2	2	0	1	1
TOTAL	19	27	17	14	17

Source: JETRO (1989/90)

Table A-2

Japanese Imports of Environmental Protection Technology

(Number of Cases)

Components	1984	1985	1986	1987	1988
Air Pollution	16	18	11	11	4
Water Pollution	22	21	14	13	11
Waste Disposal	6	6	7	4	4
Noise and Vibration	1	1	1	1	1
TOTAL	45	46	33	29	20

Source: JETRO (1989/90)

APPENDIX B

TRADE CODES USED FOR MEASURING TRADE IN ENVIRONMENTAL PROTECTION EQUIPMENT

Table B-1

U.S. Trade Codes Classified as Environmental Protection Equipment

a. Air Pollution Control Equipment

Description	Harmonized TSUSA (Imports)	Harmonized Schedule B (Exports)	TSUSA (Imports)	Schedule B (Exports)
Industrial or lab furnaces and ovens, including incinerators, n/ele nesoi	8417.80.00.00	8417.80.00.00	661.3000	661.3020
Dust collection and air purification equipment	8421.39.00.10	8421.39.00.10	661.9400	661.9825
Electrostatic precipitators	8421.39.00.20	8421.39.00.20		661.9805
Industrial gas cleaning equipment	8421.39.00.30	8421.39.00.30		661.9808
Gas separation equipment	8421.39.00.40	8421.39.00.40		661.9815
Filtering or purifying machinery and apparatus, gas, nesoi	8421.39.00.50	8421.39.00.50		
Filtering or purifying machinery and apparatus, gas, nesoi	8421.39.00.90	8421.39.00.90		
Gas or smoke analysis equipment, optical	9027.10.40.00	9027.10.00.00		

Table B-1 (continued)

b. Water Pollution Control Equipment

Description	Harmonized TSUSA (Imports)	Harmonized Schedule B (Exports)	TSUSA (Imports)	Schedule B (Exports)
Machinery for filtering or purifying water	8421.21.00.00	8421.21.00.00		661.9855
Machinery for filtering or purifying other liquids	8421.29.00.50 8421.29.00.60	8421.29.00.50 8421.29.00.60		

c. Other Pollution Control Equipment

Description	Harmonized TSUSA (Imports)	Harmonized Schedule B (Exports)	TSUSA (Imports)	Schedule B (Exports)
Parts of machinery for filtering/purifying water	8421.99.00.40	8421.99.00.40		
Parts of machinery for filtering/purifying other liquids	8421.99.00.80	8421.99.00.80	661.9580	661.9875
Filtering and purifying machinery and parts, nspf			661.9500	661.9880
Ion exchange resins			661.9520	

Table B-2

Trade Codes for Canada

Trade Code	Description
8417.80	Industrial or lab furnaces & ovens, inc incinerators non-electric nes
8421.21	Filtering or purifying machinery and apparatus for water
8421.29	Filtering or purifying machinery and apparatus for liquids nes
8421.39	Filtering or purifying machinery and apparatus for gases nes
8421.99	Parts for filtering or purifying machinery and apparatus for liquids or gases, nes
9027.10	Gas or smoke analysis apparatus

Table B-3

Trade Codes for Japan

Trade Code	Description
8417.80-000	Furnaces and ovens other than those for roasting, melting or other heat-treatment of ores, pyrites or of metals and bakery or biscuit ovens
8421.21-000	Filtering or purifying machinery and apparatus for water
8421.22-000	Filtering or purifying machinery and apparatus for beverages other than water
8421.29-000	Filtering or purifying machinery and apparatus for liquids, n.e.s.
8421.39-000	Filtering or purifying machinery and apparatus for gases, other than intake air filters for internal combustion engines
8421-99-000	Parts of filtering or purifying machinery and apparatus for liquids or gases
9027.10-000	Gas or smoke apparatus

Table B-4

Trade Codes for France, Germany, and the U.K.

Trade Code	Description
8417.80-10	Furnaces and ovens for the incineration of rubbish, (non-electric)
8417.80-90	Industrial or laboratory furnaces, including incinerators, (non-electric), (excl. 8417.10-00 to 84-17.80-10)
8421.21-90	Machinery and apparatus for filtering or purifying water, (excl. for civil aircraft)
8421.29-90	Filtering or purifying machinery and apparatus for liquids, (excl. 8421.21-10 to 8421.29-10)
8421.39-30	Machinery and apparatus for filtering or purifying air, (excl. for civil aircraft), (excl 8421.31-90)
8421.39-51	Machinery and apparatus for filtering or purifying gases (excl. air), by a liquid process, (excl. for civil aircraft)
8421.39-55	Machinery and apparatus for filtering or purifying gases (excl. air), by an electrostatic process, (excl. for civil aircraft)
8421.39-71	Machinery and apparatus for filtering or purifying gases (excl. air), by a catalytic process, (excl. for civil aircraft)
8421.39-75	Machinery and apparatus for filtering and purifying gases (excl. air) by a thermic process, (excl. for civil aircraft)
8421.39-99	Machinery and apparatus for filtering and purifying gases (excl. air) (excl. for civil air craft), (excl 8421.39-51 to 8421.39-75)
8421.99-00	Parts of machinery and apparatus for filtering or purifying liquids or gases
9027.10-10	Electronic gas or smoke analysis apparatus
9027.10-90	Gas or smoke analysis apparatus (excl. electronic)

Table B-5

Trade Codes for the Republic of Korea

Trade Code	Description
8417.80.2000	Laboratory type
8421.22.0000	For filtering or purifying beverages other than water
8421.29.2000	For the treatment of harmful waste water
8421.39.2000	For purifying exhaust gas for vehicles of chapter 87
8421.39.9010	For the treatment of harmful exhaust gas
8421.99.1000	For purifying exhaust gas for vehicles of chapter 87
8421.99.9010	Of filtering or purifying machinery and apparatus, for internal combustion
9027.10.0000	Gas or smoke analysis apparatus

Table B-6

Trade Codes for Mexico

Trade Code	Description
8417.80-02	Incinerators
8421.21-02	Chlorine-based chemical purifiers
8421.21-03	Magnetic water filters
8421.21-04	Inverted osmosis modules
8421.29-01	Liquid purifiers
8421.29-03	Precipitators
8421.39-01	Precipitators
8421.39-03	Gas filters
8421.39-05	Air filters
8421.39-06	Oil separators
8421.39-07	Oil separators for compressors
8421.39-08	De-gasifiers
9027.10-01	Gas and smoke analysis equipment

Table B-7

Trade Codes for the Republic of China

Trade Code	Description
8417.80.1000-2	Incinerators
8421.21.9000-1	Other filtering or purifying machinery and apparatus for water
8421.22.9000-9	Filtering or purifying machinery and apparatus for beverages other than water
8421.29.0000-2	Other filtering or purifying machinery and apparatus for liquids
8421.39.1000-8	Electric air filters and purifiers
8421.39.9000-1	Other filtering or purifying machinery and apparatus for gases
8421.99.1000-5	Filter elements (for instant use)
8421.99.9000-8	Other parts of filtering or purifying machinery and apparatus for liquids or gases
9027.10.0000-9	Gas or smoke analysis apparatus

APPENDIX C

INPUTS PURCHASED FOR POLLUTION ABATEMENT IN GERMANY

Total Output and Export Levels for Products Purchased for Environmental Protection (EP) in Germany

(10^6 DM)

Sector	Amount Purchased as Operation and Maintenance Expenditures	Amount Purchased as Capital Expenditures	Total Amount Purchased for EP	Total Exports	Total Output
Agricultural, forestry and fishing products	0	5	5	2,564	68,951
Electricity, gas, water, mining products	1,649	0	1,649	6,675	112,589
Chemicals, chem. products	699	0	699	43,094	131,322
Petroleum products	183	0	183	4,954	81,565
Plastic and non-metallic products	0	0	0	14,720	92,711
Basic metal products	0	5	5	29,555	174,918
Machinery (except electrical), transport equipment	202	2087	2,289	109,015	299,921
Electrical machinery, fabricated metal products, n.e.c.	60	549	609	48,375	163,921
Textiles, leather, wood, paper and products	0	13	13	24,125	163,343

Total Output and Export Levels for Products Purchased for Environmental Protection (EP) in Germany--Continued

(10^6 DM)

Sector	Amount Purchased as Operation and Maintenance Expenditures	Amount Purchased as Capital Expenditures	Total Amount Purchased for EP	Total Exports	Total Output
Food, beverages, tobacco	0	0	0	14,181	172,050
Environmental protection services	0	6658	6,658	0	18,874
Non-market services except environmental protection services	89	482	571	536	368,324
Construction	0	407	407	7,207	197,578
Trade, transport, and communication services	10,038	0	11,461*	40,312	343,736
Other market services except environmental protection services	0	0	0	10,785	508,510
TOTAL INTERMEDIATE INPUTS	12,920	10206	24,549	356,098	2,898,313
Imported products	490	261	751	---	---
Non-deductible value added tax	112	924	1,036	---	---
Consumption of fixed capital	2,246	0	2,246	---	---
Compensation of employees	1,795	0	1,795	---	---
Property and entrepreneurial income	0	0	0	---	---
GRAND TOTAL	17,563	11,391	30,377	356,098	2,898,313

*Includes 1,423 general government consumption expenditures for environmental protection.

Source: Schäfer and Stahmer (1989), pp. 210-211.