

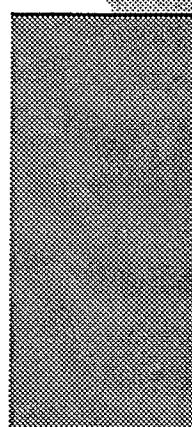
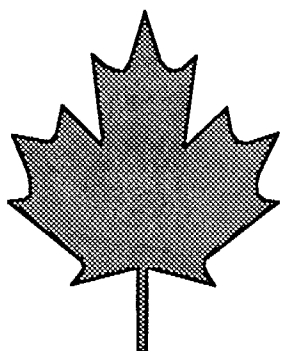
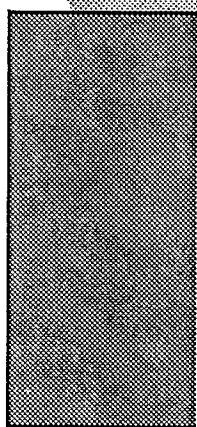
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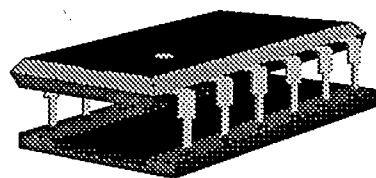
Market Intelligence

Electronic Components

Imports.



ICTM Branch



FOREWORD

The semiconductor industry is increasingly becoming a prominent presence in international trade as the world continues to advance rapidly in the field of electronics. Computers, telecommunications devices, industrial and transportation machinery, and military hardware are among the many electronic products in which semiconductors play an integral role. Therefore, new products and services developed by international electronic companies depend heavily on how efficiently leading-edge and cost-effective semiconductor devices are made available. Semiconductor producers spend significant amounts on R&D to reduce production costs and shorten the time-to-market of new products.

As the United States and Japan continue to lead the world in semiconductor production, Canadian imports of such devices outweighs its export counterpart. This report provides statistical analysis of Canadian imports of Monolithic Integrated Circuits, Diodes/Transistors, Printed Circuits, and other electronic circuit components within the 1990 to 1995 period. Professionals interested in Canada's position in the global semiconductor marketplace will find this overview an informative resource.

This report on import trends of selected electronic components includes a summary of the most significant semiconductor devices and components imported into Canada. Also included is an analysis and graphical summary of the major import trends occurring in the period 1991-1995.

The author acknowledges the contribution of Statistics Canada in the production of this report. Accurate and timely statistical information could not be produced without their co-operation. The following individuals have made invaluable contributions to the production of this statistical analysis in electronic components:

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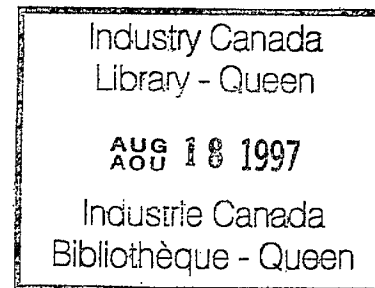
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HS CODES

- 8542 Monolithic Integrated Circuits
 - Unmounted Chips, Dies, or Wafers
 - Bipolar
 - Microprocessors
 - BiCMOS
 - EEPROM/EPROM
 - MOS RAM FET
- 8541 Diodes/Transistors
 - Diodes, Other than Photosensitive or Light Emitting Diode (LED)
 - Transistors, Other than Photosensitive
- 8534 Printed Circuits
 - Glass Bass
- 8532 Electrical Capacitors
 - Electrical Capacitors
 - Ceramic
 - Tantalum
- 8533 Electrical Resistors
 - Electrical Resistors
 - Carbon
- 8536 Electrical Apparatus for Switching
 - Fuses, Breakers, Overloads, and Protective
 - Relays, Less than 10 Amps
 - Coaxial Connectors For a Voltage Not Exceeding 1000 Volts
 - Printed Circuit Connectors

DEFINITIONS, ACRONYMS

BiCMOS - A process technology that is a combination of bipolar and CMOS transistors

Bipolar - A semiconductor process technology in which both P and N type junctions are utilized.

CAGR - Compounded Average Growth Rate

CMOS - Complementary Metal Oxide Semiconductor

Coaxial Connectors - Connectors used for high frequency signals.

Dies - Silicon area of device.

Diodes - used as a rectifier and detector in electronic circuits

Discrete - an individually packaged semiconductor circuit component.

EEPROM/EPROM - Electrically/Erasable Programmable Read-Only Memory

Electrical Capacitors - a device which stores electric charge.

Ceramic, Tantalum - Capacitors consist in principle of two conducting surfaces separated by an insulating material (commonly they come in fixed, variable or adjustable configurations).

Electrical Resistors - component that opposes the flow of either direct or alternating current.

Carbon - a popular resistance material

FET - Field-Effect Transistor

Hybrid - special packaging arrangements of either a combination of ICs or ICs with the addition of discrete components.

HS Code - "Harmonized System" is a commodity classification used globally. This is a six digit root number assigned to commodity classes.

Integrated Circuit (IC) - combinations of two or more semiconductor components.

Microprocessors - an IC functional class which combines logic with memory.

Monolithic Integrated Circuits - all circuits are on the same die.

MOS - Metal Oxide Semiconductor

RAM - Random Access Memory

Printed Circuits - structures on which multiple electronic components are soldered and used in electronic equipment.

PCBs - printed circuit boards

Printed Circuit Connectors - Connectors tie up to the outside world of voltage, grounds, input and output signals.

Transistors - a device which amplifies, controls, and generates electronic signals.

Unmounted Chips - chip or die which is ready for packaging.

Wafers - base to which ICs are fabricated (commonly silicon wafers).

INTRODUCTION

Introduction to Semiconductors

Semiconductor devices are electronic circuit components or combinations of these components produced within or on a crystal able to regulate the flow of electrons. There are three varieties of semiconductor devices: 1) discretes, 2) integrated circuits (ICs), and 3) hybrids. Discretes are commonly soldered along with other electronic components on printed circuit boards (PCBs). The most common device is the IC - a union of two or more semiconductor components that are frequently joined with other electronic components grouped on a single piece of silicon or other similar substrate. ICs are indexed according to whether they process electronic signals in a digital or an analog manner or combine these two methods of processing. Hybrids are special packaging arrangements of either a combination of ICs or ICs added with discrete components.

ICs are fabricated using metal oxide semiconductor (MOS) or bipolar technologies. In 1992, approximately 78 percent of the value of the world's IC production was attributed to MOS technologies and only about 19 percent of this value was based on bipolar technologies. MOS became favored in IC construction as techniques were exacted to manufacture these devices. Production of MOS ICs can be completed in fewer processing steps than bipolar semiconductors and with a higher density, thus having notably lower production costs. MOS technologies are used for parts of the device that are more sensitive to heat buildup; for example, in such portable electronic equipment applications as laptop computers and portable telecommunication devices which have increased in number during the past two decades.

The Semiconductor Industry

Semiconductors can be divided into two groups: commodity and noncommodity. Commodity semiconductors include devices that compete mainly on cost, exist in relatively large markets, and are based on technological know-how that is available to major manufacturers in the industry. Most discrete devices, logic circuits and memory ICs are encompassed in the commodity category. Noncommodity semiconductors have greater profit margins and involve specialized devices existing in smaller markets. Noncommodities exist based primarily on a producer or a small number of producers having patent protection on a particular semiconductor device, or the technological know-how is not readily available to most manufacturers.

Price, performance, availability, and quality are the chief marketing factors of semiconductor devices, with price considered as the principal factor, specifically for commodity products. For noncommodity products, price is less of a consideration, and consumers must often rely on only one or a few sources of supply. It is imperative that semiconductor companies invest in R&D in order to preserve their competitiveness since leading-edge products always boost sales for an innovative company and are crucial to maintaining international competitiveness.

Canadian Semiconductor Industry Activity

International trade and the specialization of production are key characteristics which define the information technology industry in Canada and the substantial role electronic components play as an enabler of the IT industry. The level of Canadian semiconductor consumption and its level of integration with the communications equipment industry help to demonstrate the feasibility of locating a major semiconductor foundry in Canada. Canadian companies involved in communications equipment play a major role in niche market segments, firms such as Nortel, MITEL, and Newbridge Networks. There are currently over 50 companies engaged in microelectronic-related activities in Canada. The large amount of imports into Canada reflects not only the willingness of the Canadian economy to trade, but also that Canadian companies are involved significantly in research and development of leading-edge products and technologies in order to stay competitive in the international market. 7.6% of Canada's 1995 gross domestic product (GDP) was attributed to information technology at factor cost, compared to 5.5% in 1990. Information technology also employs nearly 3% of total Canadian employment, a workforce of 308,000.

Statistical Overview

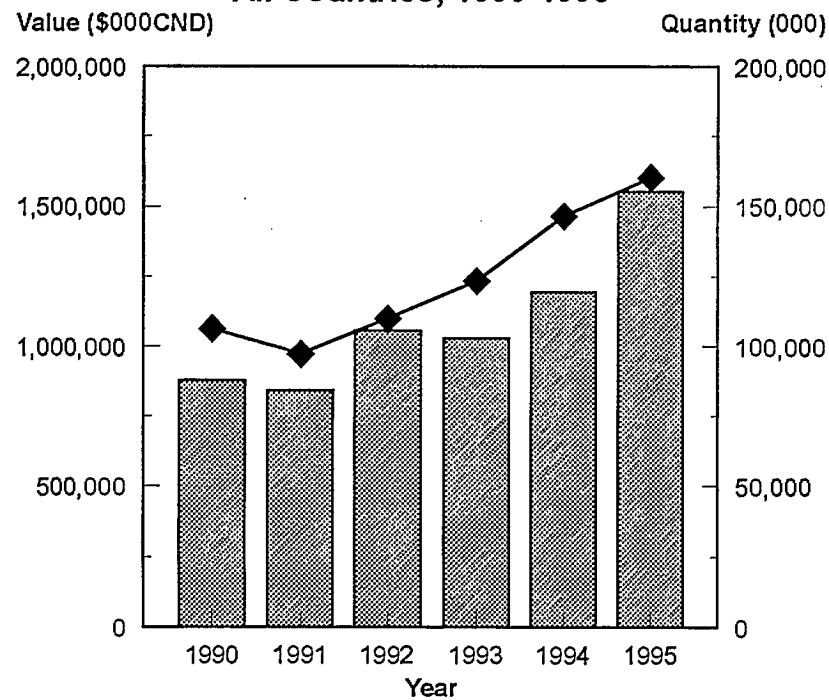
The import statistics presented in this report are divided into HS Codes, and further divided into individual items or groups of items. The statistics are also separated into totals of imports from all countries and those from the United States, the largest exporter to Canada in value and quantity, from 1990 to 1995. Also provided is an analysis of these two sets of statistics regarding the percent change in total value and quantity within the specified time period, the quantity to value ratio, and the value and quantity as a percent of total HS Code value and quantity.

OVERVIEW - UNMOUNTED CHIPS, DIES, OR WAFERS

Included in this analysis are chips or dies ready for packaging (unmounted chips), the silicon area of the semiconductor device (dies), and the bases to which ICs are fabricated (wafers). Quantity and value of these items have increased steadily over the 5 year period as the CAGR paired with the quantity-value ratios show. The one outstanding trend shown in these statistics is the steady decline of the percentage of the value of these items encompassed in the total value of HS 8542 imports. The quantity aspect of this particular analysis is decreasing over the time period as well; however, not as dramatically as its value counterpart.

Monolithic Integrated Circuits **Unmounted Chips, Dies, or Wafers** **HS Code 8542**

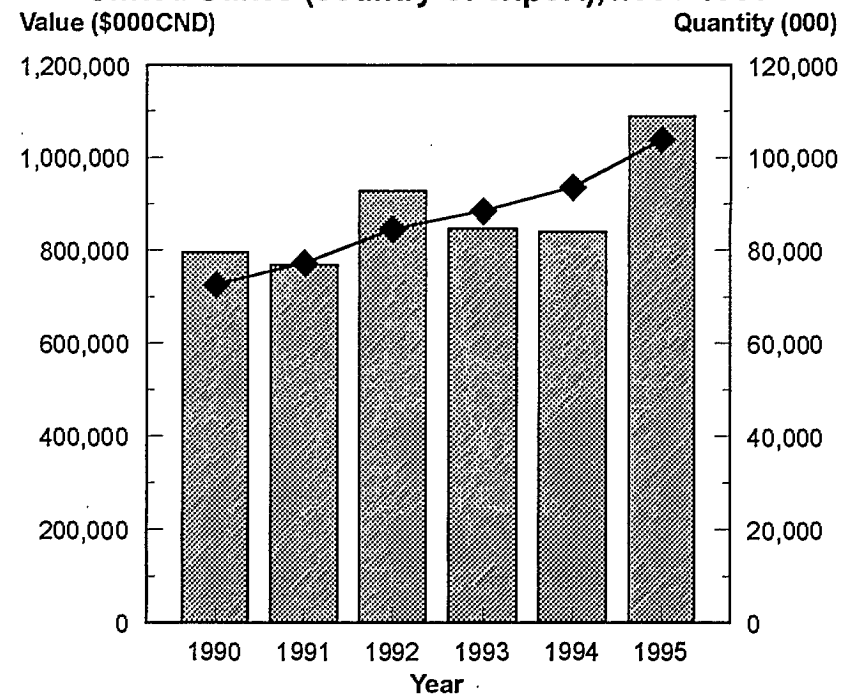
**Figure 1-1. Total Value and Quantity of Imports
All Countries, 1990-1995**



Value Quantity

Value: CAGR = 10.0%
 mean = \$1,090,748 thousand
 std. dev. = 236,778 thousand

**Figure 1-2. Total Value and Quantity of Imports
United States (country of export), 1990-1995**



Value Quantity

Value: CAGR = 5.4%
 mean = \$877,746 thousand
 std. dev. = 106,105 thousand

Monolithic Integrated Circuits Unmounted Chips, Dies, or Wafers All Countries, 1990-1995 HS Code 8542

Figure 1-3. Percent Change in Total Value and Quantity of Imports

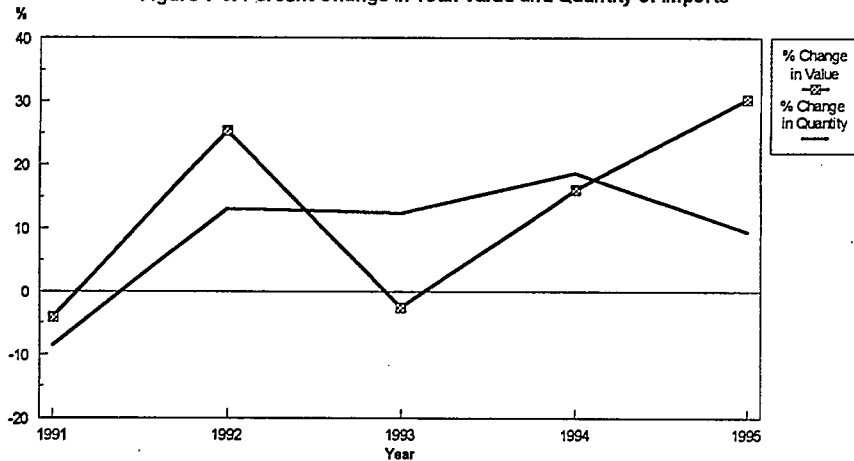


Figure 1-4. Quantity to Value Ratio

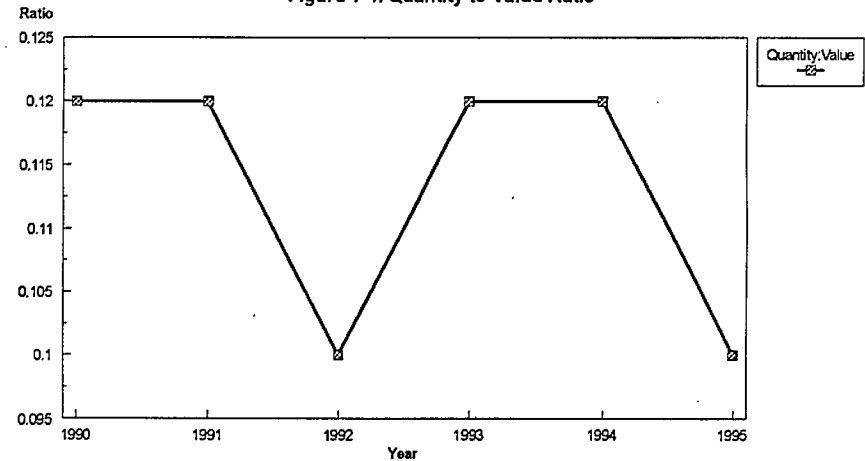
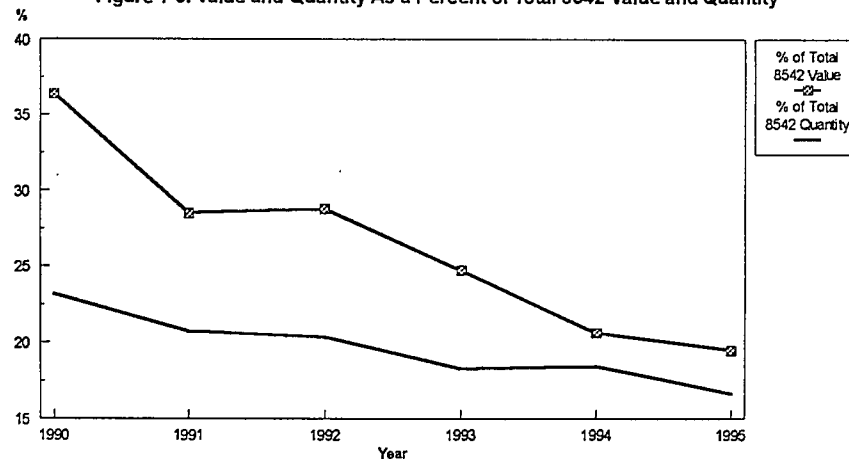


Figure 1-5. Value and Quantity As a Percent of Total 8542 Value and Quantity



Monolithic Integrated Circuits **Unmounted Chips, Dies, or Wafers** **United States, 1990-1995** **HS Code 8542**

Figure 1-6. Percent Change in Total Value and Quantity of Imports

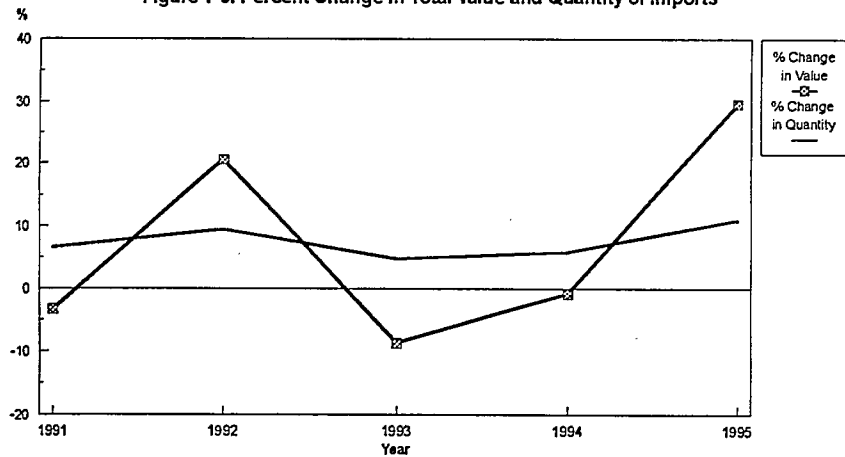
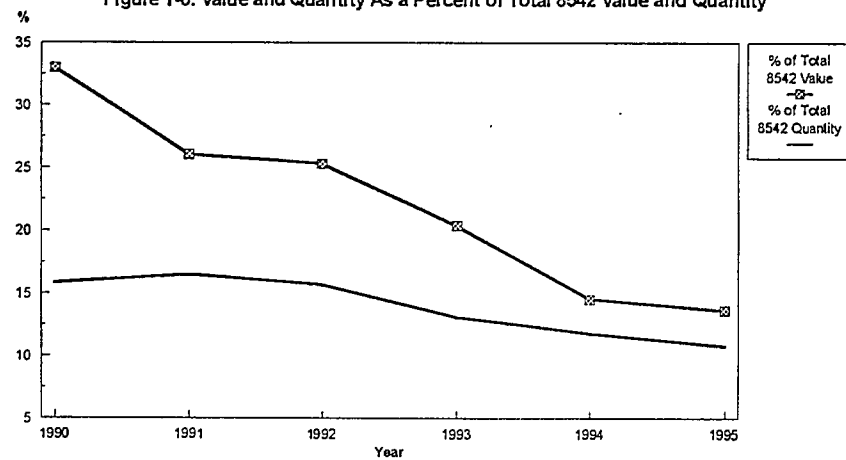


Figure 1-7. Quantity to Value Ratio



Figure 1-8. Value and Quantity As a Percent of Total 8542 Value and Quantity



OVERVIEW - BIPOLAR

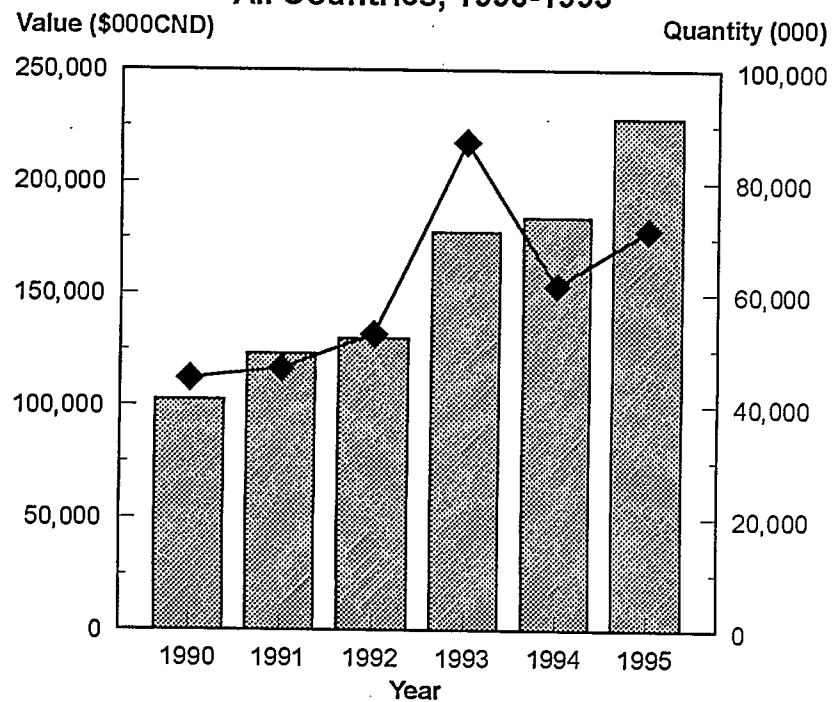
Bipolar is a semiconductor process technology in which both P and N type junctions are utilized. The total value of imported bipolar semiconductors from all countries has increased steadily over the designated time period; however, the opposite has occurred with imports of these devices from the United States. The quantity statistics follow the same pattern for all countries (increase) and the United States (decrease) with a salient number for 1993 in both sets of statistics. The value and quantity as a percent of total HS 8542 value and quantity for all countries has not fluctuated significantly with the exception of 1993, though the same statistics for imports from the United States has declined. It is anticipated the trends established in figure 2-1 to continue for the next several years.

Monolithic Integrated Circuits

BIPOLAR

HS Code 8542

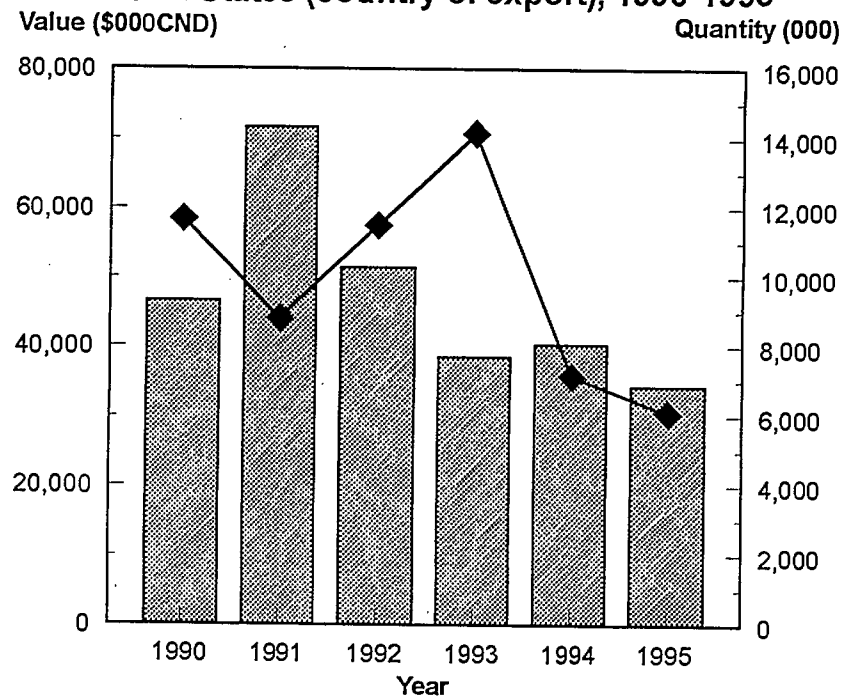
**Figure 2-1. Total Value and Quantity of Imports
All Countries, 1990-1995**



Value Quantity

Value: CAGR = 14.3%
 mean = \$157,468 thousand
 std. dev. = 43,097 thousand

**Figure 2-2. Total Value and Quantity of Imports
United States (country of export), 1990-1995**



Value Quantity

Value: CAGR = -5.0%
 mean = \$47,094 thousand
 std. dev. = 12,266 thousand

Monolithic Integrated Circuits

BIPOLAR

All Countries, 1990-1995

HS Code 8542

Figure 2-3. Percent Change in Total Value and Quantity of Imports

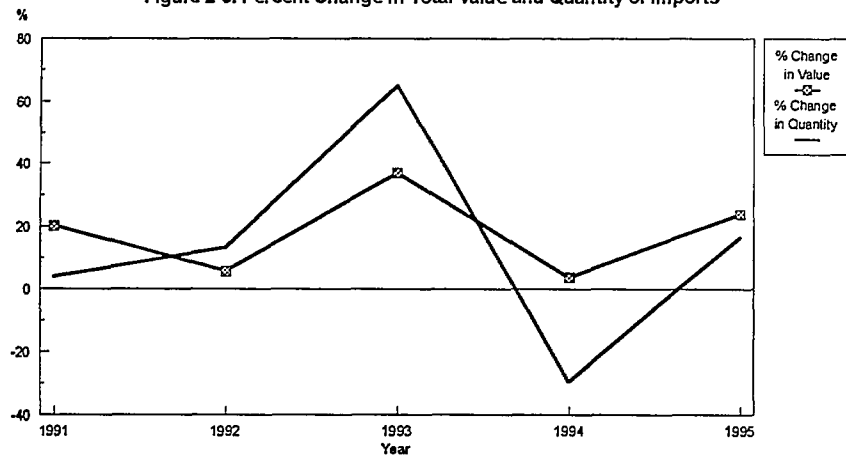


Figure 2-4. Quantity to Value Ratio

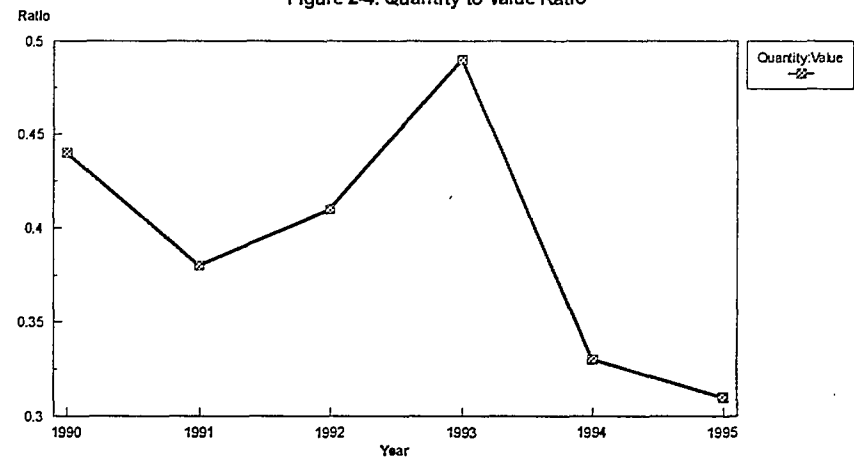
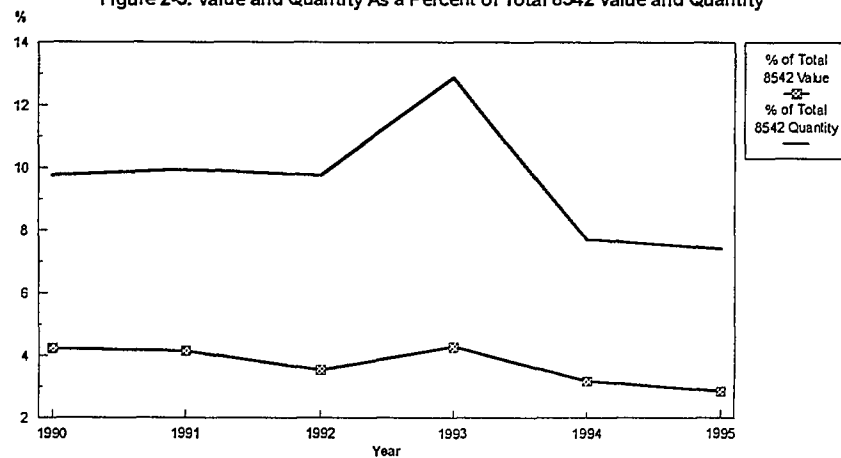


Figure 2-5. Value and Quantity As a Percent of Total 8542 Value and Quantity



Monolithic Integrated Circuits

BIPOLAR

United States, 1990-1995

HS Code 8542

Figure 2-6. Percent Change in Total Value and Quantity of Imports

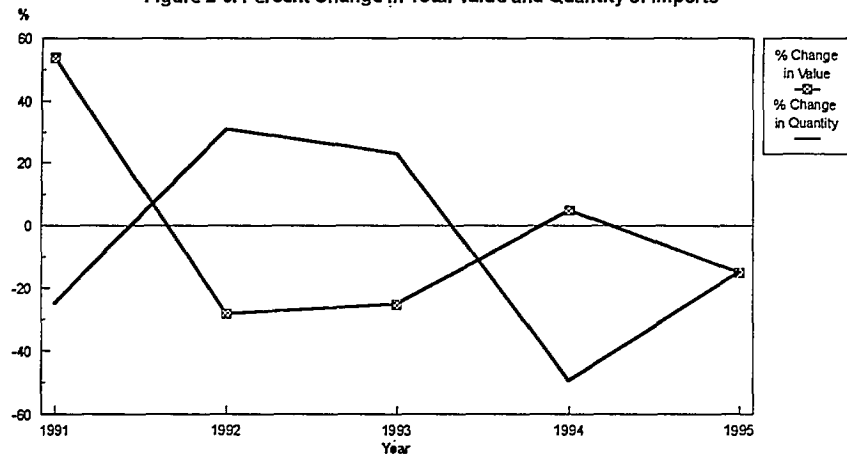


Figure 2-7. Quantity to Value Ratio

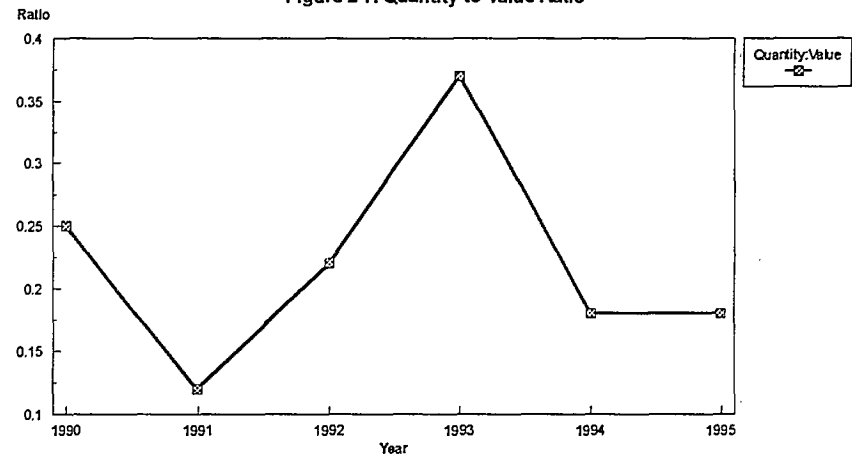
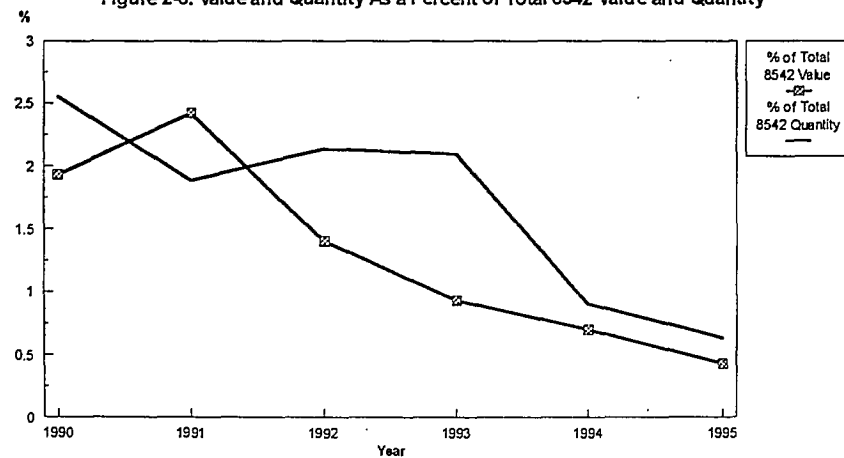


Figure 2-8. Value and Quantity As a Percent of Total 8542 Value and Quantity



OVERVIEW - MICROPROCESSORS

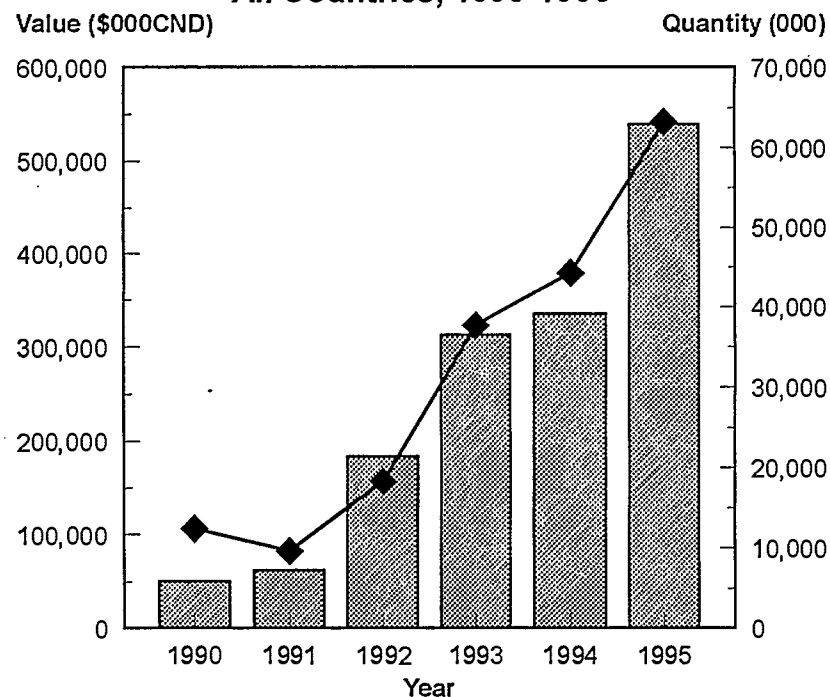
Integrated Circuits (ICs) function either by logic or memory circuits. An IC combining these two functions is generally classified as a microprocessor. Growth is the main theme of microprocessor imports into Canada from all countries. During the five year period, both the value and quantity of these imports grew both in number as well as in percent of total HS 8542 value and quantity. The imports from the U.S. did not experience the same growth pattern, growing sharply from 1991 to 1992, but falling off steadily from 1993 to 1995. The same model remained consistent in the U.S. value and quantity percent of total HS 8542 value and quantity.

The quantity to value ratio shows that the computer equipment industry is becoming an integral part of the Canadian manufacturing output with manufacturing shipment showing a consistent increase between 1990 to 1995. The complexity of microprocessors accounts for the fact that quantity to value ratios are becoming a constant and larger bus and addressing capabilities do not necessarily result in higher prices when a new generation of computers and peripherals appears. The following graphs depict important levels for MOS microprocessors only.

Microprocessors are the third largest group of semiconductors imported into Canada and it is forecast that the market for these devices will see strong growth in Canada until year 2000. In 1994, MOS microprocessors accounted for 5.5% of all semiconductor imports while all microprocessors were responsible for 9.4% of total imports in HS 8541 and 8542.

Monolithic Integrated Circuits **Microprocessors** **HS Code 8542**

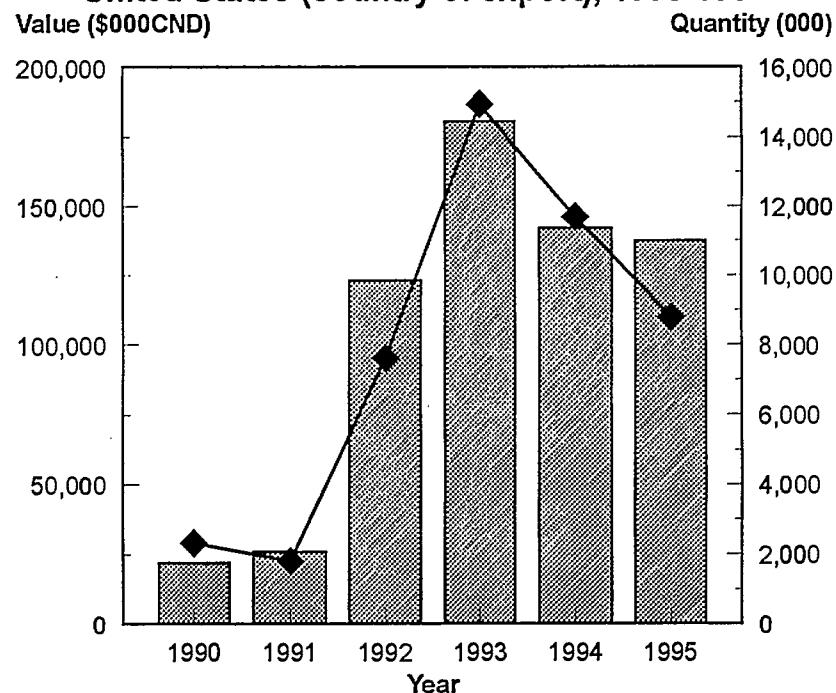
**Figure 3-1. Total Value and Quantity of Imports
All Countries, 1990-1995**



Value Quantity

Value: CAGR = 48.6%
 mean = \$247,008 thousand
 std. dev. = 170,610 thousand

**Figure 3-2. Total Value and Quantity of Imports
United States (country of export), 1990-1995**



Value Quantity

Value: CAGR = 35.7%
 mean = \$105,136 thousand
 std. dev. = 60,041 thousand

Monolithic Integrated Circuits Microprocessors All Countries, 1990-1995 HS Code 8542

Figure 3-3. Percent Change in Total Value and Quantity of Imports

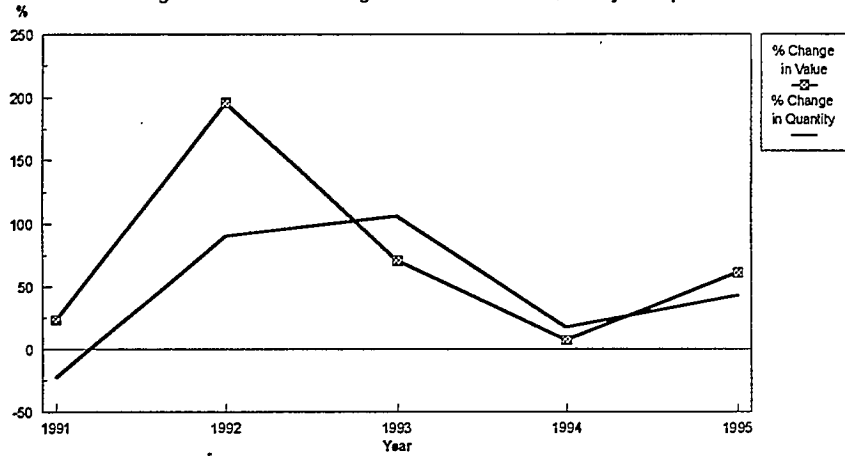


Figure 3-4. Quantity to Value Ratio

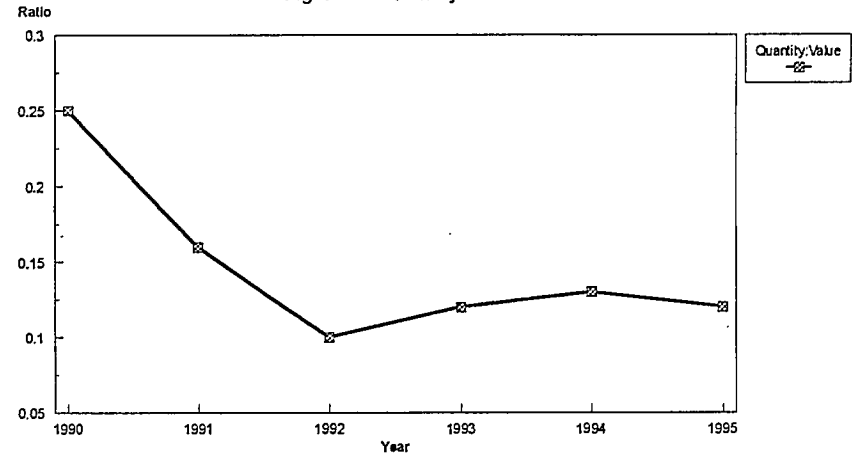
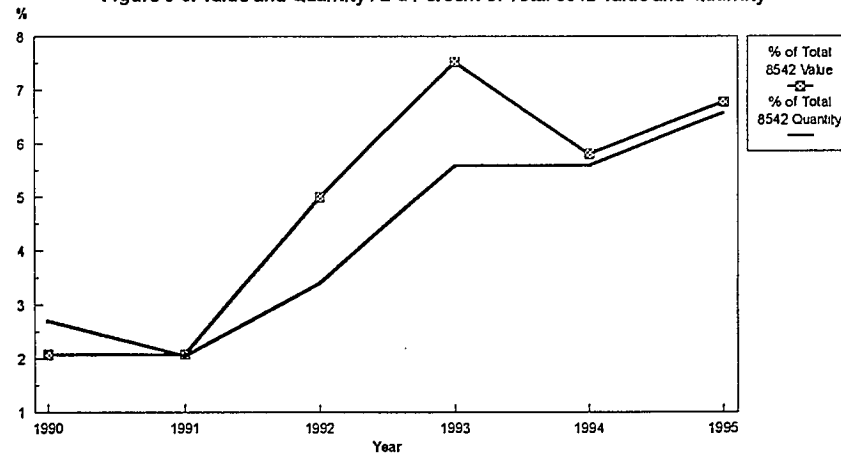


Figure 3-5. Value and Quantity As a Percent of Total 8542 Value and Quantity



Monolithic Integrated Circuits

Microprocessors

United States, 1990-1995

HS Code 8542

Figure 3-6. Percent Change in Total Value and Quantity of Imports

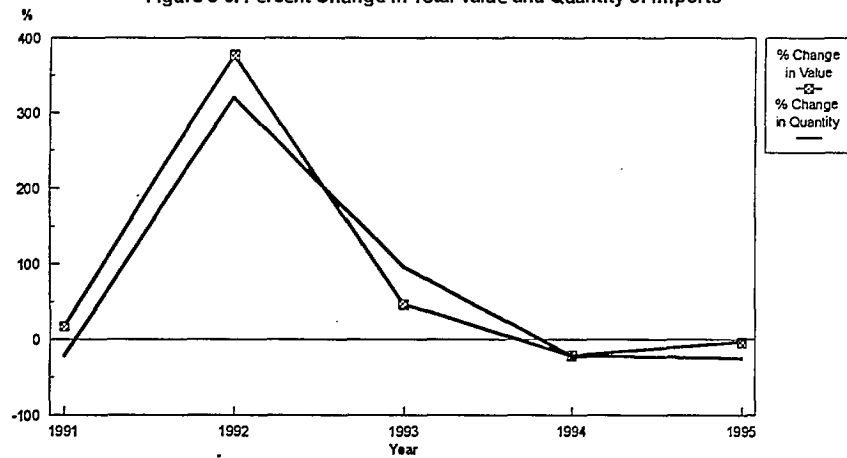


Figure 3-7. Quantity to Value Ratio

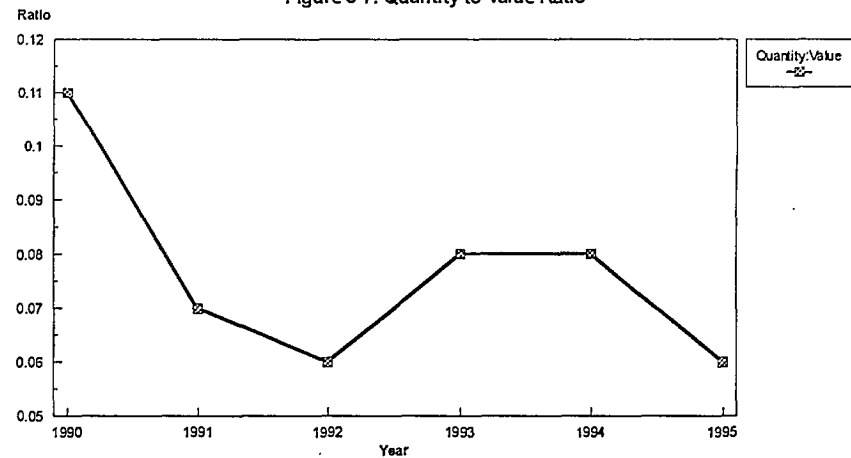
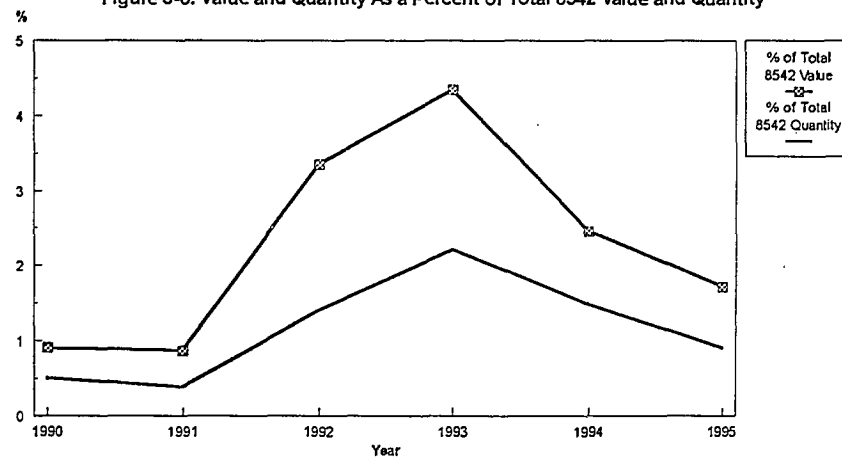


Figure 3-8. Value and Quantity As a Percent of Total 8542 Value and Quantity



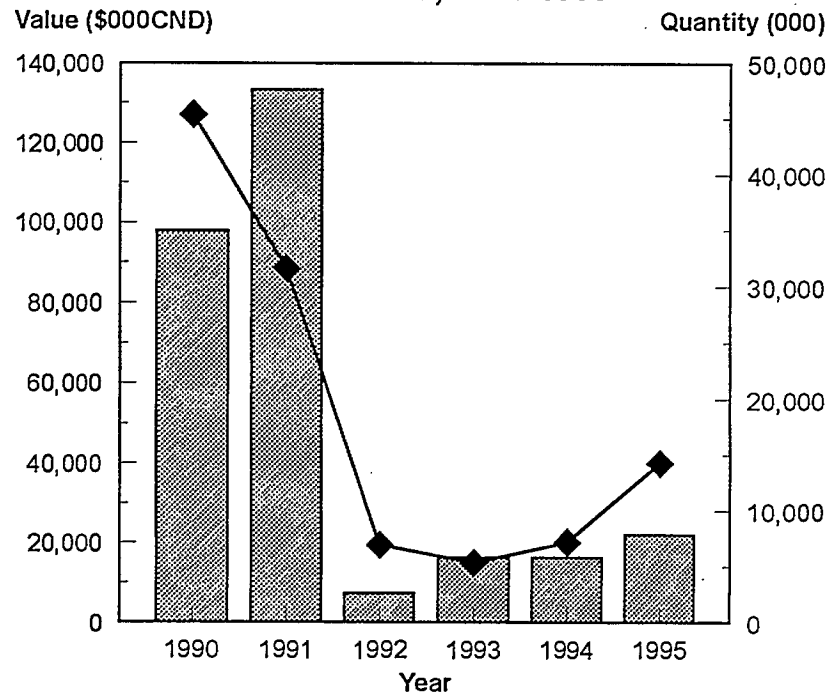
OVERVIEW - BiCMOS

BiCMOS combines the technology of bipolar and CMOS transistors. Although BiCMOS is more complex and achieves greater effectiveness than plain CMOS, it will likely never attain more than 4-7% of the integrated circuit market according to Electronic Trend Publications. There is a strong capability in Canada to design and manufacture BiCMOS circuits and this product will continue to be of interest to the Canadian communications equipment industry. The main reason for its lack of significant market penetration is due to its increased price to manufacture since production involves more steps. This explains the major drop in value and quantity of BiCMOS imports to Canada over the last few years from all exporting countries including the United States. The analysis of both sets of statistics regarding percent change in total value and quantity and the quantity to value ratio appears irregular. The fall in value and quantity is equally reflected in its percentage to total HS 8542 value and quantity.

BiCMOS components will feel increasing pressure from new CMOS designs which are effectively displacing previous BiCMOS niche markets such as RF Baseband circuits.

Monolithic Integrated Circuits BiCMOS HS Code 8542

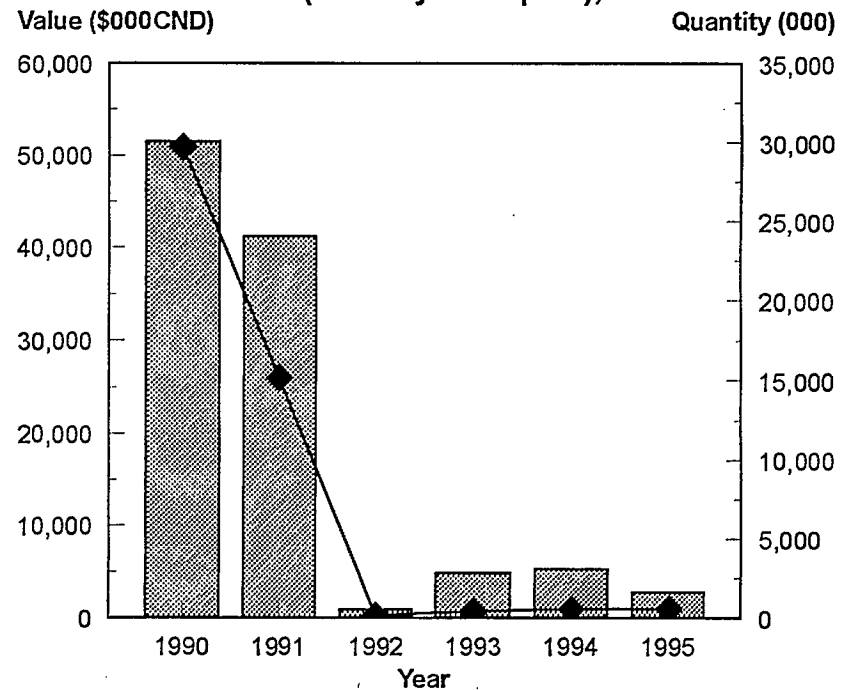
**Figure 4-1. Total Value and Quantity of Imports
All Countries, 1990-1995**



Value Quantity

Value: CAGR = -22.0%
 mean = \$48,804 thousand
 std. dev. = 48,520 thousand

**Figure 4-2. Total Value and Quantity of Imports
United States (country of export), 1990-1995**



Value Quantity

Value: CAGR = -38.5%
 mean = \$17,759 thousand
 std. dev. = 20,504 thousand

Monolithic Integrated Circuits BiCMOS

All Countries, 1990-1995
HS Code 8542

Figure 4-3. Percent Change in Total Value and Quantity of Imports

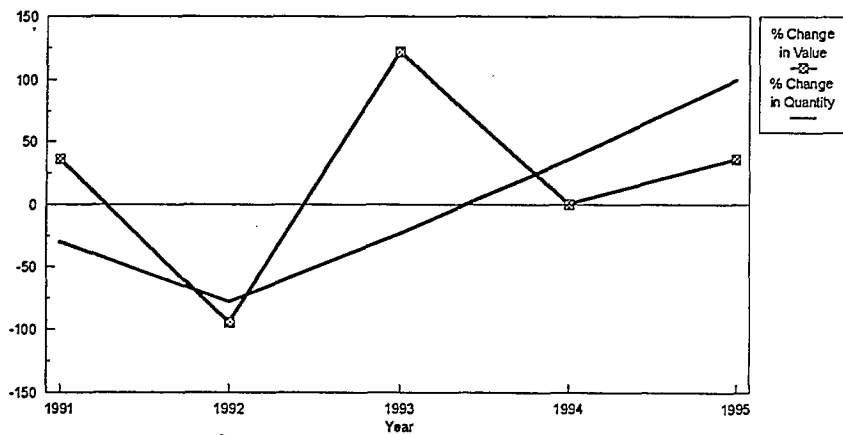


Figure 4-4. Quantity to Value Ratio

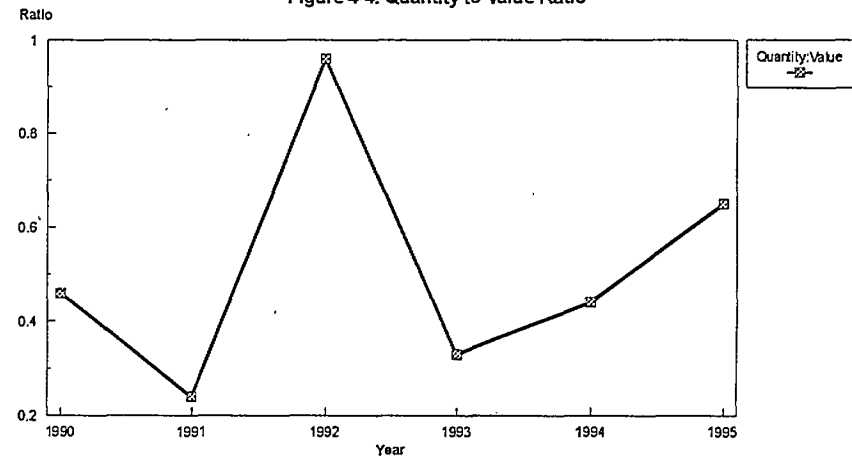
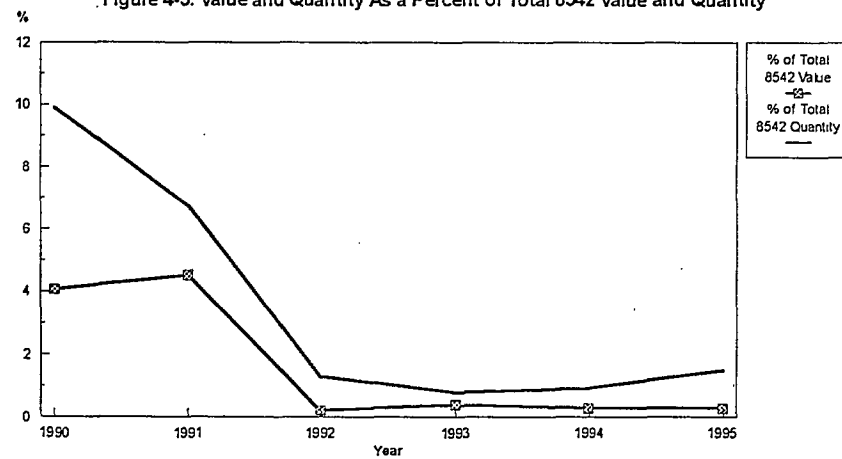


Figure 4-5. Value and Quantity As a Percent of Total 8542 Value and Quantity



Monolithic Integrated Circuits BiCMOS

United States, 1990-1995

HS Code 8542

Figure 4-6. Percent Change in Total Value and Quantity of Imports

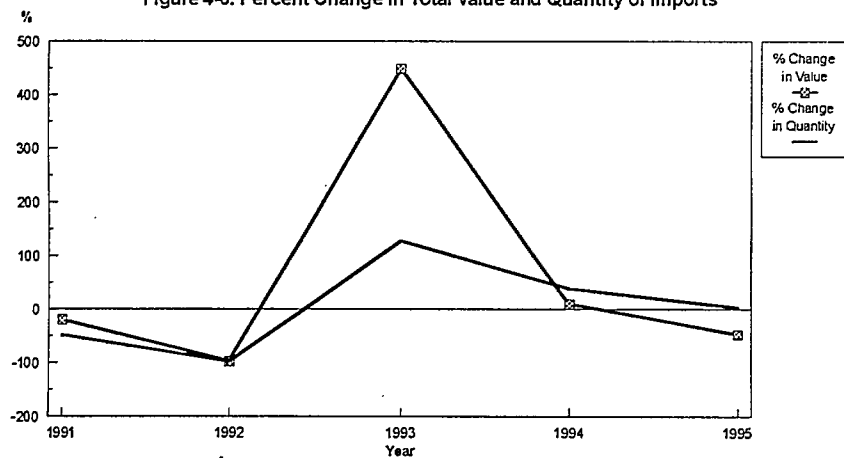


Figure 4-7. Quantity to Value Ratio

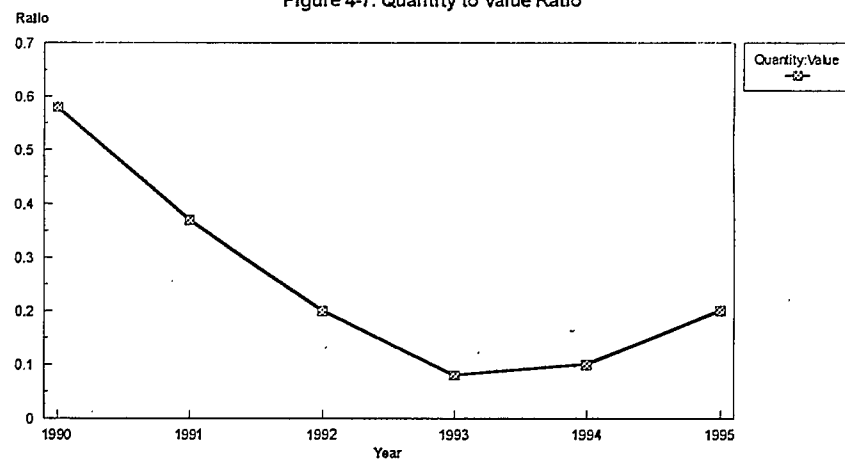


Figure 4-8. Value and Quantity As a Percent of Total 8542 Value and Quantity

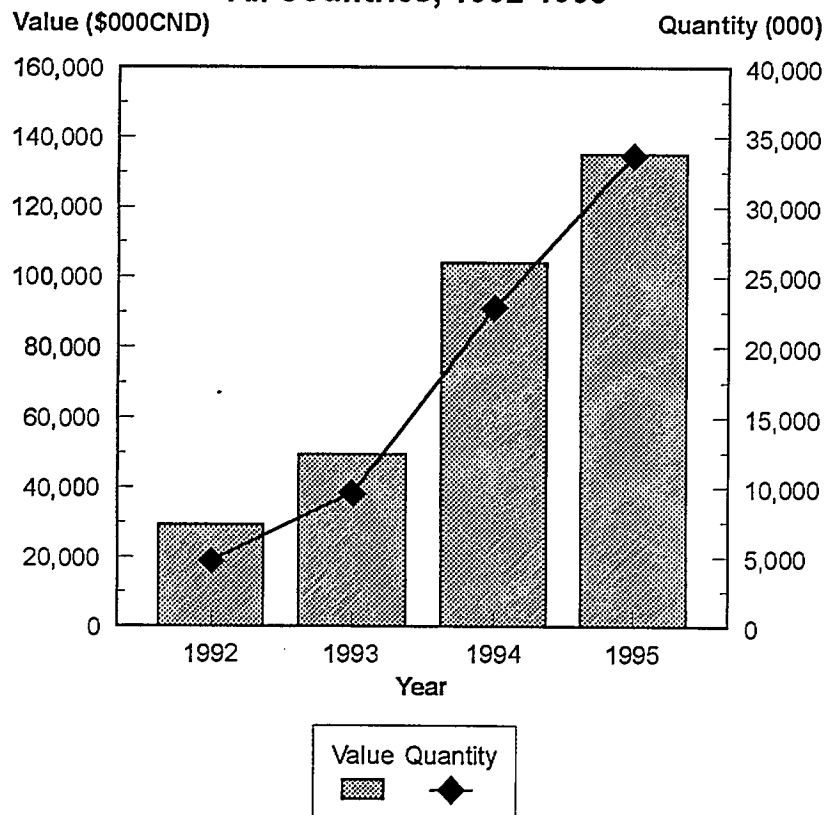


OVERVIEW - EEPROM/EPROM

An item under HS 8542 which has been consistently growing in import numbers from all countries and the United States is EEPROM/EPROM (Electrically/Erasable Programmable Read-Only Memory). Although it slowed in its rate of growth over the 1992 to 1995 term, the rise in number of EEPROM/EPROM imports was enough to increase its position amongst other HS 8542 items. An increase in the value and quantity of EEPROM/EPROM as a percent of total HS 8542 value and quantity may be apparent, however EEPROM/EPROM value does not exceed 4% of the total HS 85425 value from all countries throughout the time period, and does not break the .25% level from the U.S., and quantity less than 2% from all countries and under .25% from the U.S.

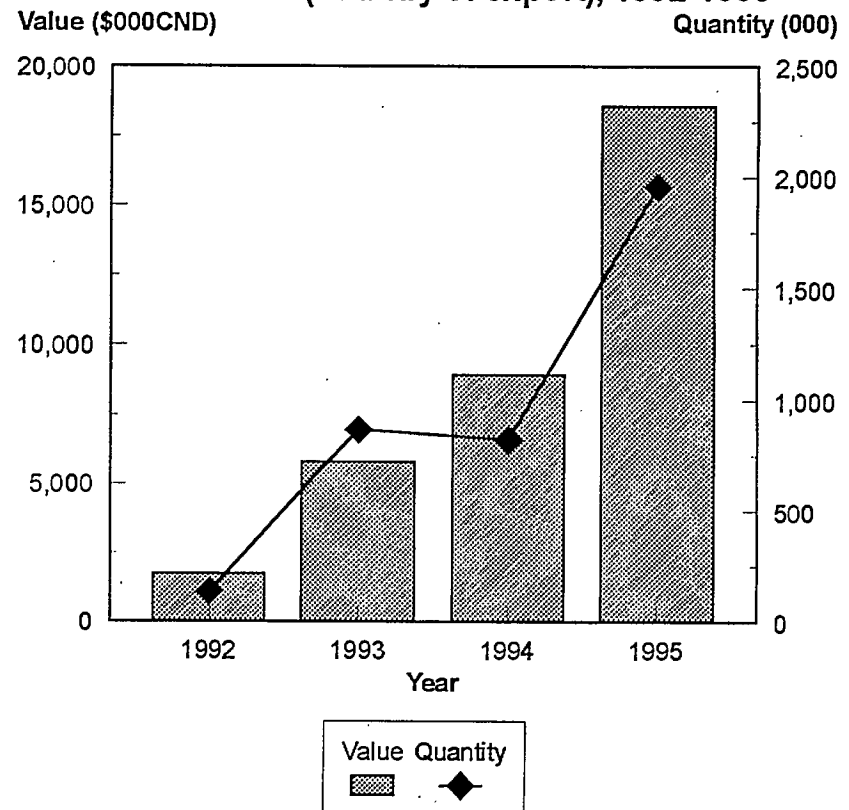
Monolithic Integrated Circuits EEPROM/EPROM HS Code 8542

**Figure 5-1. Total Value and Quantity of Imports
All Countries, 1992-1995**



Value: CAGR = 46.4%
 mean = \$79,469 thousand
 std. dev. = 42,165 thousand

**Figure 5-2. Total Value and Quantity of Imports
United States (country of export), 1992-1995**



Value: CAGR = 81.2%
 mean = \$8,750 thousand
 std. dev. = 6,218 thousand

Monolithic Integrated Circuits EEPROM/EPROM All Countries, 1992-1995 HS Code 8542

Figure 5-3. Percent Change in Total Value and Quantity of Imports

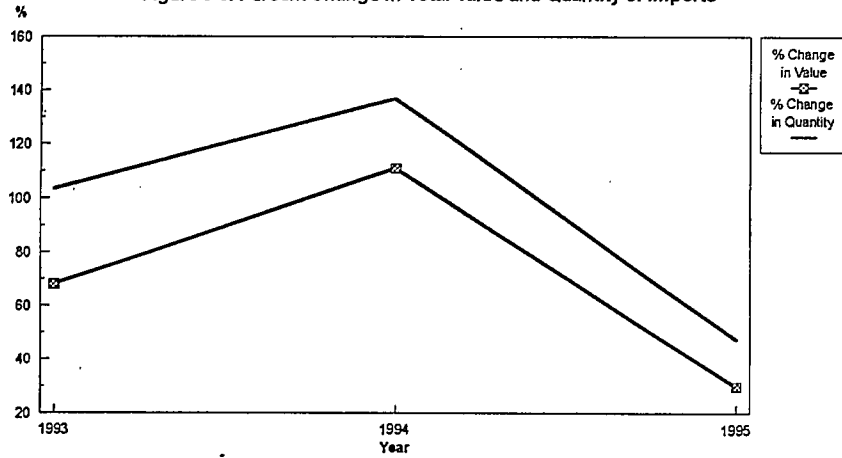


Figure 5-4. Quantity to Value Ratio

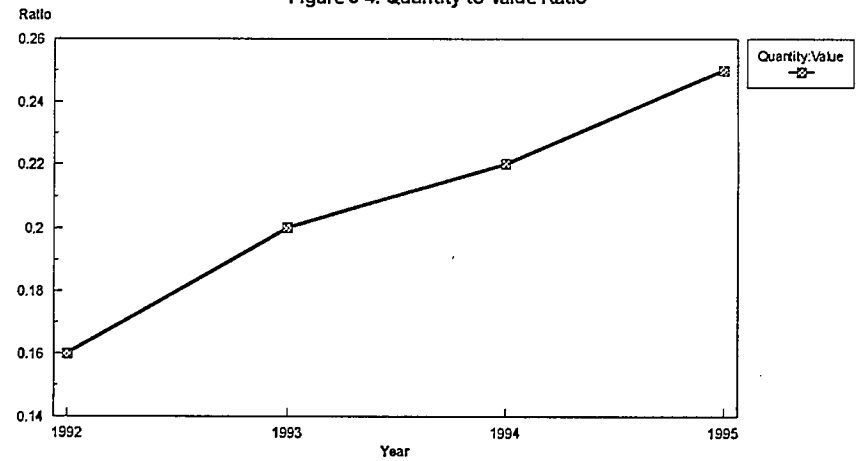
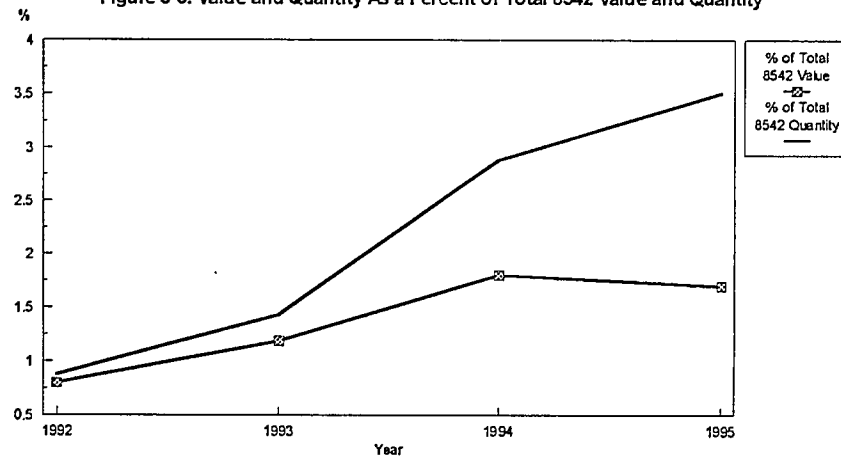


Figure 5-5. Value and Quantity As a Percent of Total 8542 Value and Quantity



Monolithic Integrated Circuits EEPROM/EPROM United States, 1992-1995 HS Code 8542

Figure 5-6. Percent Change in Total Value and Quantity of Imports

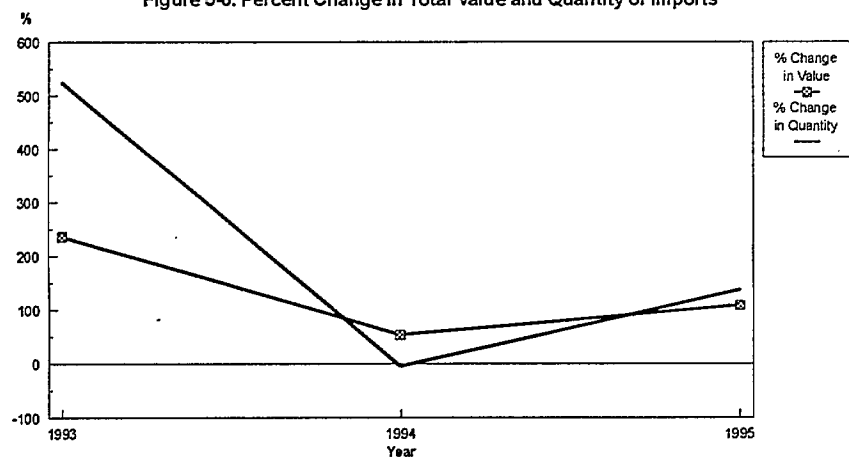


Figure 5-7. Quantity to Value Ratio

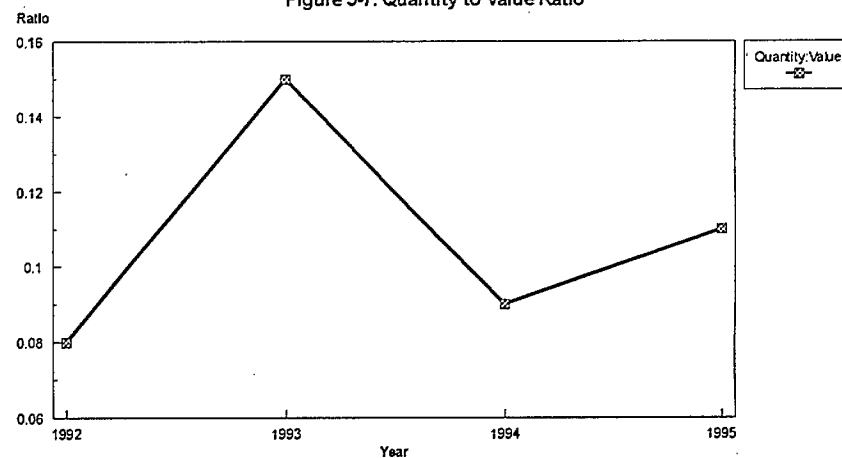
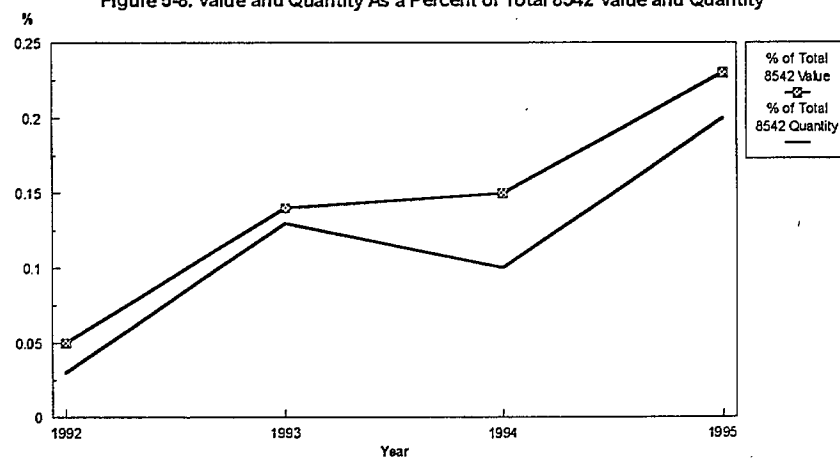


Figure 5-8. Value and Quantity As a Percent of Total 8542 Value and Quantity



OVERVIEW - MOS RAM FET

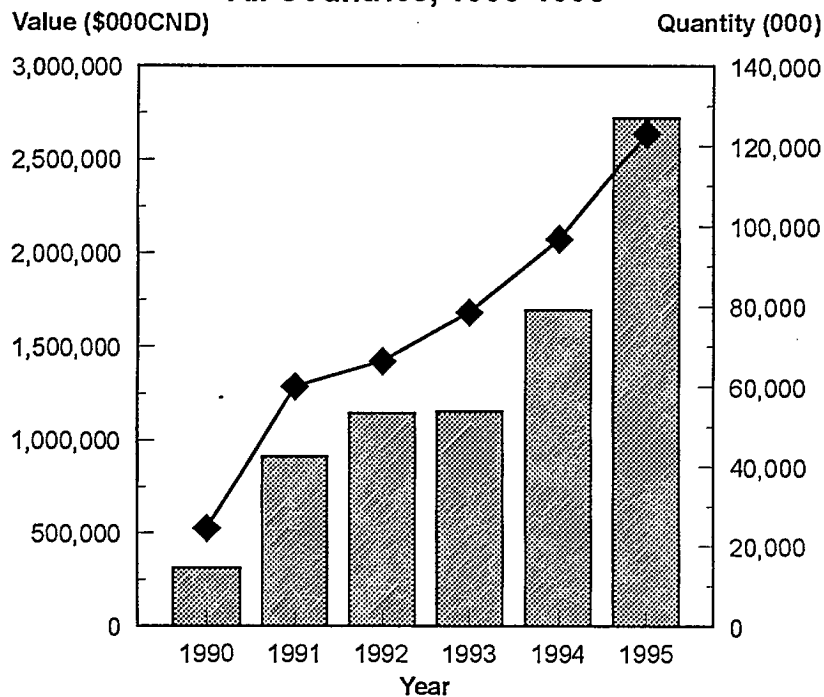
The imports of MOS RAM and FET (Metal Oxide Semiconductors, Random Access Memory, and Field-Effect Transistors, respectively) have experienced a sharp surge in 1994 and 1995 from all countries and the United States, after remaining at a relatively constant level in the previous three years. For example, the value of MOS RAM FET from all countries jumped from about \$1.25 billion in 1993 to almost \$2.75 billion in 1995, over doubling its value. The same statistics on imports from the U.S. are under \$100 million in 1993 to almost \$500 million in 1995. As expected, the percentage of total HS 8542 value and quantity that consists of MOS RAM FET also rose over the time period; however, more so from the U.S. than from all other countries.

The quantity to value ratio shows the decline in DRAM prices occurring from 1993-1995 and it is forecast that this trend will continue into 1997. The DRAM market will continue to lead the semiconductor imports category until the year 2000 and beyond. Japanese and ASEAN firms are the dominant world producers of RAM devices and they account for over 75% of the value of imported RAM devices in Canada. On a regional basis, Canadian DRAM imports in 1994 were almost exclusively to Quebec and Ontario.

MOS RAMs are a significant portion of the total HS 8542 value reflecting the high unit shipment growth rates for desktop and mobile computers and servers that has been experienced. In 1994, MOS RAM FETs accounted for 28% of all semiconductors imported in HS Codes 8541 and 8542. It is predicted that import levels in this category will continue to increase based on present economic indicators and market performance.

Monolithic Integrated Circuits **MOS RAM FET** **HS Code 8542**

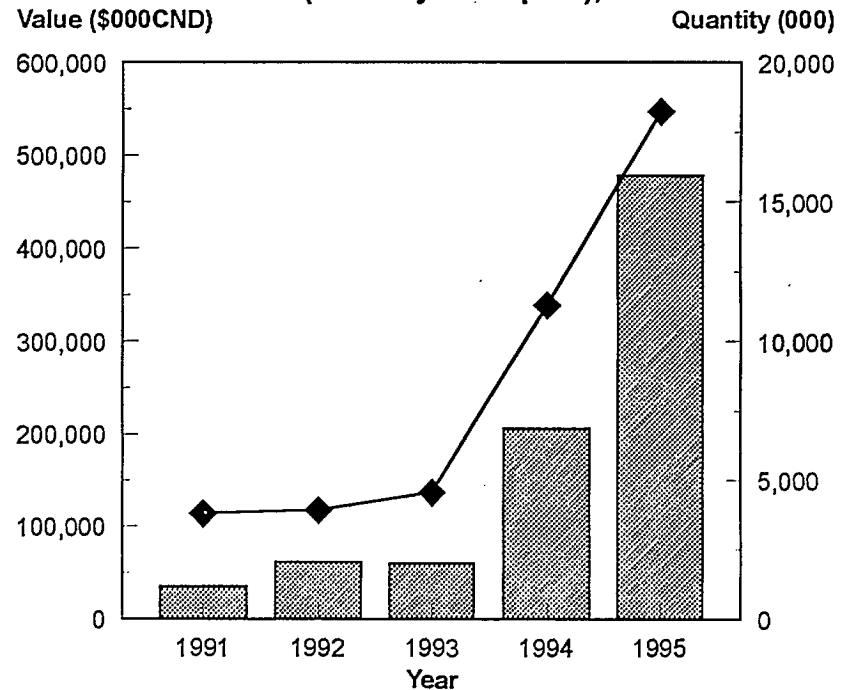
**Figure 6-1. Total Value and Quantity of Imports
All Countries, 1990-1995**



Value Quantity

Value: CAGR = 43.5%
 mean = \$1,322,548 thousand
 std. dev. = 746,558 thousand

**Figure 6-2. Total Value and Quantity of Imports
United States (country of export), 1991-1995**



Value Quantity

Value: CAGR = 69.4%
 mean = \$167,707 thousand
 std. dev. = 166,536 thousand

Monolithic Integrated Circuits

MOS RAM FET

All Countries, 1990-1995

HS Code 8542

Figure 6-3. Percent Change in Total Value and Quantity of Imports

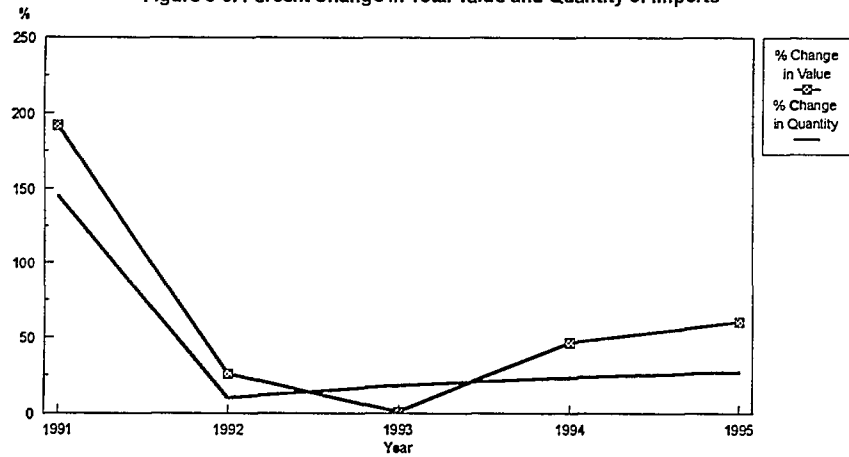


Figure 6-4. Quantity to Value Ratio

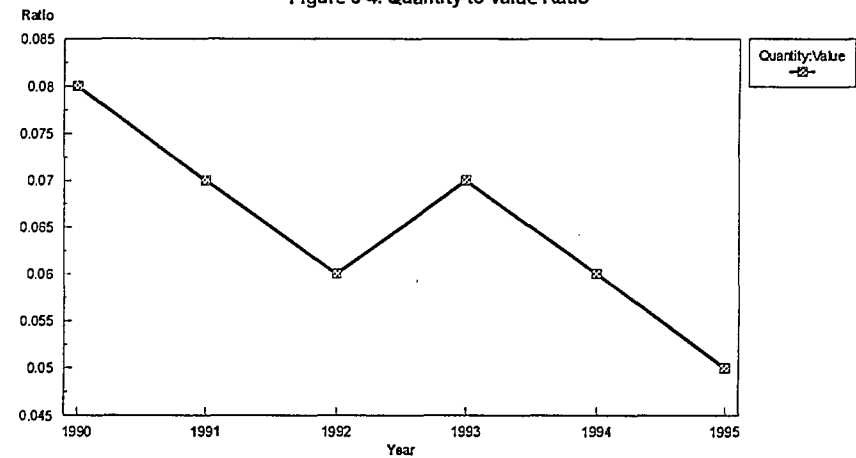
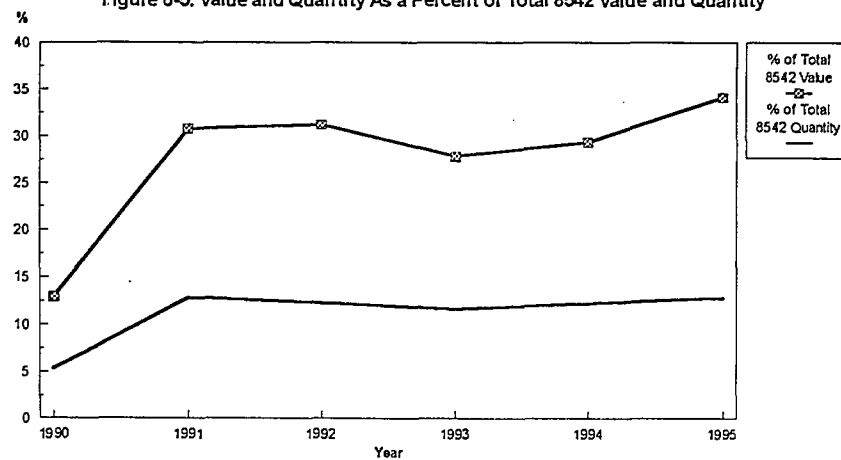


Figure 6-5. Value and Quantity As a Percent of Total 8542 Value and Quantity



Monolithic Integrated Circuits MOS RAM FET

United States, 1991-1995
HS Code 8542

Figure 6-6. Percent Change in Total Value and Quantity of Imports

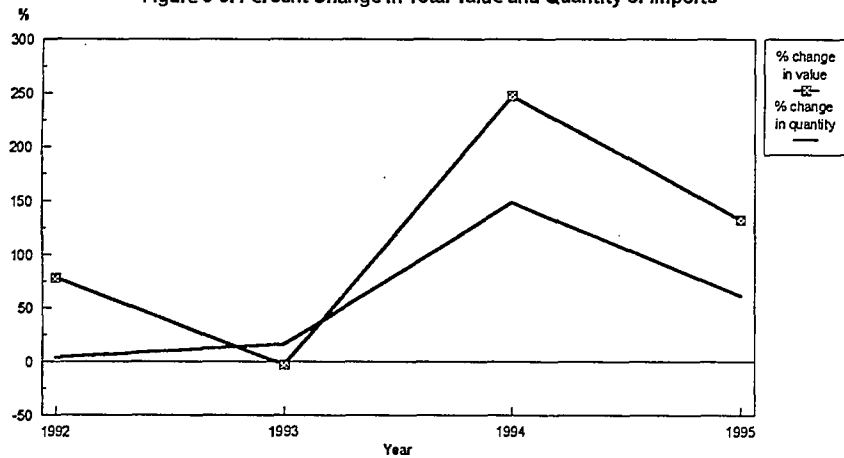


Figure 6-7. Quantity to Value Ratio

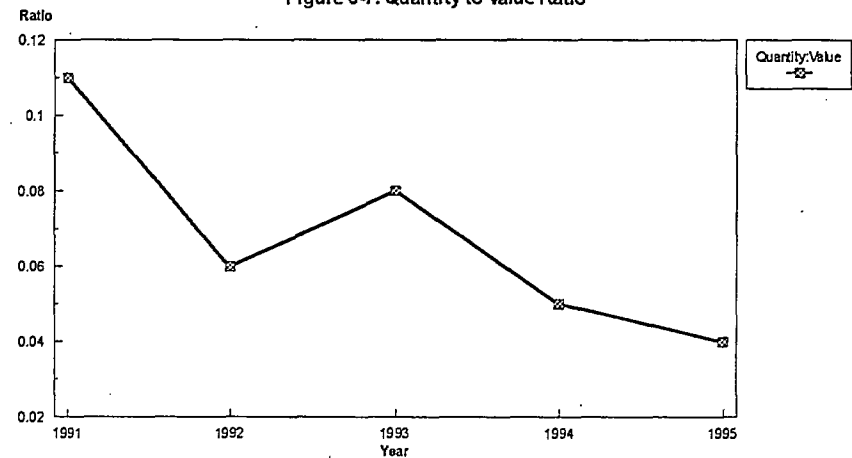
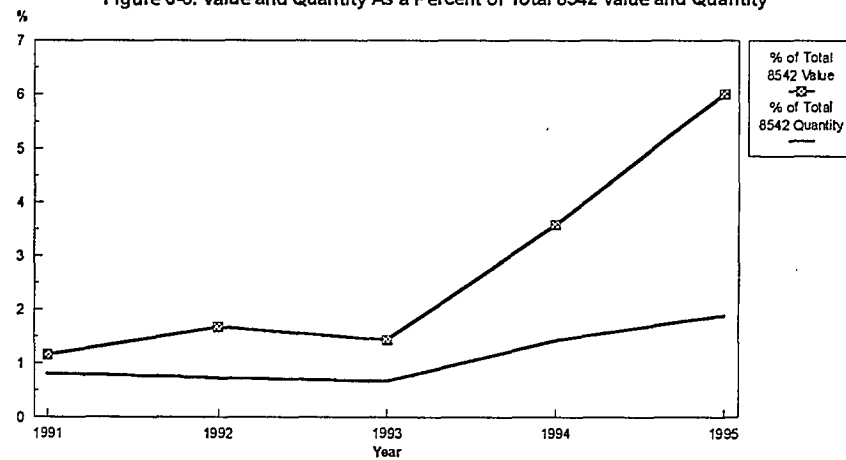


Figure 6-8. Value and Quantity As a Percent of Total 8542 Value and Quantity

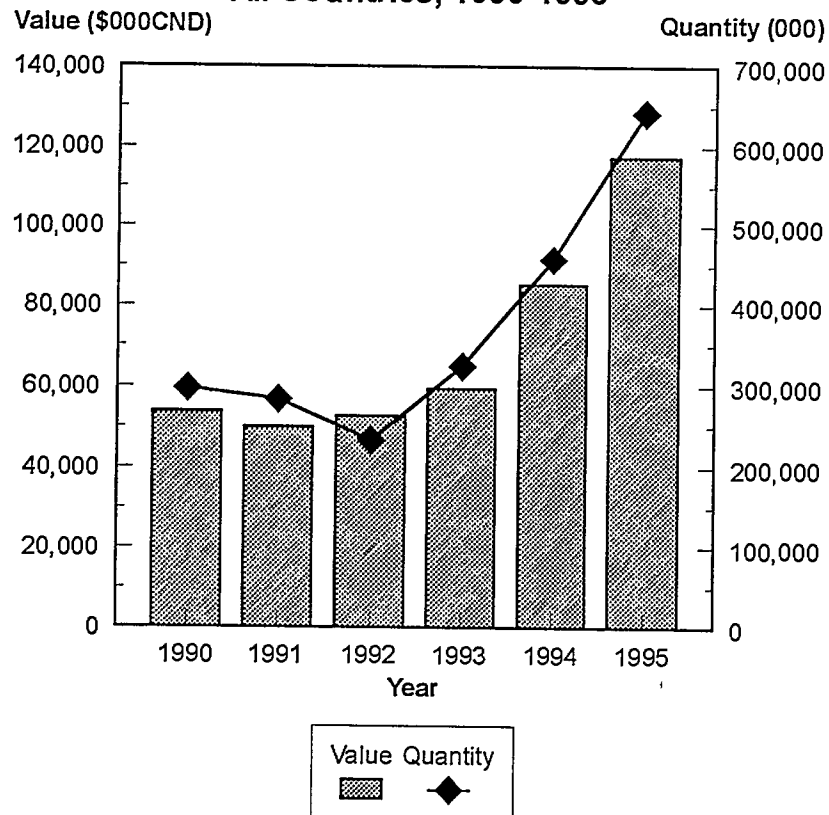


OVERVIEW - DIODES (OTHER THAN PHOTSENSITIVE OR LIGHT EMITTING DIODE (LED))

Being one of the integral components of an electric circuit, a diode is used as a rectifier and detector within electronic circuits. Diodes and transistors typically are commodity discrete semiconductors which are used to populate PCBs for power and driver applications. The optical features of diodes are widely used in different applications such as consumer products, industrial control instruments, and power control units. Japanese firms are world leaders in discrete devices for power, optoelectronics, and small-signal devices. Promising areas include intelligent power devices and fiber optic communications. Imports of photosensitive semiconductors and light emitting diodes accounted for over 65% of the total value of imports for this category.

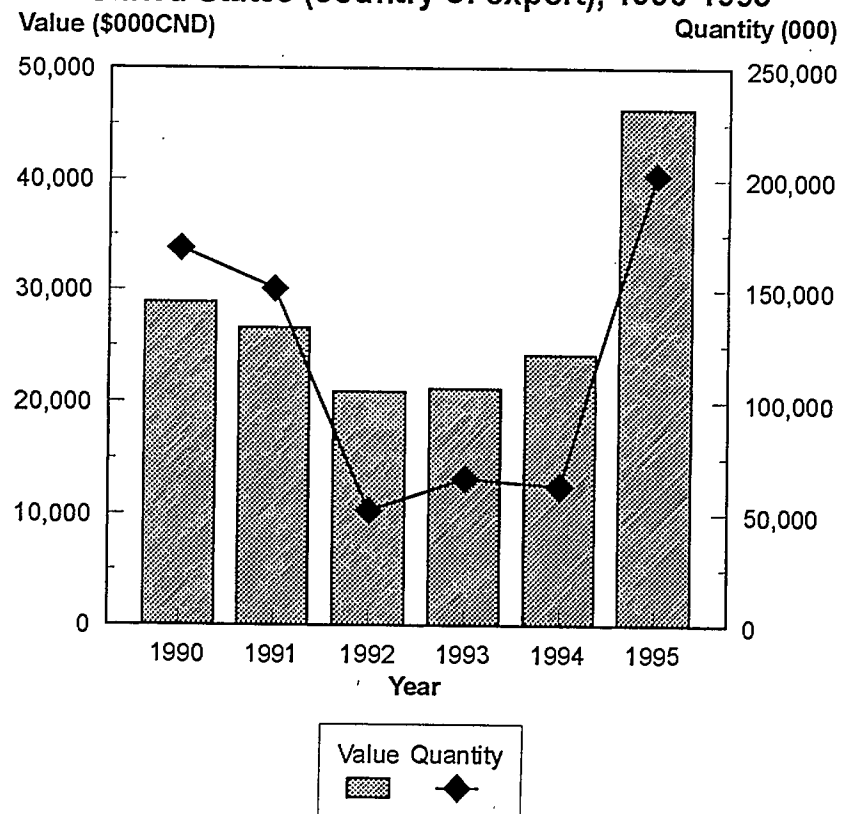
Diodes/Transistors
Diodes, Other than Photosensitive or Light Emitting Diode (LED)
HS Code 8541

Figure 1-1. Total Value and Quantity of Imports
All Countries, 1990-1995



Value: CAGR = 13.9%
 mean = \$69,709 thousand
 std. dev. = 24,404 thousand

Figure 1-2. Total Value and Quantity of Imports
United States (country of export), 1990-1995



Value: CAGR = 8.3%
 mean = \$27,986 thousand
 std. dev. = 8,675 thousand

Diodes/Transistors

Diodes, Other than Photosensitive or Light Emitting Diode (LED)

All Countries, 1990-1995

HS Code 8541

Figure 1-3. Percent Change in Total Value and Quantity of Imports

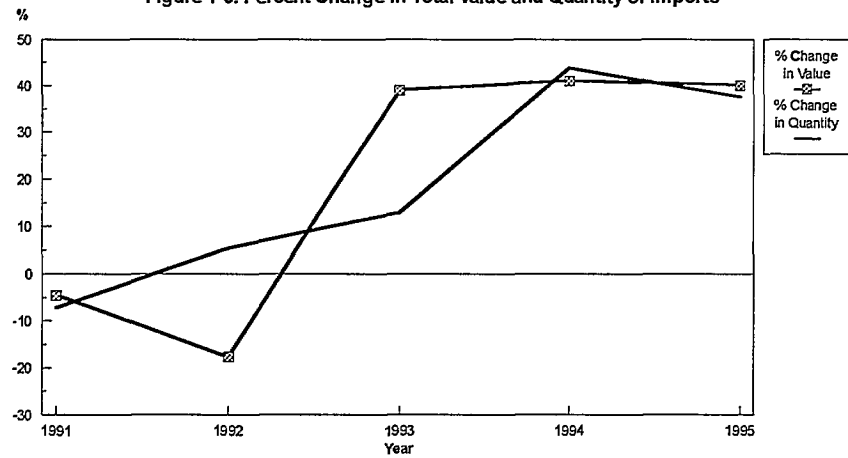


Figure 1-4. Quantity to Value Ratio

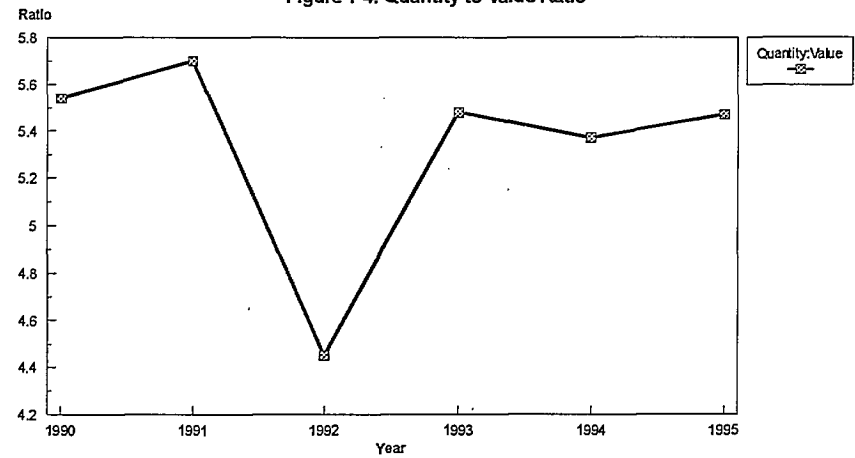
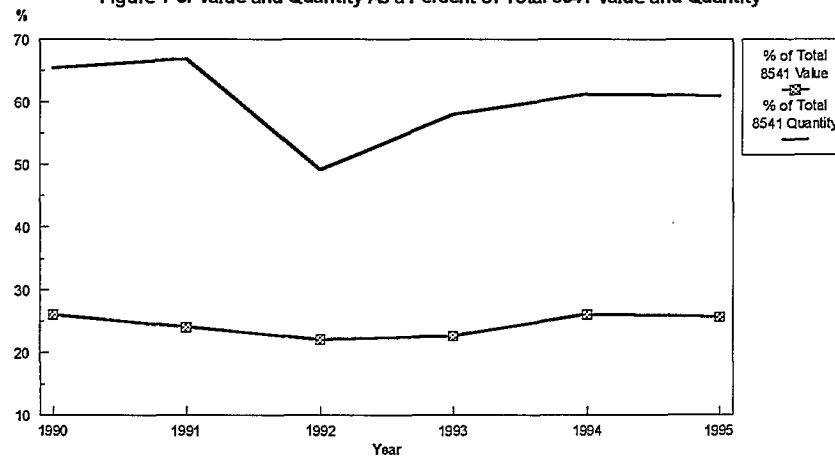


Figure 1-5. Value and Quantity As a Percent of Total 8541 Value and Quantity



Diodes/Transistors

Diodes, Other than Photosensitive or Light Emitting Diode (LED)

United States, 1990-1995

HS Code 8541

Figure 1-6. Percent Change in Total Value and Quantity of Imports

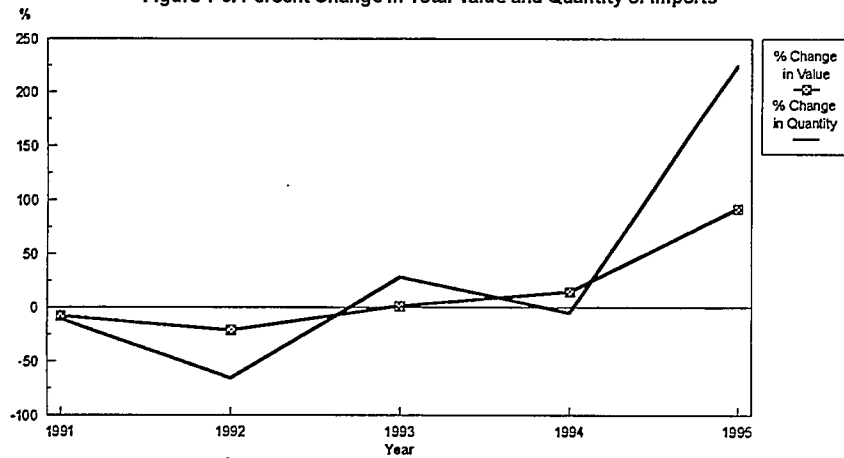


Figure 1-7. Quantity to Value Ratio

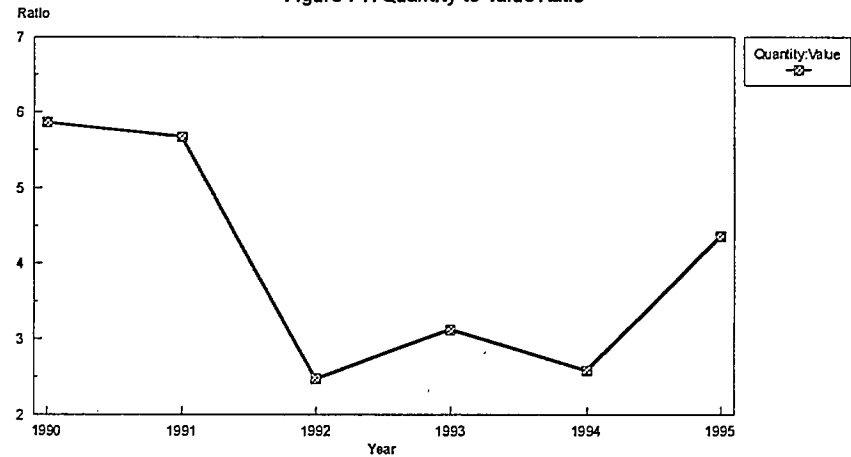
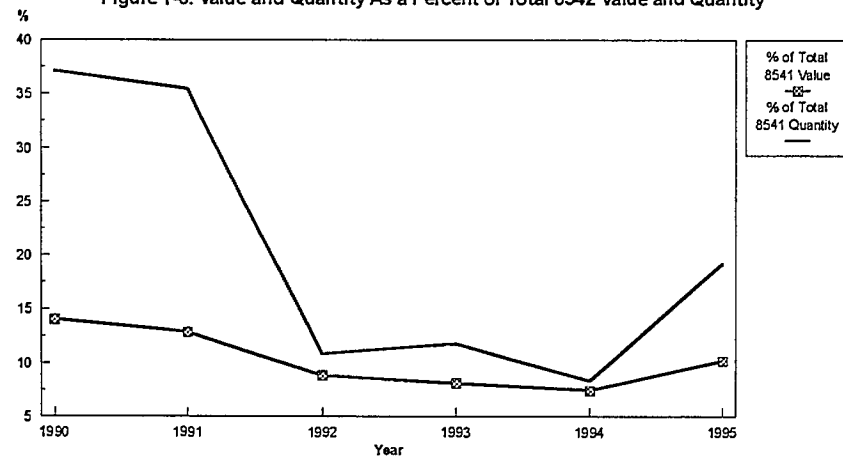


Figure 1-8. Value and Quantity As a Percent of Total 8542 Value and Quantity



OVERVIEW - TRANSISTORS (OTHER THAN PHOTSENSITIVE)

Transistors are being increasingly utilized for specific niche application areas where transistor characteristics are being matched to system requirements such as high frequency, high linearity and certain gain and noise requirements which cannot be achieved by ICs. GaAs FET and MOSFET transistors are two examples of specialized transistors that are being imported for use primarily in communications and products. The quantity of imports and the quantity to value ratio are expected to show increases until year 2000.

Diodes/Transistors
Transistors
HS Code 8541

Figure 2-1. Total Value and Quantity of Imports
All Countries, 1990-1995

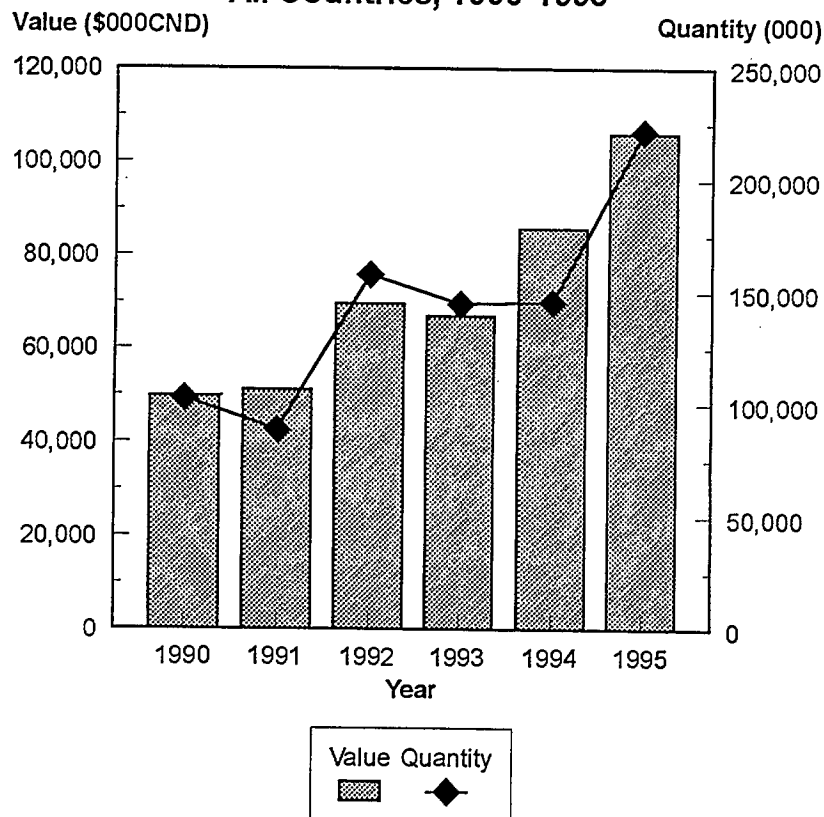
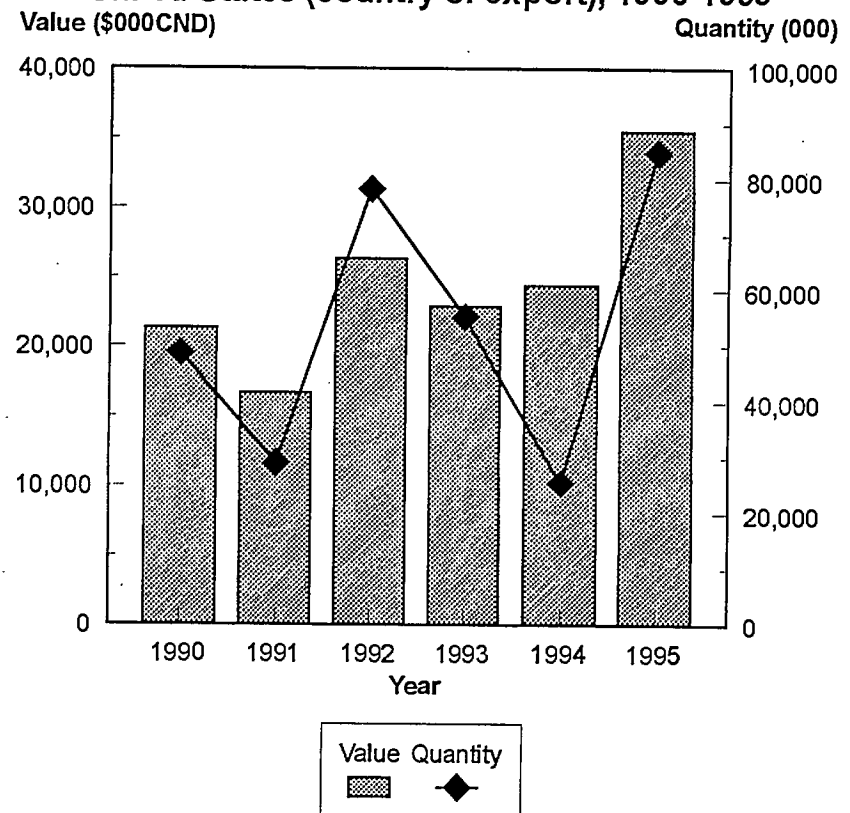


Figure 2-2. Total Value and Quantity of Imports
United States (country of export), 1990-1995



Diodes/Transistors

Transistors

All Countries, 1990-1995

HS Code 8541

Figure 2-3. Percent Change in Total Value and Quantity of Imports

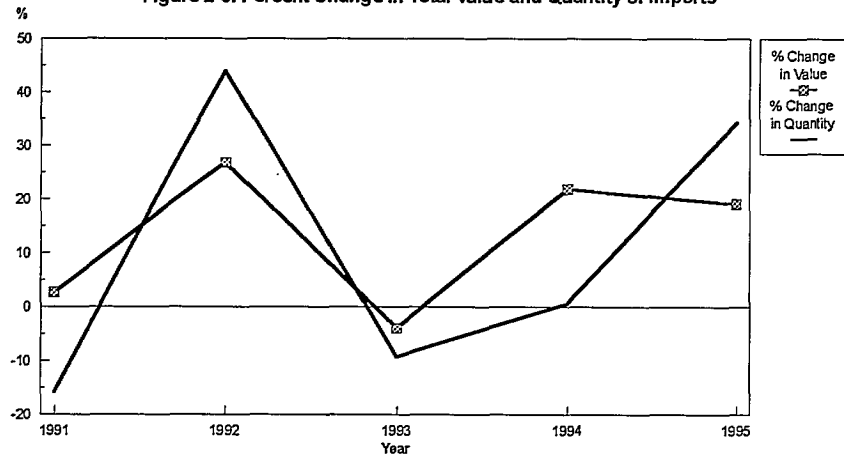


Figure 2-4. Quantity to Value Ratio

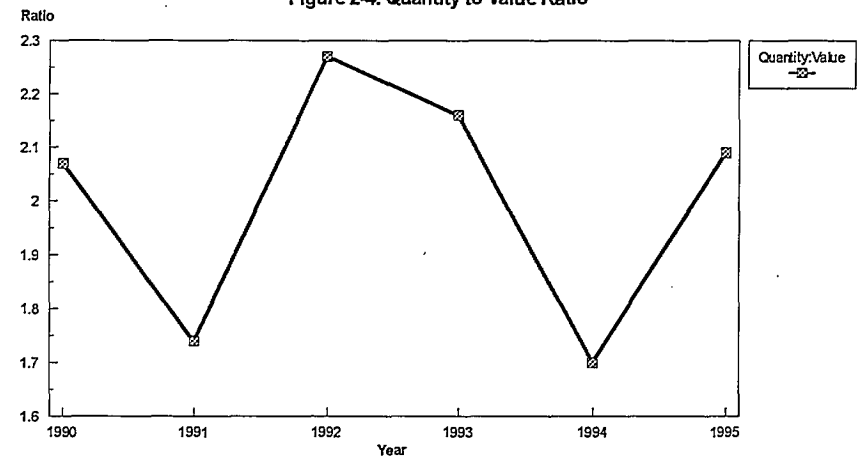
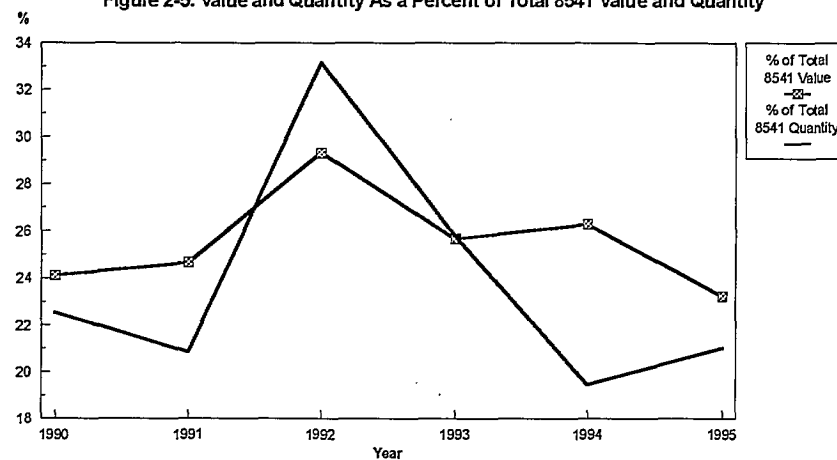


Figure 2-5. Value and Quantity As a Percent of Total 8541 Value and Quantity



Diodes/transistors Transistors États-Unis, 1990-1995 Code SH 8541

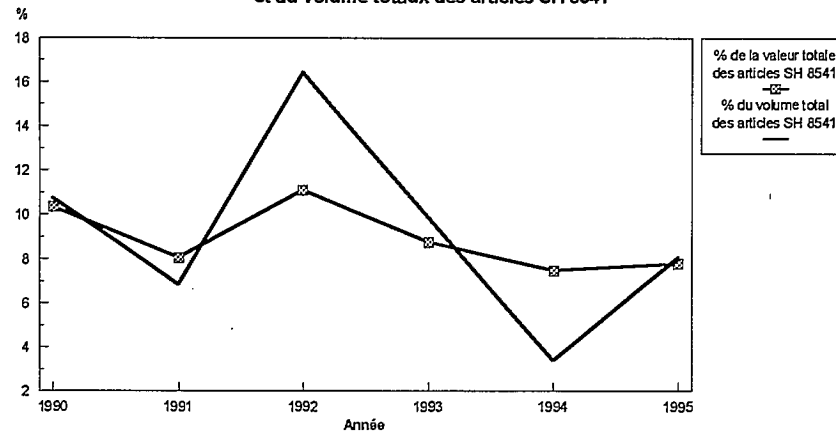
Figure 2-6. Pourcentage de changement de la valeur et du volume totaux des importations



Figure 2-7. Ratio volume/valeur



Figure 2-8. Valeur et volume en tant que pourcentage de la valeur et du volume totaux des articles SH 8541



OVERVIEW - PRINTED CIRCUIT BOARDS

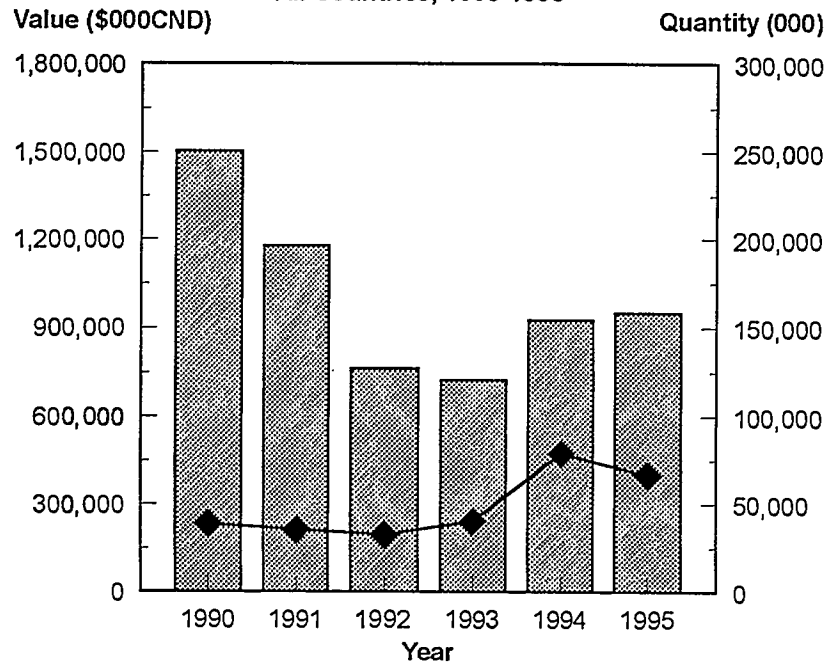
The size of the Canadian market for printed circuit boards (PCBs) was about \$4.5 billion in 1995 with imports from the U.S. dominating. Demand for printed circuit boards remains strong with 1995 import levels reaching \$948 million. It is estimated that the domestic end-user market for PCBs is dominated by the following application areas: telecommunications, computer peripherals, industrial, automotive and instrumentation. Average annual real growth increase is forecast for 1996-97 based on strong market conditions for the above product areas. Given the continuing significant demand for PCBs in Canada, allied with the fact that the communications industry is achieving record sales volumes, Canadian firms can be expected to gain some of the market share in this category by displacing imports.

Printed Circuits

HS Code 8534

**Figure 1-1. Total Value and Quantity of Imports
HS code 8534**

All Countries, 1990-1995

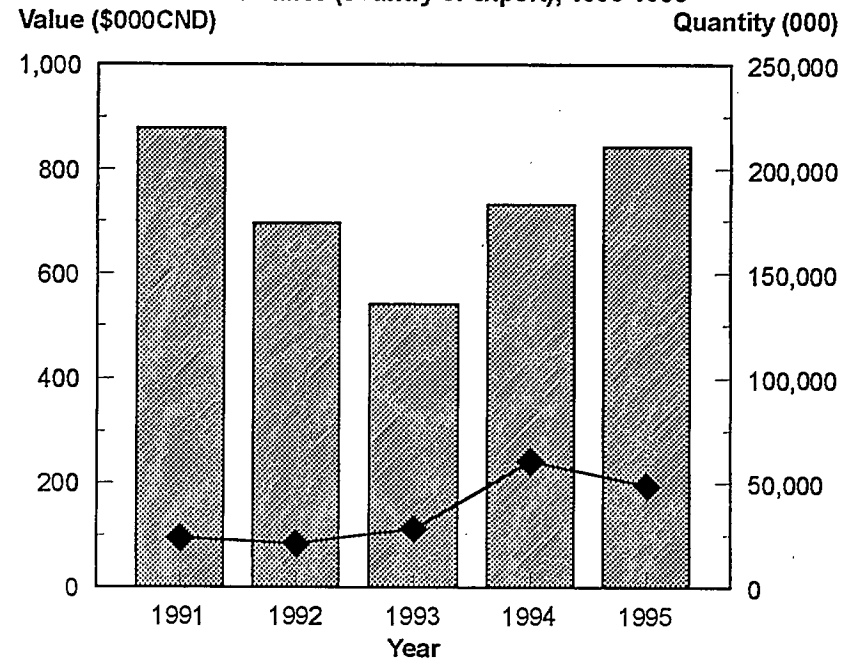


Value Quantity

Value: CAGR = %
 mean = \$ thousand
 std. dev. = thousand

**Figure 1-2. Total Value and Quantity of Imports
HS code 8534**

United States (country of export), 1990-1995



Value Quantity

Value: CAGR = %
 mean = \$731, 780 thousand
 std. dev. = thousand

Printed Circuits

All Countries, 1990-1995

HS Code 8534

Figure 1-3. Percent Change in Total Value and Quantity of Imports

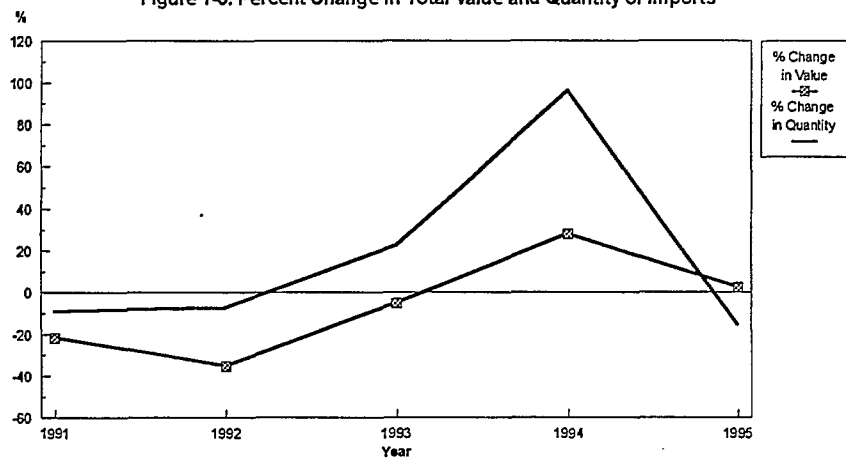
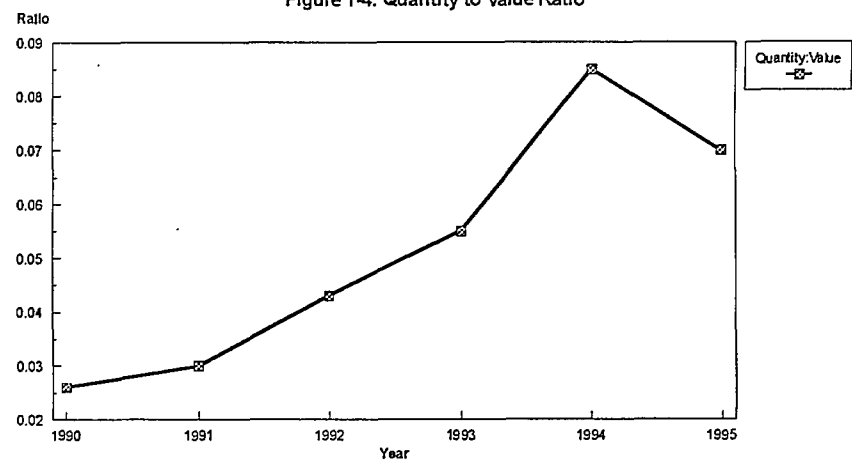


Figure 1-4. Quantity to Value Ratio



Printed Circuits
United States, 1990-1995
HS Code 8534

Figure 1-6. Percent Change in Total Value of Quantity of Imports

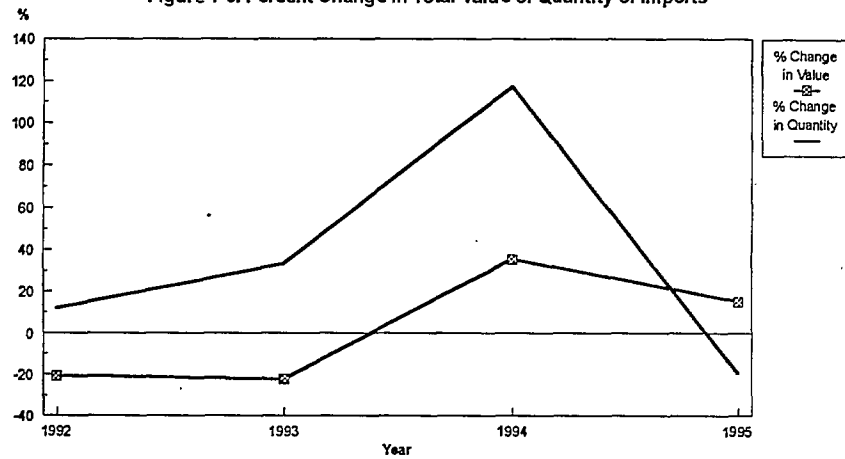
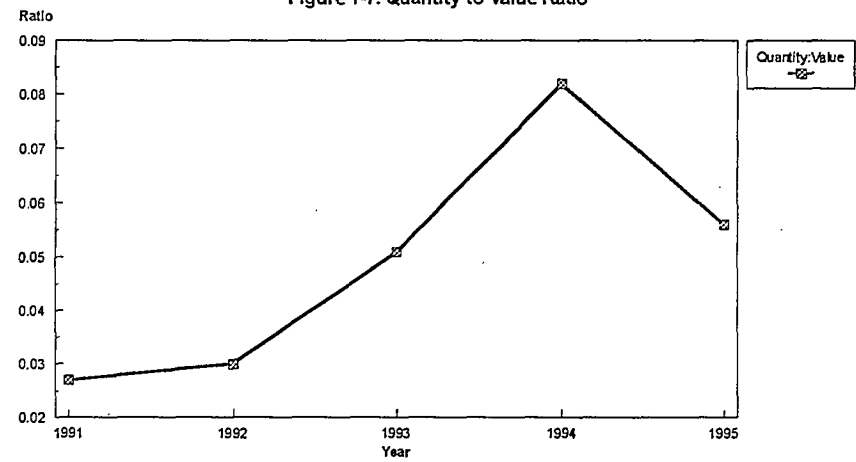


Figure 1-7. Quantity to Value Ratio



Printed Circuits
Glass Base
HS Code 8534

Figure 2-1. Total Value and Quantity of Imports
HS code 8534
All Countries, 1990-1995

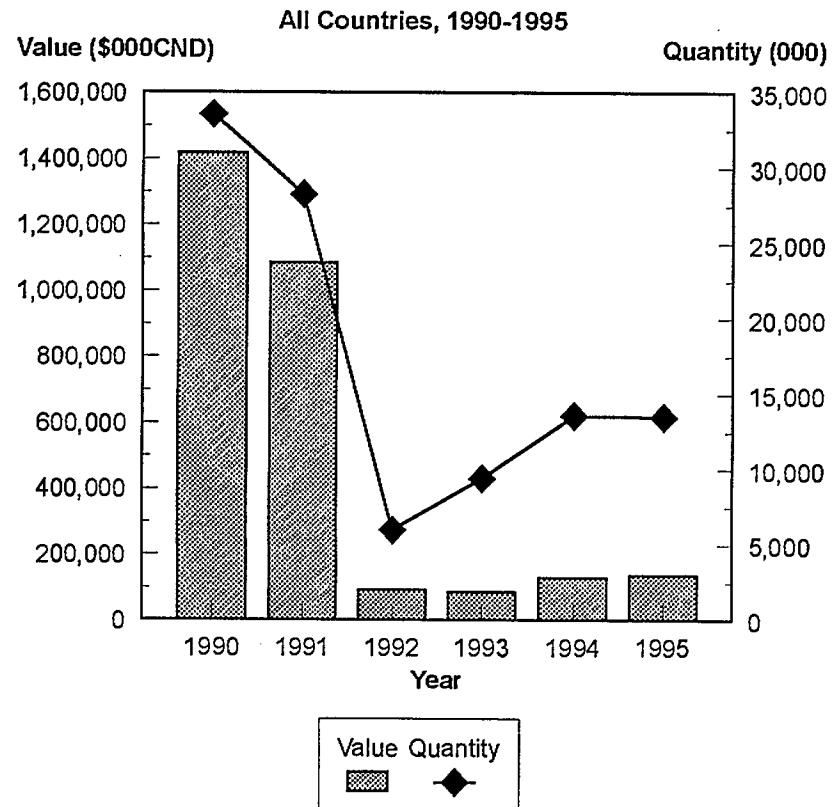
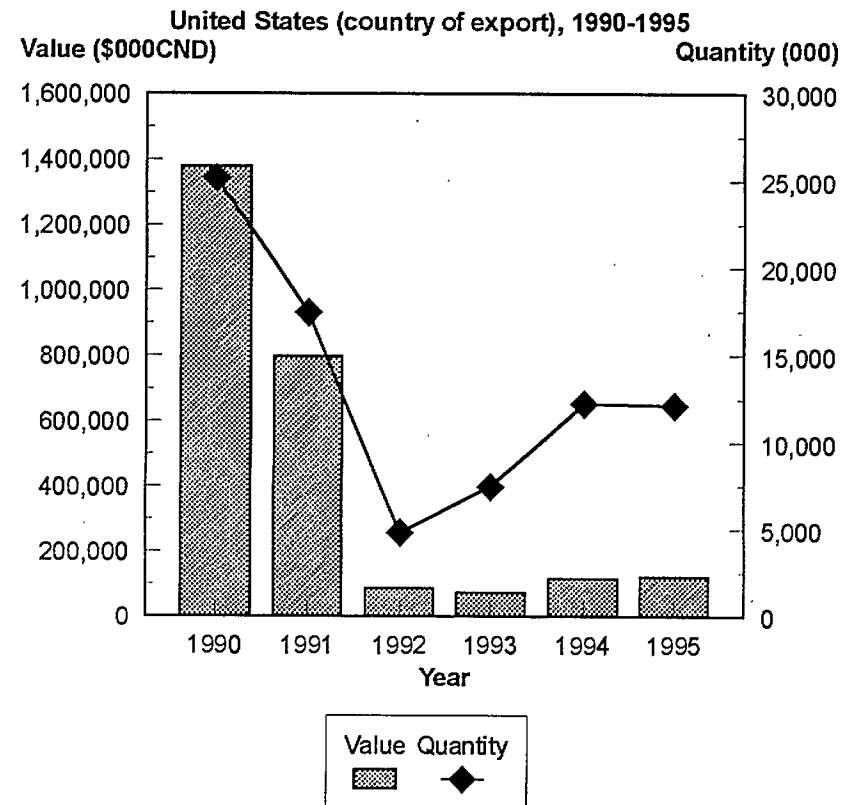


Figure 2-2. Total Value and Quantity of Imports
HS code 8534
United States (country of export), 1990-1995



Printed Circuits

Glass Base

All Countries, 1990-1995

HS Code 8534

Figure 2-3. Percent Change in Total Value and Quantity of Imports

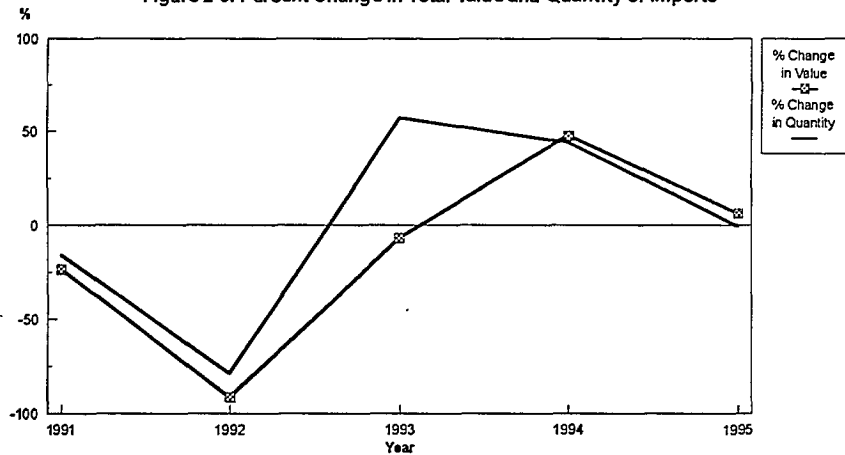


Figure 2-4. Quantity to Value Ratio

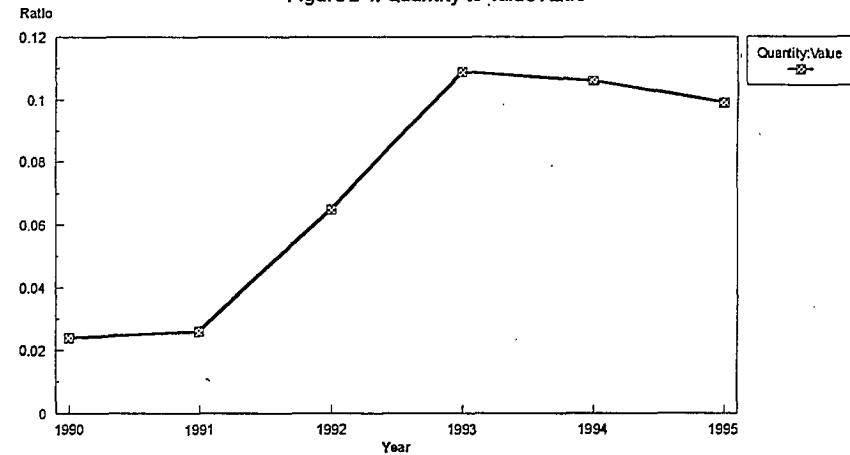
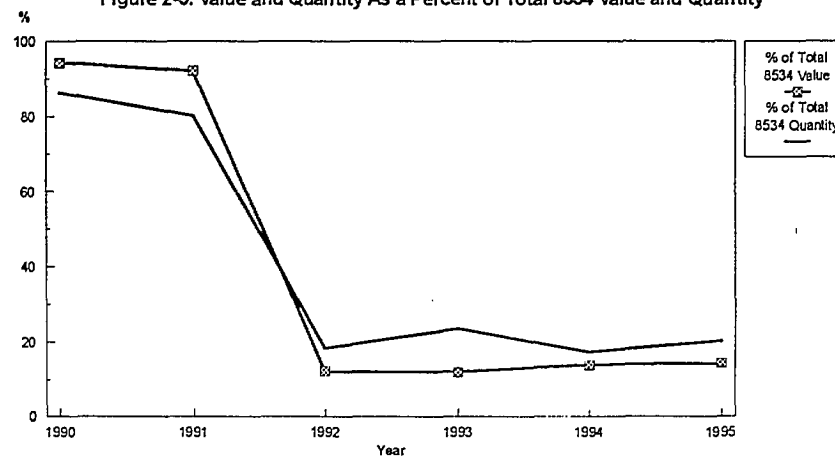


Figure 2-5. Value and Quantity As a Percent of Total 8534 Value and Quantity



**Printed Circuits
Glass Base
United States, 1990-1995
HS Code 8534**

Figure 2-6. Percent Change in Total Value and Quantity of Imports

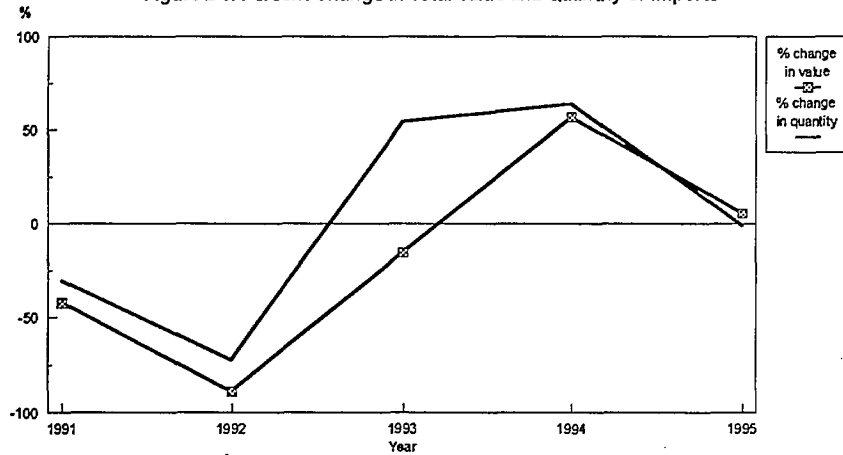
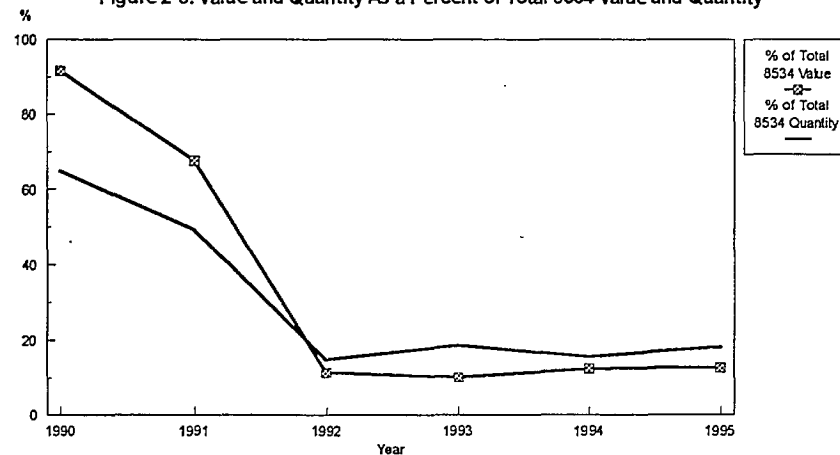


Figure 2-7. Value to Quantity Ratio



Figure 2-8. Value and Quantity As a Percent of Total 8534 Value and Quantity

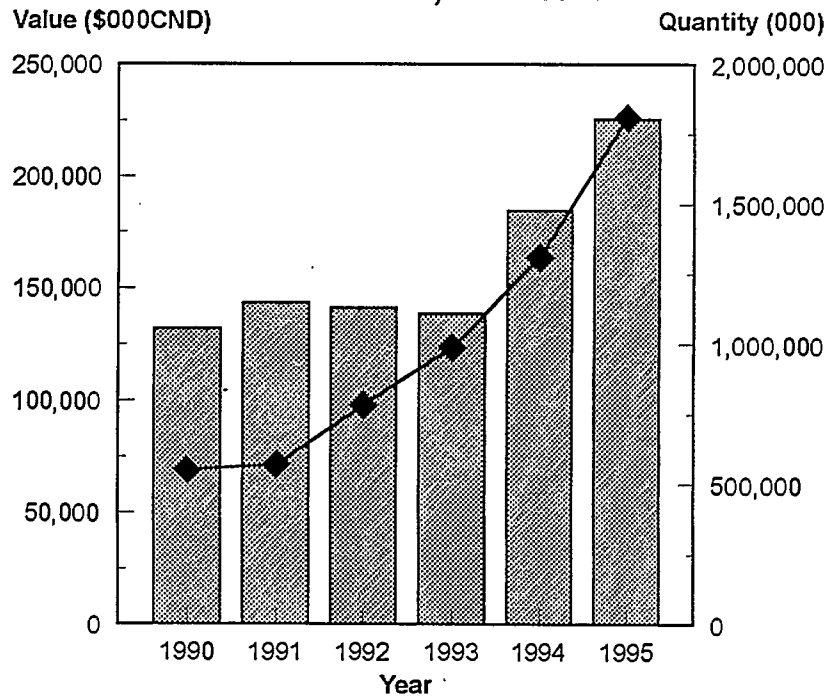


OVERVIEW - ELECTRICAL CAPACITORS

The import levels of capacitors has increased during the last 3 year period. The contribution of both the ceramic and tantalum dielectric type of capacitors is illustrated.

Electrical Capacitors HS Code 8532

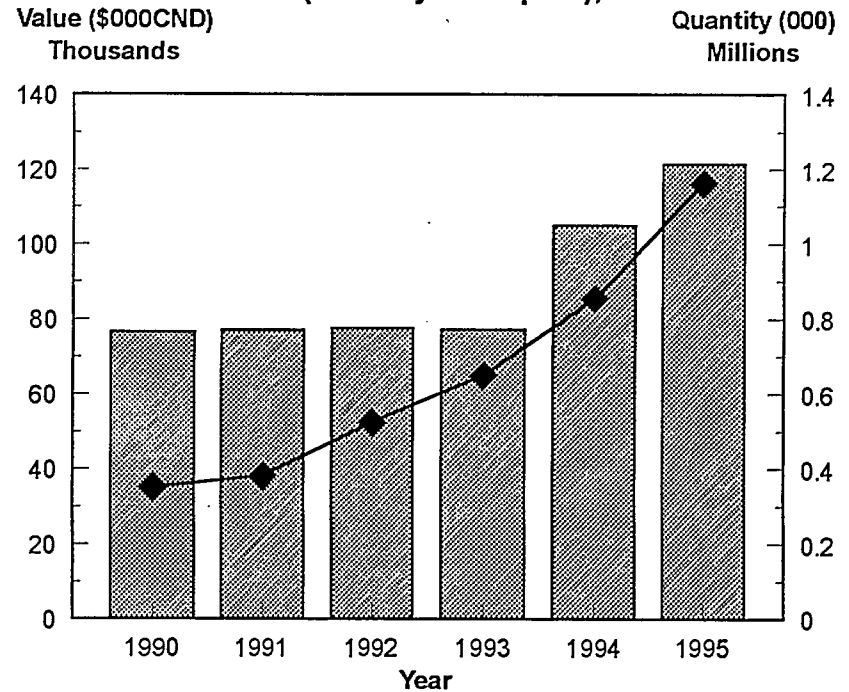
Figure 1-1. Total Value and Quantity of Imports
All Countries, 1990-1995



Value Quantity

Value: CAGR = 9.3%
 mean = \$160,821 thousand
 std. dev. = 33,563 thousand

Figure 1-2. Total Value and Quantity of Imports
United States (country of export), 1990-1995



Value Quantity

Value: CAGR = 8.0%
 mean = \$89,185 thousand
 std. dev. = 17,673 thousand

Electrical Capacitors HS Code 8532

Figure 1-3. Percent Change in Total Value and Quantity of Imports
All Countries

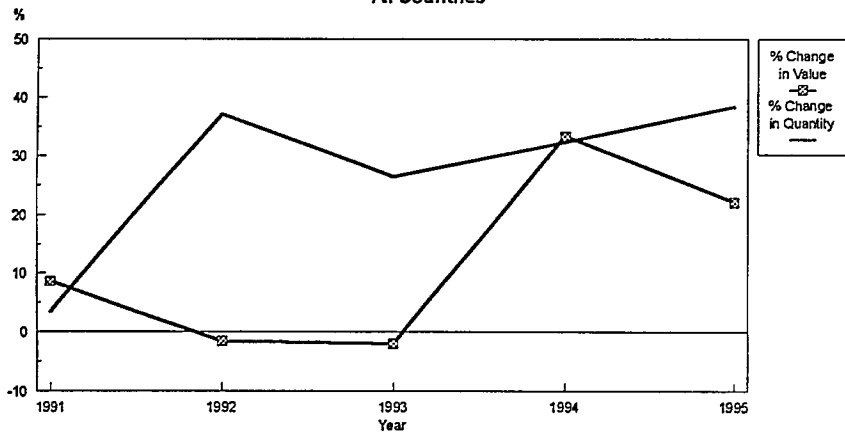


Figure 1-5. Percent Change in Total Value and Quantity of Imports
United States (Country of Export)

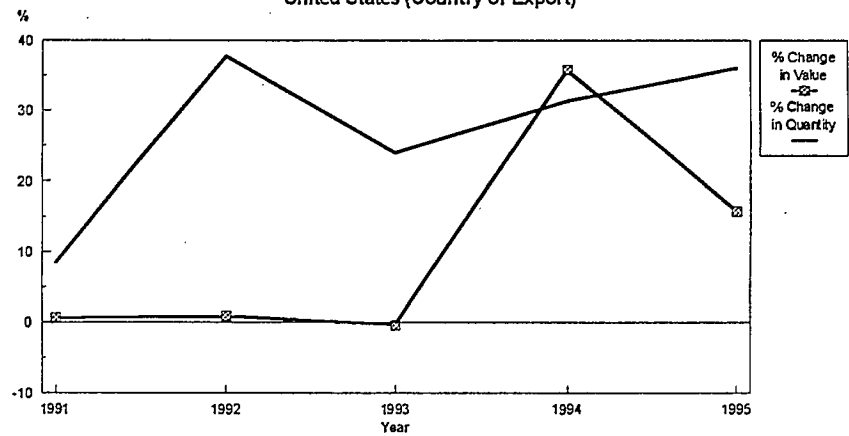


Figure 1-4. Quantity to Value Ratio
All Countries

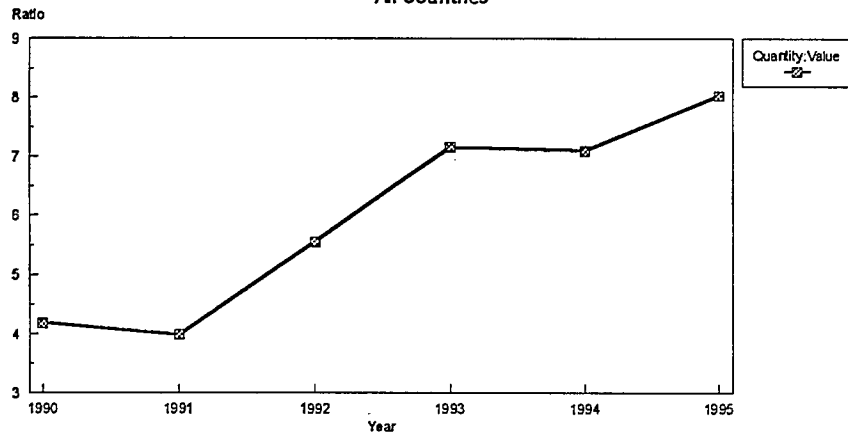


Figure 1-6. Quantity to Value Ratio
United States (Country of Export)

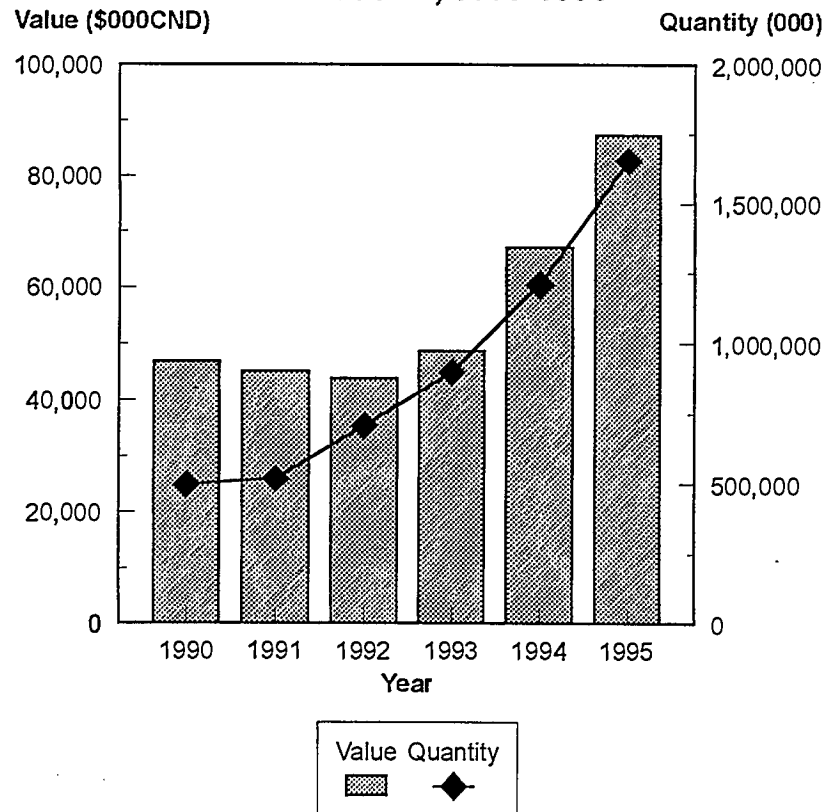


OVERVIEW - CERAMIC

Capacitors are used primarily in power and filtering applications. Ceramic and tantalum chip capacitors are shown separately because they are two of the largest volume passive components in the Canadian market. Ceramic chip capacitors are designed for surface mount applications and are generally supplied for the volume applications in tape reel configurations. Over 1.75 billion capacitors are imported into Canada (*how often*). Major application areas include computer and wireless communication devices. United States is the major country of export.

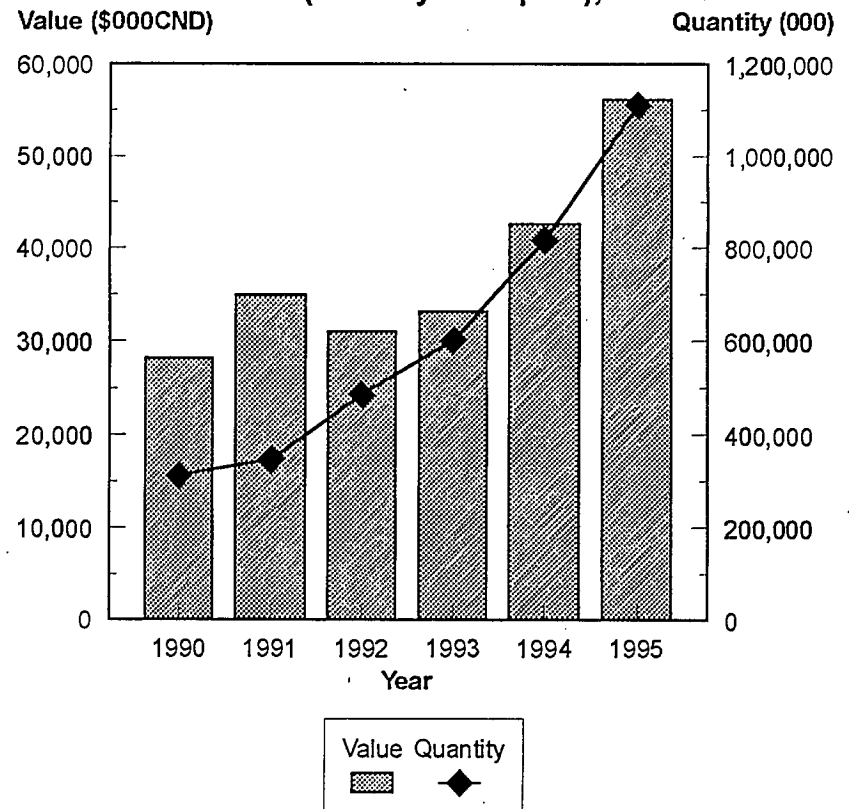
Electrical Capacitors Ceramic HS Code 8532

**Figure 2-1. Total Value and Quantity of Imports
All Countries, 1990-1995**



Value: CAGR = 11.0%
mean = \$56,468 thousand
std. dev. = 15,844 thousand

**Figure 2-2. Total Value and Quantity of Imports
United States (country of export), 1990-1995**



Value: CAGR = 12.2%
mean = \$37,670 thousand
std. dev. = 9,365 thousand

Electrical Capacitors Ceramic All Countries, 1990-1995 HS Code 8532

Figure 2-3. Percent Change in Total Value and Quantity of Imports

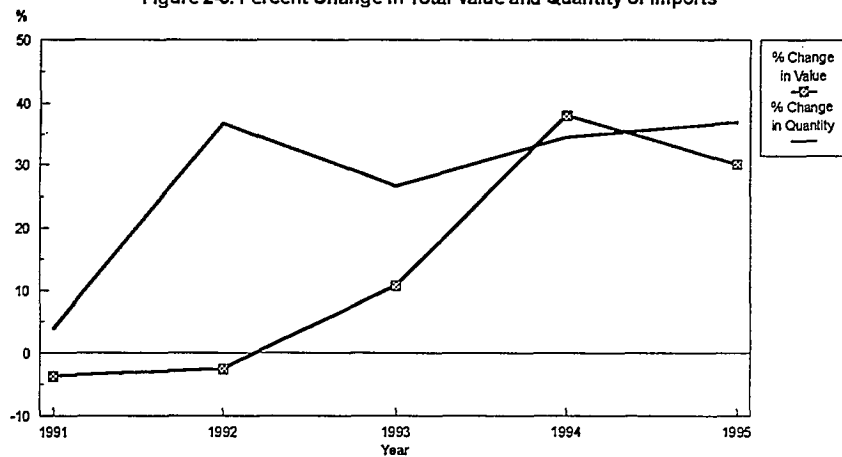


Figure 2-4. Quantity to Value Ratio

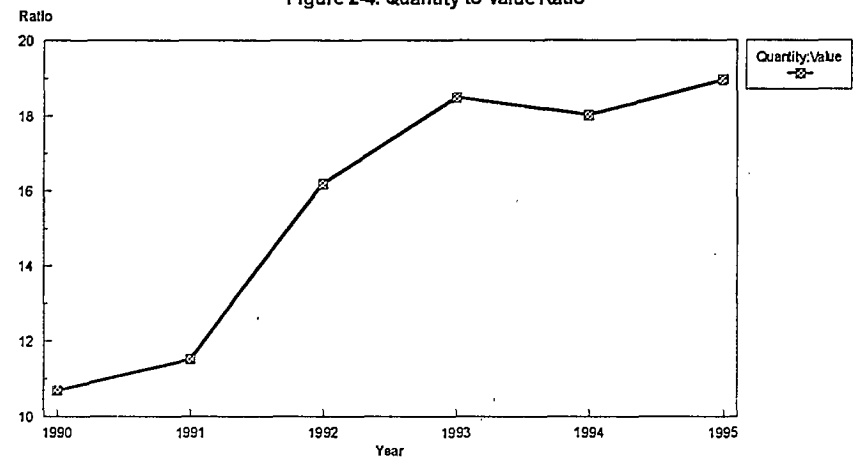
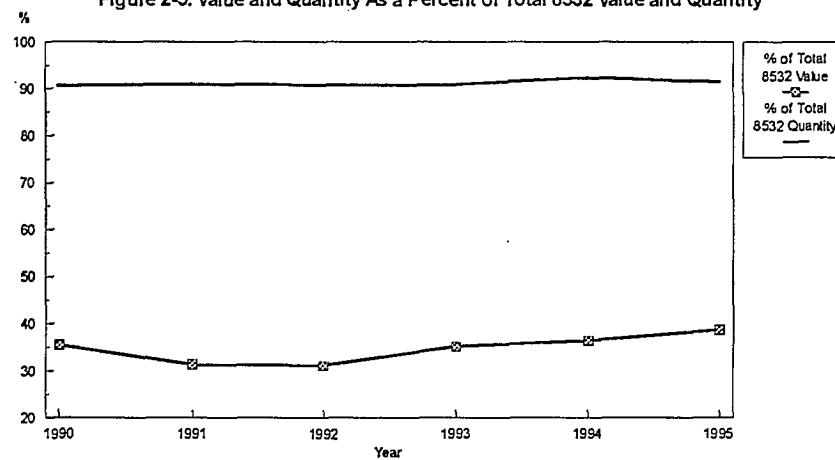


Figure 2-5. Value and Quantity AS a Percent of Total 8532 Value and Quantity



Electrical Capacitors Ceramic United States, 1990-1995 HS Code 8532

Figure 2-6. Percent Change in Total Value and Quantity of Imports

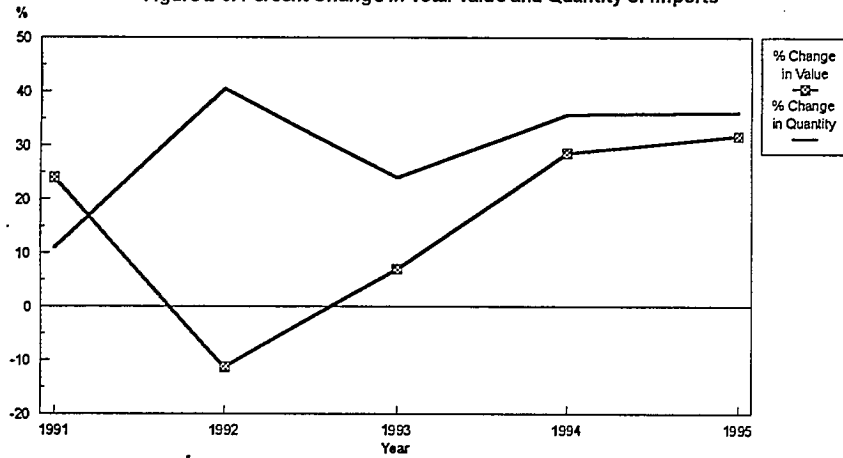


Figure 2-7. Quantity to Value Ratio

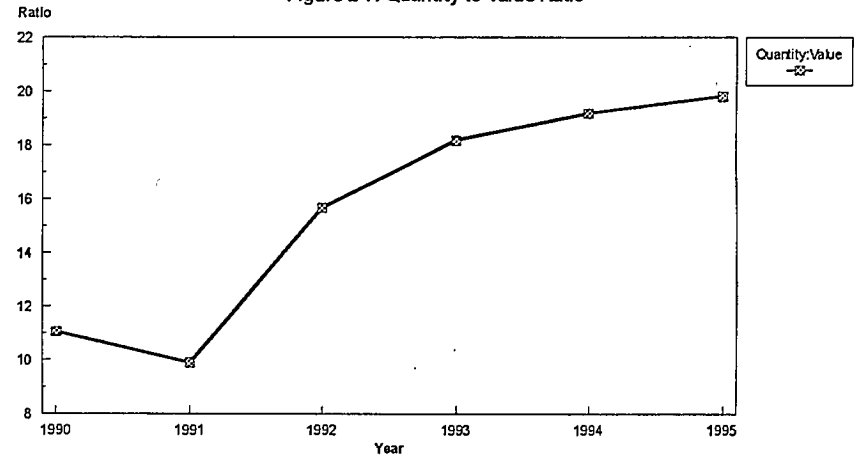


Figure 2-8. Value and Quantity As a Percent of Total 8532 Value and Quantity

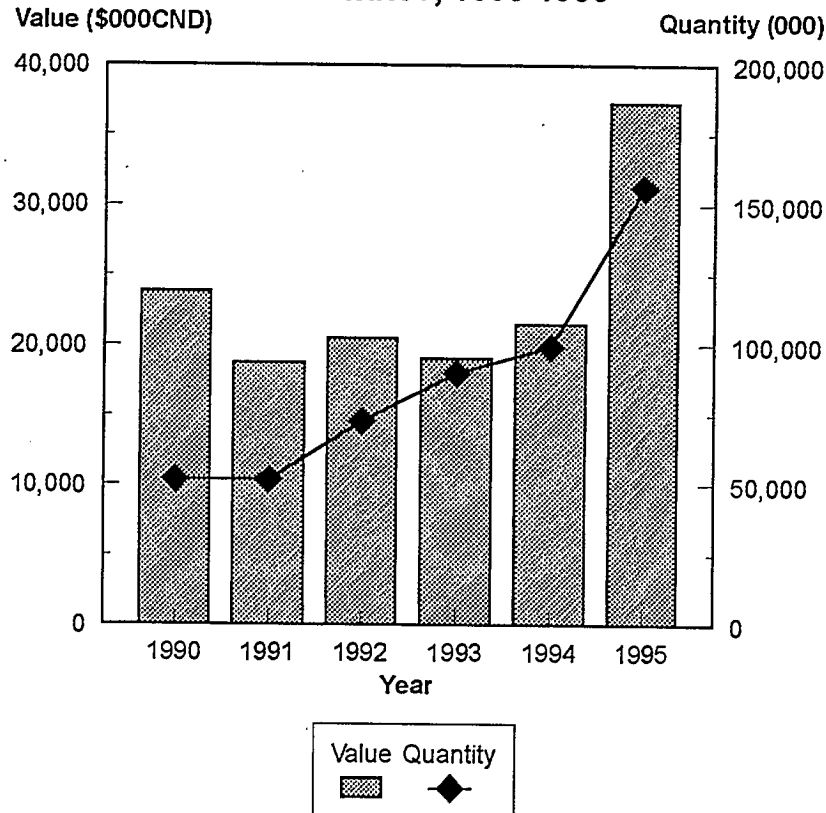


OVERVIEW - TANTALUM

Tantalum chip capacitors are designed for surface mount applications and have a strong presence in the capacitor marketplace. Ceramic and tantalum capacitors are important commodity products in the semiconductor marketplace and the governing factors regarding imports displacement are price, performance, availability and quality. The computer and automotive markets provide an outlet for tantalum capacitors which provide reliability in high temperature and fast switching applications with ultra-thin geometries. Tantalum capacitors are indicating lower import growth rates than their ceramic equivalents. Shipments of paper-film capacitors into Canada follows the other two capacitor types.

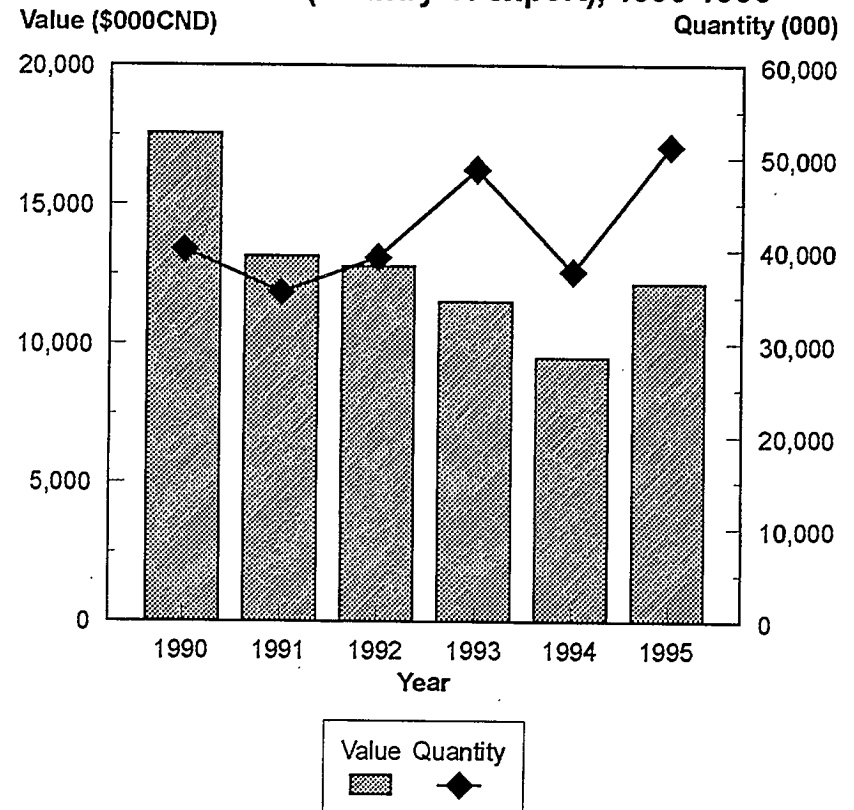
Electrical Capacitors Tantalum HS Code 8532

**Figure 3-1. Total Value and Quantity of Imports
All Countries, 1990-1995**



Value: CAGR = 7.8%
mean = \$23,455 million
std. dev. = 6,397 million

**Figure 3-2. Total Value and Quantity of Imports
United States (country of export), 1990-1995**



Value: CAGR = -6.0%
mean = \$12,766 million
std. dev. = 2,440 million

Electrical Capacitors Tantalum All Countries, 1990-1995 HS Code 8532

Figure 3-3. Percent Change in Total Value and Quantity of Imports

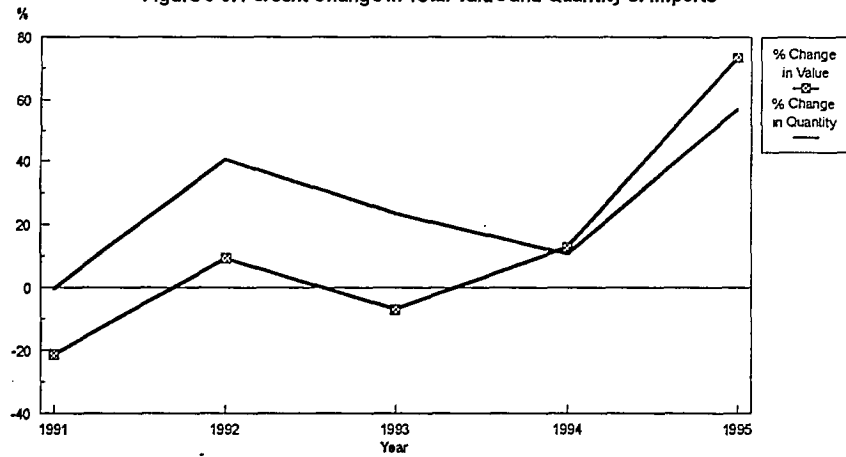


Figure 3-4. Quantity to Value Ratio

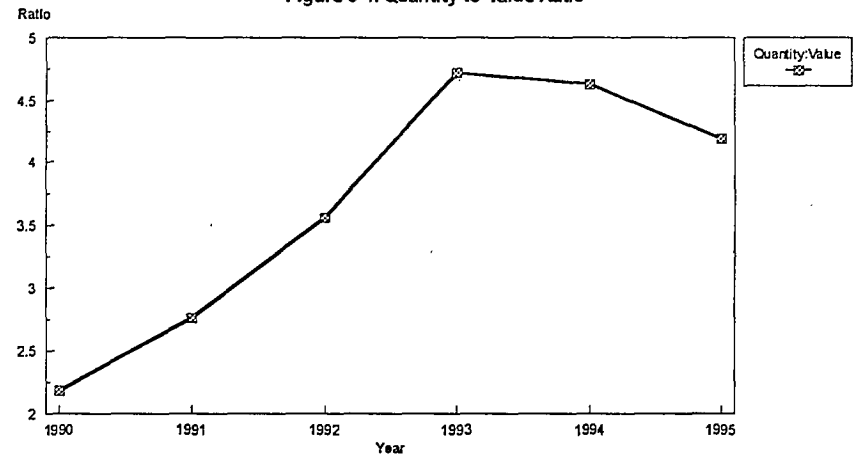
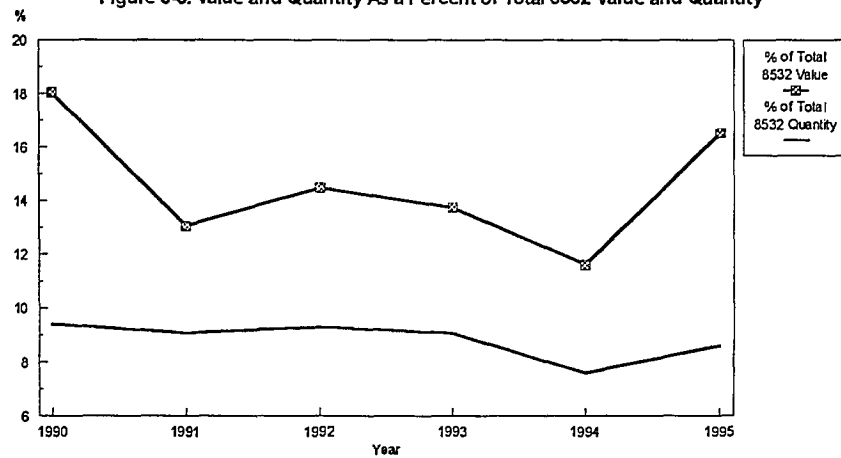


Figure 3-5. Value and Quantity As a Percent of Total 8532 Value and Quantity



Electrical Capacitors Tantalum United States, 1990-1995 HS Code 8532

Figure 3-6. Percent Change in Total Value and Quantity of Imports

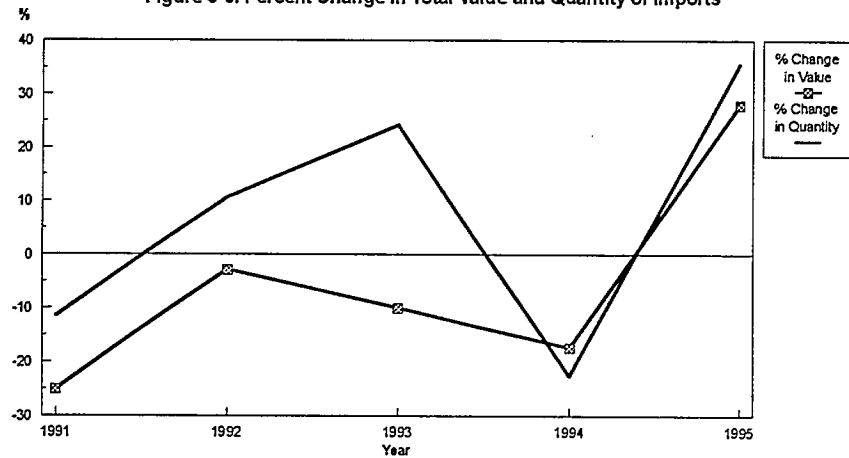


Figure 3-7. Quantity to Value Ratio

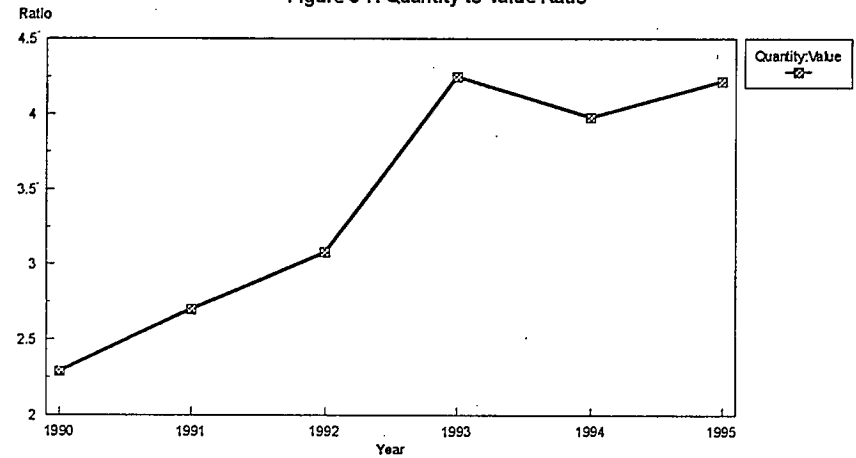
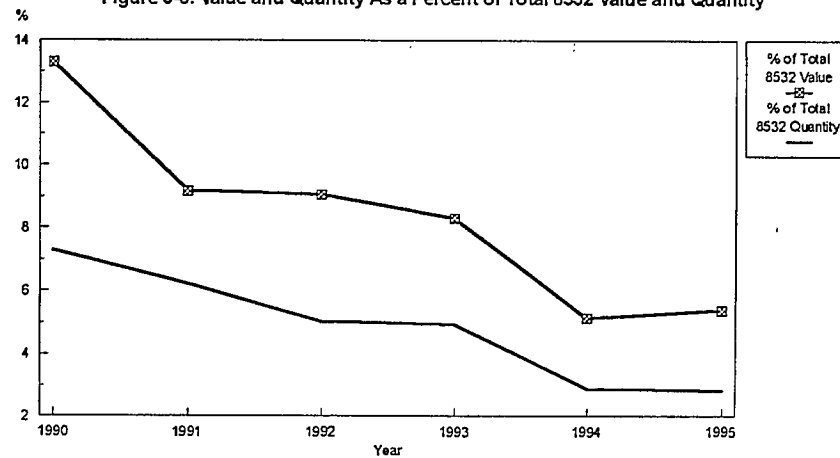


Figure 3-8. Value and Quantity As a Percent of Total 8532 Value and Quantity

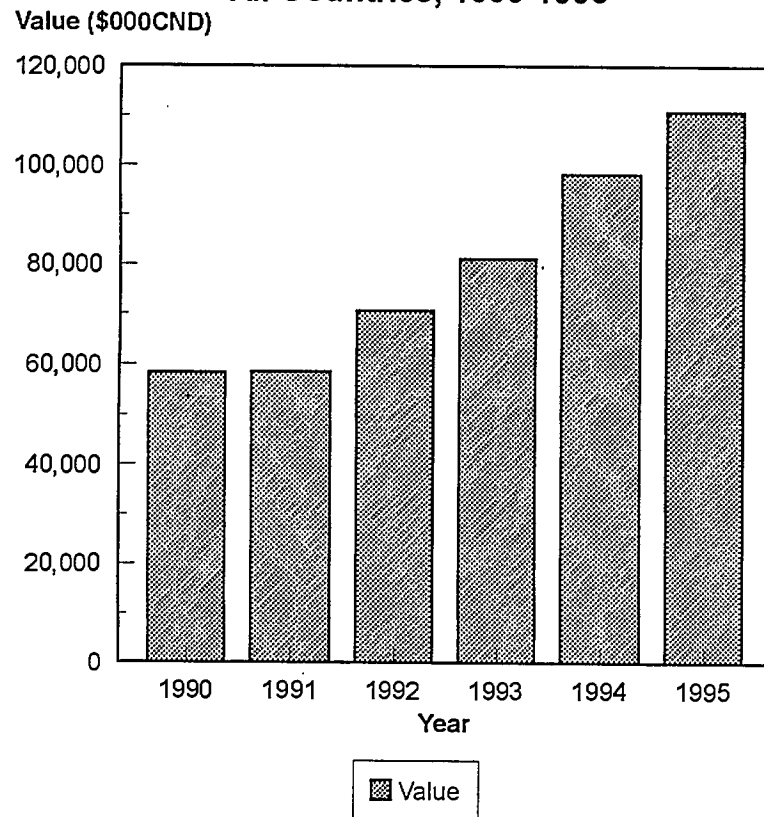


OVERVIEW - ELECTRICAL RESISTORS

The resistor chip market used for surface mount applications is driving this market. Japanese and U.S. firms are the largest foreign suppliers of these discrete devices. Passive networks will continue to replace discrete resistor devices in providing impedance to IC circuitry. Not unlike capacitors, it is forecast the end application for resistors is very similar to the two product lines particularly for surface mount applications.

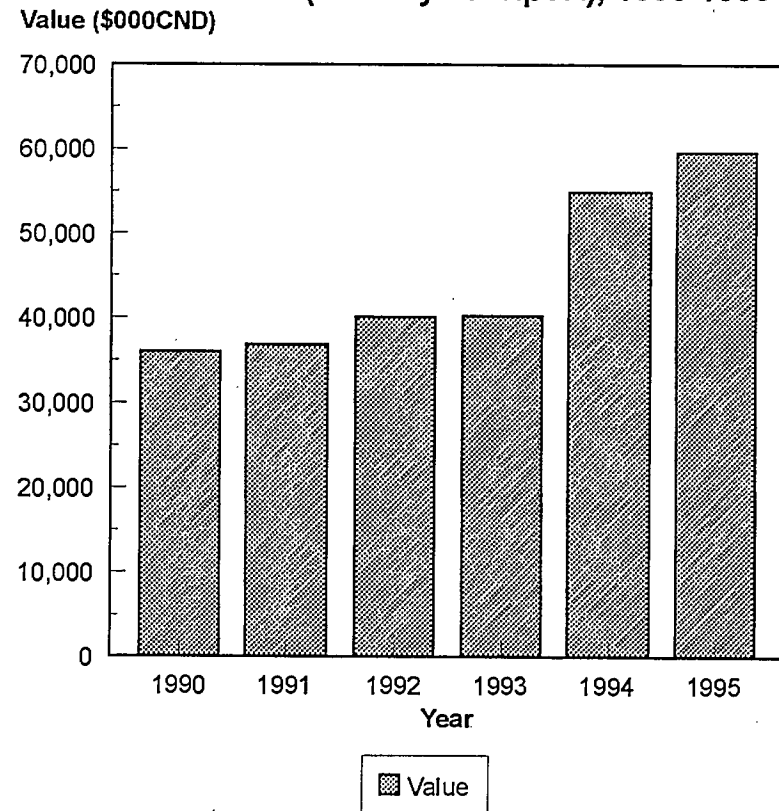
Electrical Resistors HS Code 8533

**Figure 1-1. Total Value of Imports
All Countries, 1990-1995**



Value: CAGR = 11.3%
mean = \$79,589 million
std. dev. = 19,615 million

**Figure 1-2. Total Value of Imports
United States (country of export), 1990-1995**



Value: CAGR = 8.8%
mean = \$44,625 million
std. dev. = 9,192 million

Electrical Resistors HS Code 8533

Figure 1-3. Percent Change in Total Value of Imports
All Countries

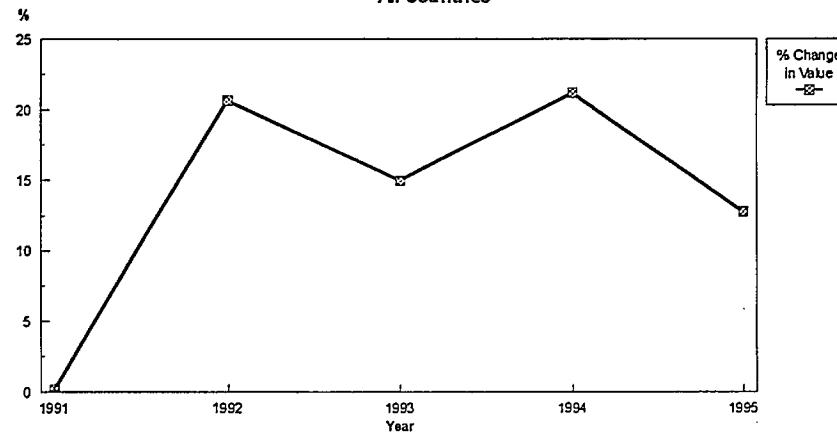


Figure 1-4. Percent Change in Total Value of Imports
United States (Country of Export)

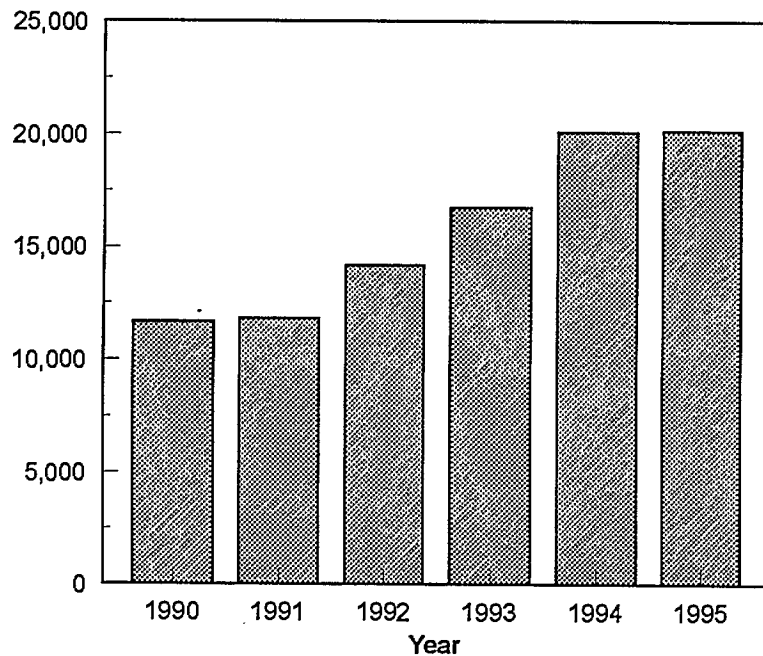


Electrical Resistors Carbon HS Code 8533

**Figure 2-1. Total Value of Imports
HS code 8533**

All Countries, 1990-1995

Value (\$000CND)



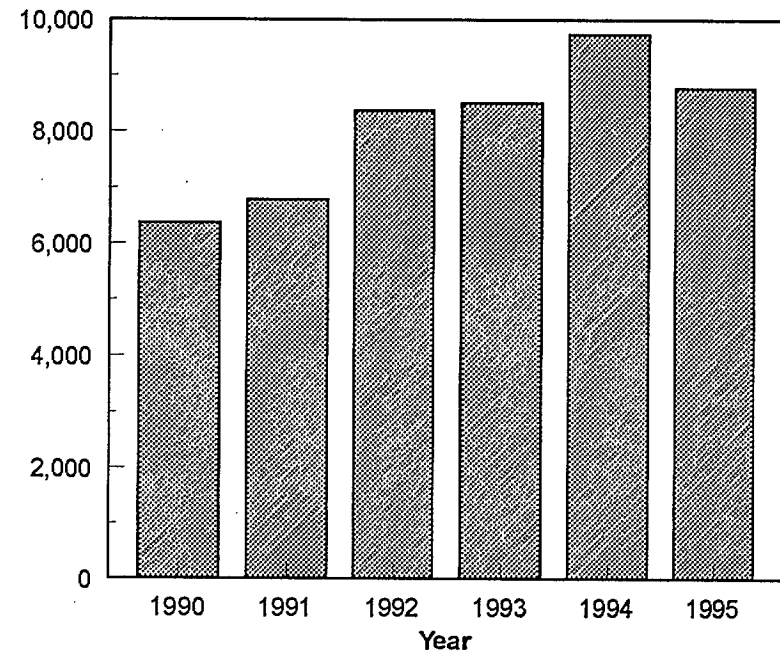
Value

Value: CAGR = 9.5%
mean = \$15,780 thousand
std. dev. = 3,509 thousand

**Figure 2-2. Total Value of Imports
HS code 8533**

United States (country of export), 1990-1995

Value (\$000CND)



Value

Value: CAGR = 5.5%
mean = \$8,094 thousand
std. dev. = 1,164 thousand

Electrical Resistors Carbon All Countries, 1990-1995 HS Code 8533

Figure 2-3. Percent Change in Total Value of Imports

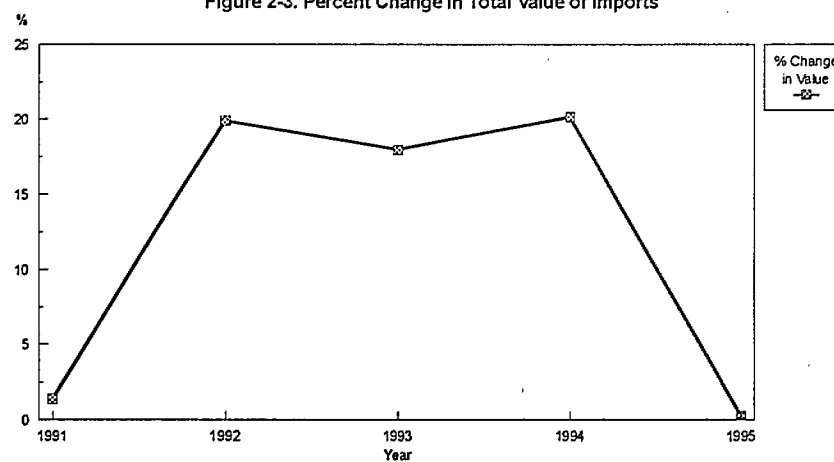
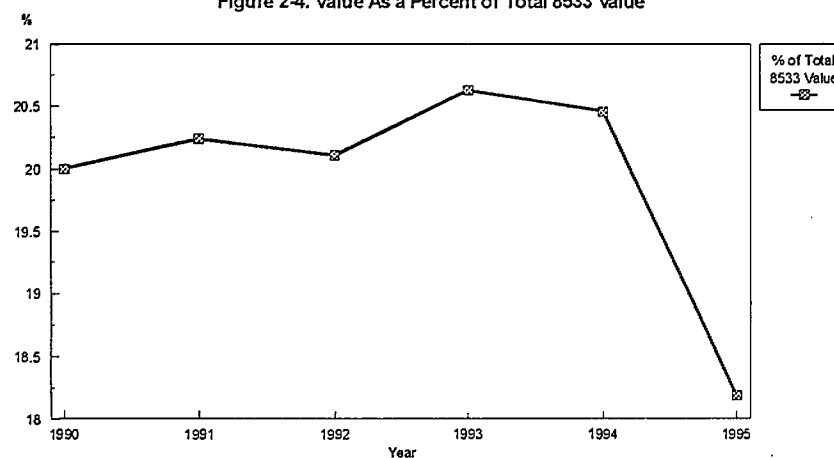


Figure 2-4. Value As a Percent of Total 8533 Value



Electrical Resistors
Carbon
United States, 1990-1995
HS Code 8533

Figure 2-5. Percent Change in Total Value of Imports

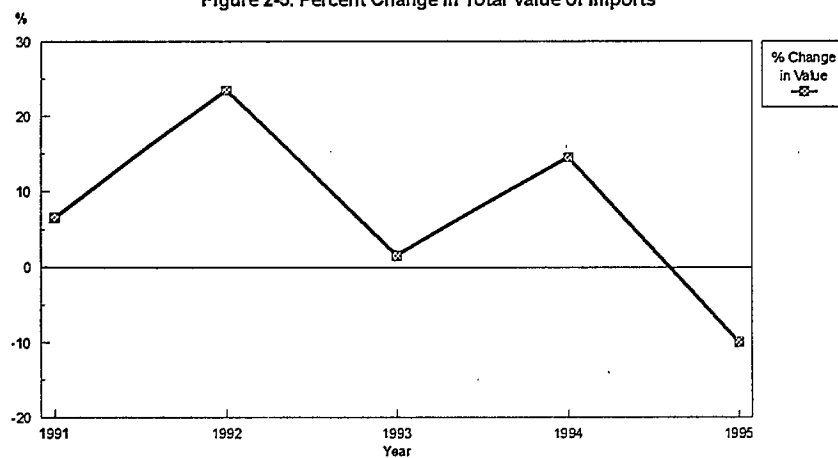
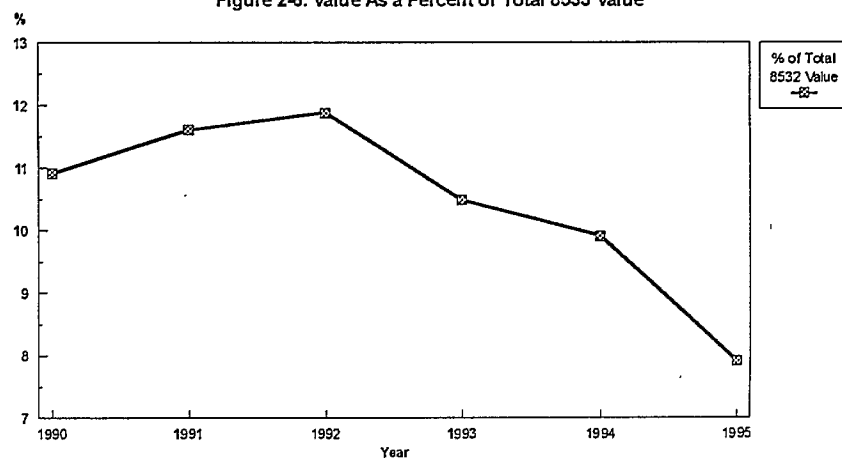


Figure 2-6. Value As a Percent of Total 8533 Value



OVERVIEW - FUSES, BREAKERS, OVERLOADS, AND PROTECTIVE DEVICES

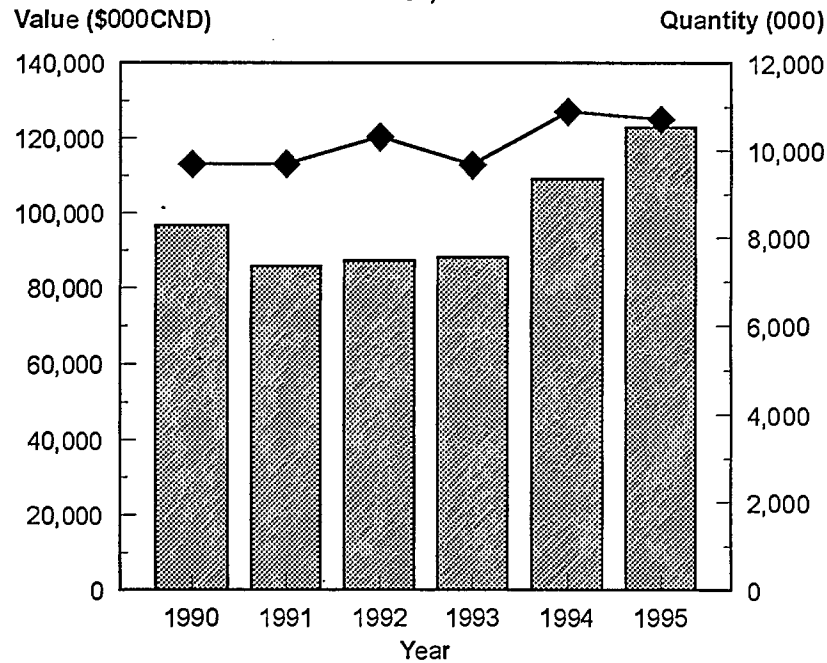
Fuse, breakers, overloads and other protective devices provide electrical protection for components mounted on PCBs and the electrical interconnections between different levels of system integration. The trend in this area, particularly in the lower power levels is to miniaturization and response times. Discrete semiconductor devices such as diodes and triacs have supplanted some of the conventional protective devices, and forecasting the level of import growth depends on level of displacement by semiconductor discrete devices. Consumption patterns appear to be steady.

The value and quantity of imports for switching and protective devices shows a modest growth for the 1991 - 1995 time period. The quantity to value ratio is not a significant indicator of price performance or value in this sub-sectoral production area because of the wide diversification in the producer range. Products run the gamut of switches, push-buttons, toggle, rocker, power, piezoelectronic, membrane, pinboard, etc. Canadian firms could look at penetration by manufacturing certain types of switches which are largely imported such as piezoelectronic switches. It is expected that this category will see continuing modest growth with no significant surge or reduction in demand.

Electrical Apparatus For Switching **Fuses, Breakers, Overloads, and Protective Devices** HS Code 8536

Figure 1-1. Total Value and Quantity of Imports
HS code 8536

All Countries, 1990-1995

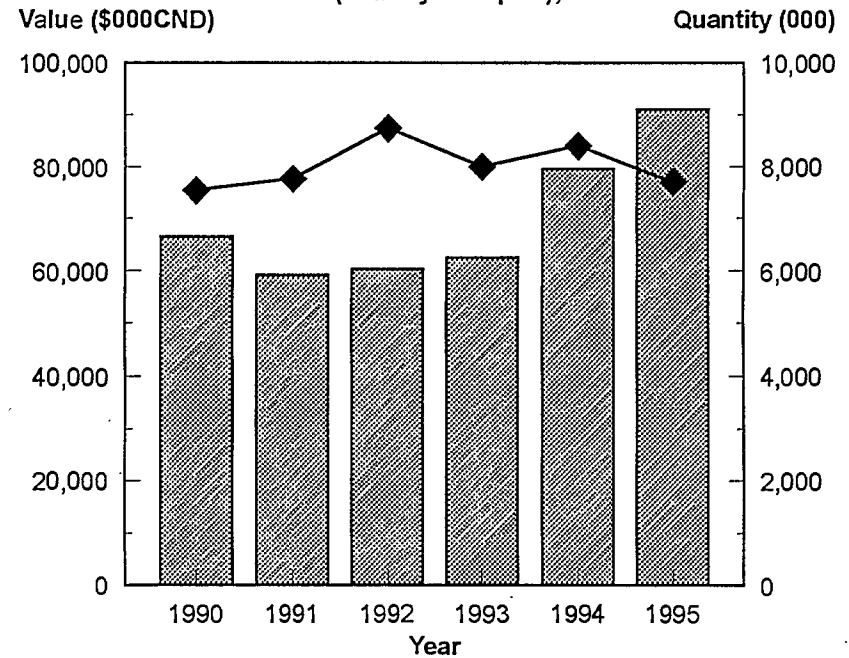


Value Quantity

Value: CAGR = 4.1%
 mean = \$98,255 thousand
 std. dev. = 13,584 thousand

Figure 1-2. Total Value and Quantity of Imports
HS code 8536

United States (country of export), 1991-1995



Value Quantity

Value: CAGR = 5.4%
 mean = \$69,830 thousand
 std. dev. = 11,664 thousand

Electrical Apparatus For Switching Fuses, Breakers, Overloads, and Protective Devices All Countries, 1990-1995 HS Code 8536

Figure 1-3. Percent Change in Total Value and Quantity of Imports

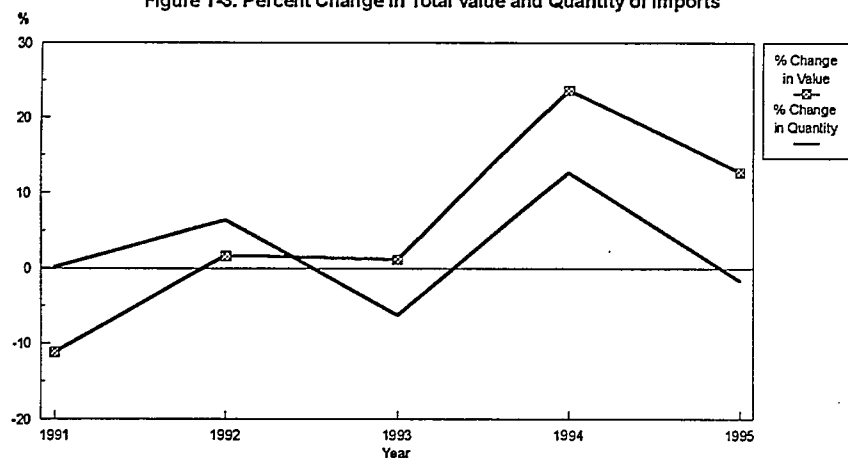


Figure 1-4. Quantity to Value Ratio

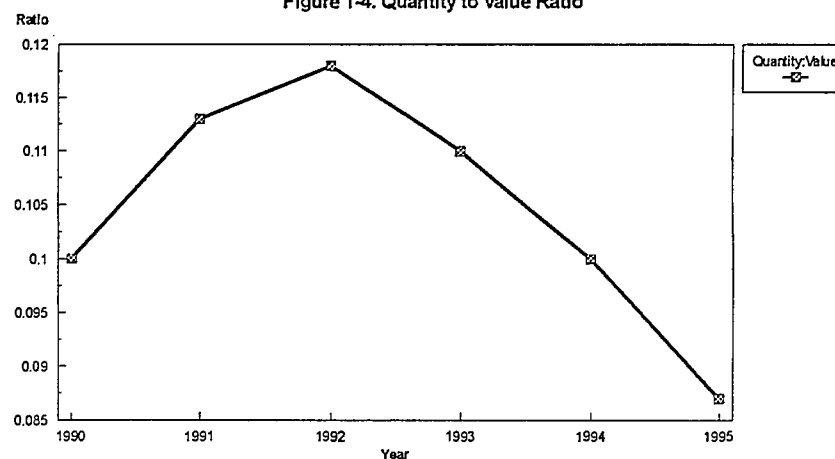
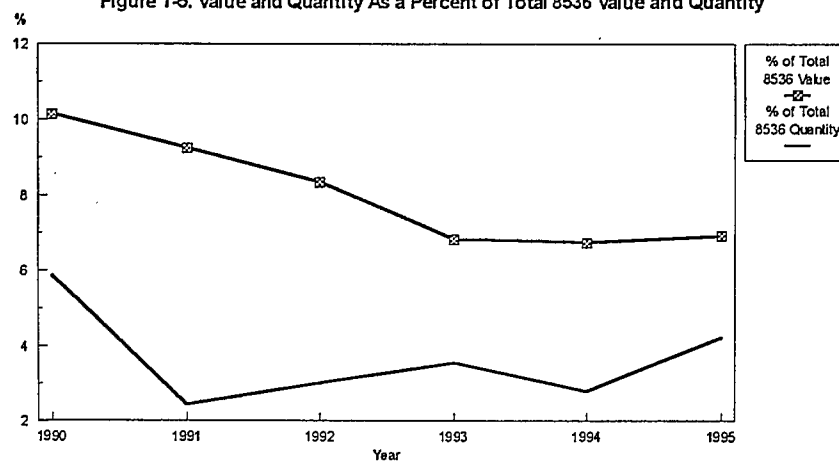


Figure 1-5. Value and Quantity As a Percent of Total 8536 Value and Quantity



Electrical Apparatus For Switching Fuses, Breakers, Overloads, and Protective Devices United States, 1990-1995 HS Code 8536

Figure 1-6. Percent Change in Total Value of Quantity of Imports

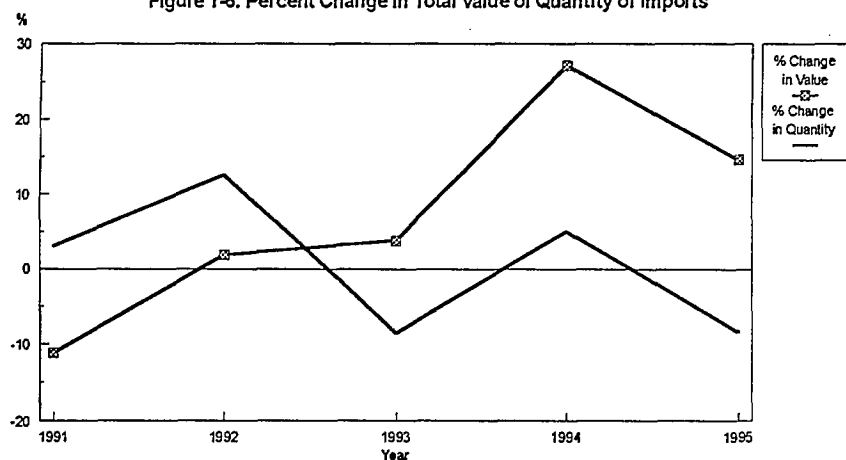


Figure 1-7. Quantity to Value Ratio

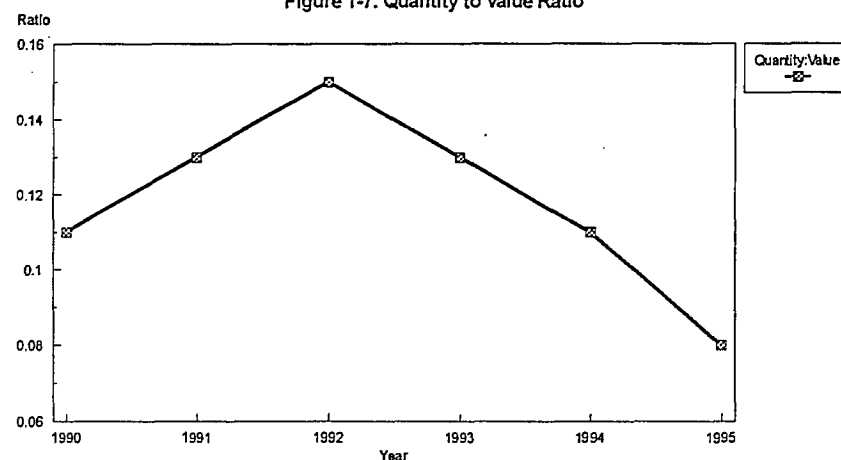
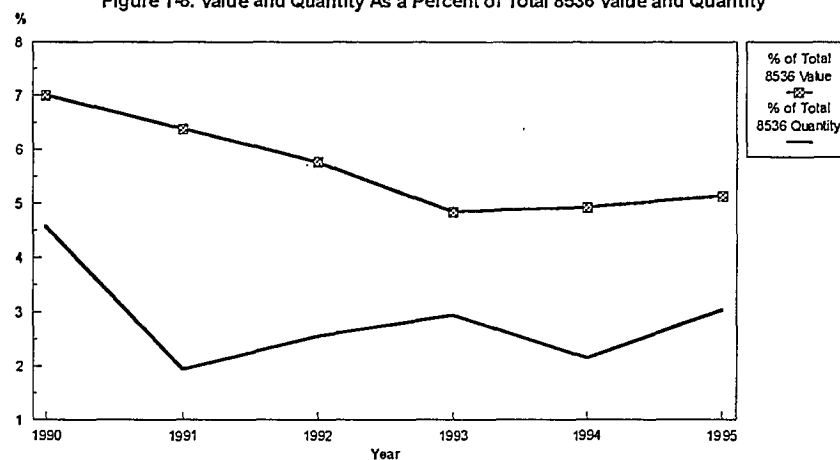


Figure 1-8. Value and Quantity As a Percent of Total 8536 Value and Quantity



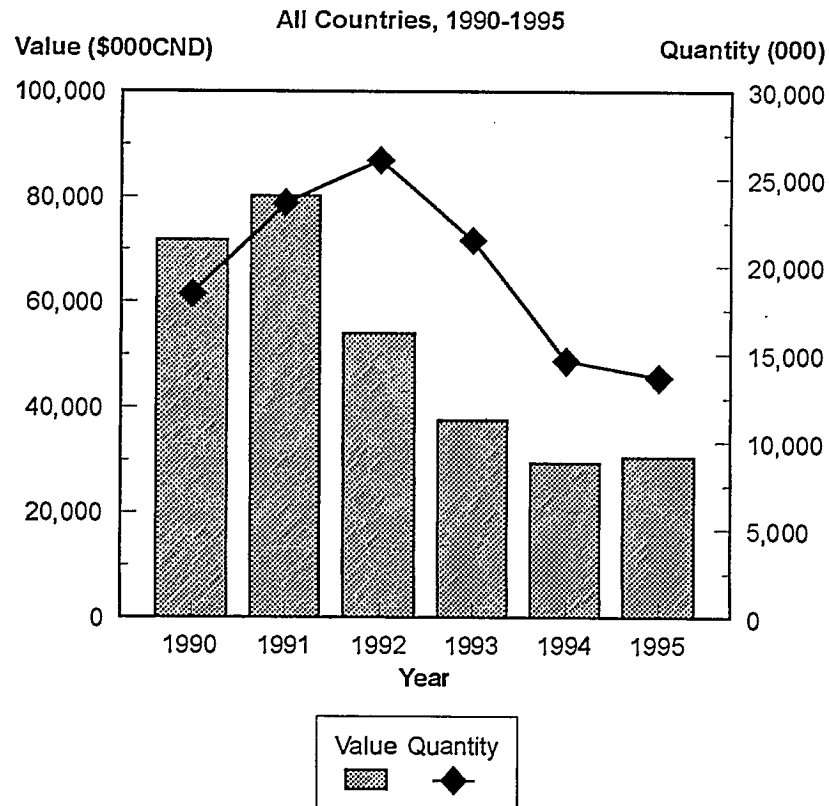
OVERVIEW - RELAYS (LESS THAN 10 AMPS)

DC Solid state relays have been developed which reduce on resistance with values equivalent or better than conventional devices and it is forecast that electrical apparatus for switch relays will be used increasingly in medium power switched applications. Micro-machined versions of electromechanical relays present an opportunity for microelectronics' firms working on the integration of electronic packages or integrated circuits.

The import level of relays has shown a decline in growth both in quantity and value. This can be probably attributed to the fact that solid state devices are replacing their electromagnetic equivalents, particularly in the low power range. Increasingly sophisticated logic functions are also decreasing the need for discrete relays in many industrial applications.

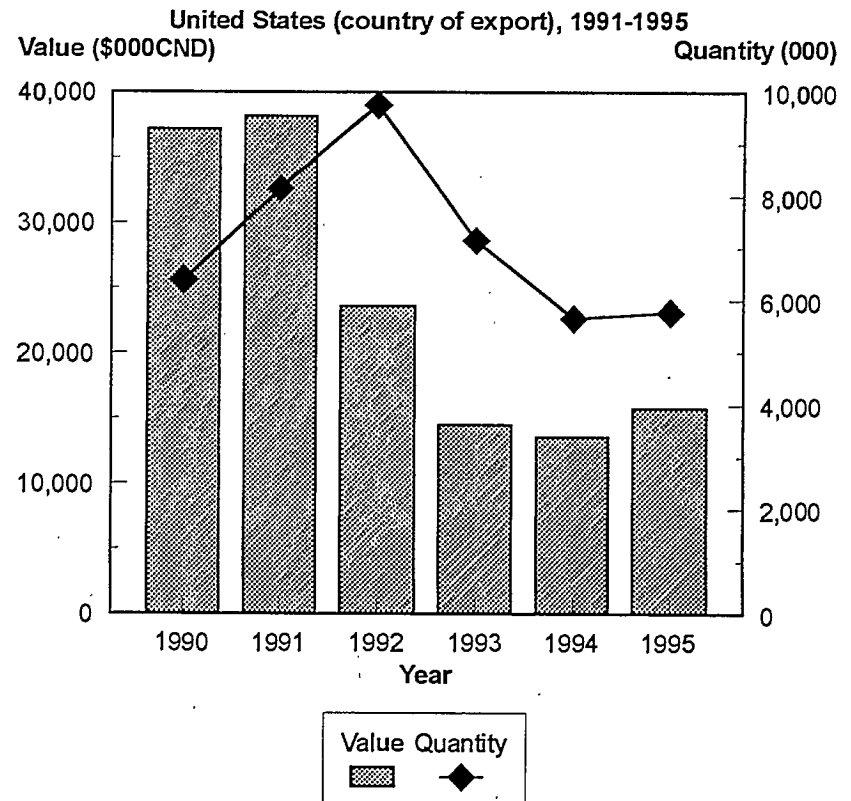
Electrical Apparatus For Switching Relays < 10 Amps HS Code 8536

Figure 2-1. Total Value and Quantity of Imports
HS code 8536



Value: CAGR = -13.3%
mean = \$50,545 thousand
std. dev. = 19,809 thousand

Figure 2-2. Total Value and Quantity of Imports
HS code 8536



Value: CAGR = -13.3%
mean = \$23,768 thousand
std. dev. = 10,333 thousand

Electrical Apparatus For Switching Relays < 10 Amps All Countries, 1990-1995 HS Code 8536

Figure 2-3. Percent Change in Total Value and Quantity of Imports

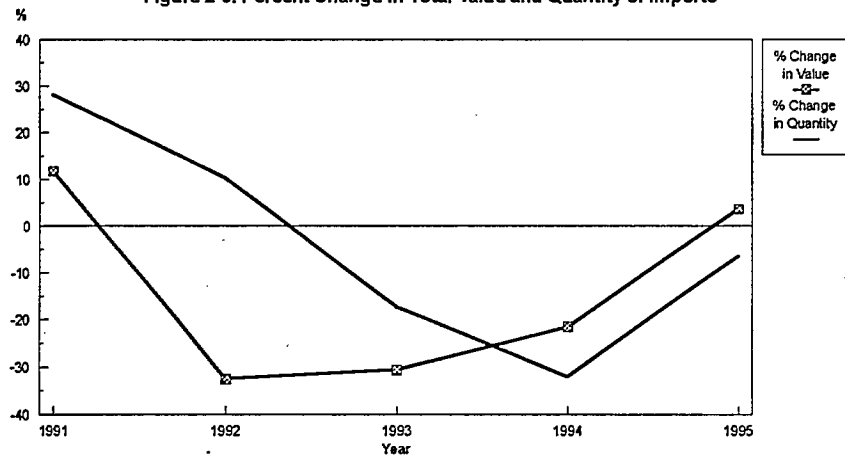


Figure 2-4. Quantity to Value Ratio

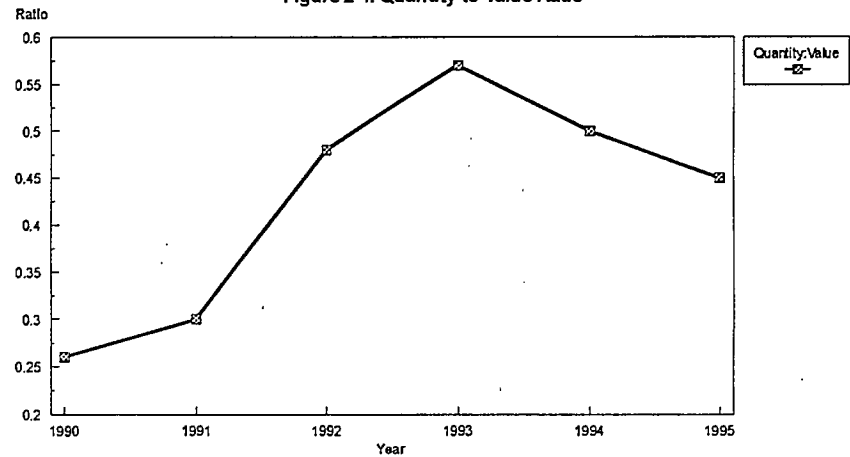


Figure 2-5. Value and Quantity As a Percent of Total 8536 Value and Quantity



Electrical Apparatus For Switching Relays < 10 Amps United States, 1990-1995 HS Code 8536

Figure 2-6. Percent Change in Total Value of Quantity of Imports

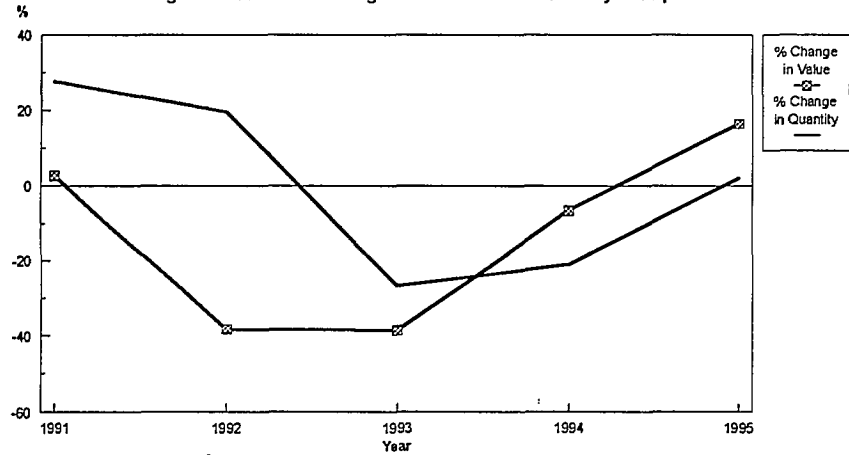


Figure 2-7. Quantity to Value Ratio

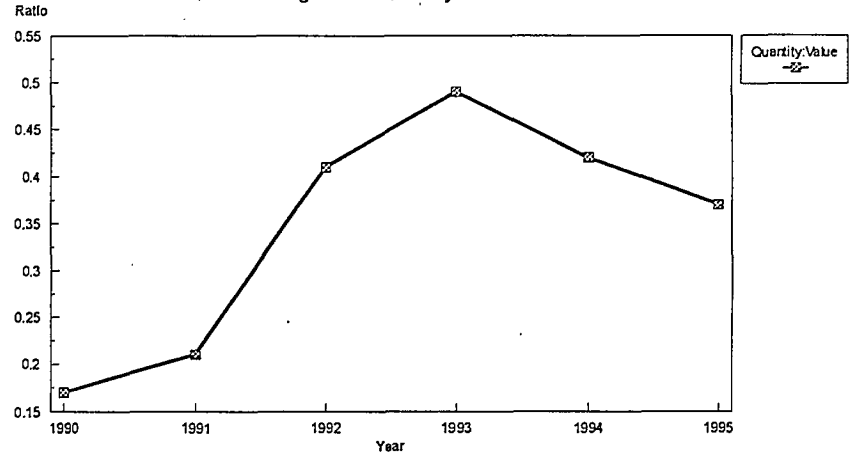
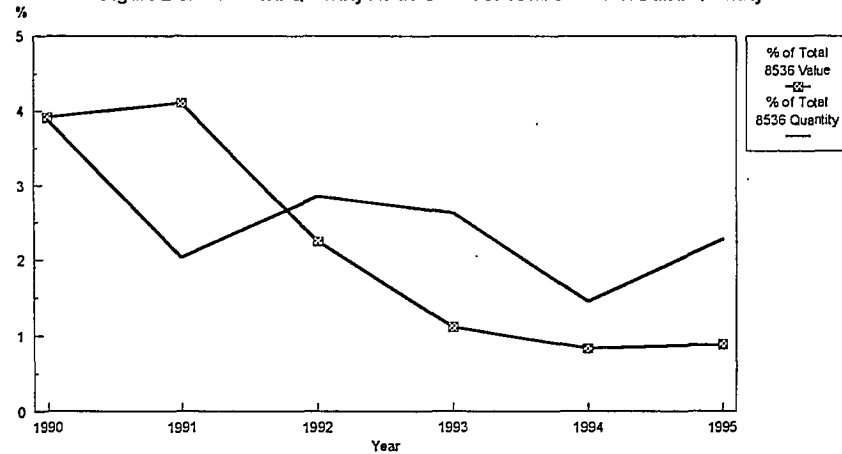


Figure 2-8. Value and Quantity As a Percent of Total 8536 Value and Quantity

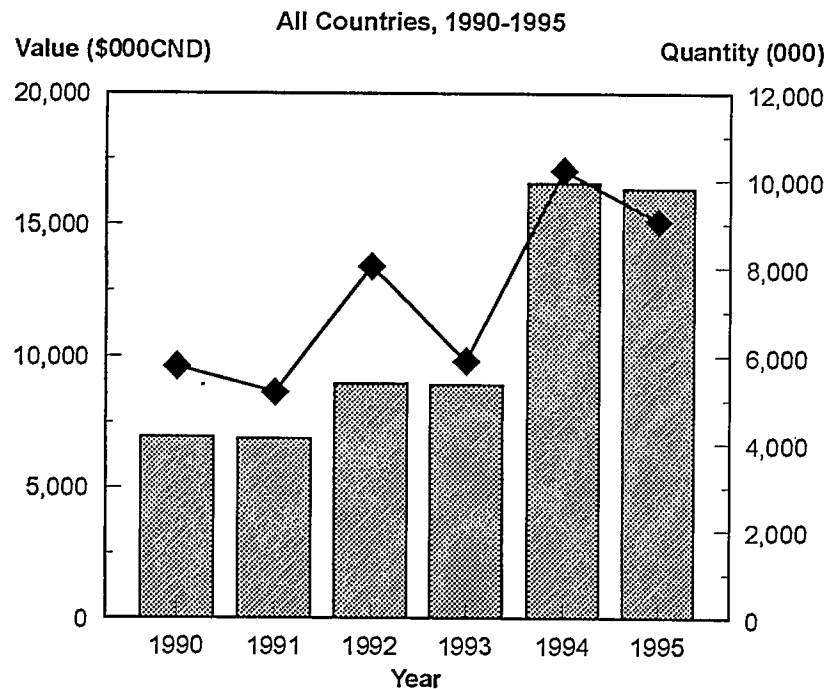


OVERVIEW - COAXIAL CONNECTORS (≤ 1000 VOLTS)

Coaxial connectors are forecast to have limited growth potential. With the CATV market forecast to face increasing competition from new broadcast technologies and higher frequencies required to propagate signals at the new spectrum allocations, it is forecast that the level of imports in this product category will not rise significantly in Canada due to the emergence of new technologies. The coefficient of variation is relatively high and the quantity to value ratio does not figure as a significant parameter to gauge the level of price performance in this product category.

Electrical Apparatus For Switching Coaxial Connectors HS Code 8536

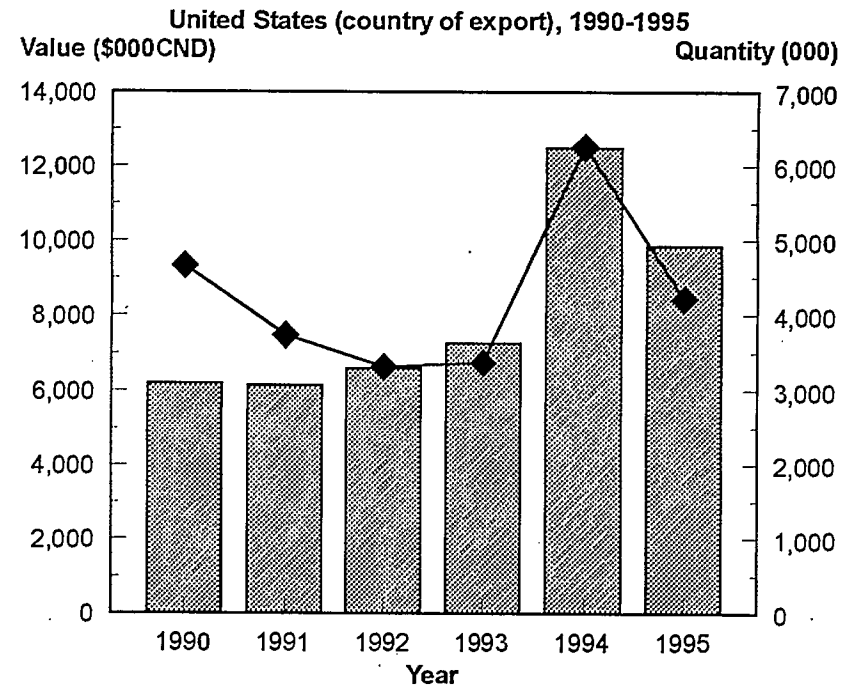
Figure 3-1. Total Value and Quantity of Imports
HS code 8536



Value Quantity

Value: CAGR = 15.3%
 mean = \$10,765 thousand
 std. dev. = 4,104 thousand

Figure 3-2. Total Value and Quantity of Imports
HS code 8536



Value Quantity

Value: CAGR = 8.1%
 mean = \$8,088 thousand
 std. dev. = 2,337 thousand

Electrical Apparatus For Switching Coaxial Connectors All Countries, 1990-1995 HS Code 8536

Figure 3-3. Percent Change in Total Value and Quantity of Imports

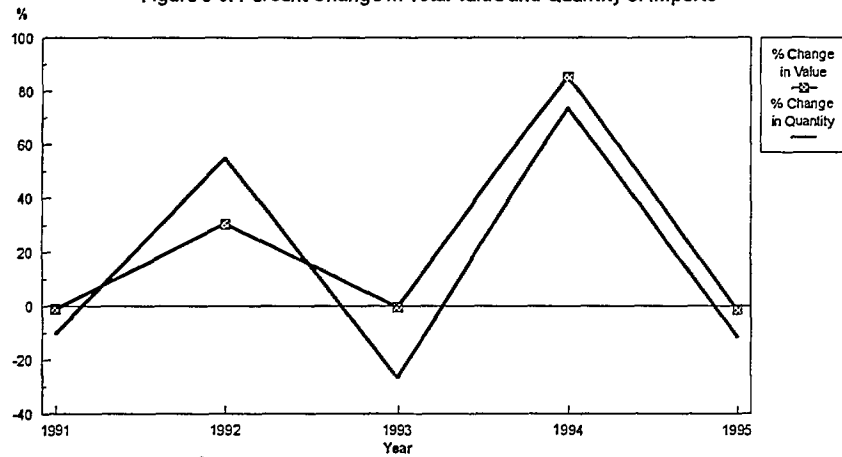


Figure 3-4. Quantity to Value Ratio

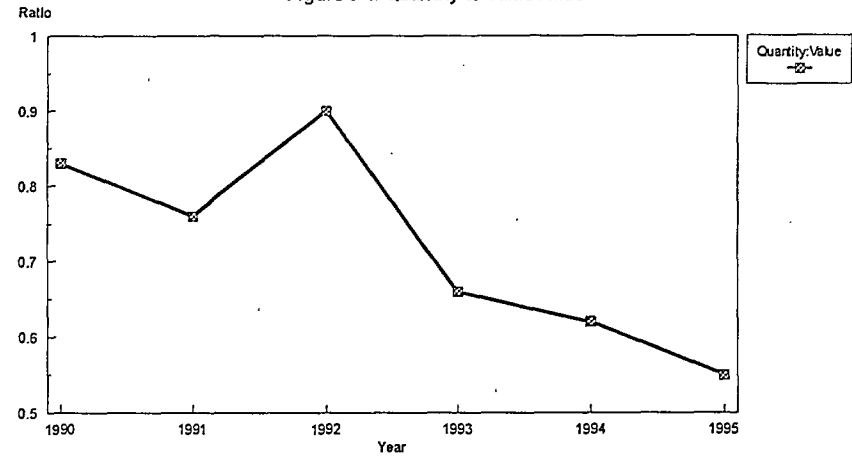
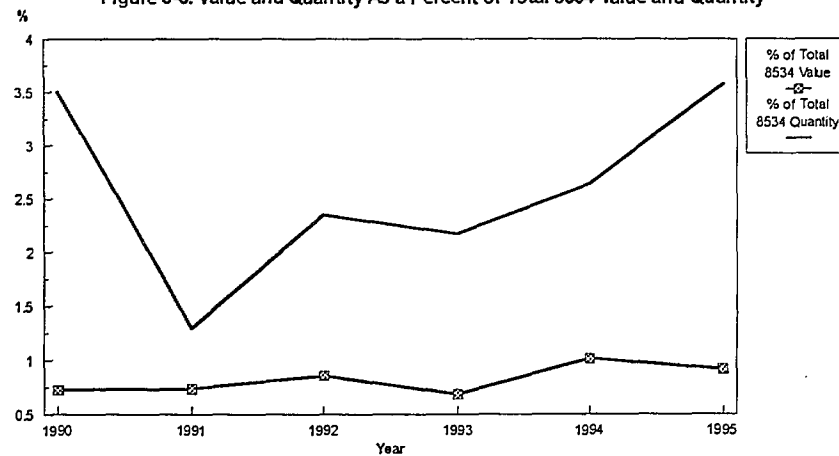


Figure 3-5. Value and Quantity As a Percent of Total 8534 Value and Quantity



Electrical Apparatus For Switching Coaxial Connectors United States, 1990-1995 HS Code 8536

Figure 3-6. Percent Change in Total Value of Quantity of Imports

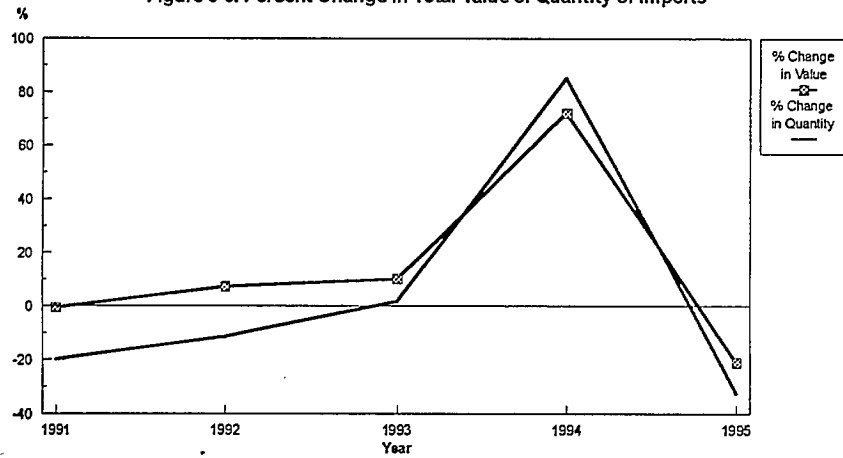


Figure 3-7. Quantity to Value Ratio

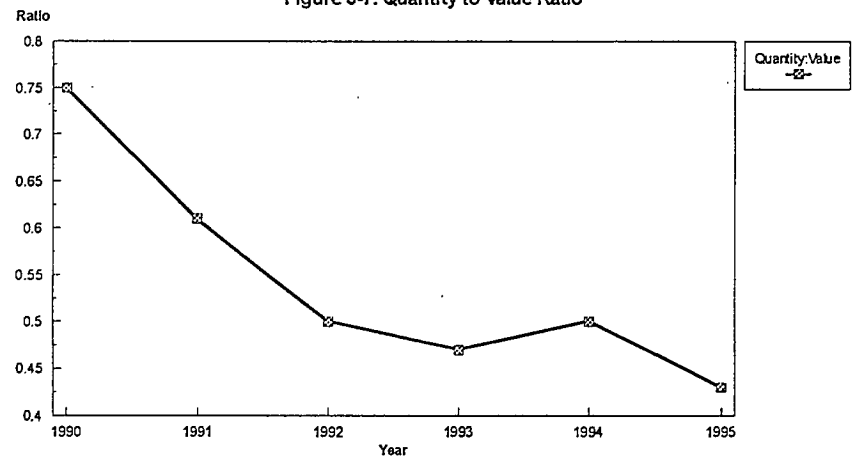
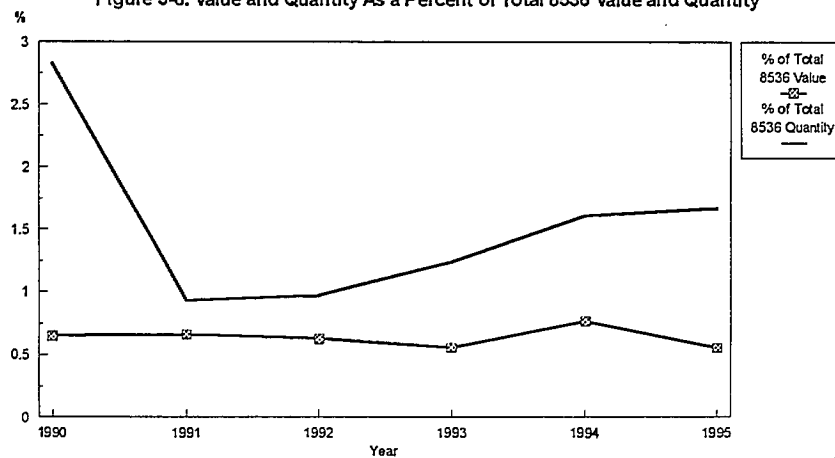


Figure 3-8. Value and Quantity As a Percent of Total 8536 Value and Quantity



OVERVIEW - PRINTED CIRCUIT CONNECTORS

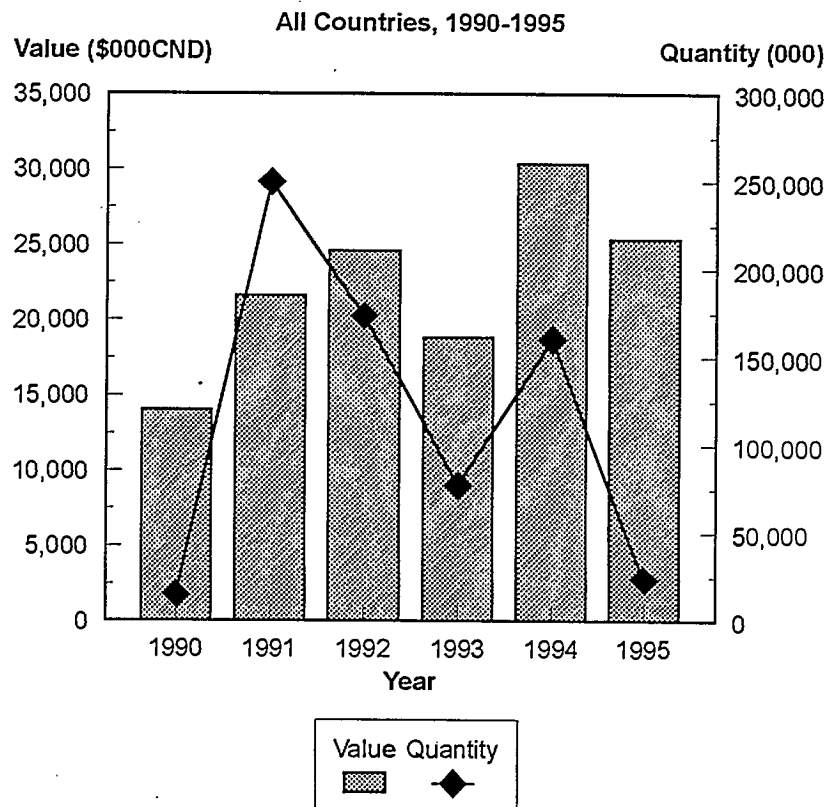
The printed circuit market was over \$1.6 Billion in 1994 and there are over 40 merchant suppliers of printed circuit boards. Connectors are considered parts incorporated along with printed circuit boards and a correlation exists between the two markets, for example in 1993 both products were experiencing some of the downturn the economy was experiencing. In 1994 the level of imports reflected the upturn in economy in the two product categories: Interconnect product imports are closely aligned to manufacturing output in the IT sector, the United States is the only significant exporter of these products, where some intracompany transfers occur from United States producers to their Canadian manufacturing affiliates. The value of imports is expected to continue increasing to meet the requirements of producers' shipments.

The growth in the electronic connector market will be lead by the computer, telecommunications and industrial instrumentation market in Canada. Sales of connectors are estimated and are expected to grow, if Canadian trends are patterned after North American sales which are predicted to expand by 10 % in 1997. The foreign market share in Canada is marked by significant variation particularly with respect to quantity of import levels for the period defined.

The trend in connectors is towards high bandwidth devices capable of large bit capacity. Typically fibre optic connectors are being utilized in these applications and all indicators are that this is burgeoning market. Certain Canadian firms have capability in this area and this could explain the drop in quantity of imports, in what is construed to be a growth market.

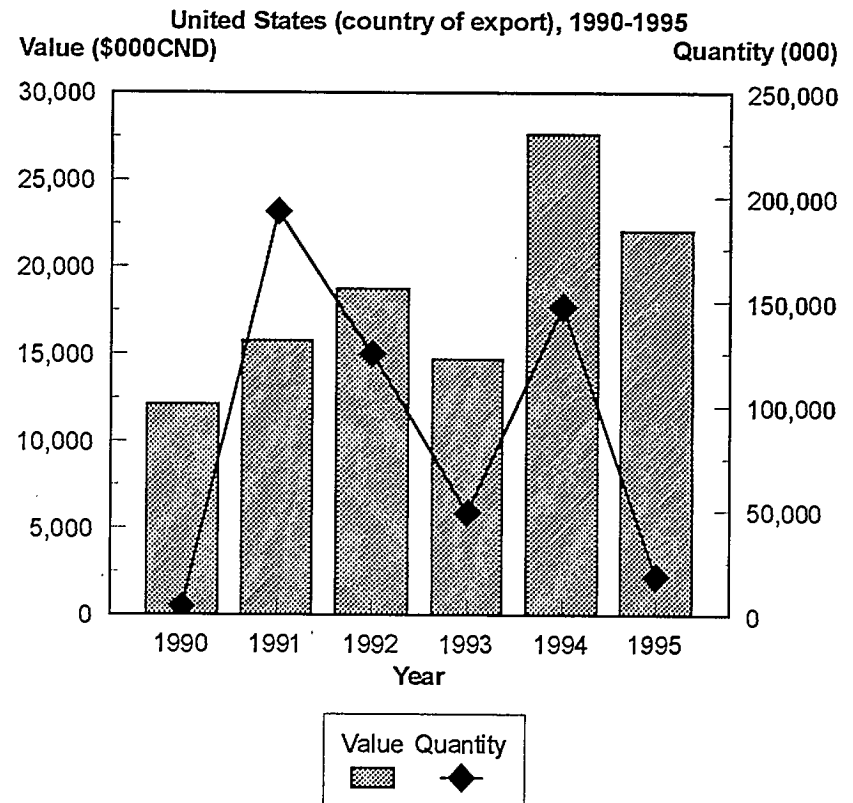
Electrical Apparatus For Switching Printed Circuit Connectors HS Code 8536

Figure 4-1. Total Value and Quantity of Imports
HS code 8536



Value: CAGR = 10.4%
mean = \$22,461 thousand
std. dev. = 5,178 thousand

Figure 4-2. Total Value and Quantity of Imports
HS code 8536



Value: CAGR = 10.5%
mean = \$18,494 thousand
std. dev. = 5,138 thousand

Electrical Apparatus For Switching Printed Circuit Connectors All Countries, 1990-1995 HS Code 8536

Figure 4-3. Percent Change in Total Value and Quantity of Imports

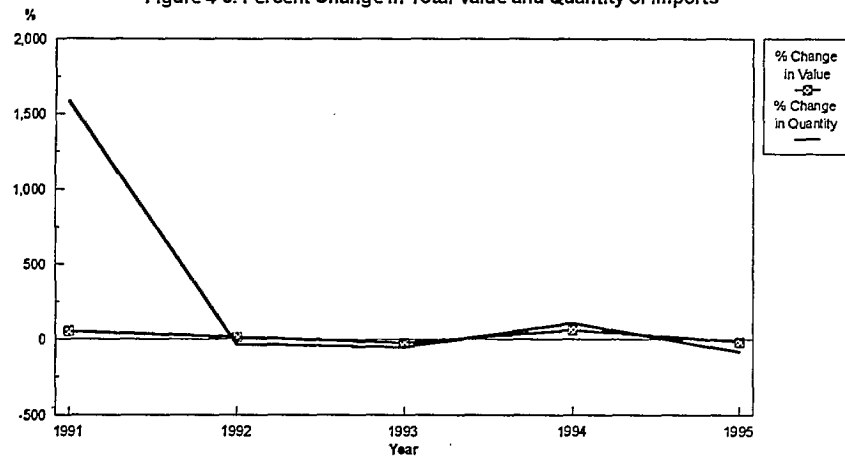


Figure 4-4. Quantity to Value Ratio

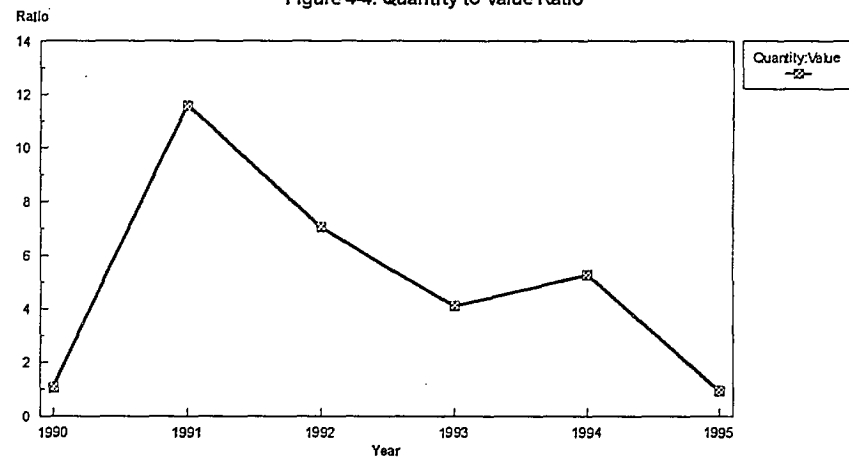
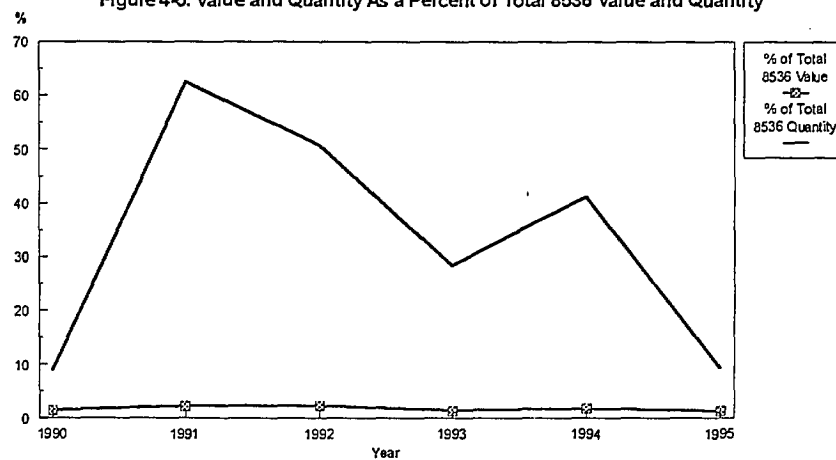


Figure 4-5. Value and Quantity As a Percent of Total 8536 Value and Quantity



Electrical Apparatus For Switching Printed Circuit Connectors

United States, 1990-1995

HS Code 8536

Figure 4-6. Percent Change in Total Value of Quantity of Imports

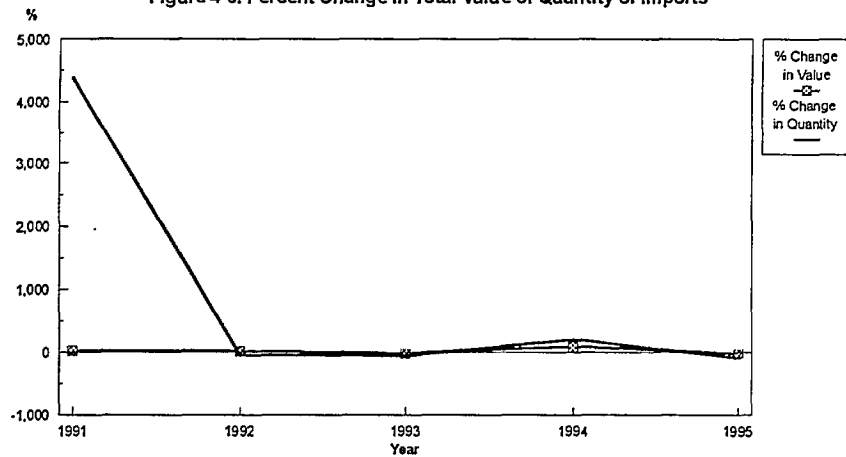


Figure 4-7. Quantity to Value Ratio

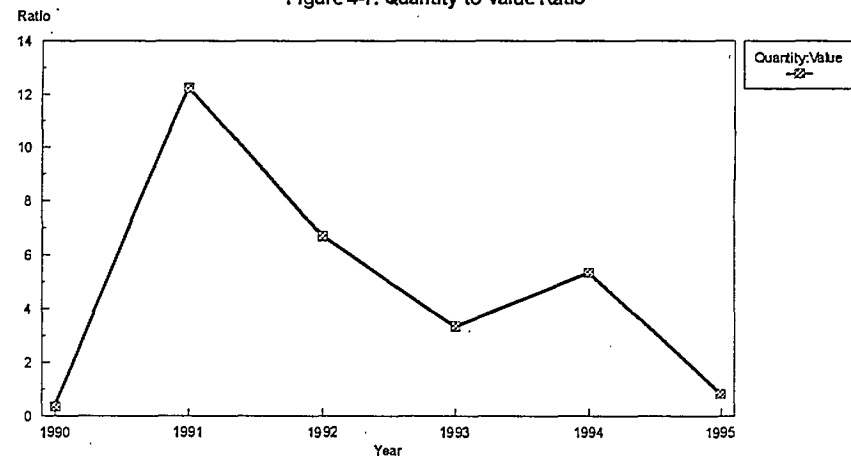
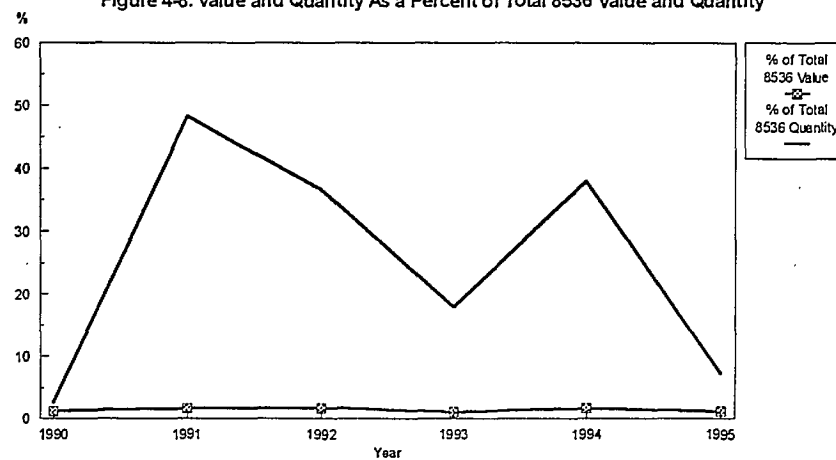
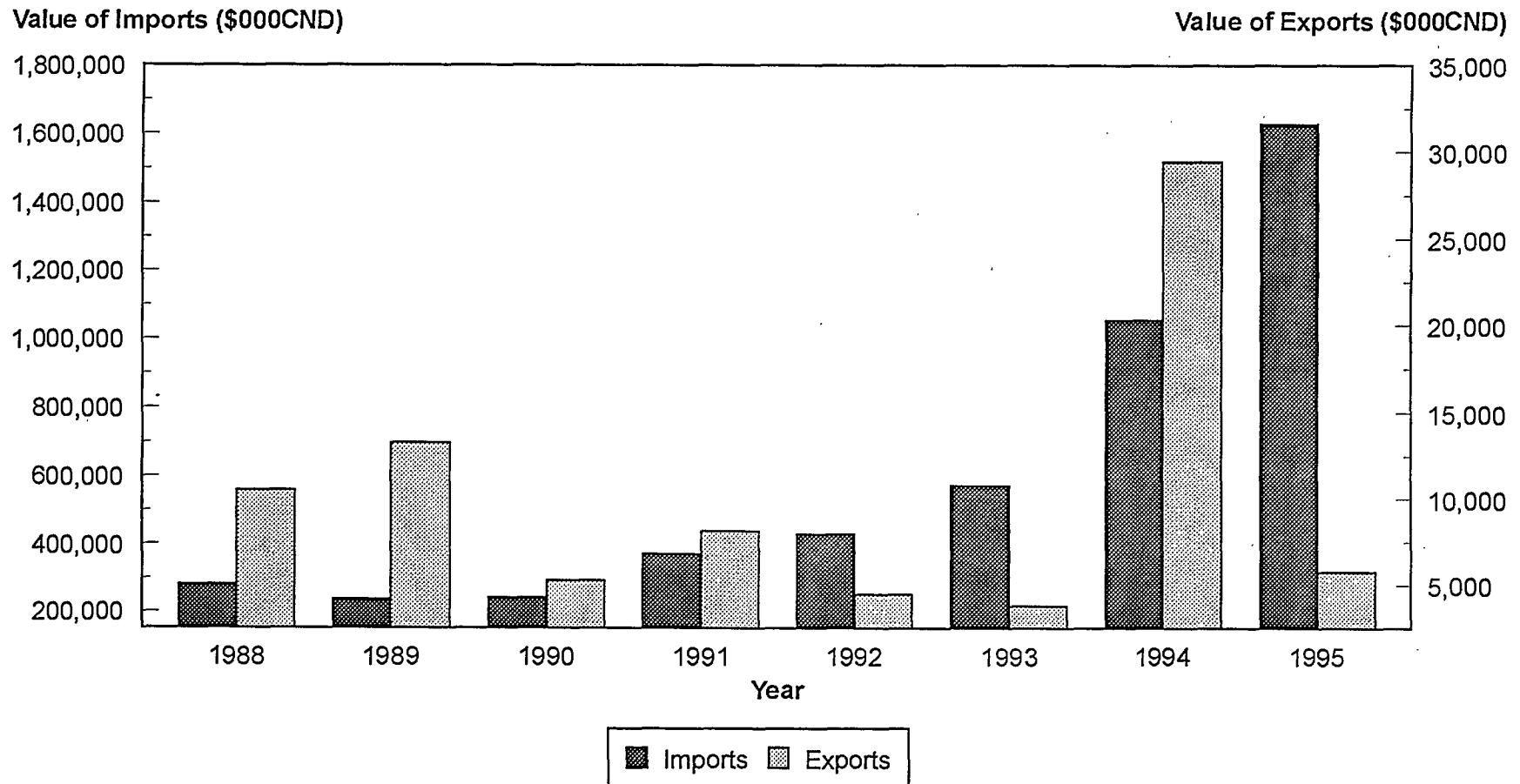


Figure 4-8. Value and Quantity As a Percent of Total 8536 Value and Quantity



Canadian Trade in Semiconductors Imports and Exports: Japan, 1988-1995

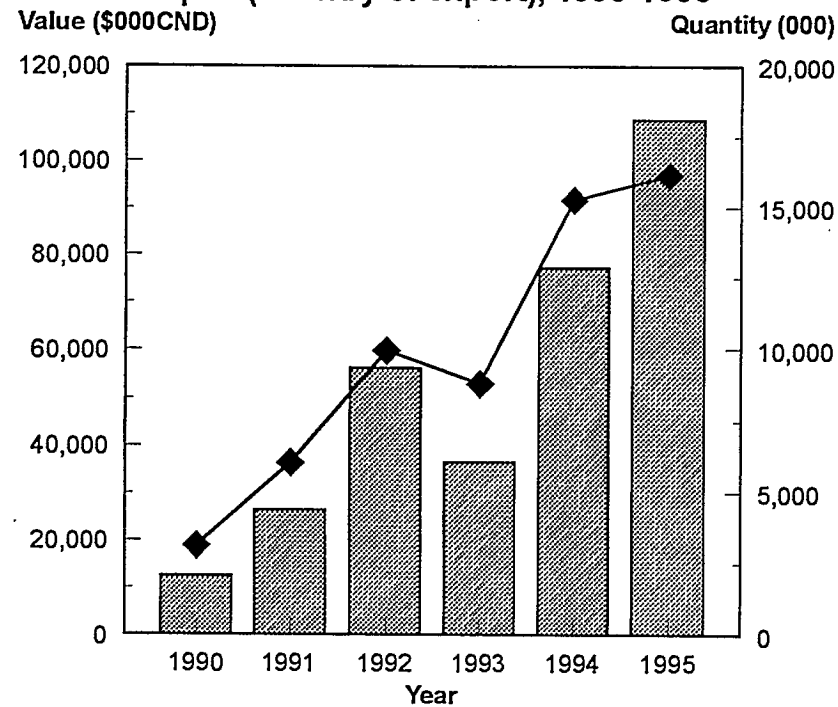


HS Codes: 8532, 8533, 8534, 8536, 8541, 8542

Value of Imports, CAAGR (Compounded average annual growth rate) = 24.6%

Monolithic Integrated Circuits
Unmounted Chips, Dies, or Wafers
HS Code 8542

Figure 1-1. Total Value and Quantity of Imports
Japan (country of export), 1990-1995

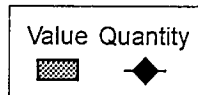
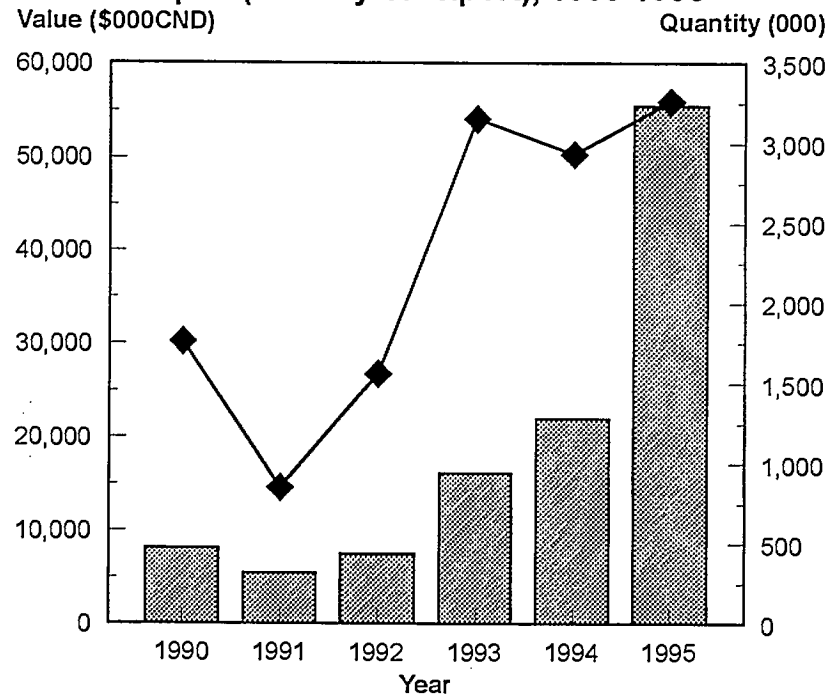


Value Quantity
■ ◆

Value: CAGR = 43.4%
mean = \$52,921 thousand
std. dev. = 32,433 thousand

Monolithic Integrated Circuits
BIPOLAR
HS Code 8542

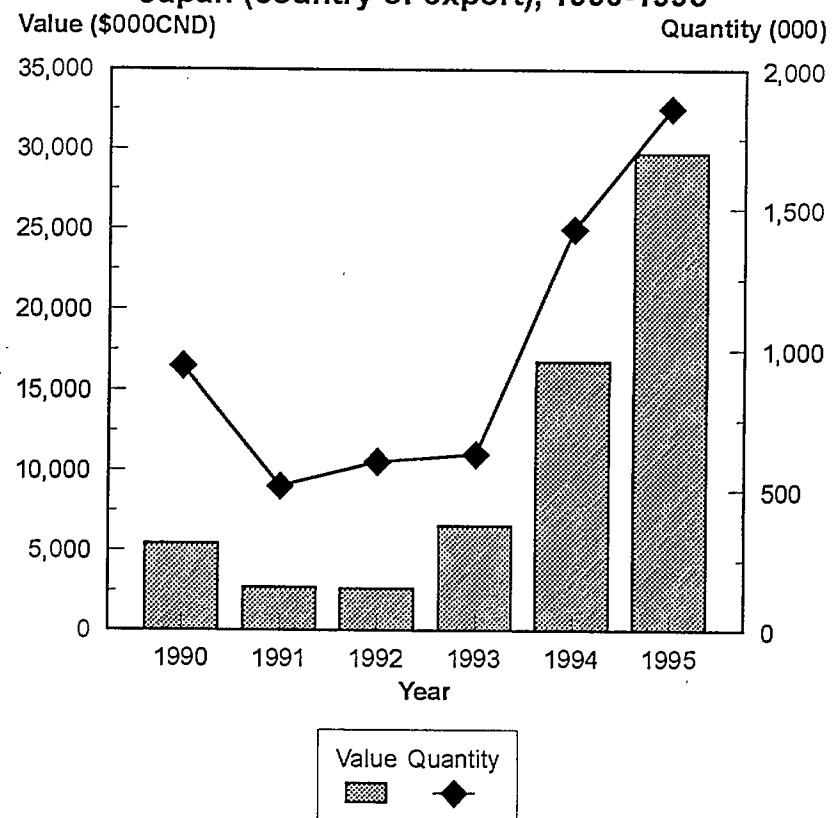
Figure 2-1. Total Value and Quantity of Imports
Japan (country of export), 1990-1995



Value: CAGR = 37.7%
mean = \$19,103 thousand
std. dev. = 17,230 thousand

Monolithic Integrated Circuits
Microprocessors
HS Code 8542

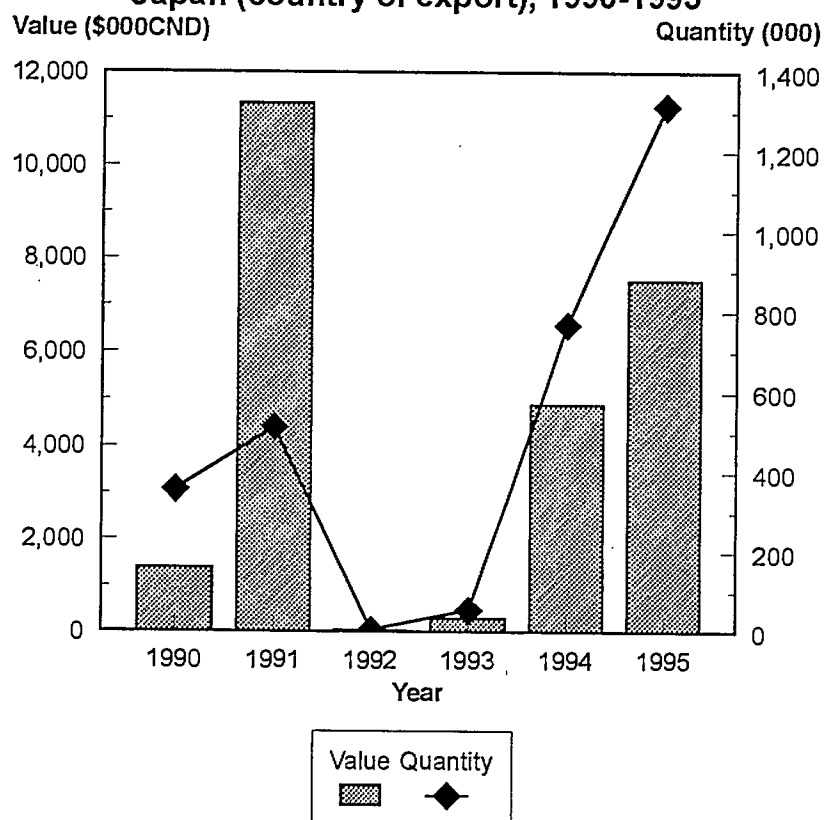
Figure 3-1. Total Value and Quantity of Imports
Japan (country of export), 1990-1995



Value: CAGR = 32.9%
mean = \$10,622 thousand
std. dev. = 9,782 thousand

Monolithic Integrated Circuits
BiCMOS
HS Code 8542

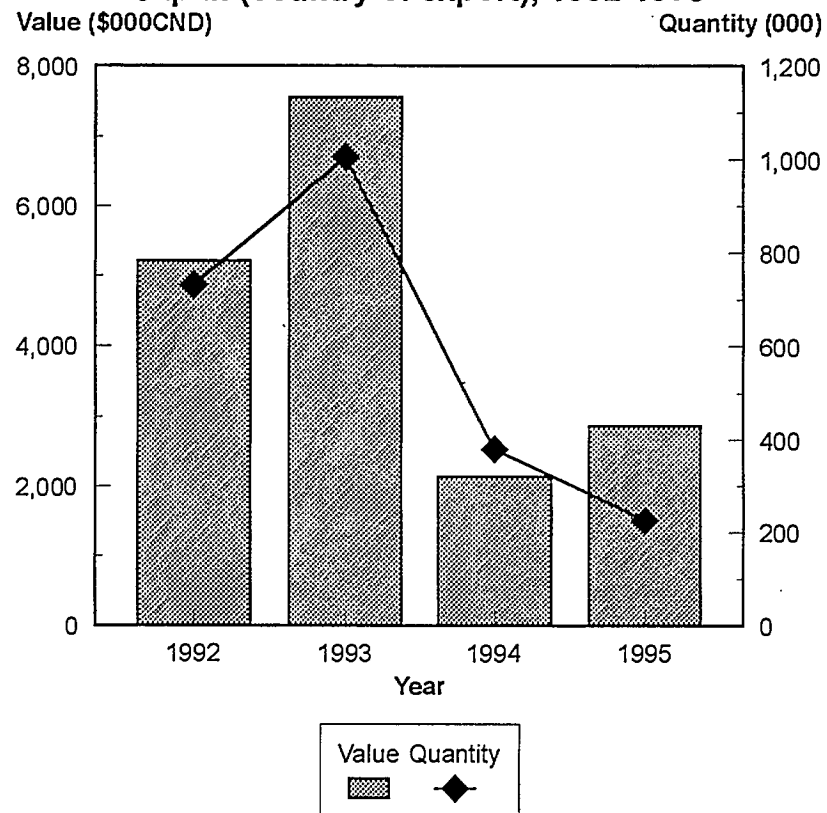
Figure 4-1. Total Value and Quantity of Imports
Japan (country of export), 1990-1995



Value: CAGR = 32.7%
mean = \$4,243 thousand
std. dev. = 4,145 thousand

Monolithic Integrated Circuits
EEPROM/EPROM
HS Code 8542

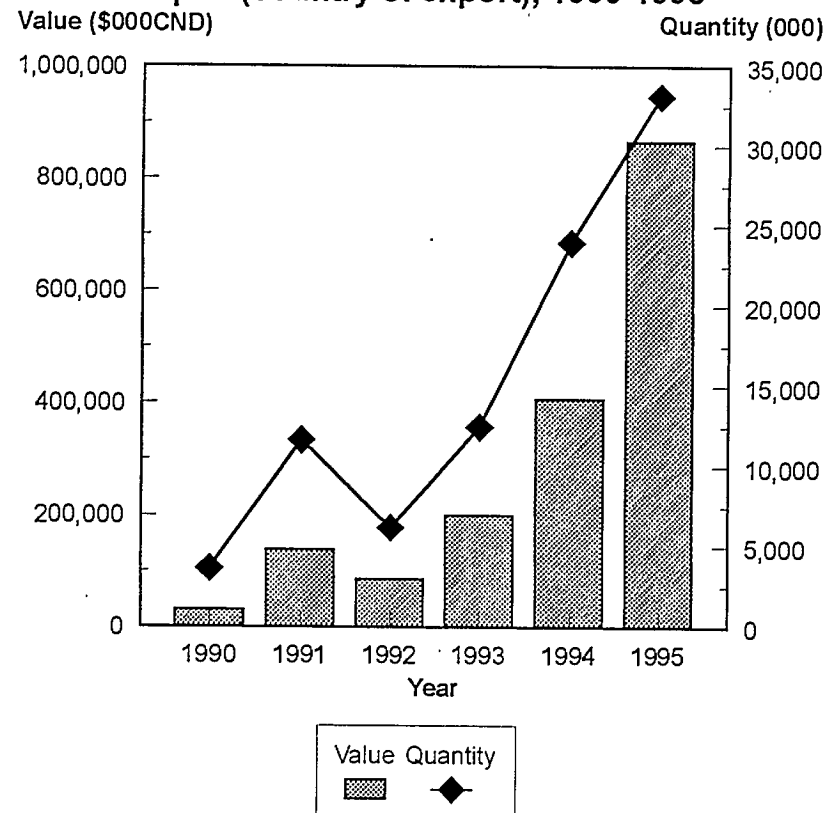
Figure 5-1. Total Value and Quantity of Imports
Japan (country of export), 1992-1995



Value: CAGR = -13.9%
mean = \$4,447 thousand
std. dev. = 2,123 thousand

Monolithic Integrated Circuits
MOS RAM FET
HS Code 8542

Figure 6-1. Total Value and Quantity of Imports
Japan (country of export), 1990-1995



Value: CAGR = 74.9%
mean = \$287,681 thousand
std. dev. = 284,572 thousand

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Market intelligence : electr

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