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# CANADA'S TRADE PERFORMANCE IN ADVANCED TECHNOLOGY PRODUCTS

DOYLETECH

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# IN ADVANCED TECHNOLOGY PRODUCTS

Prepared by

Denzil J. Doyle
and
Paul Timmins
Doyletech Corporation



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## EXECUTIVE SUMMARY

Recent attempts to measure Canada's trade performance in advanced technology products (ATP's) have been unsuccessful primarily because of a lack of consensus on what constitutes an advanced technology product. This report describes an analysis that was done on the country's imports and exports of products grouped into ten categories that are used by the United States Department of Commerce to report on that country's ATP trade with the rest of the world. Since it is based primarily on the classification of products as opposed to industry sectors (there is a second U.S. system in place that is based on industry sectors) it seems to offer a suitable framework for analysing Canada's ATP trade.

One recent attempt at such an analysis was based on a 6-digit version of a 10-digit coding system that is used by the U.S. This analysis is based on a full 10-digit system. It presents a somewhat different picture of Canada's trade in ATP's than that presented in the 6-digit analysis or in previous analyses which were based on other definitions of ATP's such as a system used by the Organization for Economic Cooperation and Development (OECD).

The following are the major differences:

1. Canada's overall annual trade deficit is in the $6B range instead of $11B. However, it is growing at about 50% per year instead of a previously estimated 29%.
2. Its balance of trade with the U.S. is considerably less negative than expected (in fact it was positive in 1994) but its balance with countries outside of Japan and Europe is considerably more negative and is growing more rapidly.
3. Canada's exports to the U.S. are growing steadily (as are its imports) but its exports to all other countries are not showing any significant growth.
4. Canada's best performing sector in terms of consistent positive trade balances has been Aerospace.
5. Its best performing sector in terms of trade growth (both imports and exports) has been Information and Communication. However, its deficit in this sector was $2.5B in 1994.
6. Its worst performing sector in terms of trade deficit is Electronics ($3.8B deficit in 1994).

In terms of economic impact, an eradication of Canada's overall trade deficit of $5.8B in 1994 could have resulted in:

a) An additional 40,000 direct jobs in disciplines such as engineering, manufacturing, selling, and marketing.
b) An additional 120,000 indirect jobs in supporting industries such as financial services, travel, advertising and consulting.
c) An additional $1.2B of tax revenues.
d) An annual increase of $600M in industrial R & D expenditures.

It is proposed that a quarterly reporting system be implemented that would inform both the public and private sectors on Canada's performance as an ATP trading nation. It would facilitate policy making in the public sector and improve the dialogue between the two sectors.

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## 1. INTRODUCTION

The relationship between science and technology and wealth creation is not well understood in Canada. Over the years, the amount of money spent on R & D as a percentage of the country's gross national product has been closely monitored. The ratio of private sector expenditures to public sector expenditures has also been the subject of much attention. The country's incentives for scientific research and development are among the most lucrative in the industrialized world, but its R & D expenditures in the private sector are still quite low relative to its major trading partners.

One of the reasons for this is that Canada has a private sector that does not need much R & D. Firms that simply use high technology products and services to solve problems in low and medium technology industries do not do as much R & D as those that actually produce the high technology products and services. Canada derives the majority of its gross domestic product and its exports from low and medium technology industries.

While policy makers and the scientific community pay close attention to the R & D parameters, they pay less attention to the country's ability to supply and export technology-based products. One of the reasons for this is a perceived difficulty in defining high technology products and of measuring their fair market value as they cross borders. Another is the proliferation of classification systems. Another is the rapidly changing nature of advanced technology products. Such systems require frequent reviews and upgrading. Even though product trade statistics will always be inexact, they have the potential of indicating whether or not Canada's industrial infrastructure is changing in a direction that would require more R & D.

This report will present the results of an analysis that was carried out on Canada's trade performance in ten specific product categories between 1990 and 1994. Those ten categories are identical to those used by the U.S. Department of Commerce to define advanced technology products (ATP's) in its so-called ATP classification system.

It should be pointed out that there is another classification system in use within the U.S. Department of Commerce known as the DOC 3 system. The main difference between the two is that the ATP system is based primarily on product classifications whereas the DOC 3 system is based primarily on industry sector classifications. The latter suffers from the deficiency that a product that would normally be a low or medium technology product might be classified as a high-technology product simply because it was produced within a high-technology sector.

When the two systems were applied to U.S. trade in high-technology products, that country's trade surplus with the rest of the world was much higher with the ATP system than with the DOC 3 system[1]. This is to be expected since it reflects the fact that the U.S. has lost world market share in low and medium-technology products in recent years. Both systems suggest that the U.S. has been gaining market in high-technology products and now has a healthy trade surplus.

The ATP classifications are as follows:

- **Biotechnology** - the medical and industrial application of advanced scientific discoveries in genetics to the creation of new drugs, hormones and other therapeutic items for both agricultural and human use.
- **Life Sciences** - the application of scientific advances (other than biological) to medical science. Recent advances, such as nuclear resonance imaging, echocardiography, and novel chemistry coupled with new production techniques for the manufacture of drugs have led to many new products for the control or eradication of disease.
- **Opto-Electronics** - encompasses electronic products and components that involve the emitting and/or detection of light. Examples of products included are optical scanners, optical disc players, solar cells, photo-sensitive semiconductors and laser printers.

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(1) Measuring the Trade in Advanced Technology Products
Abbott, McGuckin, Herrick and Norfolk

- **Information and Communications** - focuses on products that are able to process increased volumes of information in shorter periods of time. Includes central processing units, all computers, and some peripheral units such as disk drive units and control units, along with modems, facsimile machines, telephonic switching apparatus and non-customized software. Examples of other products included are radar apparatus and communications satellites.
- **Electronics** - concentrates on recent design advances in electronic components (with the exception of opto-electronic components) that result in improved performance and capacity and in many cases reduced size. Products included are integrated circuits, multi-layer printed circuit boards, and surface-mounted components such as capacitors and resistors.
- **Flexible Manufacturing** - encompasses advances in robotics, numerically-controlled machine tools, and similar products involving industrial automation that allow for greater flexibility to the manufacturing process and reduce the amount of human intervention. Includes robots, numerically-controlled machine tools and semiconductor production and assembly machines.
- **Advanced Materials** - encompasses recent advances in the development of materials that allow for further development and application of other advanced technologies. Examples are semiconductor materials, optical fibre cable and video discs.
- **Aerospace** - Encompasses most new military and civil helicopters, airplanes and spacecraft (with the exception of communications satellites that are included under Computer and Telecommunications Technology). Other products included are turbojet aircraft engines, flight simulators, and automatic pilots.
- **Weapons** - primarily encompasses products with military application. Includes such products as guided missiles and parts, bombs, torpedoes, mines, missile and rocket launchers and some firearms.
- **Nuclear Technology** - encompasses nuclear power production apparatus. Includes nuclear reactors and parts, isotopic separation equipment and fuel cartridges. Nuclear medical apparatus is included under Life Science Technology.

This list differs significantly from one that has been used by the Organization of Economic Cooperation and Development (OECD). It is based primarily on the R & D intensity of the industry sectors that produced the products. The OECD classification lost its appeal because it did not take into account emerging technologies such as advanced materials and software. The U.S. list also has its deficiencies; software is still not addressed specifically as an industry.

Nevertheless, because the U.S. is Canada's largest trading partner and because it is tracking its trade on a regular basis by these ten categories, it would seem reasonable that Canada should do the same.

It should be emphasized that the analysis to be described in this report refers only to products and not to services.

## 2. THE MEASUREMENT METHODOLOGY

An attempt to develop a Canadian ATP equivalent of the U.S. system was carried out in 1994 by Robert Squires for Industry Canada's Secretariat for Science and Technology Review. Its results were published in the Resource Book for Science and Technology Consultations (Vol II) in August 1994. (ISBN 0-662-22492-2).

Those results differ significantly from those which will be presented in this report primarily because they were obtained by using a "truncated" version of the coding system that is used to define the U.S. products. The U.S. system is based on a ten-digit HS (Harmonized System) code while the Squires system was based on a six-digit version of that ten-digit system. The Canadian list was obtained by "cropping" the last four digits from the equivalent U.S. codes. This was done for a number of reasons, but primarily to accommodate the schedule of the Science and Technology Review.

The Squires report provided much valuable data such as trade trends in key categories and the contribution of ATP trade to Canada's total merchandise trade envelope, but it did not address the need to develop an equivalent Canadian ten-digit coding system that could be used for a periodic reporting system.

Such a ten-digit system was developed for this analysis. The first step in its development was to obtain the list of HS codes that was being used by the U.S. Department of Commerce to classify its imports and exports with Canada. These were then compared with similar lists used by Statistics Canada to track both its exports to the U.S. (An 8-digit system) and its imports from the U.S. (A 10-digit system). An iterative process was used to achieve concordance between the two systems. (See Appendix A for a discussion of the HS systems of coding for Advanced Technology Products.) The resultant 10-digit system was also used to analyse Canada's trade with other economic areas, namely Japan, EEC and Other.

## 3. THE RESULTS

The results of this analysis are listed in the attached tables for each of the ten ATP categories and are grouped as follows:

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## 3.1 Balance of Trade by Economic Area (1990-94)

| Canadian Balance (1994) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | ($180,157,601) | ($2,568,785) | ($21,671,022) | ($8,639,703) | ($213,037,111) |
| Life Sciences | ($592,643,239) | ($35,245,714) | ($105,302,433) | $32,453,253 | ($700,738,133) |
| Opto-Electronics | ($66,012,511) | ($35,622,422) | $11,945,092 | $8,656,514 | ($81,033,327) |
| Information & Communication | $122,983,541 | ($1,189,495,399) | ($20,862,686) | ($1,468,897,807) | ($2,556,272,351) |
| Electronics | ($159,546,055) | ($831,178,360) | ($524,110,151) | ($2,339,012,181) | ($3,853,846,747) |
| Flexible Manufacturing | ($534,176,540) | ($127,892,216) | ($86,661,696) | $68,471,110 | ($680,259,342) |
| Advanced Materials | ($69,650,530) | ($794,335) | $60,404,206 | $52,000,427 | $41,959,768 |
| Aerospace | $1,832,969,719 | $27,700,987 | $93,366,356 | $600,349,726 | $2,554,386,788 |
| Weapons | ($151,320,260) | ($5,405,315) | ($27,592,327) | ($11,509,549) | ($195,827,451) |
| Nuclear | ($51,303,447) | ($402,293) | ($4,140,292) | ($107,431,918) | ($163,277,950) |
| *Total* | $151,143,078 | ($2,200,903,852) | ($624,624,953) | ($3,173,560,128) | ($5,847,945,855) |

| Canadian Balance (1993) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | ($147,630,863) | ($4,003,783) | ($15,902,489) | ($8,136,155) | ($175,673,290) |
| Life Sciences | ($466,199,105) | ($10,850,602) | ($86,153,134) | $48,605,749 | ($514,597,092) |
| Opto-Electronics | ($24,153,690) | ($46,541,022) | $9,549,127 | ($50,779) | ($61,196,364) |
| Information & Communication | ($634,552,421) | ($1,119,667,391) | ($8,171,161) | ($964,039,982) | ($2,726,430,955) |
| Electronics | $310,311,345 | ($415,317,473) | ($174,170,406) | ($1,849,097,919) | ($2,128,274,453) |
| Flexible Manufacturing | ($334,465,725) | ($161,210,975) | ($67,983,394) | $149,302,056 | ($414,358,038) |
| Advanced Materials | ($49,206,470) | ($3,247,363) | $42,992,519 | $36,634,722 | $27,173,408 |
| Aerospace | $1,296,200,866 | $59,589,261 | $538,390,755 | $398,764,305 | $2,292,945,187 |
| Weapons | ($97,019,634) | ($5,696,219) | ($1,687,414) | ($9,654,782) | ($114,058,049) |
| Nuclear | ($26,782,810) | ($237,732) | ($2,595,336) | ($1,926,484) | ($31,542,362) |
| *Total* | ($173,498,507) | ($1,707,183,299) | $234,269,067 | ($2,199,599,269) | ($3,846,012,008) |

| Canadian Balance (1992) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | ($113,038,166) | ($2,587,518) | ($15,198,161) | ($7,237,397) | ($138,061,242) |
| Life Sciences | ($442,123,421) | $18,672,541 | ($83,312,241) | $34,802,221 | ($471,960,900) |
| Opto-Electronics | ($9,807,497) | ($60,150,734) | $7,731,510 | $1,227,851 | ($60,998,870) |
| Information & Communication | ($972,040,716) | ($923,394,474) | $91,954,504 | ($530,614,842) | ($2,334,095,528) |
| Electronics | $348,113,733 | ($298,086,674) | ($117,584,699) | ($1,569,345,177) | ($1,636,902,817) |
| Flexible Manufacturing | ($343,914,258) | ($91,557,150) | ($47,048,240) | $74,780,866 | ($407,738,782) |
| Advanced Materials | ($58,584,226) | ($6,123,885) | $37,292,049 | $30,699,655 | $3,283,593 |
| Aerospace | $507,470,988 | $43,008,589 | ($499,680,938) | $440,165,035 | $490,963,674 |
| Weapons | ($31,804,419) | ($6,499,683) | ($4,518,493) | ($749,270) | ($43,571,865) |
| Nuclear | ($26,814,745) | ($460,127) | ($3,910,636) | ($76,468,697) | ($107,654,205) |
| *Total* | ($1,142,542,725) | ($1,327,179,115) | ($634,275,345) | ($1,602,739,755) | ($4,706,736,940) |

| Canadian Balance (1991) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | ($92,771,153) | ($2,758,187) | ($6,035,060) | ($5,530,861) | ($107,095,261) |
| Life Sciences | ($421,845,890) | ($27,643,035) | ($72,359,601) | $18,230,883 | ($503,617,643) |
| Opto-Electronics | ($2,464,712) | ($19,072,558) | $14,736,874 | $4,297,473 | ($2,502,923) |
| Information & Communication | ($72,946,115) | ($988,059,597) | $136,430,850 | ($709,440,483) | ($1,634,015,345) |
| Electronics | $1,291,267,845 | ($233,541,225) | ($20,931,713) | ($1,243,505,129) | ($206,710,222) |
| Flexible Manufacturing | ($370,201,965) | ($93,351,505) | ($68,309,040) | $69,786,981 | ($462,075,529) |
| Advanced Materials | ($771,556,276) | ($31,331,957) | ($19,723,339) | ($282,273) | ($822,893,845) |
| Aerospace | $1,306,878,811 | $35,133,637 | ($201,464,835) | $918,171,359 | $2,058,718,972 |
| Weapons | ($50,669,884) | ($4,489,709) | ($8,803,233) | ($3,698,747) | ($67,661,573) |
| Nuclear | ($19,977,889) | ($748,276) | ($1,948,857) | ($24,360,216) | ($47,035,238) |
| *Total* | $795,712,772 | ($1,365,862,412) | ($248,407,954) | ($976,331,013) | ($1,794,888,607) |

| Canadian Balance (1990) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | ($75,533,631) | ($3,377,015) | ($10,774,117) | ($3,212,967) | ($92,897,730) |
| Life Sciences | ($328,470,014) | ($30,651,293) | ($52,381,566) | $23,190,179 | ($388,312,694) |
| Opto-Electronics | ($796,249) | ($15,156,884) | $12,284,081 | $7,917,145 | $4,248,093 |
| Information & Communication | ($794,402,600) | ($1,086,993,170) | $296,120,077 | ($533,018,406) | ($2,118,294,099) |
| Electronics | $1,269,365,968 | ($25,357,171) | ($5,442,115) | ($20,128,076) | $1,218,438,606 |
| Flexible Manufacturing | ($376,568,904) | ($140,717,273) | ($72,031,941) | $26,256,489 | ($563,061,629) |
| Advanced Materials | $38,039,589 | ($7,089,668) | $33,989,109 | $18,053,547 | $82,992,577 |
| Aerospace | $1,250,843,781 | $56,270,151 | ($834,370) | $1,332,222,317 | $2,638,501,879 |
| Weapons | ($49,843,909) | ($6,578,092) | ($8,791,214) | ($7,412,609) | ($72,625,824) |
| Nuclear | ($23,951,113) | ($814,684) | ($3,204,679) | ($72,038,269) | ($100,008,745) |
| *Total* | $908,682,920 | ($1,260,465,099) | $188,933,265 | $771,829,350 | $608,980,436 |

## 3.2 Canadian Exports by Economic Area (1990-94)

| Canadian Exports (1994) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | $135,202 | $0 | $83,070 | $2,469,562 | $2,687,834 |
| Life Sciences | $260,921,952 | $25,175,358 | $67,795,806 | $103,083,832 | $456,976,948 |
| Opto-Electronics | $29,668,686 | $4,138,141 | $23,858,546 | $35,911,924 | $93,577,297 |
| Information & Communication | $7,714,695,229 | $59,732,813 | $522,997,841 | $1,153,145,036 | $9,450,570,919 |
| Electronics | $2,390,081,848 | $26,589,833 | $28,083,944 | $68,420,647 | $2,513,176,272 |
| Flexible Manufacturing | $140,239,279 | $9,024,549 | $41,573,812 | $159,876,686 | $350,714,326 |
| Advanced Materials | $98,980,179 | $6,579,722 | $62,532,516 | $56,669,540 | $224,761,957 |
| Aerospace | $3,936,342,024 | $30,685,604 | $553,410,385 | $718,711,153 | $5,239,149,166 |
| Weapons | $13,585,602 | $22,170 | $4,498,209 | $854,327 | $18,960,308 |
| Nuclear | $336,680 | $0 | $11,918 | $17,005,863 | $17,354,461 |
| *Total* | $14,584,986,680 | $161,948,190 | $1,304,846,047 | $2,316,148,570 | $18,367,929,487 |

| Canadian Exports (1993) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | $324,469 | $0 | $222,409 | $743,556 | $1,290,434 |
| Life Sciences | $199,935,195 | $31,246,350 | $62,886,452 | $99,514,102 | $393,582,099 |
| Opto-Electronics | $37,641,785 | $2,678,881 | $15,305,579 | $26,180,061 | $81,806,306 |
| Information & Communication | $5,463,920,128 | $70,897,747 | $444,409,803 | $968,207,585 | $6,947,435,263 |
| Electronics | $2,249,987,720 | $4,252,967 | $37,612,861 | $63,808,981 | $2,355,662,529 |
| Flexible Manufacturing | $104,360,040 | $8,268,760 | $27,925,171 | $214,804,750 | $355,358,721 |
| Advanced Materials | $55,852,216 | $3,036,513 | $47,254,628 | $39,020,674 | $145,164,031 |
| Aerospace | $3,208,797,148 | $64,480,230 | $1,115,657,623 | $511,672,757 | $4,900,607,758 |
| Weapons | $19,381,095 | $10,522 | $10,465,951 | $5,297,076 | $35,154,644 |
| Nuclear | $222,314 | $0 | $36,126 | $59,182,782 | $59,441,222 |
| *Total* | $11,340,422,110 | $184,871,970 | $1,761,776,603 | $1,988,432,324 | $15,275,503,007 |

| Canadian Exports (1992) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | $31,049 | $0 | $14,297 | $9,415 | $54,761 |
| Life Sciences | $156,527,447 | $59,727,319 | $58,117,972 | $80,295,786 | $354,668,524 |
| Opto-Electronics | $36,901,487 | $1,280,446 | $12,531,652 | $17,103,153 | $67,816,738 |
| Information & Communication | $3,733,532,257 | $72,888,203 | $473,196,504 | $692,867,825 | $4,972,484,789 |
| Electronics | $2,219,071,556 | $4,070,695 | $36,432,688 | $56,695,792 | $2,316,270,731 |
| Flexible Manufacturing | $45,385,533 | $7,087,705 | $41,067,448 | $116,467,338 | $210,008,024 |
| Advanced Materials | $46,526,103 | $1,472,026 | $42,357,983 | $32,352,791 | $122,708,903 |
| Aerospace | $2,966,769,324 | $49,067,880 | $700,266,825 | $524,022,300 | $4,240,126,329 |
| Weapons | $32,366,695 | $53,561 | $5,929,294 | $6,306,238 | $44,655,788 |
| Nuclear | $195,088 | $0 | $290,912 | $6,876,720 | $7,362,720 |
| *Total* | $9,237,306,541 | $195,647,835 | $1,370,205,575 | $1,532,997,358 | $12,336,157,309 |

| Canadian Exports (1991) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | $267,620 | $0 | $246,389 | $0 | $514,009 |
| Life Sciences | $143,338,006 | $15,941,823 | $53,616,031 | $62,344,937 | $275,240,797 |
| Opto-Electronics | $27,553,361 | $1,608,235 | $18,796,450 | $10,898,353 | $58,856,399 |
| Information & Communication | $4,017,960,595 | $52,420,088 | $469,616,407 | $434,997,527 | $4,974,994,617 |
| Electronics | $2,020,175,680 | $8,798,233 | $39,386,731 | $52,002,041 | $2,120,362,685 |
| Flexible Manufacturing | $36,652,286 | $7,143,183 | $36,455,160 | $121,584,889 | $201,835,518 |
| Advanced Materials | $24,383,917 | $2,278,699 | $28,498,157 | $20,374,994 | $75,535,767 |
| Aerospace | $3,736,012,239 | $43,885,811 | $868,120,804 | $1,018,047,135 | $5,666,065,989 |
| Weapons | $40,632,162 | $0 | $4,005,473 | $3,075,245 | $47,712,880 |
| Nuclear | $569,168 | $2,856 | $7,495 | $7,274,946 | $7,854,465 |
| *Total* | $10,047,545,034 | $132,078,928 | $1,518,749,097 | $1,730,600,067 | $13,428,973,126 |

| Canadian Exports (1990) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | $1,820,355 | $0 | $29,988 | $29,526 | $1,879,869 |
| Life Sciences | $119,226,930 | $15,592,019 | $58,586,238 | $59,734,907 | $253,140,094 |
| Opto-Electronics | $26,811,141 | $764,096 | $16,216,133 | $12,592,253 | $56,383,623 |
| Information & Communication | $3,273,845,675 | $25,005,206 | $510,748,064 | $554,763,785 | $4,364,362,730 |
| Electronics | $1,474,062,752 | $5,427,599 | $29,569,449 | $46,321,829 | $1,555,381,629 |
| Flexible Manufacturing | $38,301,083 | $7,712,134 | $32,237,107 | $84,844,246 | $163,094,570 |
| Advanced Materials | $63,849,091 | $1,926,226 | $36,872,747 | $27,775,049 | $130,423,113 |
| Aerospace | $3,524,158,099 | $70,083,366 | $780,952,037 | $1,457,229,031 | $5,832,422,533 |
| Weapons | $43,678,622 | $0 | $6,257,682 | $2,631,235 | $52,567,539 |
| Nuclear | $250,664 | $0 | $276,813 | $2,312,738 | $2,840,215 |
| *Total* | $8,566,004,414 | $126,510,646 | $1,471,746,258 | $2,248,234,599 | $12,412,495,917 |

## 3.3 Canadian Imports by Economic Area (1990-94)

| Canadian Imports (1994) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | $180,292,803 | $2,568,785 | $21,754,092 | $11,109,265 | $215,724,945 |
| Life Sciences | $853,565,191 | $60,421,072 | $173,098,239 | $70,630,579 | $1,157,715,081 |
| Opto-Electronics | $95,681,197 | $39,760,563 | $11,913,454 | $27,255,410 | $174,610,624 |
| Information & Communication | $7,591,711,688 | $1,249,228,212 | $543,860,527 | $2,622,042,843 | $12,006,843,270 |
| Electronics | $2,549,627,903 | $857,768,193 | $552,194,095 | $2,407,432,828 | $6,367,023,019 |
| Flexible Manufacturing | $674,415,819 | $136,916,765 | $128,235,508 | $91,405,576 | $1,030,973,668 |
| Advanced Materials | $168,630,709 | $7,374,057 | $2,128,310 | $4,669,113 | $182,802,189 |
| Aerospace | $2,103,372,304 | $2,984,617 | $460,044,029 | $118,361,427 | $2,684,762,377 |
| Weapons | $164,905,861 | $5,427,485 | $32,090,536 | $12,363,876 | $214,787,758 |
| Nuclear | $51,640,127 | $402,293 | $4,152,210 | $124,437,781 | $180,632,411 |
| *Total* | $14,433,843,602 | $2,362,852,042 | $1,929,471,000 | $5,489,708,698 | $24,215,875,342 |

| Canadian Imports (1993) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | $147,955,332 | $4,003,783 | $16,124,898 | $8,879,711 | $176,963,724 |
| Life Sciences | $666,134,300 | $42,096,952 | $149,039,586 | $50,908,353 | $908,179,191 |
| Opto-Electronics | $61,795,475 | $49,219,903 | $5,756,452 | $26,230,840 | $143,002,670 |
| Information & Communication | $6,098,472,549 | $1,190,565,138 | $452,580,964 | $1,932,247,567 | $9,673,866,218 |
| Electronics | $1,939,676,375 | $419,570,440 | $211,783,267 | $1,912,906,900 | $4,483,936,982 |
| Flexible Manufacturing | $438,825,765 | $169,479,735 | $95,908,565 | $65,502,694 | $769,716,759 |
| Advanced Materials | $105,058,686 | $6,283,876 | $4,262,109 | $2,385,952 | $117,990,623 |
| Aerospace | $1,912,596,282 | $4,890,969 | $577,266,868 | $112,908,452 | $2,607,662,571 |
| Weapons | $116,400,729 | $5,706,741 | $12,153,365 | $14,951,858 | $149,212,693 |
| Nuclear | $27,005,124 | $237,732 | $2,631,462 | $61,109,266 | $90,983,584 |
| *Total* | $11,513,920,617 | $1,892,055,269 | $1,527,507,536 | $4,188,031,593 | $19,121,515,015 |

| Canadian Imports (1992) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | $113,069,215 | $2,587,518 | $15,212,458 | $7,246,812 | $138,116,003 |
| Life Sciences | $598,650,868 | $41,054,778 | $141,430,213 | $45,493,565 | $826,629,424 |
| Opto-Electronics | $46,708,984 | $61,431,180 | $4,800,142 | $15,875,302 | $128,815,608 |
| Information & Communication | $4,705,572,973 | $996,282,677 | $381,242,000 | $1,223,482,667 | $7,306,580,317 |
| Electronics | $1,870,957,823 | $302,157,369 | $154,017,387 | $1,626,040,969 | $3,953,173,548 |
| Flexible Manufacturing | $389,299,791 | $98,644,855 | $88,115,688 | $41,686,472 | $617,746,806 |
| Advanced Materials | $105,110,329 | $7,595,911 | $5,065,934 | $1,653,136 | $119,425,310 |
| Aerospace | $2,459,298,336 | $6,059,291 | $1,199,947,763 | $83,857,265 | $3,749,162,655 |
| Weapons | $64,171,114 | $6,553,244 | $10,447,787 | $7,055,508 | $88,227,653 |
| Nuclear | $27,009,833 | $460,127 | $4,201,548 | $83,345,417 | $115,016,925 |
| *Total* | $10,379,849,266 | $1,522,826,950 | $2,004,480,920 | $3,135,737,113 | $17,042,894,249 |

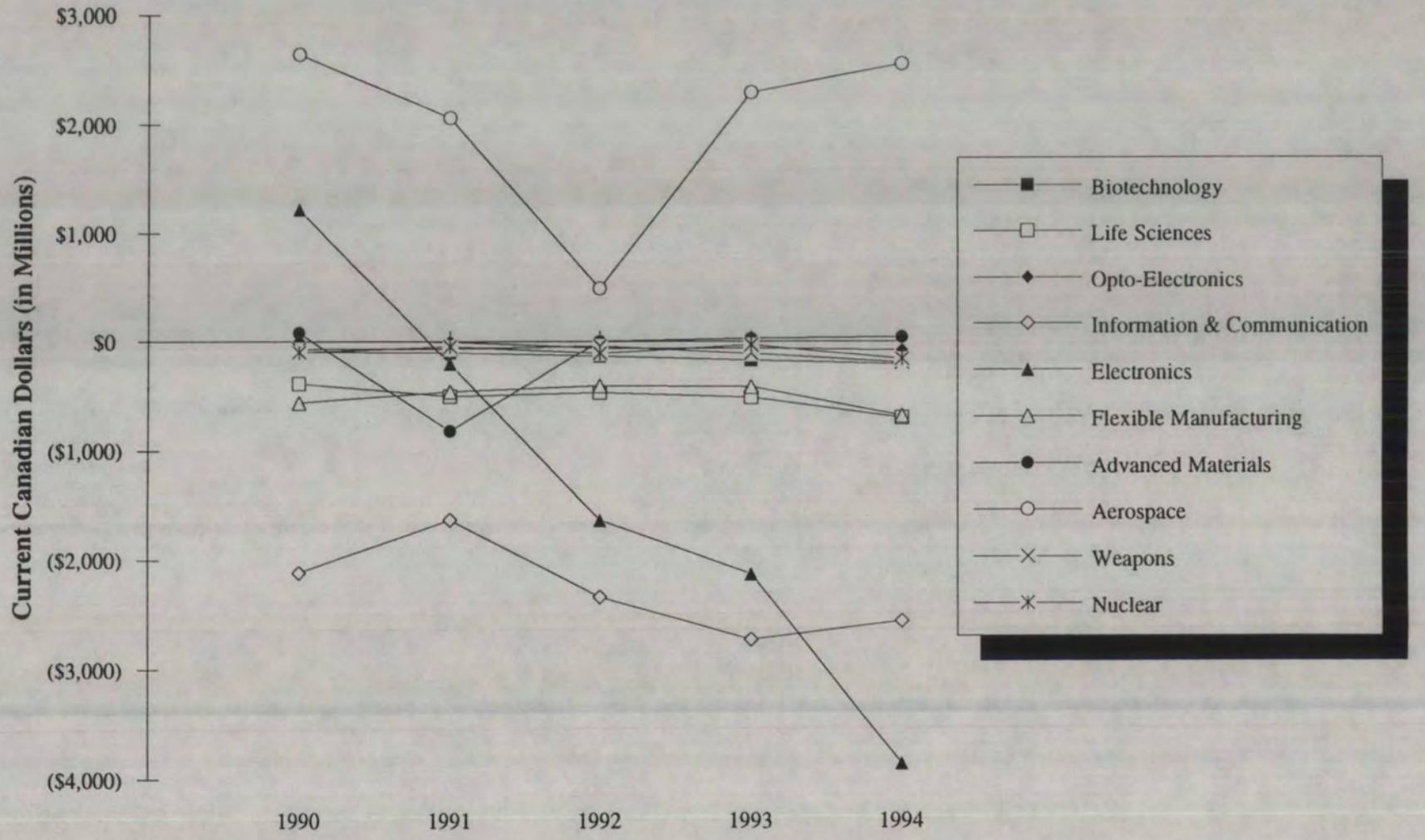
| Canadian Imports (1991) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | $93,038,773 | $2,758,187 | $6,281,449 | $5,530,861 | $107,609,270 |
| Life Sciences | $565,183,896 | $43,584,858 | $125,975,632 | $44,114,054 | $778,858,440 |
| Opto-Electronics | $30,018,073 | $20,680,793 | $4,059,576 | $6,600,880 | $61,359,322 |
| Information & Communication | $4,090,906,710 | $1,040,479,685 | $333,185,557 | $1,144,438,010 | $6,609,009,962 |
| Electronics | $728,907,835 | $242,339,458 | $60,318,444 | $1,295,507,170 | $2,327,072,907 |
| Flexible Manufacturing | $406,854,251 | $100,494,688 | $104,764,200 | $51,797,908 | $663,911,047 |
| Advanced Materials | $795,940,193 | $33,610,656 | $48,221,496 | $20,657,267 | $898,429,612 |
| Aerospace | $2,429,133,428 | $8,752,174 | $1,069,585,639 | $99,875,776 | $3,607,347,017 |
| Weapons | $91,302,046 | $4,489,709 | $12,808,706 | $6,773,992 | $115,374,453 |
| Nuclear | $20,547,057 | $751,132 | $1,956,352 | $31,635,162 | $54,889,703 |
| *Total* | $9,251,832,262 | $1,497,941,340 | $1,767,157,051 | $2,706,931,080 | $15,223,861,733 |

| Canadian Imports (1990) | USA | Japan | EEC | Other | Total |
|---|---|---|---|---|---|
| Biotechnology | $77,353,986 | $3,377,015 | $10,804,105 | $3,242,493 | $94,777,599 |
| Life Sciences | $447,696,944 | $46,243,312 | $110,967,804 | $36,544,728 | $641,452,788 |
| Opto-Electronics | $27,607,390 | $15,920,980 | $3,932,052 | $4,675,108 | $52,135,530 |
| Information & Communication | $4,068,248,275 | $1,111,998,376 | $214,627,987 | $1,087,782,191 | $6,482,656,829 |
| Electronics | $204,696,784 | $30,784,770 | $35,011,564 | $66,449,905 | $336,943,023 |
| Flexible Manufacturing | $414,869,987 | $148,429,407 | $104,269,048 | $58,587,757 | $726,156,199 |
| Advanced Materials | $25,809,502 | $9,015,894 | $2,883,638 | $9,721,502 | $47,430,536 |
| Aerospace | $2,273,314,318 | $13,813,215 | $781,786,407 | $125,006,714 | $3,193,920,654 |
| Weapons | $93,522,531 | $6,578,092 | $15,048,896 | $10,043,844 | $125,193,363 |
| Nuclear | $24,201,777 | $814,684 | $3,481,492 | $74,351,007 | $102,848,960 |
| *Total* | $7,657,321,494 | $1,386,975,745 | $1,282,812,993 | $1,476,405,249 | $11,803,515,481 |

## 3.4 Balance of Trade by ATP Category Only (1990-94)

| Canadian Balance of Trade | 1990 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|
| Biotechnology | ($92,897,730) | ($107,095,261) | ($138,061,242) | ($175,673,290) | ($213,037,111) |
| Life Sciences | ($388,312,694) | ($503,617,643) | ($471,960,900) | ($514,597,092) | ($700,738,133) |
| Opto-Electronics | $4,248,093 | ($2,502,923) | ($60,998,870) | ($61,196,364) | ($81,033,327) |
| Information & Communication | ($2,118,294,099) | ($1,634,015,345) | ($2,334,095,528) | ($2,726,430,955) | ($2,556,272,351) |
| Electronics | $1,218,438,606 | ($206,710,222) | ($1,636,902,817) | ($2,128,274,453) | ($3,853,846,747) |
| Flexible Manufacturing | ($563,061,629) | ($462,075,529) | ($407,738,782) | ($414,358,038) | ($680,259,342) |
| Advanced Materials | $82,992,577 | ($822,893,845) | $3,283,593 | $27,173,408 | $41,959,768 |
| Aerospace | $2,638,501,879 | $2,058,718,972 | $490,963,674 | $2,292,945,187 | $2,554,386,788 |
| Weapons | ($72,625,824) | ($67,661,573) | ($43,571,865) | ($114,058,049) | ($195,827,451) |
| Nuclear | ($100,008,745) | ($47,035,238) | ($107,654,205) | ($31,542,362) | ($163,277,950) |
| *Total* | $608,980,436 | ($1,794,888,607) | ($4,706,736,940) | ($3,846,012,008) | ($5,847,945,855) |

***Canadian Balance of Trade in Advanced Technology Products 1990 - 1994***

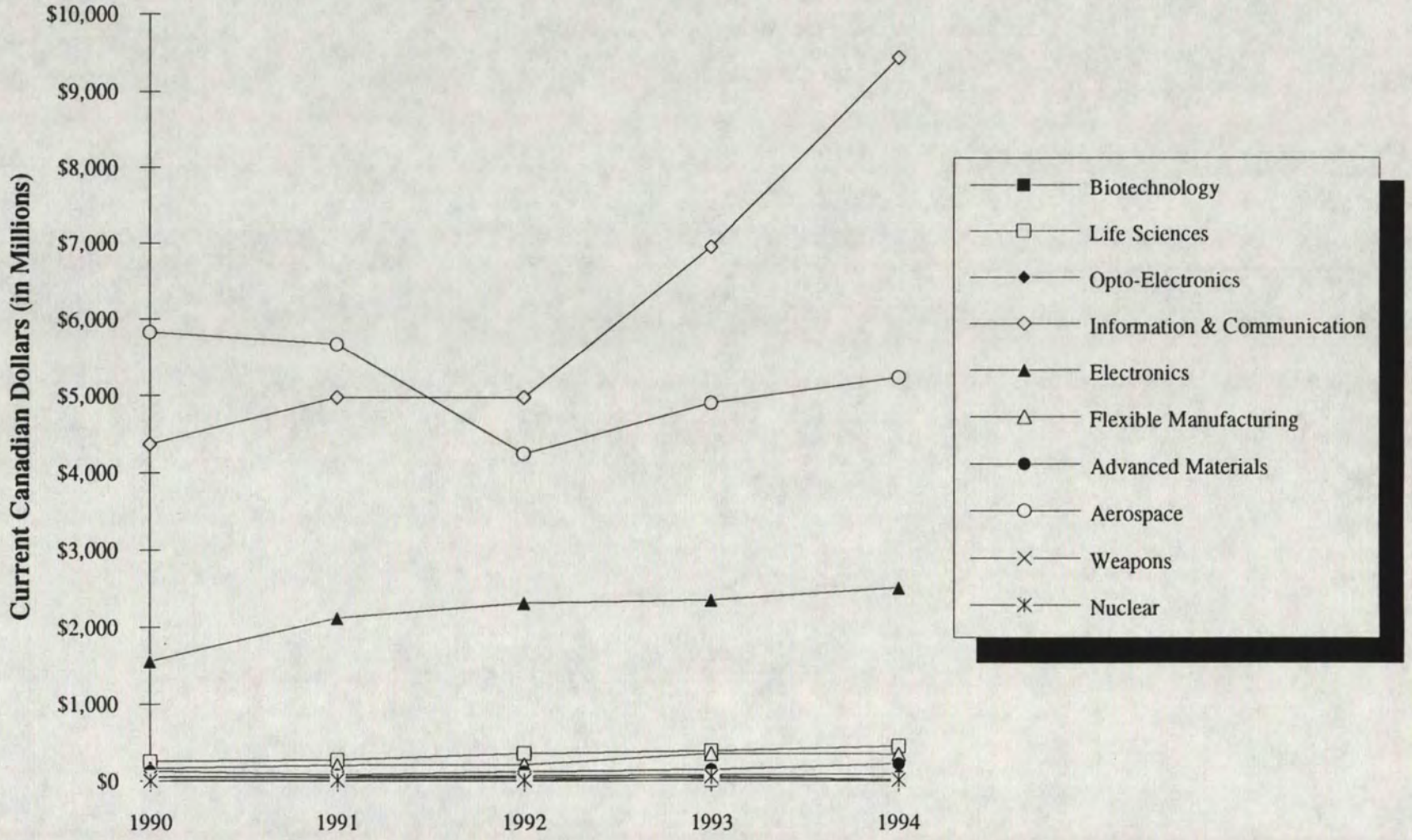



Source: Doyletech Corporation

## 3.5 Canadian Exports by ATP Category Only (1990-94)

| CanadianExports | 1990 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|
| Biotechnology | $1,879,869 | $514,009 | $54,761 | $1,290,434 | $2,687,834 |
| Life Sciences | $253,140,094 | $275,240,797 | $354,668,524 | $393,582,099 | $456,976,948 |
| Opto-Electronics | $56,383,623 | $58,856,399 | $67,816,738 | $81,806,306 | $93,577,297 |
| Information & Communication | $4,364,362,730 | $4,974,994,617 | $4,972,484,789 | $6,947,435,263 | $9,450,570,919 |
| Electronics | $1,555,381,629 | $2,120,362,685 | $2,316,270,731 | $2,355,662,529 | $2,513,176,272 |
| Flexible Manufacturing | $163,094,570 | $201,835,518 | $210,008,024 | $355,358,721 | $350,714,326 |
| Advanced Materials | $130,423,113 | $75,535,767 | $122,708,903 | $145,164,031 | $224,761,957 |
| Aerospace | $5,832,422,533 | $5,666,065,989 | $4,240,126,329 | $4,900,607,758 | $5,239,149,166 |
| Weapons | $52,567,539 | $47,712,880 | $44,655,788 | $35,154,644 | $18,960,308 |
| Nuclear | $2,840,215 | $7,854,465 | $7,362,720 | $59,441,222 | $17,354,461 |
| *Total* | $12,412,495,917 | $13,428,973,126 | $12,336,157,309 | $15,275,503,007 | $18,367,929,487 |

***Canadian Exports of Advanced Technology Products 1990 - 1994***

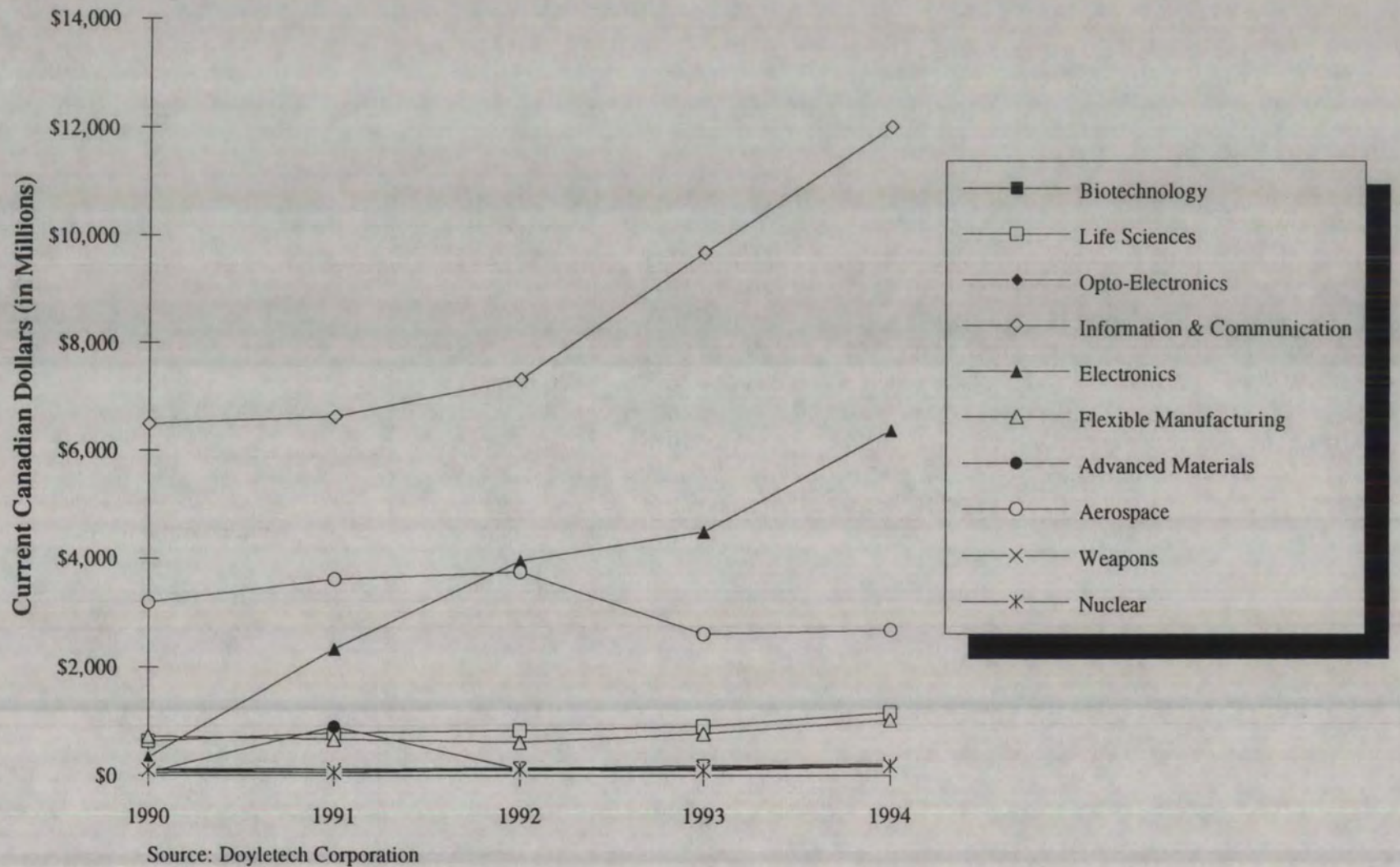



Source: Doyletech Corporation

## 3.6 Canadian Imports by ATP Category Only (1990-94)

| Canadian Imports | 1990 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|
| Biotechnology | $94,777,599 | $107,609,270 | $138,116,003 | $176,963,724 | $215,724,945 |
| Life Sciences | $641,452,788 | $778,858,440 | $826,629,424 | $908,179,191 | $1,157,715,081 |
| Opto-Electronics | $52,135,530 | $61,359,322 | $128,815,608 | $143,002,670 | $174,610,624 |
| Information & Communication | $6,482,656,829 | $6,609,009,962 | $7,306,580,317 | $9,673,866,218 | $12,006,843,270 |
| Electronics | $336,943,023 | $2,327,072,907 | $3,953,173,548 | $4,483,936,982 | $6,367,023,019 |
| Flexible Manufacturing | $726,156,199 | $663,911,047 | $617,746,806 | $769,716,759 | $1,030,973,668 |
| Advanced Materials | $47,430,536 | $898,429,612 | $119,425,310 | $117,990,623 | $182,802,189 |
| Aerospace | $3,193,920,654 | $3,607,347,017 | $3,749,162,655 | $2,607,662,571 | $2,684,762,377 |
| Weapons | $125,193,363 | $115,374,453 | $88,227,653 | $149,212,693 | $214,787,758 |
| Nuclear | $102,848,960 | $54,889,703 | $115,016,925 | $90,983,584 | $180,632,411 |
| *Total* | $11,803,515,481 | $15,223,861,733 | $17,042,894,249 | $19,121,515,015 | $24,215,875,342 |

***Canadian Imports of Advanced Technology Products 1990 - 1994***




Source: Doyletech Corporation

## 3.7 Balance of Trade by Economic Area and ATP Category (1990 - 94)

| Canada-USA HT Trade Balance | USA 1990 | USA 1991 | USA 1992 | USA 1993 | USA 1994 |
|---|---|---|---|---|---|
| Biotechnology | ($75,533,631) | ($92,771,153) | ($113,038,166) | ($147,630,863) | ($180,157,601) |
| Life Sciences | ($328,470,014) | ($421,845,890) | ($442,123,421) | ($466,199,105) | ($592,643,239) |
| Opto-Electronics | ($796,249) | ($2,464,712) | ($9,807,497) | ($24,153,690) | ($66,012,511) |
| Information & Communication | ($794,402,600) | ($72,946,115) | ($972,040,716) | ($634,552,421) | $122,983,541 |
| Electronics | $1,269,365,968 | $1,291,267,845 | $348,113,733 | $310,311,345 | ($159,546,055) |
| Flexible Manufacturing | ($376,568,904) | ($370,201,965) | ($343,914,258) | ($334,465,725) | ($534,176,540) |
| Advanced Materials | $38,039,589 | ($771,556,276) | ($58,584,226) | ($49,206,470) | ($69,650,530) |
| Aerospace | $1,250,843,781 | $1,306,878,811 | $507,470,988 | $1,296,200,866 | $1,832,969,719 |
| Weapons | ($49,843,909) | ($50,669,884) | ($31,804,419) | ($97,019,634) | ($151,320,260) |
| Nuclear | ($23,951,113) | ($19,977,889) | ($26,814,745) | ($26,782,810) | ($51,303,447) |
| | $908,682,920 | $795,712,772 | ($1,142,542,725) | ($173,498,507) | $151,143,078 |

| Canada-Japan HT Trade Balance | Japan 1990 | Japan 1991 | Japan 1992 | Japan 1993 | Japan 1994 |
|---|---|---|---|---|---|
| Biotechnology | ($3,377,015) | ($2,758,187) | ($2,587,518) | ($4,003,783) | ($2,568,785) |
| Life Sciences | ($30,651,293) | ($27,643,035) | $18,672,541 | ($10,850,602) | ($35,245,714) |
| Opto-Electronics | ($15,156,884) | ($19,072,558) | ($60,150,734) | ($46,541,022) | ($35,622,422) |
| Information & Communication | ($1,086,993,170) | ($988,059,597) | ($923,394,474) | ($1,119,667,391) | ($1,189,495,399) |
| Electronics | ($25,357,171) | ($233,541,225) | ($298,086,674) | ($415,317,473) | ($831,178,360) |
| Flexible Manufacturing | ($140,717,273) | ($93,351,505) | ($91,557,150) | ($161,210,975) | ($127,892,216) |
| Advanced Materials | ($7,089,668) | ($31,331,957) | ($6,123,885) | ($3,247,363) | ($794,335) |
| Aerospace | $56,270,151 | $35,133,637 | $43,008,589 | $59,589,261 | $27,700,987 |
| Weapons | ($6,578,092) | ($4,489,709) | ($6,499,683) | ($5,696,219) | ($5,405,315) |
| Nuclear | ($814,684) | ($748,276) | ($460,127) | ($237,732) | ($402,293) |
| | ($1,260,465,099) | ($1,365,862,412) | ($1,327,179,115) | ($1,707,183,299) | ($2,200,903,852) |

| Canada-EEC HT Trade Balance | EEC 1990 | EEC 1991 | EEC 1992 | EEC 1993 | EEC 1994 |
|---|---|---|---|---|---|
| Biotechnology | ($10,774,117) | ($6,035,060) | ($15,198,161) | ($15,902,489) | ($21,671,022) |
| Life Sciences | ($52,381,566) | ($72,359,601) | ($83,312,241) | ($86,153,134) | ($105,302,433) |
| Opto-Electronics | $12,284,081 | $14,736,874 | $7,731,510 | $9,549,127 | $11,945,092 |
| Information & Communication | $296,120,077 | $136,430,850 | $91,954,504 | ($8,171,161) | ($20,862,686) |
| Electronics | ($5,442,115) | ($20,931,713) | ($117,584,699) | ($174,170,406) | ($524,110,151) |
| Flexible Manufacturing | ($72,031,941) | ($68,309,040) | ($47,048,240) | ($67,983,394) | ($86,661,696) |
| Advanced Materials | $33,989,109 | ($19,723,339) | $37,292,049 | $42,992,519 | $60,404,206 |
| Aerospace | ($834,370) | ($201,464,835) | ($499,680,938) | $538,390,755 | $93,366,356 |
| Weapons | ($8,791,214) | ($8,803,233) | ($4,518,493) | ($1,687,414) | ($27,592,327) |
| Nuclear | ($3,204,679) | ($1,948,857) | ($3,910,636) | ($2,595,336) | ($4,140,292) |
| | $188,933,265 | ($248,407,954) | ($634,275,345) | $234,269,067 | ($624,624,953) |

| Canada-OTH HT Trade Balance | OTH 1990 | OTH 1991 | OTH 1992 | OTH 1993 | OTH 1994 |
|---|---|---|---|---|---|
| Biotechnology | ($3,212,967) | ($5,530,861) | ($7,237,397) | ($8,136,155) | ($8,639,703) |
| Life Sciences | $23,190,179 | $18,230,883 | $34,802,221 | $48,605,749 | $32,453,253 |
| Opto-Electronics | $7,917,145 | $4,297,473 | $1,227,851 | ($50,779) | $8,656,514 |
| Information & Communication | ($533,018,406) | ($709,440,483) | ($530,614,842) | ($964,039,982) | ($1,468,897,807) |
| Electronics | ($20,128,076) | ($1,243,505,129) | ($1,569,345,177) | ($1,849,097,919) | ($2,339,012,181) |
| Flexible Manufacturing | $26,256,489 | $69,786,981 | $74,780,866 | $149,302,056 | $68,471,110 |
| Advanced Materials | $18,053,547 | ($282,273) | $30,699,655 | $36,634,722 | $52,000,427 |
| Aerospace | $1,332,222,317 | $918,171,359 | $440,165,035 | $398,764,305 | $600,349,726 |
| Weapons | ($7,412,609) | ($3,698,747) | ($749,270) | ($9,654,782) | ($11,509,549) |
| Nuclear | ($72,038,269) | ($24,360,216) | ($76,468,697) | ($1,926,484) | ($107,431,918) |
| | $771,829,350 | ($976,331,013) | ($1,602,739,755) | ($2,199,599,269) | ($3,173,560,128) |

| Canadian Exports | USA 1990 | USA 1991 | USA 1992 | USA 1993 | USA 1994 |
|---|---|---|---|---|---|
| Biotechnology | $1,820,355 | $267,620 | $31,049 | $324,469 | $135,202 |
| Life Sciences | $119,226,930 | $143,338,006 | $156,527,447 | $199,935,195 | $260,921,952 |
| Opto-Electronics | $26,811,141 | $27,553,361 | $36,901,487 | $37,641,785 | $29,668,686 |
| Information & Communication | $3,273,845,675 | $4,017,960,595 | $3,733,532,257 | $5,463,920,128 | $7,714,695,229 |
| Electronics | $1,474,062,752 | $2,020,175,680 | $2,219,071,556 | $2,249,987,720 | $2,390,081,848 |
| Flexible Manufacturing | $38,301,083 | $36,652,286 | $45,385,533 | $104,360,040 | $140,239,279 |
| Advanced Materials | $63,849,091 | $24,383,917 | $46,526,103 | $55,852,216 | $98,980,179 |
| Aerospace | $3,524,158,099 | $3,736,012,239 | $2,966,769,324 | $3,208,797,148 | $3,936,342,024 |
| Weapons | $43,678,622 | $40,632,162 | $32,366,695 | $19,381,095 | $13,585,602 |
| Nuclear | $250,664 | $569,168 | $195,088 | $222,314 | $336,680 |
| *Total* | $8,566,004,414 | $10,047,545,034 | $9,237,306,541 | $11,340,422,110 | $14,584,986,680 |

| Canadian Exports | Japan 1990 | Japan 1991 | Japan 1992 | Japan 1993 | Japan 1994 |
|---|---|---|---|---|---|
| Biotechnology | $0 | $0 | $0 | $0 | $0 |
| Life Sciences | $15,592,019 | $15,941,823 | $59,727,319 | $31,246,350 | $25,175,358 |
| Opto-Electronics | $764,096 | $1,608,235 | $1,280,446 | $2,678,881 | $4,138,141 |
| Information & Communication | $25,005,206 | $52,420,088 | $72,888,203 | $70,897,747 | $59,732,813 |
| Electronics | $5,427,599 | $8,798,233 | $4,070,695 | $4,252,967 | $26,589,833 |
| Flexible Manufacturing | $7,712,134 | $7,143,183 | $7,087,705 | $8,268,760 | $9,024,549 |
| Advanced Materials | $1,926,226 | $2,278,699 | $1,472,026 | $3,036,513 | $6,579,722 |
| Aerospace | $70,083,366 | $43,885,811 | $49,067,880 | $64,480,230 | $30,685,604 |
| Weapons | $0 | $0 | $53,561 | $10,522 | $22,170 |
| Nuclear | $0 | $2,856 | $0 | $0 | $0 |
| *Total* | $126,510,646 | $132,078,928 | $195,647,835 | $184,871,970 | $161,948,190 |

| Canadian Exports | EEC 1990 | EEC 1991 | EEC 1992 | EEC 1993 | EEC 1994 |
|---|---|---|---|---|---|
| Biotechnology | $29,988 | $246,389 | $14,297 | $222,409 | $83,070 |
| Life Sciences | $58,586,238 | $53,616,031 | $58,117,972 | $62,886,452 | $67,795,806 |
| Opto-Electronics | $16,216,133 | $18,796,450 | $12,531,652 | $15,305,579 | $23,858,546 |
| Information & Communication | $510,748,064 | $469,616,407 | $473,196,504 | $444,409,803 | $522,997,841 |
| Electronics | $29,569,449 | $39,386,731 | $36,432,688 | $37,612,861 | $28,083,944 |
| Flexible Manufacturing | $32,237,107 | $36,455,160 | $41,067,448 | $27,925,171 | $41,573,812 |
| Advanced Materials | $36,872,747 | $28,498,157 | $42,357,983 | $47,254,628 | $62,532,516 |
| Aerospace | $780,952,037 | $868,120,804 | $700,266,825 | $1,115,657,623 | $553,410,385 |
| Weapons | $6,257,682 | $4,005,473 | $5,929,294 | $10,465,951 | $4,498,209 |
| Nuclear | $276,813 | $7,495 | $290,912 | $36,126 | $11,918 |
| *Total* | $1,471,746,258 | $1,518,749,097 | $1,370,205,575 | $1,761,776,603 | $1,304,846,047 |

| Canadian Exports | OTH 1990 | OTH 1991 | OTH 1992 | OTH 1993 | OTH 1994 |
|---|---|---|---|---|---|
| Biotechnology | $29,526 | $0 | $9,415 | $743,556 | $2,469,562 |
| Life Sciences | $59,734,907 | $62,344,937 | $80,295,786 | $99,514,102 | $103,083,832 |
| Opto-Electronics | $12,592,253 | $10,898,353 | $17,103,153 | $26,180,061 | $35,911,924 |
| Information & Communication | $554,763,785 | $434,997,527 | $692,867,825 | $968,207,585 | $1,153,145,036 |
| Electronics | $46,321,829 | $52,002,041 | $56,695,792 | $63,808,981 | $68,420,647 |
| Flexible Manufacturing | $84,844,246 | $121,584,889 | $116,467,338 | $214,804,750 | $159,876,686 |
| Advanced Materials | $27,775,049 | $20,374,994 | $32,352,791 | $39,020,674 | $56,669,540 |
| Aerospace | $1,457,229,031 | $1,018,047,135 | $524,022,300 | $511,672,757 | $718,711,153 |
| Weapons | $2,631,235 | $3,075,245 | $6,306,238 | $5,297,076 | $854,327 |
| Nuclear | $2,312,738 | $7,274,946 | $6,876,720 | $59,182,782 | $17,005,863 |
| *Total* | $2,248,234,599 | $1,730,600,067 | $1,532,997,358 | $1,988,432,324 | $2,316,148,570 |

| Canadian Imports | USA 1990 | USA 1991 | USA 1992 | USA 1993 | USA 1994 |
|---|---|---|---|---|---|
| Biotechnology | $77,353,986 | $93,038,773 | $113,069,215 | $147,955,332 | $180,292,803 |
| Life Sciences | $447,696,944 | $565,183,896 | $598,650,868 | $666,134,300 | $853,565,191 |
| Opto-Electronics | $27,607,390 | $30,018,073 | $46,708,984 | $61,795,475 | $95,681,197 |
| Information & Communication | $4,068,248,275 | $4,090,906,710 | $4,705,572,973 | $6,098,472,549 | $7,591,711,688 |
| Electronics | $204,696,784 | $728,907,835 | $1,870,957,823 | $1,939,676,375 | $2,549,627,903 |
| Flexible Manufacturing | $414,869,987 | $406,854,251 | $389,299,791 | $438,825,765 | $674,415,819 |
| Advanced Materials | $25,809,502 | $795,940,193 | $105,110,329 | $105,058,686 | $168,630,709 |
| Aerospace | $2,273,314,318 | $2,429,133,428 | $2,459,298,336 | $1,912,596,282 | $2,103,372,304 |
| Weapons | $93,522,531 | $91,302,046 | $64,171,114 | $116,400,729 | $164,905,861 |
| Nuclear | $24,201,777 | $20,547,057 | $27,009,833 | $27,005,124 | $51,640,127 |
| *Total* | $7,657,321,494 | $9,251,832,262 | $10,379,849,266 | $11,513,920,617 | $14,433,843,602 |

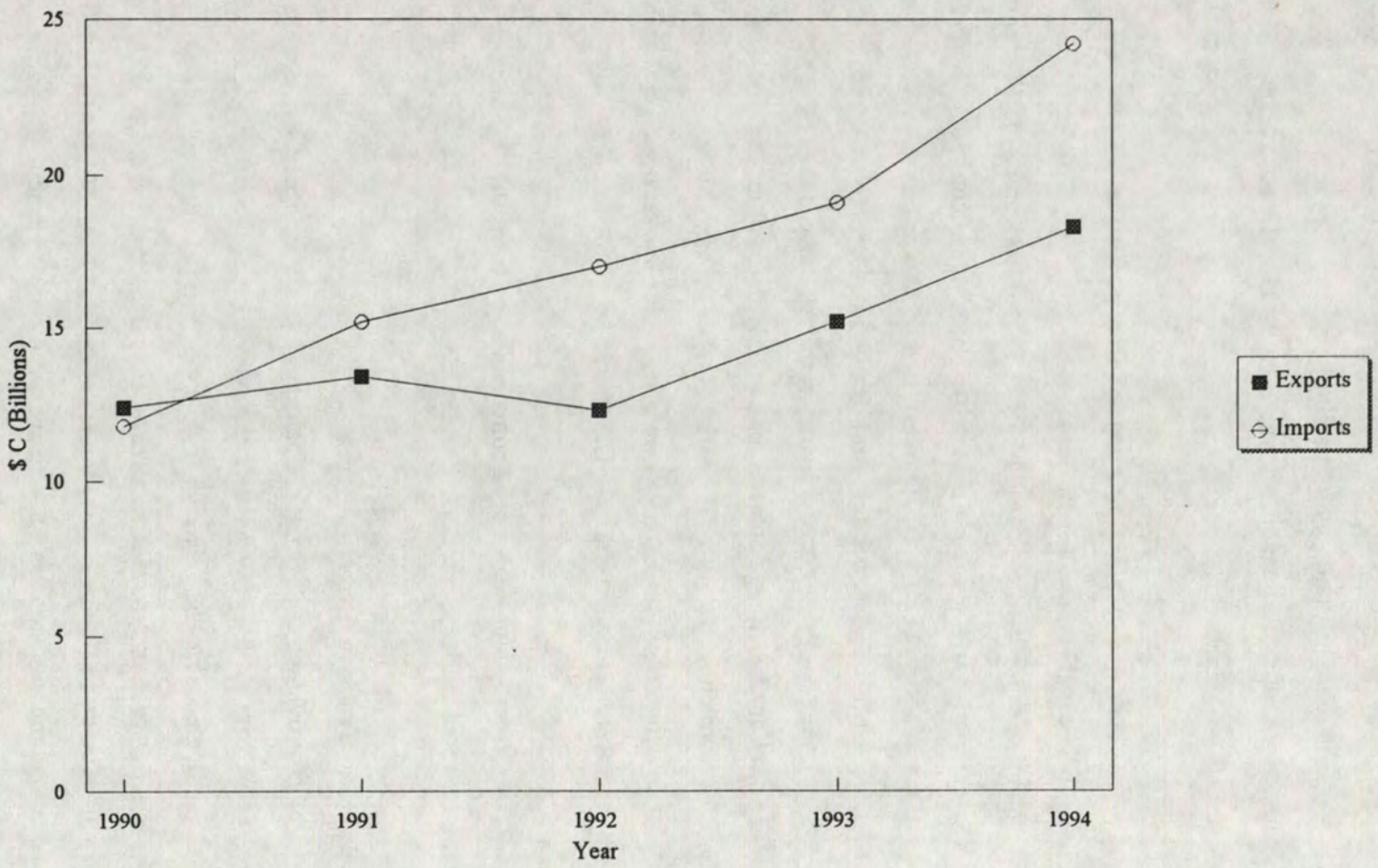
| Canadian Imports | Japan 1990 | Japan 1991 | Japan 1992 | Japan 1993 | Japan 1994 |
|---|---|---|---|---|---|
| Biotechnology | $3,377,015 | $2,758,187 | $2,587,518 | $4,003,783 | $2,568,785 |
| Life Sciences | $46,243,312 | $43,584,858 | $41,054,778 | $42,096,952 | $60,421,072 |
| Opto-Electronics | $15,920,980 | $20,680,793 | $61,431,180 | $49,219,903 | $39,760,563 |
| Information & Communication | $1,111,998,376 | $1,040,479,685 | $996,282,677 | $1,190,565,138 | $1,249,228,212 |
| Electronics | $30,784,770 | $242,339,458 | $302,157,369 | $419,570,440 | $857,768,193 |
| Flexible Manufacturing | $148,429,407 | $100,494,688 | $98,644,855 | $169,479,735 | $136,916,765 |
| Advanced Materials | $9,015,894 | $33,610,656 | $7,595,911 | $6,283,876 | $7,374,057 |
| Aerospace | $13,813,215 | $8,752,174 | $6,059,291 | $4,890,969 | $2,984,617 |
| Weapons | $6,578,092 | $4,489,709 | $6,553,244 | $5,706,741 | $5,427,485 |
| Nuclear | $814,684 | $751,132 | $460,127 | $237,732 | $402,293 |
| *Total* | $1,386,975,745 | $1,497,941,340 | $1,522,826,950 | $1,892,055,269 | $2,362,852,042 |

| Canadian Imports | EEC 1990 | EEC 1991 | EEC 1992 | EEC 1993 | EEC 1994 |
|---|---|---|---|---|---|
| Biotechnology | $10,804,105 | $6,281,449 | $15,212,458 | $16,124,898 | $21,754,092 |
| Life Sciences | $110,967,804 | $125,975,632 | $141,430,213 | $149,039,586 | $173,098,239 |
| Opto-Electronics | $3,932,052 | $4,059,576 | $4,800,142 | $5,756,452 | $11,913,454 |
| Information & Communication | $214,627,987 | $333,185,557 | $381,242,000 | $452,580,964 | $543,860,527 |
| Electronics | $35,011,564 | $60,318,444 | $154,017,387 | $211,783,267 | $552,194,095 |
| Flexible Manufacturing | $104,269,048 | $104,764,200 | $88,115,688 | $95,908,565 | $128,235,508 |
| Advanced Materials | $2,883,638 | $48,221,496 | $5,065,934 | $4,262,109 | $2,128,310 |
| Aerospace | $781,786,407 | $1,069,585,639 | $1,199,947,763 | $577,266,868 | $460,044,029 |
| Weapons | $15,048,896 | $12,808,706 | $10,447,787 | $12,153,365 | $32,090,536 |
| Nuclear | $3,481,492 | $1,956,352 | $4,201,548 | $2,631,462 | $4,152,210 |
| *Total* | $1,282,812,993 | $1,767,157,051 | $2,004,480,920 | $1,527,507,536 | $1,929,471,000 |

| Canadian Imports | OTH 1990 | OTH 1991 | OTH 1992 | OTH 1993 | OTH 1994 |
|---|---|---|---|---|---|
| Biotechnology | $3,242,493 | $5,530,861 | $7,246,812 | $8,879,711 | $11,109,265 |
| Life Sciences | $36,544,728 | $44,114,054 | $45,493,565 | $50,908,353 | $70,630,579 |
| Opto-Electronics | $4,675,108 | $6,600,880 | $15,875,302 | $26,230,840 | $27,255,410 |
| Information & Communication | $1,087,782,191 | $1,144,438,010 | $1,223,482,667 | $1,932,247,567 | $2,622,042,843 |
| Electronics | $66,449,905 | $1,295,507,170 | $1,626,040,969 | $1,912,906,900 | $2,407,432,828 |
| Flexible Manufacturing | $58,587,757 | $51,797,908 | $41,686,472 | $65,502,694 | $91,405,576 |
| Advanced Materials | $9,721,502 | $20,657,267 | $1,653,136 | $2,385,952 | $4,669,113 |
| Aerospace | $125,006,714 | $99,875,776 | $83,857,265 | $112,908,452 | $118,361,427 |
| Weapons | $10,043,844 | $6,773,992 | $7,055,508 | $14,951,858 | $12,363,876 |
| Nuclear | $74,351,007 | $31,635,162 | $83,345,417 | $61,109,266 | $124,437,781 |
| *Total* | $1,476,405,249 | $2,706,931,080 | $3,135,737,113 | $4,188,031,593 | $5,489,708,698 |

## 3.8 Composite Balance of Trade in Advanced Technology Products (1990-94)

# Canadian Balance of Trade in Advanced Technology Products (1990-94)




Source: Doyletech Corporation

## 4. ANALYSIS OF RESULTS

The most significant aspect of the above results is that Canada's ATP trade deficit, when measured in this way, is much less than it was generally understood to be. Using the OECD system that was in use until about 1986, the figure was assumed to be about $8B at that time. The Squires report indicated that it was about $11B ( the actual figure was $11.3B in constant 1986 dollars) in 1993.

The Squires data indicated that Canada's imports were $26.0B in 1993 (again in constant 1986 dollars) whereas this analysis indicates that they were only $19.1B in current dollars. The corresponding export figures were $14.7B in 1986 dollars and $15.2B in current dollars. (All references to the Squires data in this report are in constant 1986 dollars.) It appears that Canada's imports have been overstated but its exports have been more accurately stated. Most of the overstatement on imports seems to have been in relation to the U.S. One of the possible distorting factors in this category is the re-export of products from the U.S. to Canada. Many countries, particularly Pacific Rim countries, use U.S. warehouses as distribution points for the entire North American Market. There is less of a tendency for any country to use Canadian warehouses for this purpose. In this analysis, such re-exports were eliminated from the U.S. figures.

The following sectors will provide a brief commentary on the results in the same order in which they appeared in the last section.

### 4.1 Balance of Trade by Economic Area

Figure 3.1 provides a listing of trade balances by ATP category, by economic area, for the period from 1990 - 94. Canada's relatively strong performance against the U.S. has been due mainly to Aerospace. It shows a Canadian trade surplus with the U.S. of $1.3B in this category for 1993 whereas the Squires report showed only a $354M surplus. The corresponding world figures were $2.3B and $954M (both surpluses). It was beyond the scope of this study to analyse this discrepancy, but in this case it would appear that Canadian exports were understated and imports were stated

correctly. Since the Canadian export figures are derived mainly from U.S. import data, it would appear that this particular discrepancy is due more to the relationship between the 10-digit and the 6-digit coding systems than to such factors as re-exporting or inter-company pricing. (A discussion on inter-company pricing is included as Appendix B.) Also, $3.2B of Aerospace exports to the U.S. and $4.9B in total in 1993 seem reasonable, based on information published by the Air Industries Association of Canada. It forecasts that its industry will have sales in excess of $10 billion in 1995 and that exports account for between 70% and 80% of sales (Globe and Mail, July 29, 1995).

The other major observations from these statistics are as follows:

a) Canada's trade with the U.S. is reasonably balanced and has been so for the period under study.

b) Its trade deficit with Japan is $2.2B and has been growing rapidly.

c) Its trade deficit with EEC follows the same pattern as with the U.S.

d) Its trade deficit with the Other category (mostly non-Japanese Pacific Rim countries) is the highest of all and has been growing rapidly.

### 4.2 Canadian Exports by Economic Area

The following are the key observations:

a) Canada's exports to the U.S. have been growing rapidly.

b) Its exports to Japan were only about 1.5% of what they were to the U.S. for the entire period from 1990 to 1994 and have not been growing significantly.

c) Its exports to the EEC were about 10% of what they were to the U.S. during the same period and have also been static.

d) Its exports to Other countries are about 15% of what they are to the U.S. and have also been static.

### 4.3 Canadian Imports by Economic Area

The following are the key observations:

a) Imports from both the U.S. and Japan have approximately doubled between 1990 and 1994.

b) Imports from the EEC have not grown as quickly (about 70% increase).

c) Imports from Other Countries have increased by over 300%. Electronics accounts for most of the increase - from $66M in 1990 to $2.4B in 1994.

### 4.4 Balance of Trade by ATP Category

The following are the key observations:

a) Canada's major trade imbalances in 1994 were in Information and Communication ($2.6B) and Electronics ($3.8B), but the import growth was greatest in Electronics.

b) The total balance of trade, although significantly less than expected, is growing faster than expected. The Squires report suggested that it had been growing by about 29% annually, whereas this data suggests that it is growing at about 50%.

### 4.5 Canadian Exports by ATP Category

The following are the key observations:

a) Canadian exports of Biotechnology and Life Sciences products are growing rapidly, but still represent a very low percentage of the world market. Since it is well known that foreign-owned pharmaceutical companies have dramatically increased their R & D spending in Canada in recent years, it would be interesting to analyse why that has not yet translated into significant exports.

b) Canadian exports of Information and Communication products are growing rapidly (from $4.4B in 1990 to $9.5B in 1994).

c) Canadian exports of Aerospace products, although growing less rapidly, are much higher than previous statistics indicated. They exceeded $5B in 1994.

### 4.6 Canadian Imports by ATP Category

The following are the key observations:

a) Information and Communication imports ($12B) accounted for half of all ATP imports in 1994.

b) Import growth is highest in Electronics, and such products accounted for 25% of all ATP imports in 1994.

## 5. ECONOMIC IMPLICATIONS

Canada is obviously not a major player in the world of advanced technology trade - at least from a product perspective. Its total exports of $18B in 1994 probably accounted for about 2% of the world demand for such products. No attempt has been made to measure the world demand using this ATP coding system, but total U.S. exports to all countries in 1994 amounted to U.S. $121B or Cdn. $165B. Of this amount, $14.4B was exported to Canada. (Source: U.S. Department of Commerce News, February, 1995)

Canada's presence on the world stage of ATP trade is characterized mainly by its strengths in Information and Communication and Aerospace. These two categories account for almost 80% of 1994 exports.

The major opportunities for additional exports would appear to be in Information and Communication and in Electronics which, on a combined basis, accounted for a deficit of $6.4B in 1994. (The total trade deficit in 1994 was only $5.8B.)

While it is probably unreasonable for Canada to anticipate a balance of trade in these two categories in the foreseeable future, they provide a good basis for analysing the impact that a balance of trade would have on the country because the firms that supply such products have similar financial characteristics.

## 6. THE IMPLICATIONS FOR THE INFORMATION AND COMMUNICATIONS AND ELECTRONICS INDUSTRIES

The following is a typical income statement for a product firm operating in these sectors:

| | |
|---|---|
| Sales revenues | 100% |
| Cost of sales (labour, materials & overhead) | 45% |
| Gross profit | 55% |
| | |
| Operating expenses | |
| Selling | 5% |
| Marketing | 10% |
| R & D | 10% |
| Warranty/support | 5% |
| General and administration | 8% |
| Total operating expenses | 38% |
| Profit before tax | 17% |
| Taxes | 7% |
| Profit after tax | 10% |

The sales per employee for such a company is typically about $150,000. However, the indirect employment typically amounts to about 4 external employees for every internal employee. Some of this employment is related to the company's income statement and some of it is related to its balance sheet.

For example, in the above income statement, materials account for about one third of the cost of sales or 15% of selling price and these are produced by outside firms that have similar income statements to this. The manufacturing department of an ATP firm of this type will typically generate 1.5 outside jobs for every internal job. The other major generators of external jobs are Marketing (graphic artists, printers, etc.) and General and Administration (accountants, landlords, lawyers, etc.)

The balance sheet "creates" jobs primarily for the financial services industry. Fixed assets are leased through leasing companies and current assets are financed by the banks; the company's shares are traded by stock brokers.

Its balance sheet also creates jobs for the construction industry because its buildings are built by carpenters and other tradespeople.

Estimates of indirect employment in the high technology industry have ranged from 3 to 5 times the direct employment depending on the sector and the product. A figure of 3 will be used in the analysis which follows. This is consistent with data presented in a U.S. Department of Commerce report entitled: U.S. Jobs Supported by Goods and Services Exports, 1983-92. (May 1995) It is based on the DOC 3 classification system. In Canada, the ARA Consulting Group Inc. has produced similar data using the OECD classification systems.

### 6.1 The Impact on Jobs

Based on the above assumptions, a $6 billion ATP trade deficit which is dominated by Information and Communication and Electronics would have the following impact on jobs:

| | | |
|---|---|---|
| a) | Direct jobs - $\frac{\$6B}{\$150K}$ = | 40,000 |
| b) | Indirect jobs | 120,000 |
| | Total | 160,000 |

### 6.2 The Impact on R & D

A conservative estimate for these two sectors is that they would spend 10% of sales on R & D as indicated in the above income statement model. Some Canadian-owned companies in these sectors spend much more than this. Also, the suppliers of products and services to such companies spend money on R & D. A figure of 10% of net sales

is conservative and would amount to $600M of additional research that would be done in Canada.

### 6.3 The Impact on Tax Revenues

It is much more difficult to relate tax revenues to either the income statement, the balance sheet, or even to the employment created. A firm that does not generate profits does not generate corporate taxes, but it still generates employment taxes. These employment taxes can vary widely in advanced technology companies and may include taxes on benefits such as stock options.

In order to arrive at a figure that would correlate total income taxes generated with sales revenues, reference was made to an analysis that was done on an Ottawa-based supplier of hardware and software products for the first eight years of its existence. The results of that analysis are shown in figure 4.

| Taxes | Amount Paid Per Dollar of Sales (8 yr accumulated) | 1994 |
|---|---|---|
| Employment Health Tax | .005 | .007 |
| Canada Pension Plan | .006 | .006 |
| Unemployment Insurance | .008 | .006 |
| Employee Income Taxes | .047 | .030 |
| Stock Option Taxes | .040 | .071 |
| Corporate Taxes | .077 | .137 |
| Total | .183 | .257 |

**Figure 4: Taxes paid per dollar of sales for a high technology firm over an eight year period.**

A figure of 20 cents per dollar of sales will be assumed. This figure will vary from firm to firm depending on the firm's profitability (which will impact corporate taxes) and on whether its shares are publicly traded (which will impact stock option taxes), but 20 cents would appear to be conservative for a successful firm.

This means that a $6B trade deficit translates into $6B x .2 or $1.2B of tax revenue.

### 6.4 A Summary of Economic Implications

The following is a summary of the above economic implications based on the assumption that an additional $6B of exports could have been achieved in 1994 in these two sectors:

| | | |
|---|---|---|
| a) | Number of additional jobs that would have been created | 160,000 |
| b) | Amount of additional R & D that would have been done | $600M |
| c) | Additional taxes that would have been collected | $1.2B |

## 7. WHAT IS REALISTIC?

By whatever measure that is applied, Canada is not a major exporter of advanced technology products. Its performance in the software sector (both products and services) would indicate that it can compete with any country in the world, particularly with the U.S. Unfortunately, this system of classification does not identify software explicitly; most of it is included in Information and Communications. Also, the distinction between software products and services is blurred. However, there is a wide consensus within the Canadian software sector that despite all of the software that Canadians import from firms such as Microsoft, the country's balance of trade in this sector is either positive or only slightly negative.

It was beyond the scope of this project to pursue it in further detail, but it begs the question: "Why can Canadians supply software and not microcircuits, both of which are the key building blocks of computers?" The answer would seem to be related more to the cost of entry into the two sectors rather than to the make-up of our education system or to public expenditures on R & D in the two sectors.

Obviously, a goal of zero trade balance should not discourage imports. Canada must make

optimum use of whatever technology it can acquire both locally and internationally to make its traditional industries as efficient as possible. While a figure of $24B in 1994 imports appears to be high in relation to that of the U.S. (US $98B), this is probably not surprising since so much more of Canada's Gross Domestic Product (GDP) is derived from international trade - on a percentage basis. Canada is much more of a trading nation than most of its trading partners.

Any strategic initiative to close its ATP trade gap should be based entirely on increasing exports, particularly in Information and Communications and Electronics, and not on reducing imports in any of the categories. Its relative success in the software sector could form the basis of a study of the impediments in doing so. There can be no doubt that the early stage investment gap that has been so widely documented is having a serious impact on Canada's ability to create and grow technology-based companies.

## 8. A PROPOSED REPORTING SYSTEM

It is recommended that Industry Canada, with assistance from Statistics Canada, implement a quarterly report that would include the following:

a) A cover page that would show a plot of total imports and exports for the current quarter and each of the previous seven quarters.

b) The cover page would also have a tabular breakdown of imports and exports by ATP sector for these same time periods.

c) The inside of the cover page would provide a tabular breakdown of the same data as in b) above but also broken out by trading area (i.e., U.S.A., Japan, ECC and Other)

d) A page devoted to commentary on the tabular and graphical results broken out by:
   - Recent Quarter
   - Recent Twelve Months

e) A page devoted to a definition of the ten sectors (e.g. Life Sciences) and other pertinent data such as exchange rates.

A model of such a report is attached in Appendix C.

The main users of this report would likely be Industry Canada and the Department of Foreign Affairs and International Trade. However, because of the close relationship that appears to exist between Canada's fiscal policy and the investment gap referred to above, it should be of interest to the Department of Finance and Revenue Canada. Although there is no private sector constituency that has the interest and/or the power to address this gap, it will undoubtedly attract the attention of technology-related trade associations such as the Canadian Advanced Technology Association (CATA) or the Information Technology Association (ITAC) at some time in the future. This attraction is more likely to happen if they are exposed to more information on their industry's outputs (i.e. trade) as well as on its inputs (i.e. R & D).

## 9. CONCLUSION

Companies and industries and associations are more motivated by strategic initiatives than by dialogue on issues which are generally beyond their control. The level of publicly funded R & D is an issue that is beyond their control. Their own R & D expenditures are within their control, but R & D is not a strategic initiative in itself. R & D is seldom mentioned in a company's mission statement or in its goals and objectives. Sales and profits and market shares are. If the public sector can focus more on these issues, its dialogue with the private sector will become more meaningful.

The U.S. system of ATP classification is not perfect. Some of its limitations have been identified in this study. However, it is a system that is being used by our largest trading partner. It is recommended that it be used to implement a Canadian system that would report quarterly on the country's performance as an advanced technology trading nation.

## Appendix A - A Harmonized System of Coding for Advanced Technology Products

The Harmonized System (HS) of coding used by nations to track imports and exports is based on a 10-digit code. The first six digits are common to all countries for any given product, but the last four are specific to each country. Two of them are used to define the product in further detail (e.g., water resistant coats as opposed to regular coats) and two are used for tariff classifications. There are more than 22,000 HS codes in use today and they change as new products are introduced and as tariffs change.

Until quite recently, a six-digit HS code was deemed to be sufficient to track advanced technology products. In fact, it was deemed necessary in order to compare one country's figures with another. However, the U.S. department of Commerce uses an ten-digit code because they felt it was necessary to precisely define a product and to accommodate the rapid changes that are common in the industry. It defines its "Advanced Technology Products" (ATP) with a series of such ten-digit codes which are further categorized into ten sectors such as Biotechnology and Aerospace.

It provides a good basis for tracking Canada's trade in high technology products because Statistics Canada maintains a concordance between Canadian and U.S. codes. In this study, the U.S. ATP list was converted into Canadian HS codes to the eight-digit level. This allows Statistics Canada to compile import and export statistics for the U.S., Japan, the EEC and all of its major trading partners.

The following example shows how a vapour deposition device is classified.

| Tech Code | U.S. HS Code | Canadian HS Code | Description |
|---|---|---|---|
| Flexible Manufacturing | 8479899076 | 8479899021 | Chemical Vapour Deposition Apparatus |

This is a device used in the manufacture of semiconductors. Other versions of such a device are manufactured as medium-technology devices and the last four digits of the ten-digit code are used to differentiate the medium-technology devices from the high-technology devices.

The data base compiled by Doyletech Corporation for this study includes 331 import codes and 328 export codes for 1994.

## Appendix B - The Impact of Intercompany Transfer Pricing

There are two types of inter-company transactions that can affect transfer pricing between two closely related companies (e.g. parent and subsidiary), namely:

1. **World Product Mandate** - the Canadian subsidiary of a foreign company has a mandate to develop and manufacture products in Canada for sale to customers around the world or back to the parent company for resale.

2. **Canadian Value Added Only** - the Canadian subsidiary performs assembly work on components shipped from the parent company and the assembled product is shipped back to the parent company.

The following calculations relate to a product that would sell in the U.S. for $10,000 Cdn. and that undergoes some processing in Canada.

1. **World Product Mandate**

   a) if product is shipped to U.S. parent for resale
   - transfer price = cost of goods sold (45%) + R & D (10% of 100%) + G & A (10% of 45%) + profit (10% of 45%) $ 6,400

   b) if product is shipped to U.S. end customers $ 10,000

2. **Canadian Value Added Only**

   a) it generates imports to Canada from U.S. equal to cost of parts (15%) + G & A (10% of 15%) $ 1,650

   b) it generates exports to U.S. equal to cost of parts (15%) + labour (30%) + G & A (10% of 45%) $ 4,950
   + profit (10% of 49.5%) $ 495

   $ 5,445

Under 1) above, Canadian exports to U.S. could be understated by 36% if the product is shipped to the U.S. parent rather than directly to a U.S. customer. This will be the major distortion due to world product mandating.

Under 2) above, U.S. exports to Canada could be overstated by 16.5% because the parts do not remain in Canada. Canadian exports are similarly overstated by 16.5% because the Canadian subsidiary only sold labour and overhead and profit to the parent.

To determine the total impact that such transactions might have, it is useful to look at the

Information and Communications and Electronics sectors, because this is where ATP trade between Canada and the U.S. is greatest and where most of these types of inter-company transactions occur. In 1994, Canada's exports to the U.S. were $10B in these two areas and its imports were about the same.

It is not unreasonable to assume that 10% of the $10B of exports were from world product mandates of type a), another 10% were from type b) and another 10% were from Canadian value added activity. This would have the following impact:

a) due to type a) WPM - Canadian exports understated by 36% of 10% of $10B or $360M

b) due to type b) WPM - no distortion

c) due to Canadian value added - U.S. exports to Canada would be overstated by 16.5% of 10% of $1B (10% of $10B) or $165M. Also, Canadian exports to the U.S. would be overstated by 1.6%.

This would suggest that Canadian exports are understated by $360M - $165M or $95M and Canadian imports are overstated by $165M (16.5% of 10% of $10B). Both of these numbers are well below the margin of error in all of the statistics presented here.

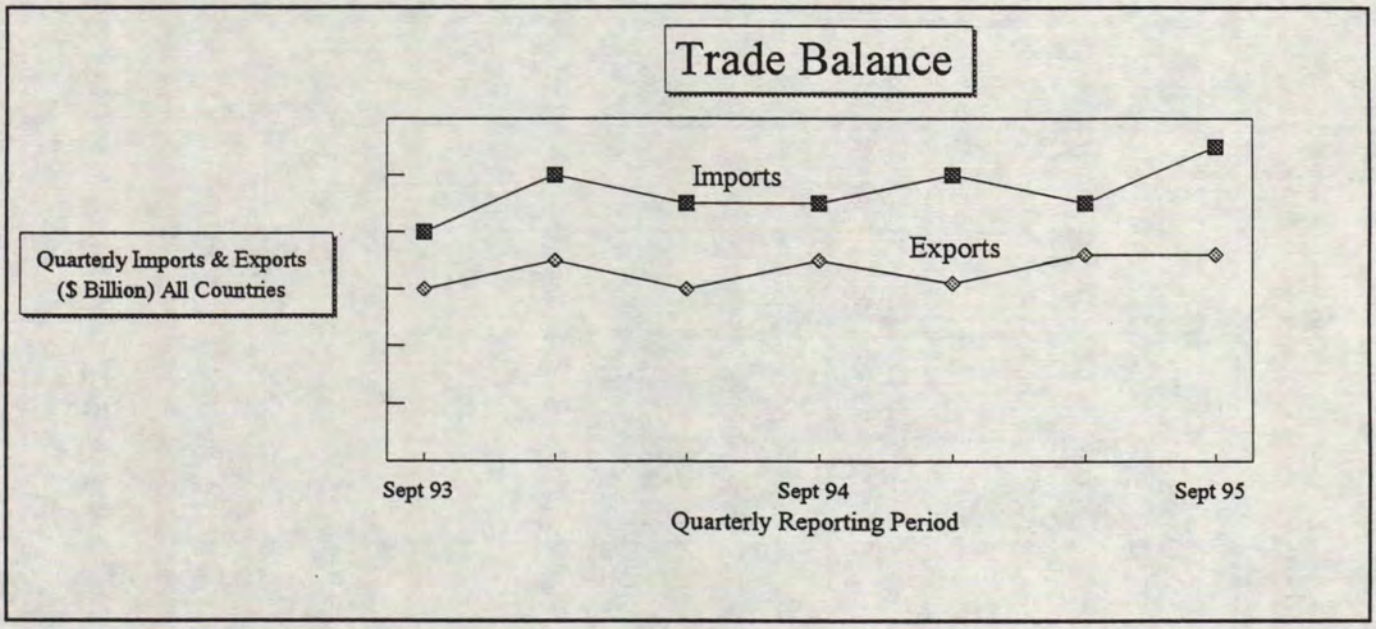
# ADVANCED TECHNOLOGY TRADE BULLETIN

CANADIAN INTERNATIONAL TRADE IN ADVANCED TECHNOLOGY PRODUCTS

THIS BULLETIN PROVIDES STATISTICS ON CANADA'S IMPORTS AND EXPORTS OF PRODUCTS WHICH CONFORM TO THE CLASSIFICATION OF ADVANCED TECHNOLOGY PRODUCTS (ATP'S) AS DEFINED BY THE U.S. DEPARTMENT OF COMMERCE.

PUBLISHED BY INDUSTRY CANADA, 235 QUEEN STREET, OTTAWA, ONTARIO.

FOR MORE INFORMATION CALL 613 - 998 - 9916




## World Trade by Sector

| | Recent 12 Months | | | Recent Quarter | | |
|---|---|---|---|---|---|---|
| Sector | Imports | Exports | Balance | Imports | Exports | Balance |
| Biotechnology | | | | | | |
| Life Sciences | | | | | | |
| Opto-Electronics | | | | | | |
| Information/Comm. | | | | | | |
| Electronics | | | | | | |
| Flexible MFC | | | | | | |
| Advanced Materials | | | | | | |
| Aerospace | | | | | | |
| Weapons | | | | | | |
| Nuclear | | | | | | |
| Total | | | | | | |

# Trade by Sector by Economic Area

| **A. Recent Twelve Months** | USA | | | EEC | | | Japan | | | Other | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sector | Imp | Exp | Bal | Imp | Exp | Bal | Imp | Exp | Bal | Imp | Exp | Bal | Imp | Exp | Bal |
| Biotechnology | | | | | | | | | | | | | | | |
| Life Sciences | | | | | | | | | | | | | | | |
| Opto-Electronics | | | | | | | | | | | | | | | |
| Information/Comm. | | | | | | | | | | | | | | | |
| Electronics | | | | | | | | | | | | | | | |
| Flexible MFC | | | | | | | | | | | | | | | |
| Advanced Materials | | | | | | | | | | | | | | | |
| Aerospace | | | | | | | | | | | | | | | |
| Weapons | | | | | | | | | | | | | | | |
| Nuclear | | | | | | | | | | | | | | | |
| *Total* | | | | | | | | | | | | | | | |
| **B. Recent Quarter** | | | | | | | | | | | | | | | |
| Biotechnology | | | | | | | | | | | | | | | |
| Life Sciences | | | | | | | | | | | | | | | |
| Opto-Electronics | | | | | | | | | | | | | | | |
| Information/Comm. | | | | | | | | | | | | | | | |
| Electronics | | | | | | | | | | | | | | | |
| Flexible MFC | | | | | | | | | | | | | | | |
| Advanced Materials | | | | | | | | | | | | | | | |
| Aerospace | | | | | | | | | | | | | | | |
| Weapons | | | | | | | | | | | | | | | |
| Nuclear | | | | | | | | | | | | | | | |
| *Total* | | | | | | | | | | | | | | | |

## COMMENTARY

### A. Recent Twelve Months

- Sector

- Economic Area

- General

### B. Recent Quarter

- Sector

- Economic Area

- General

## MISCELLANEOUS INFORMATION

### ATP Descriptions

- **Biotechnology** - the medical and industrial application of advanced scientific discoveries in genetics to the creation of new drugs, hormones and other therapeutic items for both agricultural and human use.
- **Life Sciences** - the application of scientific advances (other than biological) to medical science. Recent advances, such as nuclear resonance imaging, echocardiography, and novel chemistry coupled with new production techniques for the manufacture of drugs have led to many new products for the control or eradication of disease.
- **Opto-Electronics** - encompasses electronic products and components that involve the emitting and/or detection of light. Examples of products included are optical scanners, optical disc players, solar cells, photo-sensitive semiconductors and laser printers.
- **Information and Communications** - focuses on products that are able to process increased volumes of information in shorter periods of time. Includes central processing units, all computers, and some peripheral units such as disk drive units and control units, along with modems, facsimile machines, telephonic switching apparatus and non-customized software. Examples of other products included are radar apparatus and communications satellites.
- **Electronics** - concentrates on recent design advances in electronic components (with the exception of opto-electronic components) that result in improved performance and capacity and in many cases reduced size. Products included are integrated circuits, multi-layer printed circuit boards, and surface-mounted components such as capacitors and resistors.
- **Flexible Manufacturing** - encompasses advances in robotics, numerically-controlled machine tools, and similar products involving industrial automation that allow for greater flexibility to the manufacturing process and reduce the amount of human intervention. Includes robots, numerically-controlled machine tools and semiconductor production and assembly machines.
- **Advanced Materials** - encompasses recent advances in the development of materials that allow for further development and application of other advanced technologies. Examples are semiconductor materials, optical fibre cable and video discs.
- **Aerospace** - Encompasses most new military and civil helicopters, airplanes and spacecraft (with the exception of communications satellites that are included under Computer and Telecommunications Technology). Other products included are turbojet aircraft engines, flight simulators, and automatic pilots.
- **Weapons** - primarily encompasses products with military application. Includes such products as guided missiles and parts, bombs, torpedoes, mines, missile and rocket launchers and some firearms.
- **Nuclear Technology** - encompasses nuclear power production apparatus. Includes nuclear reactors and parts, isotopic separation equipment and fuel cartridges. Nuclear medical apparatus is included under Life Science Technology.

| Exchange Rate | | | |
|---|---|---|---|
| | | U.S. (U.S.$ perCdn) | Japan (Yen per Cdn) |
| 1990 | | | |
| 1991 | | | |
| 1992 | | | |
| 1993 | | | |
| 1994 | $Q_1$ | | |
| | $Q_2$ | | |
| | $Q_3$ | | |
| | $Q_4$ | | |
| 1995 | $Q_1$ | | |
| | $Q_2$ | | |
| | $Q_3$ | | |
| | $Q_4$ | | |