Trends in the Pharmaceutical Industry in Canada in the Post 1987 Environment

DRAFT

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EXECUTIVE SUMMARY

The four year review of the 1987 amendments to the Patent Act specified in 1987's Bill C-22 was intended to look at price and R&D levels in order to assess the performance of the innovative pharmaceutical industry over the four year period. However, since the amendments were enacted in December 1987 a number of significant events have occurred internationally that require the analysis to be somewhat broader in scope and detail.

First, rationalization is occurring in both the R&D and manufacturing segments of the innovative industry as it reacts to the pressures of global competition. Mergers, buy-outs and other forms of corporate restructuring are changing the face of this industry in Canada and abroad. Second, and perhaps more importantly, there has been increasing competition by national governments for investments and changes in the style and intensity of such intergovernmental competition. Some foreign governments have, or are planning to, implement patent term extension legislation and/or other industrial policies that will influence R&D and manufacturing decisions. This worldwide emphasis on policies that foster the growth of competitive national pharmaceutical sectors will have significant long term impacts on the economies of many nations and the structure of this industry.

Given these new and rather complex developments it is necessary to obtain accurate information that reflects the current economic status of this industry in Canada. This information will enable the government to make informed policy decisions that reflect Canada's best interests in this area.

The research conducted focuses on assessing the domestic impact of the 1987 changes to compulsory licensing within the context of the new global environment that Canada's pharmaceutical industry is faced with. The general structure of the paper is as follows:

1. Background information is provided so that the reader understands the motivation for this research.

2. Next, there is an overview of the Canadian pharmaceutical industry which is mainly descriptive in nature. This section of the paper places the Canadian pharmaceutical sector within the global marketplace.

3. Then the full impact of the amendments is assessed. This looks at sales, employment, trade, profits, prices, R&D and several other measures of economic activity.

4. After this, a review of the consequences for consumers is conducted. The work includes an assessment of the impact on the Canadian healthcare system, as well as calculations of the costs/benefits for consumers.

5. Following this, there is an overview of the main policy goals associated with the amendments is provided. These policies are reviewed in an attempt to see if the legislation has had the desired effects on the pharmaceutical industry and the Canadian economy.

6. Finally, all of the above analyses are brought together and evaluated. Particular attention is given to the impact that the legislation has had on consumers and the pharmaceutical industry itself.

Before the conclusions of the analysis can be presented it is very important to note that the legislation has affected the economy on two separate levels. The impact of these legislative changes will take place in the short term and in the long term. A brief summary of these changes, and their expected time frame, is as follows:

- There was an immediate impact on the price of drugs due to the formation of the PMPRB.

- There was an immediate change in the amount of pharmaceutical R&D performed as a result of the PMAC's public commitment to raise the level of R&D conducted in this country.

- The seven or ten years of market exclusivity that the amendments provide will only begin to affect the generic sector in 1994 or 1995. This is because generic products took, on average, five to ten years to reach the market prior to 1987.

- The forgone savings by provincial governments and individual consumers as a result of delayed introductions of generic copies of pharmaceuticals will begin to be felt in the next couple of years.

It is also important to note that due to unavoidable problems and delays in the gathering and analysis of statistical information, only limited information is available for the post-1987 period. While considerable data is available from other sources and is used in this analysis, not all the gaps in information can be filled. For these reasons, a) the short time that has passed since 1987 and b) incomplete data in several areas, any conclusions drawn from this report must be considered tentative. The direction of impacts can usually be inferred with reasonable confidence but for the most part, the magnitude of those impacts remain uncertain.

The research conducted has found that the structure of the Canadian industry is similar to other sectors of our economy in that it is mainly comprised of branch plants of foreign owned

companies. The quantity of R&D done plus the high value of patent protection makes the pharmaceutical industry somewhat unique. These facts have, of course, been central to the long term intellectual property policy debate on pharmaceuticals in Canada. The number of chemical entities for which licences have first been applied for under the Patent Act's compulsory licensing provisions has risen since 1987. This is not surprising given the current environment. Generic firms appear to have attempted to protect their future interests against the possibility of further changes to compulsory licences.

In terms of sales, investment, manufacturing and other general economic indicators, this sector of the Canadian economy is very healthy. The simple fact that pharmaceuticals are very price inelastic - through necessity people will buy them at almost any price - has ensured, and will continue to ensure, that this industry will realize excellent economic returns.

This observation is backed up by the financial research conducted for this review. Both sections of this industry are extremely profitable. In this regard, the calls from both the innovative and generic companies for respectively greater or lesser protection of intellectual property interests have been questioned by provincial governments and consumer interests. The evidence clearly indicates that both groups did very well under the old system of compulsory licensing. The generic companies will most likely experience some economic losses as a result of delays in reaching the market but for Apotex and Novopharm (the two largest generic companies) the impact of the 1987 amendments does not appear to, in any way, threaten their existence. Only the smaller generic companies might need to be worried. As for the innovative companies, their profit levels are expected to continue.

s. 21(1)(c) + b)

With regard to R&D, the positive benefits in terms of employment have been somewhat neutralized by the rationalization process occurring in the industry. Plant closures and the reduction in manufacturing activities have partially offset the positive economic effects of increased employment opportunities for medical researchers.

As well, given the concurrent increases in R&D in other countries it is not clear that the increases in pharmaceutical R&D in Canada represent an absolute rise in the quantity of R&D that

Canada may have received in any event. Furthermore, it is unclear what the long term effects of the change in the Canadian R&D level will be. New products may come out of this research but there is no way of knowing what their therapeutic value will be or of estimating their impact on the viability of the Canadian based drug firms. If they are of little or no potential for therapeutic gain over existing drug therapies, as is quite often the case, then the economic and social value of these products is unclear.

The pressure in the GATT and NAFTA negotiations to remove the compulsory licensing provisions from our Patent Act comes from many countries. This pressure is based on both economics and politics. These countries see Canada's current intellectual property regime as a threat to their economic prosperity in that many developing countries are considering Canada's system for themselves. Obviously, this would provide a lower cap on the revenues of pharmaceutical companies than would be the case if compulsory licensing were completely eliminated. The point that is often ignored, however, is that by implementing a system comparable to Canada's, those countries would have much higher IP standards than they do presently, and the industry's revenue picture would be improved considerably over what it is now. In any event, the government is being asked to change its legislation once again. However, this request must be considered alongside the other policies that are integrally tied to this intellectual property issue. Hopefully this document has provided some of the information needed for the government to formulate policy initiatives that best match Canadians needs.

I. INTRODUCTION

When the amendments to the 1969 Patent Act concerning pharmaceuticals were passed in 1987, there was a public expectation that no further changes to compulsory licensing of patented drugs would be contemplated until after the study of the impact of the 1987 amendments was conducted by a committee of Parliament in 1996. However, since the amendments were enacted a number of significant events have occurred internationally that require the issue to be addressed intensively, once again.

First, rationalization is occurring in both the R&D and manufacturing segments of the innovative industry as it reacts to the pressures of global competition. Second, and perhaps more importantly, there has been increasing competition by national governments for investments and changes in the style and intensity of such intergovernmental competition (eg. patent term extension legislation).

Superimposed over these events have been the introduction of intellectual property negotiations in the GATT forum, the continuing pressure on Canada by the United States to eliminate compulsory licensing and the formation of large multinational trading blocs such as the European Community, the Asian nations and, as now proposed, North America.

Given these new and rather complex developments it is necessary to obtain accurate information that reflects the current economic status of this industry. This information will enable the government to make well informed policy decisions that reflect Canada's best interests in this area.

This paper focuses on assessing the domestic impact of the amendments to date within the context of the new global environment that Canada's pharmaceutical industry is faced with. The general structure of the paper is as follows:

1. Background information is provided so that the reader understands the motivation for this research.

2. Next, there is an overview of the Canadian pharmaceutical industry which is mainly descriptive in nature. This section of the paper places the Canadian pharmaceutical sector within the global marketplace.

3. Then an analysis of the 1987 amendments is performed. This looks at sales, employment, trade, profits, prices, R&D and several other measures of economic activity.

4. After this, a review of the consequences for consumers is conducted. The work includes an assessment of the impact on the Canadian healthcare system, as well as calculations of the costs/benefits for consumers.

5. Following this there is an overview of the main policy goals associated with the amendments. These policies are reviewed in an attempt to see if the legislation has had the desired effects on the pharmaceutical industry and the Canadian economy.

6. Finally, all of the above analyses are brought together and evaluated. Particular attention is given to the impact that the legislation has had on consumers and the generic sector of the pharmaceutical industry.

It is very important to note at this time that since the amendments were only passed four years ago it is hard to determine what the impact on the pharmaceutical industry has been. The main problem is that there has, as yet, been little impact on the generic sector of the market as a result of the amendments. The seven or ten years of market exclusivity that the amendments provide will only begin to affect the generic sector during the next three to four years. This is because generic products took, on average, five to ten years to appear on the market prior to 1987. The increased costs that will be borne by provincial governments and individual consumers as a result of later introductions of generic copies of pharmaceuticals are very difficult to forecast. The fact of the matter is that the date on which a generic would have been introduced in the absence of the amendments can not be determined with any degree of certainty.

It is also important to note that due to unavoidable problems and delays in the gathering and analysis of statistical information, only limited information is available for the post-1987 period. For example, many of the Statistics Canada data series are not available for the very recent years and/or, given confidentiality requirements, cannot be released by that organization. Similarly, it is difficult to disaggregate many of the Statistics Canada data series to the pharmaceutical industry level as it is discussed in this and associated papers.

While considerable data is available from other sources and is used in this analysis, not all the gaps in information can be filled. For these reasons, a) the short time that has passed since 1987 and b) incomplete data in several areas, any conclusions drawn from this report must be considered tentative. The direction of impacts can usually be inferred with reasonable confidence but for the most part the magnitude of those impacts remain uncertain. The paper concludes with a set of Appendices which provide all of the data used in the course of the research.

II. BACKGROUND

A. Legislative History

Compulsory licensing came into being in Canada in 1923 following British amendments to their patent legislation. From 1923 until 1969, compulsory licences were only available for purposes of manufacturing the medicine in Canada. Only a very few applications were received and this limited licence has been agreed to have had no impact on pharmaceuticals in this country. In 1969, after several reviews of the intellectual property system, the health care system and the pharmaceutical industry during the late 50s and the 60s, amendments to the Patent Act were passed which created the compulsory licence to import patented pharmaceuticals. These amendments were intended to foster price competition in the industry as a response to complaints that Canadian prices were higher than they should be and to assist in the creation of a "Canadian" drug industry in response to complaints that what had been a Canadian industry had been taken over by multinationals.

By the mid-80s a significant generic drug sector had emerged in Canada. The Eastman Report estimated that the total value of the savings in drug costs resulting from the creation of that industry was some $211 million in 1983 alone. Provincial drug benefit plans had been significantly expanded during this period, in part based on the availability of low cost alternatives to many popular "brand-name" drugs whether patented or not.

As the generic industry gained in experience and technological competence, the length of time taken to produce copies of patented drugs decreased and the array of products copied started to increase. Without examining the rationale behind many of the measurements made at the time to produce generic copies, it is sufficient to note that during the 1970s the average length of time taken was probably in the 11 to 12 year range with several drugs having taken much longer. By the mid-80s, with the increasing sophistication of the generic sector, the average length of time taken to produce generic copies had likely shrunk to about 9 to 10 years with some products being copied within very short periods of time. The most notable of these is, of course, cimetidine, for which the originator had only about 4½ years of exclusive marketing prior to the entry of the first generic copy. Some other generic products were entering the market about 5½ to 7 or so years after the originator's products.

The Eastman Report noted that overall, the innovative pharmaceutical industry in Canada had not been significantly negatively impacted by the 1969 amendments but that in certain instances some innovative companies had certainly suffered on an individual basis. Profit rates continued to be considerably above industry wide averages and the financial health of the innovative sector as a whole was certainly not in danger. Nonetheless the Report,

and several other analyses of the industry, accepted that some rebalancing was necessary and that, even if the industry was financially healthy, the 1969 amendments had caused pharmaceutical R&D in Canada to stagnate. Given the increasing concern that developed countries such as Canada would, more and more, have to rely on knowledge-based industries to remain internationally competitive, the Government took action to put that rebalancing into effect.

The result was Bill C-22 which, after one of the longest and stormiest legislative procedures in Canadian history, became law in November 1987. The amendments in respect of pharmaceutical patents provided guaranteed periods of market exclusivity for originators and created the Patented Medicine Prices Review Board to monitor and review prices and thereby assuage consumer concerns.

B. Review of Current Legislation

The term of pharmaceutical patents in Canada is 20 years from the date of filing of the application. At any time after a patent has been granted on a medicine, anyone can apply for a compulsory licence to manufacture or import the medicine for sale in Canada. Other than using the compulsory licence for purposes of exporting from Canada or doing those things necessary to prepare for sale in Canada, the compulsory licensee may not use the licence for purposes of sale in Canada until the appropriate period of patentee market exclusivity has expired.

In the case of a compulsory licence to manufacture (the active ingredient) in Canada, the licensee cannot sell the medicine in Canada for seven years after the first notice of compliance issued by Health and Welfare Canada for the medicine or its obvious chemical equivalent.

In the case of a compulsory licence to import (the active ingredient) into Canada, the licensee cannot sell the medicine in Canada for ten years after the first notice of compliance issued by Health and Welfare Canada for the medicine or its obvious chemical equivalent.

Where a medicine has been granted Canadian invented and developed status (the major part of the inventing and the major part of the development have occurred in Canada), a compulsory licence to import may not be issued by the Commissioner of Patents. In addition, a compulsory licence to manufacture may not be used by the licensee if the patentee is, after seven years, making the medicine in Canada for purposes of completely or substantially supplying the Canadian market. None of the periods of patentee market exclusivity described above may extend beyond the expiry date of the first patent issued for the medicine or its obvious chemical equivalent.

While the following rudimentary listing does not correspond to the exact terminology or categorizations used by the Patent Office, it illustrates the different types of patents available in Canada. Subject to these interpretive limitations, patents may be granted in Canada for pharmaceutical products themselves, products prepared by specific processes, pharmaceutical production processes, and for particular uses of drug products.

III. INDUSTRY OVERVIEW

A. Canadian Industry Structure

The Canadian pharmaceutical industry is dominated by multinational companies. The bulk of the leading firms are those that are part of the "innovative" pharmaceutical industry. As one can see in the Table provided on the next page, the majority of these firms are headquartered in the U.S. and Europe. These companies are responsible for the R&D and patenting of most new drugs that are marketed today. The majority of these firms are members of the Pharmaceutical Manufacturers Association of Canada (PMAC). Only two of the top twenty firms are fully owned by Canadians (Novopharm and Apotex). Both of these companies produce generic drugs and conduct little of their own basic research although some investments have been made in biotechnology start-up firms and in the form of university grants.

Table 1: Top Twenty Drug Companies in Canada, by Sales: 1990

Company Name	Type of Firm	Country of Control	Canadian Sales ($000)	Worldwide Sales (mill)

1650

Source: IMS Canada & SCRIP Pharmaceutical League Tables, 1990

* These firms are subsidiaries of other firms within Canada.

B. Concentration/Competition

Examining the extent to which output is concentrated in the hands of a few manufacturers is perhaps the most common method used for investigating the degree of competition in an industry. Given that the amendments give an extended period of market exclusivity to the patent holder, one would predict that concentration would increase over time as generics would not be permitted to compete as early as before. However, due to the fact that the Bill is not retroactive and it takes between 4 and 7 years on average for a generic to market a drug, it will likely take 5-10 years before any trend regarding industry concentration resulting from the amendments surfaces.

In 1984, when the federal government set up a Royal Commission on the Pharmaceutical Industry in Canada (The Eastman Commission). One area that was studied was the overall concentration of sales of ethical pharmaceuticals and medicines for the year 1982. The results indicated that the four largest firms accounted for 23.4% of total sales while the 12 largest account for half of the total market. The top 30 accounted for just over 80%. Not surprisingly, the corresponding figures for 1988 have changed very little. In 1988, the four largest firms were responsible for 22.68% of all sales. The figures for the top 12 and top 30 are 47.82% and 79.76%, respectively. Table 2 gives a more detailed account of concentration figures since 1984.

Table 2: Concentration of Pharmaceutical Sales Among the Top Four, Twelve and Thirty Firms

Year	CR_4	CR_{12}	CR_{30}
1984	23.04	48.21	78.65
1985	23.50	46.15	76.18
1986	23.96	48.34	80.40
1987	23.73	48.37	80.06
1988	22.68	47.82	79.76

Source: IMS Canada

Compared to other chemical and chemical products industries the concentration of sales among the top four companies in the pharmaceutical industry is low. For example, in 1980, the sales concentration ratios for the largest four companies among manufacturers of plastics and synthetics (SIC 3730) and soap and cleaning compounds (SIC 3760) were 57.3% and 64.9% respectively.

Although the overall concentration level for pharmaceuticals is relatively low, it is likely that this figure underestimates the degree of competition in the industry. Strictly speaking, the overall market for pharmaceuticals is not as homogenous as those that it was compared to in various chemical industries. This is due to the fact that each drug does not compete against all other drugs, but rather competes against those drugs which are used for treating similar illnesses. To fully capture this aspect of competition in the pharmaceutical industry one can break down the industry into different therapeutic classes which better represent distinct classes of chemical compounds. Using many of the same major therapeutic classes that Eastman used, Table 3 outlines some of his results, as well as, the corresponding figures since 1984.

Table 3: Concentration of Sales Among the Four Largest Firms in Eleven Major Therapeutic Classes of Ethical Drugs for Canada, 1974 and 1984-1988 (%)

Therapeutic Class	1974	1984	1985	1986	1987	1988	Class Trend
Ethical Analgesics	66.70	59.36	59.50	57.17	53.48	50.91	DOWN
Antibiotics *	54.70	49.34	49.43	49.64	47.90	49.64	DOWN
Bronchial Therapy	65.20	83.94	86.10	87.62	87.78	88.91	UP
Anti-hypertensives	NA	76.88	79.21	80.26	83.22	79.52	EVEN
Cough/Cold Remedies	52.00	48.07	49.56	50.90	45.83	47.43	EVEN
Hemantics	35.50	41.16	42.61	46.27	44.85	46.65	UP
Plain ** Corticoids	68.10	61.85	60.55	61.01	60.48	61.35	DOWN
Corticoid ** Combinations	63.10	55.81	58.09	58.00	58.63	60.09	DOWN
Laxatives, Innovative	49.00	51.38	51.40	50.43	44.41	45.50	EVEN
Tranquilizers	67.00	59.13	57.43	56.99	52.55	52.07	DOWN
Vitamins, Innovative	32.90	37.14	38.71	37.05	39.11	40.12	UP

Source: Eastman (1985) and IMS Canada.
*Antibiotics in this class are of the broad and medium spectrum.
**These are specific types of hormones.

It is clear that concentration as measured in each therapeutic class is considerably higher than when concentration is measured within the entire market. In 1988, concentration among the top four firms ranged from 40.12% (ethical vitamins) to 88.91% (bronchial therapy). These levels of concentration are equal to or greater than those in other chemical industries and some are comparable with industries characterized by high levels of concentration such as breweries or motor vehicle manufacturers. In some classes, such as bronchial therapy and hemantics, concentration has been steadily increasing over the past two decades. In other classes, most notably ethical analgesics and ataractics, concentration has been decreasing for the past five years, much the same as it has for the previous decades. The other therapeutic classes examined here either show no clear upward or downward trend or have experienced a steady level of concentration over the past two and a half decades.

There is, however, some debate over the appropriateness of using therapeutic classes as a fair measure of concentration. While using overall concentration in the ethical drug market gives too low a measure of concentration, Eastman believes that using therapeutic classes gives too high a measure of concentration. Therapeutic classes, he states, do not exactly represent a well defined market whose drugs are in direct competition with each other as they do not include drugs in other therapeutic classes that may also be useful for treating a certain illness. The "true" concentration level is thus likely to be somewhere between the two different ratios presented. Regardless of what the "true" concentration level is, one must realize that resource requirements and patent protection both serve to limit entry into the industry and participation in multiple sub-markets. Extensive funds are required to identify and develop an active ingredient that has valuable therapeutic effects, and to carry out the lengthy tests required to obtain marketing approval.

This approval process is the source of many complaints by the innovative sector of the industry. The cost and delays involved with regulatory approval are large. These costs, however, play a large part in preventing smaller firms from entering this market. Many of the new biotechnology companies formed in the 1980's (usually Canadian owned start-ups) had hoped to become full fledged pharmaceutical companies but their inability to get a product through the development process (for financial and lack of experience reasons) has acted as a barrier to entry into the market. Several of these firms have had to sign joint ventures with large pharmaceutical companies to get their products onto the market. Additional capital expenditures are also needed to develop the production and manufacturing techniques that allow for economic commercialization.

The pharmaceutical industry is one of the largest users of the patent system. Patent protection is important in safeguarding the developer's financial return from the invention, since the

lack of technical knowledge does not represent a barrier to the reproduction of most drugs.

Unlike other industries, the competitive efforts of drug firms are based on marketing strategies and the introduction of either new or slightly modified drug entities. This produces a continual shifting in their hold on market share, within sub-markets and the total market. In other words, innovative firms try to attain a greater market share by aggressively marketing a newly developed drug that competes with another firm's product, rather than introducing the new product at a lower price. This is mainly due to the fact that ordinary economics does not apply to this market. Prices are not a prime concern to the group which decides what will be consumed - doctors. Therefore, price competition neither wins market share nor stimulates overall demand.

C. Manufacturing

The pharmaceutical industry in Canada consists of roughly 150 manufacturing establishments. More than eighty per cent of these establishments are concentrated in Ontario (50.9%) and Quebec (32.1%). The remaining establishments are mainly in Western Canada (14.6%). The Atlantic provinces only account for 2.4% of the total.

The manufacture of pharmaceuticals can be divided into two processes: synthesizing of chemicals to produce the active ingredients of a particular drug, and compounding of the active ingredients into final dosage form. Neither of these processes is labour intensive, so labour costs are not a major factor. In addition, neither process depends on the proximity to raw materials, nor is transportation of the final product an important component. These characteristics allow the location of production facilities in a wide variety of alternative sites.

Therefore, it is not surprising that the active ingredients of pharmaceuticals sold in Canada are mainly imported. Many of these active ingredients are prepared in countries which provide tax breaks and other forms of financial incentives. All other markets are then supplied by shipping active ingredients in bulk or final form to branch plants in market countries. This organizational structure also provides the firm with economies of scale.

The fine-chemicals industry in Canada continues to consist of a few relatively small firms supplying mostly materials for the Canadian market. This fact, together with the rationalization process that has served to cause relatively large adjustments in the organization of the world pharmaceutical industry in the last few years, is problematic for Canada. While we must adjust to this process it is difficult to determine what the future will hold under any policy alternative for this sector.

D. Research & Development

There is little doubt that effective research and development is the key to survival and growth in the pharmaceutical industry. Without the ability to develop and patent new drugs on a consistent basis, an innovative firm will slowly lose its market share. Over time, generic brands and improved versions of the old drug will erode sales of the patented product, leaving the original innovating firm with a product that generates little revenue.

Undertaking the research necessary to produce a new drug is an extremely expensive and lengthy process. From the time an idea for a new drug is first conceived until the time it is brought to the marketplace can take up to ten years. Meanwhile, the costs of development are estimated to usually reach at least [illegible][1] This high cost of development means that drugs must be marketed internationally in order for firms to recoup their R&D costs as well as make a reasonable rate of return on their investment. R&D investment decisions are therefore based upon the revenues that each firm is expected to earn worldwide rather than in any one single country.

This need to market a drug internationally has led most companies to set up subsidiaries in each national market in order to properly promote and adapt their products to the local market. As well, the subsidiary will often set-up small scale manufacturing plants for the purposes of formulation/packaging and/or perform clinical testing to ensure that they meet domestic health regulations. However, economies of scale and control requirements dictate that most basic research takes place in the multinational's home country. It has long been held that concentrating the basic research around one research centre is necessary in order to reach the "critical mass" (probably in the range of 200-300 employees) where new discoveries are most likely to be made. The Canadian industry structure reflects this situation well with most firms having only very small in-house R&D units.

Most R&D taking place domestically is of the clinical testing type. Although the PMAC has committed itself to increasing R&D by $1.4 billion between 1987 and 1996, it is likely that most of this money will be spent on clinical research. However, the Board's Third Annual Report points out that basic research is on the rise in Canada over the past three years, reaching 26.3 per cent of the total amount spent on pharmaceutical R&D in 1990. The Canadian owned generic companies spend approximately 10% of sales on R&D, but, at this point in time, little is spent on basic research.

There is evidence though that traditional patterns of R&D are changing. More importantly, some of these newly emerging pat-

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[1]SCRIP, Review Issue 1989, p. 1.

terns may have implications for the structure of the industry in Canada and abroad. First, the process of drug discovery by trial and error is being used less and less. Instead, computers are being used to "design" new chemical entities by examining the microbiological foundations of diseases. Moreover, pharmaceutical firms are spending more money than ever on R&D as the diseases that have yet to be cured are of a nature that makes it difficult to find an effective drug that will properly treat them (eg. viral diseases). These developments, coupled with the fact that product development times have been continually rising, could contribute to increasing concentration in the international pharmaceutical industry. Both of these factors mean the cost of bringing drugs to market will continue to escalate and thus increase the chances of company mergers as firms strive for the larger cash flow needed in order to develop and market their new drugs successfully.

E. Innovation in the Pharmaceutical Industry

The reasons behind the pharmaceutical innovation which is conducted, the manner in which it is conducted and its value need to be addressed. By looking at these factors one can better understand the underlying mechanisms which drive the innovation related business decisions made in this industry.

It has been suggested that patents are an instrument to facilitate product differentiation. In this regard, patents can contribute to significant product innovation by encouraging investments in R&D. However, patents can also be used to protect inventions of limited therapeutic value and patent licences may also be used to encourage brand proliferation. There are two differing perspectives on innovation in the pharmaceutical industry - the focus on product differentiation strategies versus innovation of significant and therapeutic value. These two viewpoints are respectively advocated by the National Pharmaceutical Council and the United States Senate Special Committee on Aging. Arguments from both sides are presented below for the reader. No conclusions are drawn on the relative merits of the various arguments. Rather, the varying opinions are presented so that the complexity of this issue is better understood.

The National Pharmaceutical Council has concluded that:

(1) Pharmaceutical R&D is an evolutionary process characterized by incremental advances - The accumulation of small successive improvements to older drugs is more important than high profile "breakthrough" therapies in the vast majority of clinically important medicines.

(2) Incremental changes result in better products and cost competitive care - Important new drug uses

are often discovered as a result of clinical experience after initial marketing and multiple agents in a class enable physicians to optimize therapy and provide the best treatment for patients.

(3) Savings to society exceed the cost of R&D - Incremental innovations result in substantial cost savings to public and private health insurers and consumers through reduced hospital and nursing home stays, physician visits and surgery.

(4) Public policy should encourage incremental innovation - The evolutionary process of pharmaceutical R&D is best appreciated form a long term developmental perspective whereas a static analysis may lead to the mistaken appearance that incremental innovations are duplicative, profit-driven imitations of successful drugs already in the market. Public policies such as therapeutic substitution or formularies which restrict the use of incremental innovation reduce the incentives to develop such products and should be used to penalize progress through incremental innovation in pharmaceuticals (Levy, 1990).

The pharmaceutical industry perspective of the social benefits of incremental improvements contrasts sharply with findings of the United States Senate Special Committee on Aging. The findings pertaining to the value of new prescription drug products include:

(1) The bulk of R&D by prescription drug manufacturers produces insignificant new compounds that add little or nothing to drug therapies already marketed. Evidence to support this finding consisted of the following:

- The top 25 pharmaceutical companies introduced to the market just 12 important drugs between 1981 and 1988.

- Eighty-four percent of the 348 new drugs brought to market by the 25 largest U.S. drug manufacturers between 1981 and 1988 were "C"-rated by the Food and Drug Administration meaning that they had little or no therapeutic gain.

- For every "important" or "A"-rated new drug marketed by the 25 largest drug manufacturers, 24 "C"-rated drugs with little therapeutic value were brought to market (i.e., the drug duplicates the medical importance and therapeutic usage of drugs already on the market).

(2) Prescription drug manufacturers charge the public high prices for new drugs that duplicate existing and generally less expensive drug therapies. This finding is supported by the following information:

- FDA classifications of new drugs include an implicit consideration of potential for large cost reduction; therefore, the FDA "C"-rating on most drugs means these drugs did not provide significant economic advantages to the patent compared to existing drugs used for the same ailment.

- Prices for new "C"-rated anti-ulcer drugs during the 1980s were higher than the therapeutically equivalent innovative product; an example given is Glaxo's anti-ulcer drug Zantac which was marketed at a cost 46% higher than the innovative brand Tagamet made by SmithKline Beechman Corp., even though Zantac was FDA "C"-rated and offered little or no therapeutic gain.

- Based upon the industry's published figure for R&D costs for a "new drug" between 1981 and 1988, the top 25 U.S. drug makers spent, and passed on to consumers, about $37 billion for R&D to produce 292 new drugs with little or no potential for therapeutic gain over existing drug therapies.

F. The Use of Compulsory Licensing

Most compulsory licences have been granted for three types of drugs: those prescribed for the central nervous system (tranquilizers & anti-depressants); anti-infective drugs (penicillins); and cardiovascular drugs. A fourth category of drugs (anti-ulcer) has, over the past four to six years, become another major area of compulsory licensing activity.

From 1970 to 1990 the Commissioner of Patents has granted 595 compulsory licences for 164 drugs. These licences involved about 90 patentees and 50 licensees, most of which were generic manufacturers. In general most of the best-selling drugs in Canada face competition from compulsory licensed generic products. Of the 20 largest multinational pharmaceutical companies world-wide, 17 had compulsory licences against at least one of their products.

For those generic drugs that have entered the market, they received their NOC within an average of 11 years after the original's patent date. Several drugs have been introduced in much less time, but other generics appeared ten or more years later. As of December 20, 1991, licence applications were outstanding on 29 drugs.

In 1990, licensees paid royalties on 41 drugs. Generic sales of the 38 compulsory licensed drugs in that same year totalled just over $167 million. Looking at Table 4 one can see that the greatest period of growth for sales of compulsory licensed drugs occurred in 1986/87 and 1987/88. This is due almost entirely to the sales of the generic copy of ranitidine (Zantac), an anti-ulcer medication.

Table 4: Sales of Compulsory Licensed Drugs in Canada: 1983 - 1990

Year	Sales ($000)	% Change-Year
1983	28,373	NA
1984	43,800	54%
1985	42,909	-2%
1986	43,686	2%
1987	70,713	62%
1988	118,225	67%
1989	162,186	37%
1990	167,411	3%

Source: Patent Office and IMS Canada

Another factor which affects the impact that compulsory licensing has on the health care system is the response of the provinces to these products. When compulsory licensing was first introduced, virtually all drugs sold in Canada were paid for directly by the consumer. Reimbursements were limited to people covered by private insurance. The situation today is radically different.

Medicare came into being in the 1960's and all provinces now reimburse welfare recipients for most or all of the cost of drugs. The same assistance is available to qualified residents over 65 years of age. Several other provinces offer some degree of assistance to all of their residents. The concern about drug prices is now as much a governmental budgetary matter as it is a family health care matter. Provincial treasuries spent approximately $47.9 billion in 1991 on these programs of which $3.1 billion comprised of drugs costs to pharmacies.

To encourage substitution of lower-price drugs, some provinces have enacted legislation that shifts most of the legal liability formerly borne by pharmacists onto the government. Permission to substitute generic versions is determined by the province and may

involve testing that is additional to the requirements of federal health regulations.

For drugs purchased under many of the provinces' reimbursement programs, pharmacists are required to dispense a low-cost substitute when available, unless the doctor has explicitly stipulated no substitutions. The pharmacist is now reimbursed a dispensing fee plus an agreed upon amount for the drug itself. This payment method has replaced the traditional fixed mark-up to lessen the incentive to dispense more expensive drugs.

The cost of reimbursement programs can be expected to grow significantly over the next decade as the Canadian population ages. In 1982, 20 per cent of prescriptions were for people over the age of 65, although this group comprised under 10 per cent of the population. By 1988, these people represented 11.3 per cent of the population.

IV. IMPACT ANALYSIS OF BILL C-22

A. Trends in the Drug Industry

1. General Economic Indicators

To identify effects that might be associated with the changes in the compulsory licensing regime, this analysis now focuses, to the extent data is available, on major trends in the pharmaceutical sector before and after the 1987 amendments to the Patent Act.

The following analysis shows that, from a national economic perspective, the Canadian pharmaceutical industry is relatively small. For 1989 (1988 and 1986 for some of the statistics), the principal indicators describing the firms in the industry are shown in the table below.

Table 5: Comparison Between the Pharmaceutical and Total Manufacturing Sectors - Various Economic Indicators

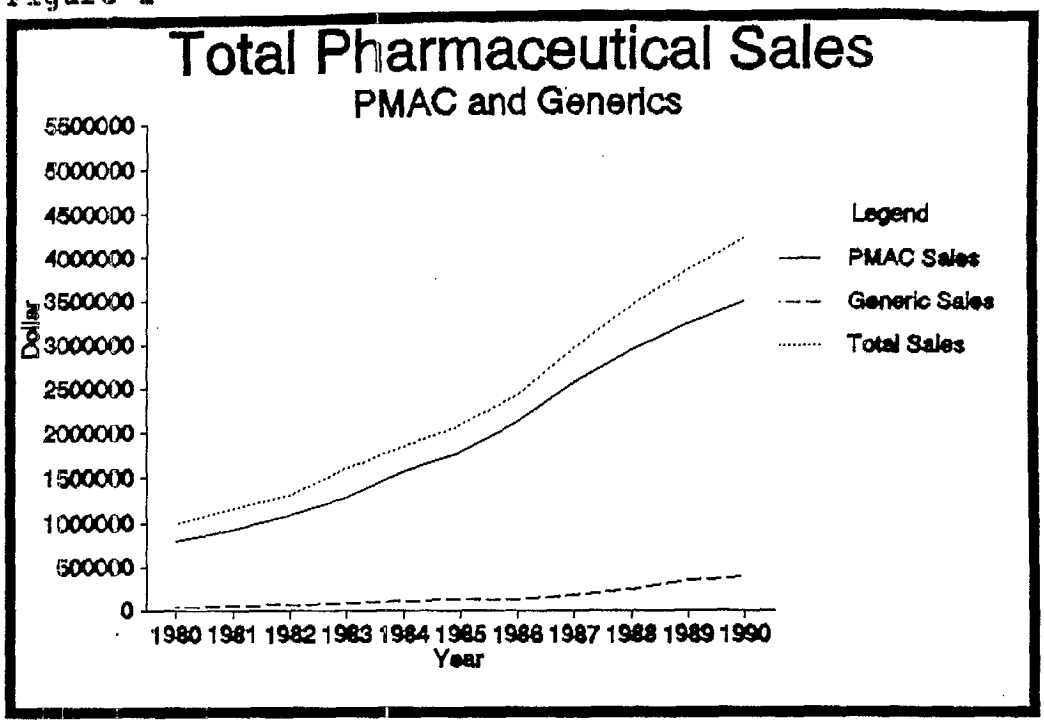
Economic Indicator	Numerical Value	Total Share of All Manufacturing Industries
Factory Shipments(89)	$2120.5 million	1.0 per cent
Imports(89)	$785.0 million	3.1 per cent
Exports (89)	$175.4 million	0.4 per cent
Investment(89)	$182.7 million	0.6 per cent
Employment(88)	$1932 million	1.0 per cent
Gross Dom. Prod.(89)	$963.4 million	1.2 per cent
Establishments(88)	$148 million	0.4 per cent
Value Added(86)	$1737.3 million	1.7 per cent

i. Sales

The total market for drugs in Canada has grown steadily since 1980, as can be seen in the following graph. During the 1980's, the domestic sales of pharmaceuticals (the graph does not include trade data) grew at an average annual rate of 15.6 per cent.

Within this total growth the sales of generic companies grew at an annual average rate of 24.9 per cent between 1980 and 1990. Despite the impressive growth record the generic firms' share of the total market remains quite small. In 1980, generics accounted for less than five per cent of total sales. This figure had risen to 9.3 per cent by 1990. This growth was, in part, fuelled by the fact that many drugs went off-patent in the 1980's. The market for compulsory licensed products has also exhibited a strong level of growth in the 1980's (see Table 4). The average annual rate of growth in sales of compulsory licensed drugs was 31.8 per cent for the period 1983-1990.

Figure 1



These figures for the generic sector mean that their sales of drugs have grown ninefold over the past decade. More importantly, the growth in sales of compulsory licensed products, as a percentage of total sales by generic firms, has been quite marked during the 1980s. In 1983 approximately one-third of all sales by generic firms represented sales of compulsory licensed products. By 1990, this figure had risen to 43 per cent. Generic firms are more reliant on the sales of compulsory licensed products than they were a decade ago.

The next sales breakdown to be made is for the member companies of the PMAC. Their sales record (estimate only) during the 1980's can be seen, in comparison to the sales of the generic sector, in Figure 1 above. The total sales of the PMAC (pharmaceuticals only) have more than quadrupled over the past decade. This means that the average annual rate of growth in sales of drugs by the PMAC was 15.9 per cent for the period of 1980-1990.

Finally, it is of some interest to see a comparison of the sales of patented versus non-patented drugs over time. Figures on these two classes of pharmaceuticals is only available for 1988, 1989 and 1990 (ie. since the Board was formed). In 1988 sales of patented drugs were $2,718 million. In 1989 and 1990 this figure was $2.973 million and $3,203.6 million respectively. The sales of non-patented drugs for these three years were as follows: $720

million in 1988; $862 million in 1989; and $994.4 million in 1990. The non-patented drugs are slowly increasing their presence in the pharmaceutical market as their share of the market rose from 21 per cent in 1988 to approximately 24 per cent in 1990. It is unclear whether this was due to a rise in volume or a rise in prices, relative to the patented drug section of the market.

ii. Employment

Employment is an issue of great concern at this point in time in the pharmaceutical sector. The influence of globalization and rationalization is leading companies to streamline their production facilities. Many plants are being closed around the world as firms move the manufacturing capacity for specific products to one location.

As an example of what this means consider the manufacturing capacity of Firm X. This company presently formulates all locally sold products in each country that it supplies. In order to reduce its costs it may shut down its analgesics plant in all countries except one. The same thing may occur for each product line so that the final situation would be one in which each country would produce only one type of drug. The majority of this product would be exported to other countries while other finished dosage forms would be imported from the company's plants in other countries. With trade barriers coming down in the pharmaceutical sector this type of occurrence is becoming more prevalent.

Figure 2

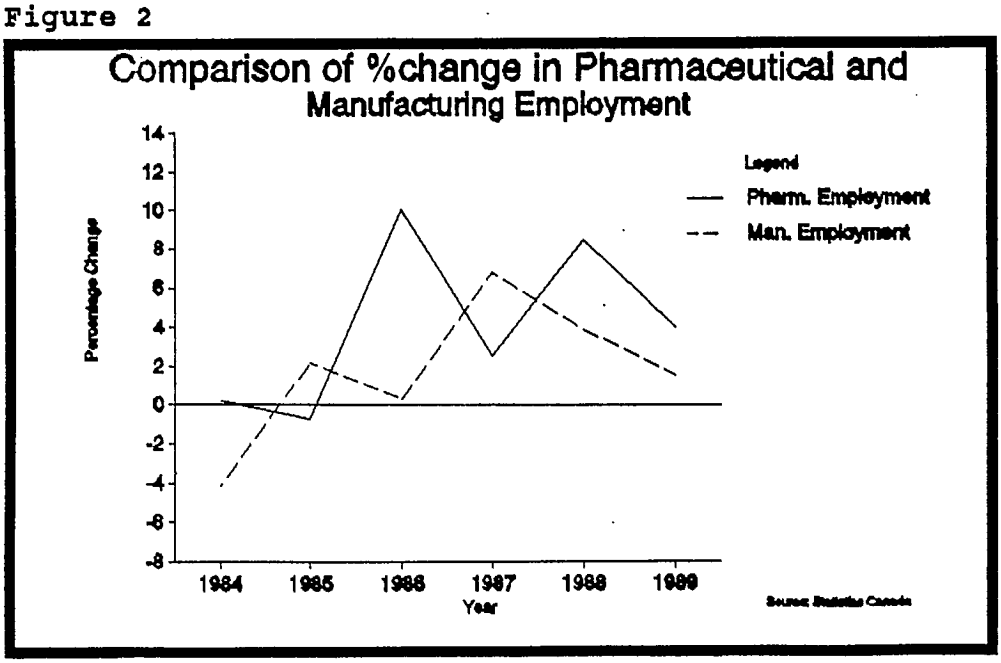


Figure 2 indicates that between 1980 and 1989, employment of pharmaceutical workers increased by 38.9 per cent, compared with an increase of 16 per cent for all manufacturing industries. The average annual growth in employment in the drug sector was 5.2 per cent. This compares with growth rates for all manufacturing of 1.2 per cent for the same time period.

Figure 3

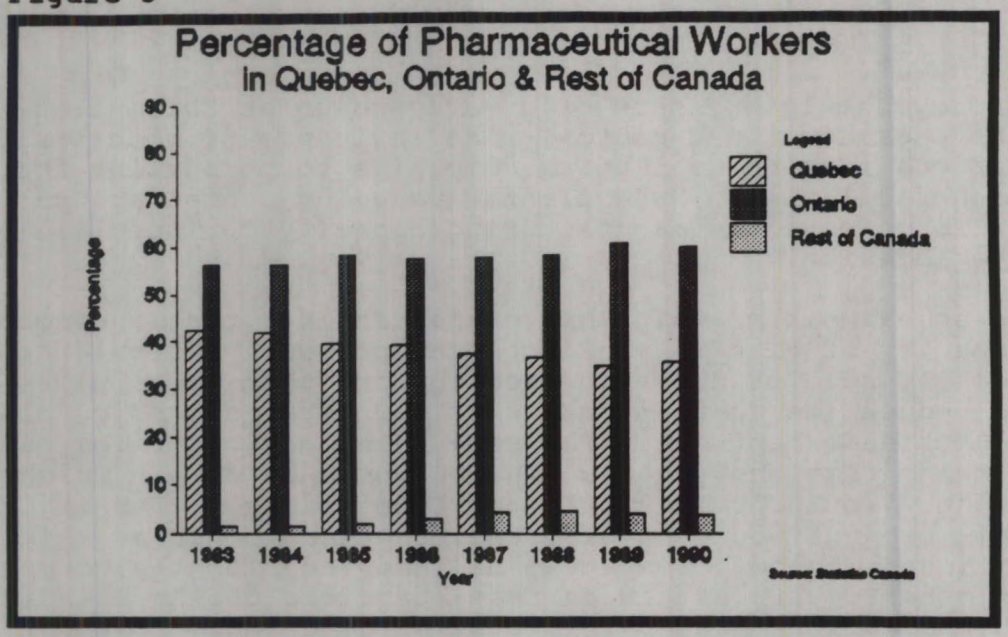


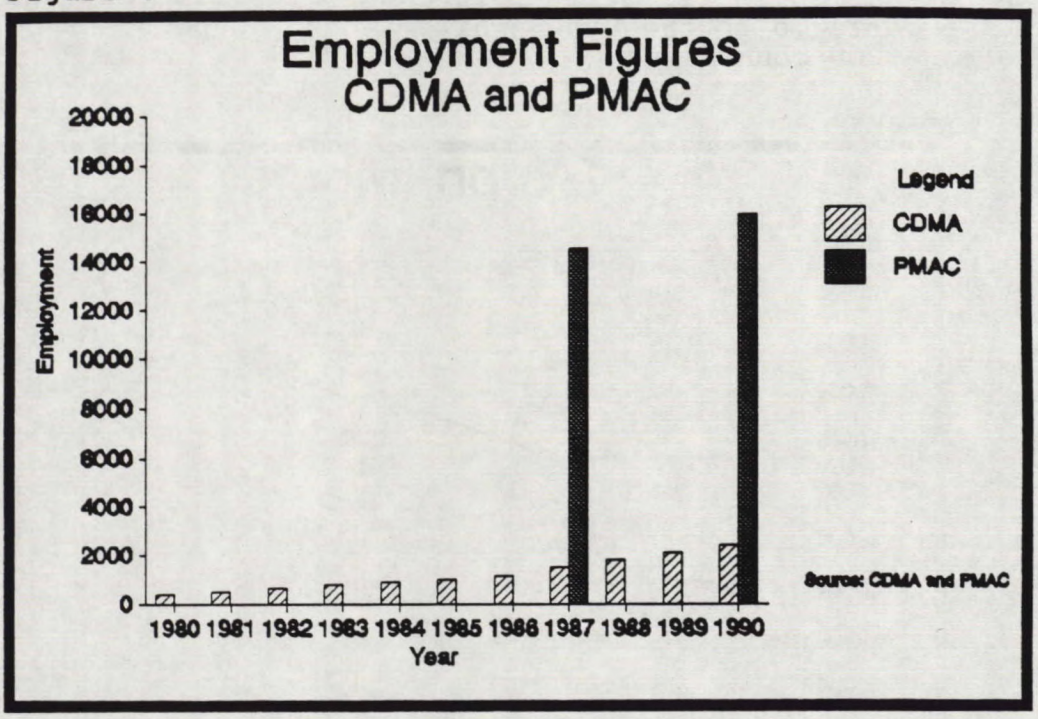
Figure 3 shows the level of employment in regions of the country. Obviously, Ontario and Quebec have the bulk of the manufacturing jobs (58.4 and 38.5 per cent respectively), with Western Canada and the Maritimes making up the remainder (3.9%).

For the PMAC employment has, according to statistics provided by the Association, risen by 10 per cent between 1987 and 1990. This represents a total of 1386 new jobs. Approximately one-half of these new jobs are in marketing and sales while another 32 per cent are in medical R&D. A total of 54 manufacturing jobs were lost over this time period. This represents a one per cent drop in manufacturing related employment.

The generic side of the sector has experienced significant employment growth during the 1980s. In a 1983 survey of generic pharmaceutical companies CCA determined that the industry employed about 1300 people in 1981. According to figures provided by the industry in 1991, total employment in the generic sector was around 2600 in 1990. This represents a doubling of the number of people working in this sector over a nine year period. The average annual rate of growth in employment would

then be roughly eight per cent. The average rate of growth in employment for this sector between 1975 and 1982 was only about 4 per cent. Therefore, it seems as though it took quite a long time for the 1969 changes in the Patent Act to have a significant impact on the size and growth in employment of this sector.

Figure 4*



* The employment figures for CDMA are rough estimates. PMAC figures are available only for the years 1987 and 1990.

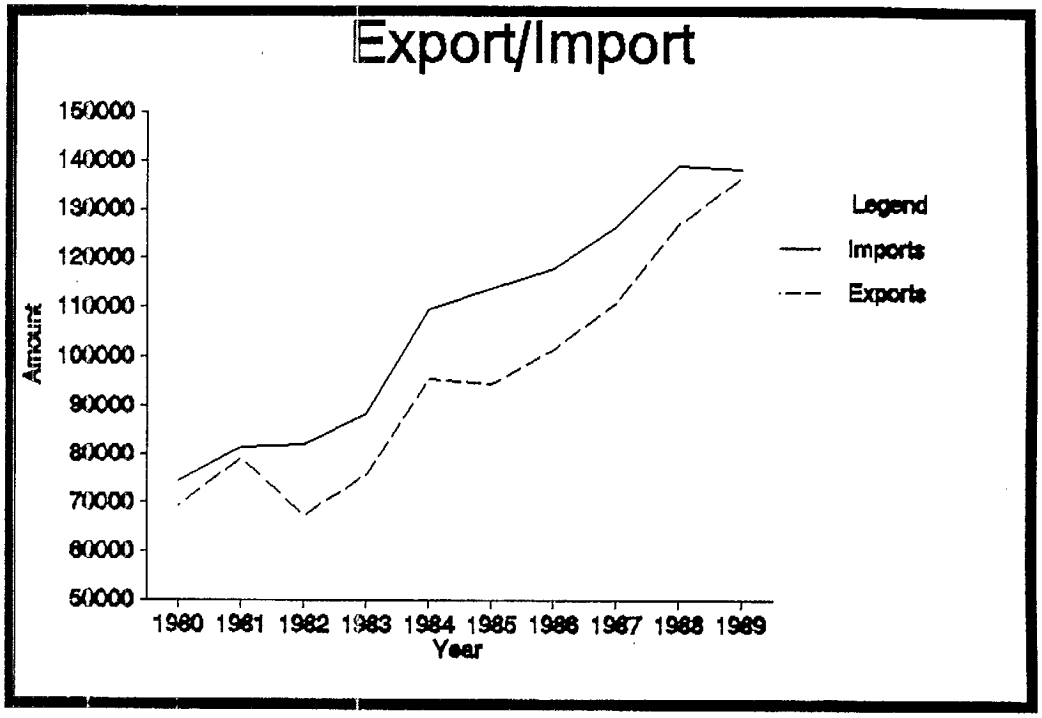
iii. Trade

Both exports and imports have been growing steadily during the 1980's. Between 1982 and 1989 the average annual rate of growth in exports has been 11.1 per cent. For imports this figure is 8.9 per cent. When these are compared to the general rate of growth for all Canadian exports and imports, 7.3 and 8.1 per cent respectively, one can see that the pharmaceutical sector has fared reasonably well even though export levels remain quite low in absolute terms. This reflects the structure of the industry with regard to manufacturing: production is focused in a small number of foreign countries.

Exports as a percentage of shipments have, on average, been 7.1 per cent for the years 1982-89. In sharp contrast to this figure imports as a percentage of the Canadian market have, on average,

been 25 per cent over the same period of time. This is not surprising given that the productive capacity for active ingredients is concentrated in a few countries (the U.S., Puerto Rico, Ireland, Switzerland and the U.K.). This can be clearly seen if one looks at the source of these imports. More than 40 per cent of them come from the U.S. and another 30 per cent originate from the E.C. For Canada's exports of pharmaceuticals the situation is slightly different. Approximately one-third of our exports go to the U.S., while almost 50 per cent of them go to non-OECD countries.

Figure 5



The export of finished dosage medicines under compulsory licence in Canada by generic drug companies is quite low. The total for 1990 was less than $20 million. This represents approximately five per cent of the total generic drug industry's sales in 1990.

iv. Other Indicators

Investment by the pharmaceutical industry has been somewhat erratic during the 1980's. Between 1982 and 1984 investment fell by $20.4 million (31%). However, the trend reversed after 1984 and there was a strong expansion in the level of investment. The total had reached $182.7 million by 1989 and the sector experienced, on average, 13 per cent annual growth.

In comparison, the manufacturing sector as a whole went through a similar period of disinvestment in the early 1980's but it rebounded fairly well. The main difference is in the current levels of investment. Pharmaceutical investment grew by 47 per cent between 1988 and 1989 while the figure for the manufacturing sector was only 16.5 per cent.

With regard to GDP, the results are slightly different from those just presented. From 1981-88 the portion of GDP (constant 1981 dollars) attributed to the pharmaceutical industry experienced less growth. The annual average rate of growth for this time period was 5.5 per cent. For the entire manufacturing sector the same figure was only 3.3 per cent.

Pharmaceutical manufacturing is not labour intensive, but it does have one of the highest values of output per production employee of any industry in Canada. This was the case in 1980 and in 1986 (latest available data). One will also notice that the value added by each production worker rose a great deal for the pharmaceutical sector (109.7%), whereas the average increase over all sectors reviewed was only 55 per cent.

Table 6: Cross-Sectoral Comparison of Value Added by Production Workers - 1980 and 1986

Industry	Value Added per Worker (1980)	Value Added per Worker (1986)	Growth in Value Add.
Petroleum Ref.	224.1	314.4	40.1%
Industrial Chem.	138.6	228.1	64.6%
Pharmaceuticals	107.0	224.4	109.7%
Communications	51.6	82.6	60.1%
Industrial Elec.	48.6	71.6	47.3%
Sci/Prof. Equip.	39.0	65.4	67.7%
Manufacturing	48.9	75.8	55.0%

Source: Statistics Canada

2. Financial Statistics

A firm's level of earnings may be measured in terms of: the rate earned on revenues; the rate earned on total assets; or the rate earned on shareholders' equity. Satisfactory operating results require rates of return for each of the three measures of profitability that approach international standards for the individual members of the various corporate families. Of course, this is subject to tax differences.

The level of return on revenues is most useful in intra-industry comparisons of firms since this ratio focuses on key operational

variables; the price in relation to the cost of output in a sector. Interindustry comparisons are not as meaningful because cost structures and sales volumes may differ considerably across the economy (manufacturing versus retailing and R&D based versus non-R&D based). This study only compares industries from the manufacturing sector. Therefore, a comparison of returns on revenues is not without merit, given the relatively similar structure of firms in the manufacturing sector.

The return earned on total assets employed by a firm (or sector) measures the management's performance. Management is responsible for the way in which a firm's assets are used to earn a profit. When using returns on assets it is best to compare similar-sized companies engaged in the same business or to compare the returns earned by one company over time.

Net income may also be expressed as the rate earned on the shareholder's equity. Given our concern with the level of incentives provided by the Patent Act to encourage investment in R&D this profitability measure may be the most useful indicator of industry performance. This is because it compares investment opportunities for existing shareholders (retained earnings) and other investors (new entrants).

To obtain profit figures defined similarly to those in the pharmaceutical sector with respect to the bias that may be caused by accounting practices, industries which invest heavily in R&D and/or are fairly capital intensive were chosen for comparative analysis. The final sample consisted of seven sectors ranging from communications equipment to petroleum refineries.

i. Canadian Industry Profits

For the period 1979-1987, the pharmaceutical sector in Canada exhibited rates of return on revenues (ROR) that were, on average, more than double the level of profits in the other sectors reviewed (see Table provided below). This was also the case for rates of return on equity (ROE). When looking at the return on assets (ROA) the pharmaceutical sector did almost two and a half times as well as the other sectors.

Table 7: A Comparison of Rates of Return For Selected Manufacturing Sectors, Averages for 1979-1987

Sectors	Return on Income (%)	Return on Assets (%)	Return on Equity (%)	$ Volume of Prof.(mill)
Pharm.	8.3	12.3	23.0	192.6
Petrol Ref	5.4	5.4	10.1	1583.2
Comm.	5.6	5.5	9.9	245.0
Sci. Eq.	4.3	7.0	13.3	87.0
Ind. Chems	4.5	4.2	12.0	213.0
Ind. Elec.	3.8	5.7	11.0	116.6
Total Mfg.	3.7	5.0	11.5	9251.2

Source: Statistics Canada Catalogue 61- 207

Another revealing comparison comes from Table 8. It lists the profit level of the total manufacturing sector as a percentage of the profits earned in the pharmaceutical industry. Of the profit measures listed none had the manufacturing sector achieving returns greater than 50 per cent of the profits earned by the pharmaceutical sector.

Table 8: Comparative Financial Ratios for the Pharmaceutical and Total Manufacturing Sectors, Averages for 1979-1987

Financial Ratios	Pharmaceuticals	Total Manufacturing	Col 2 as % of Col 1
Profit (After Tax) on Total Income	8.3%	3.7%	44.6%
Profit (After Tax) on Assets	12.3%	5.0%	40.7%
Profit (After Tax) on Equity	23.0%	11.5%	50.0%

In response to such findings the innovative pharmaceutical sector admits that it is highly profitable <u>but</u> it has also been stated that these high profit levels are necessary due to the inherent risks that firms in this sector face.[2] Some people have questioned this statement on the basis that profits, by definition, are the residual which remains after all costs, including those for R&D, have been met. On top of this, one must take into

[2]W.W. Wigle, Canadian Medical Association Journal, 100:441-442, 1969 in Lexchin, 1984, p. 58.

consideration the influence of business cycles. Given the strong motive an individual has for purchasing drugs - illness - the impact of a recession in the general economy will have a limited impact on a drug company's sales. This means that risks, on average, display less variation around the mean in the pharmaceutical sector because the returns earned fluctuate less than those in other industries.

This seems to reflect the fact that each pharmaceutical company has a broad portfolio of products. By having a diverse product line a company can avoid the inherently risky nature of pharmaceutical R&D. The significant risk associated with the development of one particular drug is offset by the other products being sold by the firm. Therefore, it seems that drug companies do a relatively good job of dealing with the risky nature of R&D in this industry.

These findings are supported by the evidence listed in Table 9. Throughout the early 1980's the pharmaceutical sector experienced steady growth in it's ROR, ROA, and ROE. This situation can be explained, in part, by the nature of the market for pharmaceuticals. Doctors are the product selectors and distributors. Therefore, demand is inelastic and the pharmaceutical sector remains, given the increasing number of prescriptions written by doctors, almost recession proof. This does not, of course, alter the fact that an individual company may suffer periods of reduced earnings, however, this has more to do with the outcome of its R&D activities than the state of the general economy.

Table 9: After-Tax Return on Revenues for the Pharmaceutical, Petroleum Refining and Total Manufacturing Sectors

Year	Pharmaceutical Sector	Manufacturing Sector	Petrol. Ref. Sector
1979	6.3	5.0	8.2
1980	7.3	4.7	7.5
1981	7.0	4.1	5.5
1982	7.3	1.3	3.7
1983	8.6	2.4	1.1
1984	10.2	3.9	4.7
1985	10.3	3.1	2.0
1986	9.6	4.3	10.8
1987	8.3	4.4	5.1
AVERAGE	8.3	3.7	5.4

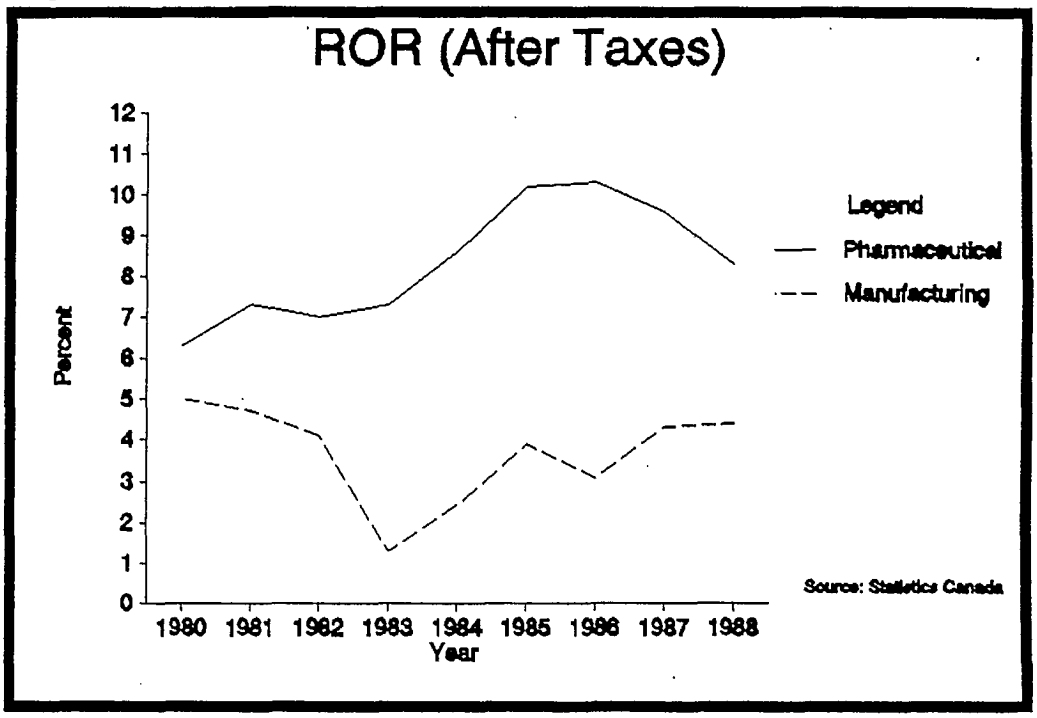
Source: Statistics Canada Catalogue 61-207

When compared to some of the other sectors the results become even more impressive. As can be seen, the ROR for the petroleum

refineries sector fell from 8.2% in 1979 to 1.10% in 1983 and only rose back up to 5.1% by 1987. The situation was similar for that sector's ROA, and ROE. The manufacturing sector, on the whole, experienced a drop in its profit levels in the early 1980's. The ROR fell from 5.0% in 1979 to 2.4% in 1983. The ROA dropped from 7.2% in 1979 to 1.7% in 1982, and the ROE experienced a sharp decline from 16.2% in 1979 to 4.2% in 1982. (See Appendix 3, Table 8 for details).

Table 9 is expressed graphically below.

Figure 6



ii. Transfer Pricing

Another factor that must be considered whenever the profits of multinational enterprises (MNE) are being studied is transfer pricing. A "transfer price" can be defined as the price used for internal sales of goods and services between the divisions of a business enterprise (Rugman, 1985). An MNE that operates in a profit maximizing manner will reduce the profits (and therefore, taxes) of a division located in a high tax area. This is done by having other divisions overcharge it for supplies and underpay it for purchases of its output. MNE's may also charge subsidiaries management fees for services rendered as an alternative to direct manipulation of commodity transfer prices. These activities make the analysis of profit levels especially difficult in the "sub-

sidiary" countries. Needless to say, the multinational structure of the pharmaceutical industry is suited to this type of business activity.

Gordon & Fowler (1981) found that, in 1976, the costs to Canadian subsidiaries for resale products was 73.4% of sales. This figure represents more than twice the production cost for these products in the United States . In addition, the 26.4% gross margin was not large enough to cover the overhead expenses incurred by the Canadian subsidiaries.

In 1980, the Department of National Revenue (DNR) investigated the international transactions of the pharmaceutical industry. The audit included fourteen major drugs in Canada for the period 1977-79. The analysis revealed that prices charged between two subsidiaries of the same company were more than three times higher than the prices paid for the same drugs when the transaction took place between two independent companies (CCAC,1983). These results prompted a representative of the DNR to state that "profits were not being reported in Canada but somewhere else." (Globe & Mail, Nov. 23, 1981)

As part of the Eastman report a background study on the probable incidence of transfer pricing in Canada was prepared by G.D. Quirin (1985). In his study Quirin calculates the effective combined tax rates for Canada, the main features of corporate income tax law for a number of foreign countries, and the principal countries from which Canada imported pharmaceutical products or materials at the time of the study. On the basis of his computations he came up with three groups of countries:

1 Those from which it pays to <u>reduce</u> transfer prices to Canada.
2 Those from which it pays to <u>increase</u> transfer prices to Canada.
3 Uncertain.

Those countries in category 2 usually have lower marginal tax rates than Canada. Interestingly, Quirin's analysis indicated that a substantial and growing minority of Canada's pharmaceutical imports were coming from countries with lower marginal rates of corporate income tax. He also stated that one might expect this trend to continue since MNE's would move their manufacturing operations to such countries in an attempt to maximize profits.

iii. PMAC/Generic Profits

Throughout the 1970's and early 1980's the Pharmaceutical Manufacturers Association of Canada (PMAC) was calling for changes in the compulsory licensing provisions of the Patent Act due to a supposed lack of resources for R&D. To get a clearer picture of the financial status of these firms the detailed

income statements and balance sheets for the member companies of the PMAC were obtained at an aggregated level from Statistics Canada for the years 1980-87. Not all firms could be included but the analysis includes more than 90 per cent of the sales of the member firms in each year.

Table 10: After-Tax Return on Income, Assets and Equity for the Member Companies of the PMAC

Year	Return on Income	Return on Assets	Return on Equity	$ Volume of Profits(000)
1980	9.4	13.6	17.8	161,425
1981	5.8	8.6	11.1	110,446
1982	6.6	9.5	12.1	133,726
1983	10.9	15.7	19.1	256,162
1984	12.8	18.0	21.6	328,856
1985	9.3	13.1	15.5	263,302
1986	12.2	18.5	20.8	387,984
1987	12.9	20.8	22.9	418,032
AVERAGE	10.0	14.7	17.6	257,492

Source: Statistics Canada- Special Data Run by CALURA

Overall, these results are quite similar to those for the industry as a whole with the PMAC members aggregate ROR, ROA and ROE, on average, at least 50 per cent greater than the figures for any other manufacturing sector analyzed. However, all three profit measures did decline in 1981 and 1982 before rebounding to their previous levels. Initially, one might assume that the PMAC felt the effects of the recession slightly more than the industry as a whole did. This, however, may not be the case. The reason for this lies in the fact that the financial data provided by Statistics Canada for the PMAC firms outlines the business activity of each firm's entire operations. Typically, pharmaceuticals only account for roughly one-half of the sales of these companies. As will be shown below, the non-pharmaceutical portions of these firms are, in general, less profitable than the drug components.

The financial status of the generic sector also needs to be reviewed. These firm's detailed income statements and balance sheets were also obtained (also on an aggregated basis) from Statistics Canada for the years 1980-87. Once again, the analysis attempts to include all of the sales of these firms in each year. The list of firms from which this sample was drawn can be found in Appendix 2.

Table 11: After-Tax Return on Income, Assets and Equity for Generic Drug Companies*

Year	Return on Income	Return on Assets	Return on Equity	$ Volume of Profits
1980	6.7	15.1	21.4	2,764
1981	11.3	22.8	29.3	5,079
1982	12.8	9.5	31.9	7,177
1983	15.9	15.7	35.5	10,551
1984	17.5	18.0	31.5	14,273
1985	11.7	13.1	23.0	10,851
1986	7.8	18.5	16.3	8,880
1987	4.0	18.3	23.4	13,257
AVERAGE	11.0	16.4	26.5	9,104

Source: Statistics Canada - Special Data Run by CALURA

*The number of firms in this sample goes from eight in 1980 to twelve in 1987.

Evidently, the generic portion of this industry has benefitted from the compulsory licensing regime. The average level of returns for each of the profit measures exceed the average for the pharmaceutical sector as a whole. These profit levels are impressive but they should not be expected to last. It is very important to note that the full impact of the amendments have not yet hit the generic firms. Any product that a generic firm obtained a compulsory licence on in 1987 would not be on the market at this point in time even if the amendments had not been passed. The major impact on this group of firms will not occur for another two or three years. Unfortunately, the data available on profits is almost four years out of date. This means that it will not be possible to assess the impact on the profits of the generic sector caused by the amendments until the late 1990's.

iv. Worldwide Industry Profits

To gain some perspective on the overall profitability and general economic "health" of the world pharmaceutical industry an assessment of statistics on the performance of multinational drug companies will be presented. These statistics were compiled by SCRIP (PJB Publications) and published as their Pharmaceutical Company League Tables, 1989 and 1990. This analysis is valuable because it sets out the "environment" of the world pharmaceutical industry, of which the Canadian market is but a small part.

Looking at the profits of these firms it becomes readily apparent that they enjoy healthy returns on their investment. Table 11 lists the profits derived from the sale of pharmaceuticals for a

selection of the top fifty firms in the world. Seventeen of these companies had profits in excess of 20% (ROR) in 1989.

Table 12: Multinational Profit Levels - 1990

Company	World Rank	Profit ($ million)	Sales ($ million)	ROR (%)

Source: Pharmaceutical Company League Tables, 1990, PJB Publ.

An even more interesting picture arises in Table 16 and 16B in Appendix 3, where there is a comparison between the pharmaceutical component of a company's profits and the overall profitability of the company. In <u>every</u> case the pharmaceutical profits, expressed as a percentage, of these firms exceeded the profit of the entire company's operations. As an example,

The evidence supports the statement made earlier regarding the impact on profits of non-pharmaceutical sales for the PMAC statistical review.

3. Impact on Prices

This section will review and compare the price levels of drugs in Canada with other domestic prices, and drug prices in other countries. The following analysis makes use of the Consumer Price Index (CPI) and the Industrial Product Price Index (IPPI), both of which are published by Statistics Canada as well as information provided by the PMPRB on prices of existing and new patented medicines.

Both the general and the pharmaceutical components of the CPI and IPPI will be reviewed. The IPPI, the drug component is a monthly Canada-wide price index designed to measure price changes at the factory gate for products sold by domestic manufacturers. The pharmaceuticals included in the IPPI provide a broad sample of the prices of both patented and non-patented medicines. The CPI tracks the prices of final sales of all goods and services to the consumer. The next section looks at the price analysis done by the Board and the Program Evaluation Division (PED) of CCAC.

i. Domestic Price Changes

The price impact of the 1987 amendments to the Patent Act have two basic elements. First, the delay of competition in the market for new medicines, via the delay in the introduction of compulsory licensed generic products, will increase the price of medicines in general. Second, the creation of the Board is supposed to protect consumers from excessive price increases for patented medicines. The Board influences prices at the manufacturing level only. Retail prices are a matter of provincial jurisdiction.

From January 1982 until the PMPRB was formed in December 1987, the IPPI (pharmaceutical component) increased at an average annual rate of 8.95%. By contrast, the CPI increased at an average annual rate of 5.58% during the same time period. From December 1987 to December 1990, the pharmaceutical component of the IPPI increased at an average annual rate of 5.25% as compared to the CPI, which increased at an average annual rate of 4.6%. this change in the rate of increase of the IPPI can be seen in Figure 7 provided on the next page.

Figure 7

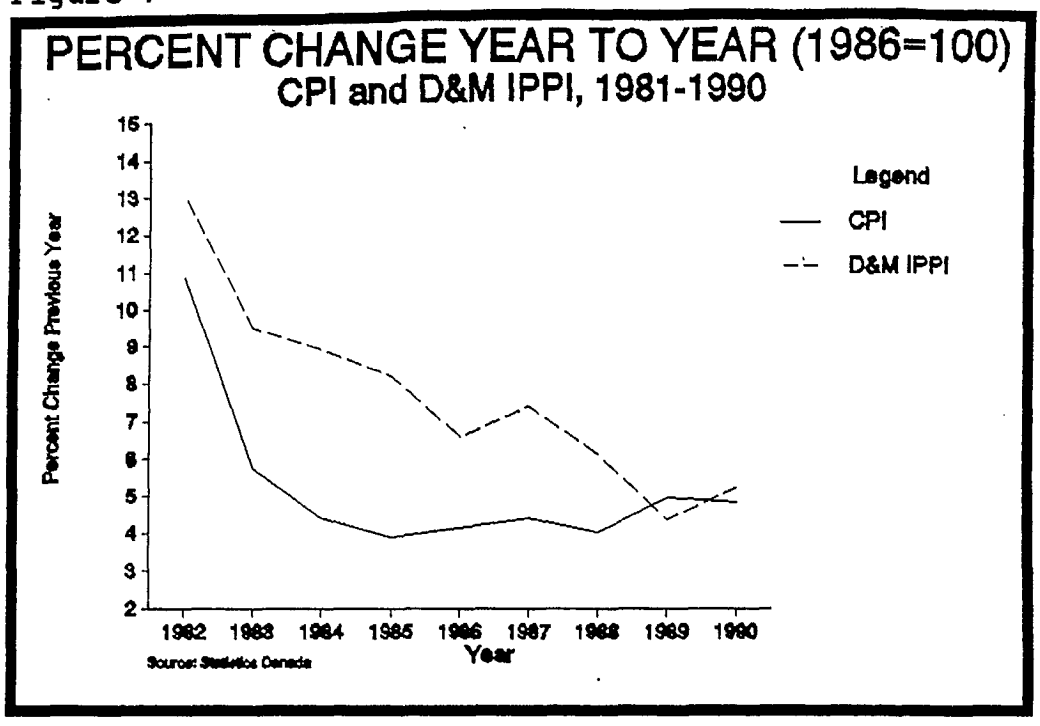
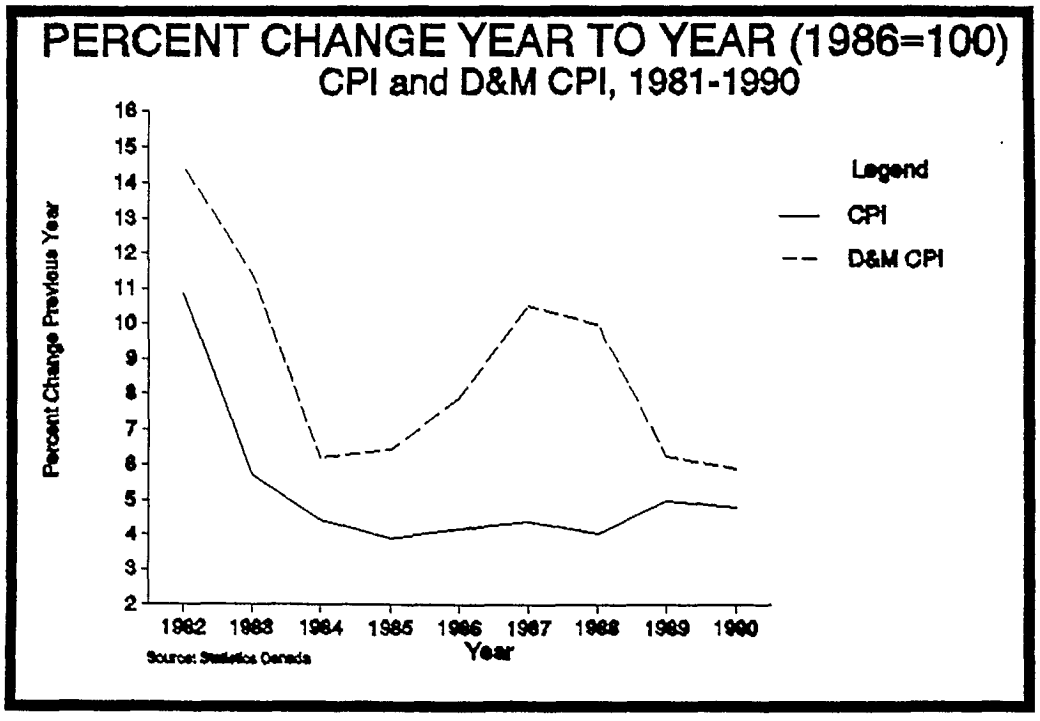


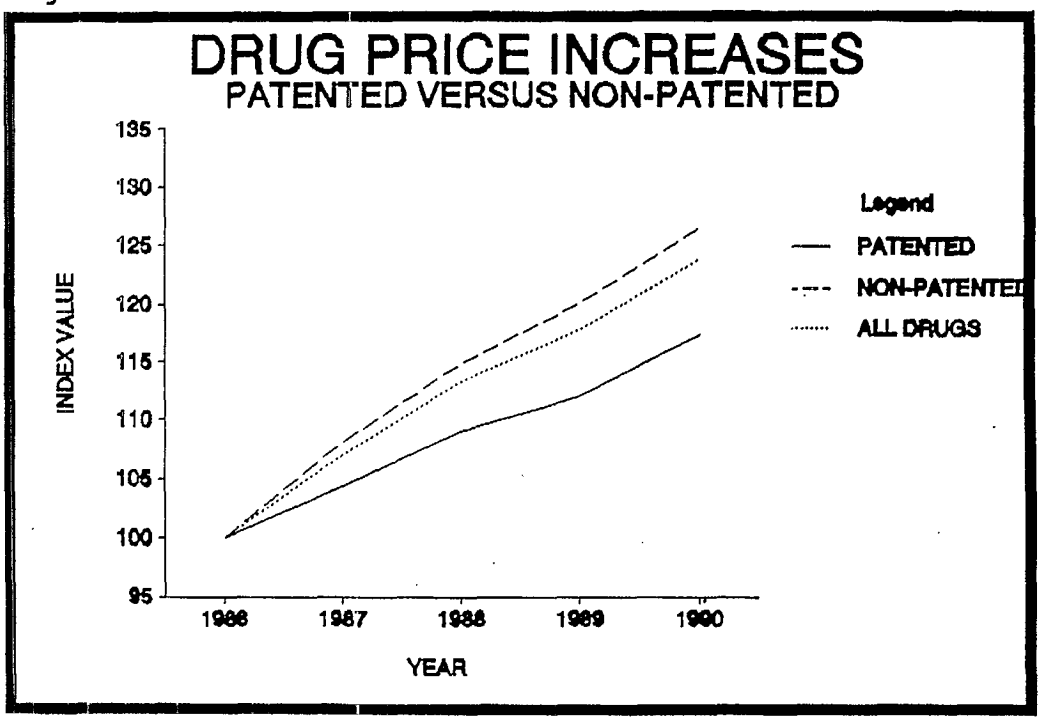
Figure 8



Despite the decline in the rate of increase in the drug component of the IPPI over the past three years the value of this index is still well above the comprehensive IPPI. From January 1982 to December 1987 the IPPI (all items) increased at an average annual rate of 3.52%. The yearly average increase from January 1988 to December 1989 is 2.20%. This highlights the fact that the manufacturing price levels of other sectors in the economy have risen by much less than pharmaceutical prices.

Comparing the drug component of the CPI to the CPI (all items) supports the findings just presented. Throughout the 1980s the year-to-year increases for the drug component of the CPI were on, average, approximately three to four percentage points greater than the corresponding change in the general CPI. For instance, the 1987 yearly increase for the drug component of the CPI is 10.50%, while the general CPI increase is only 4.40%. (Figure 8).

Figure 9



While the recently reduced differential between the pharmaceutical component of the IPPI and the all-items CPI does seem to indicate that the Board has had a significant impact on prices one must remember that the Board's mandate is restricted to patented pharmaceutical products. From December 1987 until December 1990 the prices of patented products within the Boards jurisdiction have increased at an average annual rate of only 3.1%. However, the pharmaceutical component of the IPPI

increased at an average annual rate of 5.25% over the same time period. This means that non-patented medicine prices have been increasing at an average annual rate in excess of 5.1 per cent. This is quite a bit higher than the 4.6% average annual increase in the CPI over the same time period.

The Board recently had Statistics Canada conduct a special study to determine exactly how the prices of non-patented drugs have changed since 1987. From January 1987 to December 1990 the annual change in the prices of non-patented medicines was 5.4 per cent as compared to the prices of patented medicines, which increased at an average annual rate 3.6 per cent over the same period. During 1990, the average change for patented medicines was 4.8 per cent and 5.3 per cent for non-patented drug prices.

There has been research conducted by PED, CCAC which addresses the price impact of the amendments in two ways. First, one study tried to determine the extent of the impact Canadian drug manufacturing prices have on retail drug prices. The extent to which these variables are related enables one to assess the value of government efforts directed at restricting the growth of manufacturing prices. Second, a literature review, telephone interviews and graph analyses were conducted in order to uncover any institutional and/or structural factors other than the C-22 amendments that may have affected pharmaceutical prices between 1969 and 1989. Historical data was reviewed in order to ensure that the determinants of drug prices were fully understood.

The analysis conducted in the first report showed that Canadian manufacturing prices have the greatest influence on retail prices. For every one per cent change in the manufacturing price level one can expect a 0.52 per cent change in the level of retail prices. This result seems to indicate that it is worthwhile to try to influence prices at the manufacturing level. However, one should recognize that other factors do affect the level of retail prices: the CPI and American drug manufacturing prices were found to affect retail drug prices.

In the second PED report the review of institutional and structural factors revealed several events that could be expected to have had a direct impact on pharmaceutical prices at the manufacturing level. These events include:

- The passage of legislation in Quebec in 1972 whose aim was to provide financial support for the elderly and welfare recipients.
- The amendment of this piece of legislation in 1982.
- The passage of a Bill in Ontario that was designed to lower the cost of prescription drugs.

Regression analysis showed that the net impact of these events on the price of pharmaceuticals at the manufacturing level was ambiguous. However, the qualitative research seemed to indicate that the effect would most likely be negative. Pharmaceutical prices at the manufacturing level do not appear to have risen by as much as they would have in the absence of the amendments. As it is not possible to separate the relative effects of each of the individual factors involved, it is difficult to attribute this fact to any one event.

ii. International Prices

In this section the results and methodology of some international price comparisons are described. Such comparisons are fraught with difficulty because of the wide variations in methodology across countries. In addition, exchange rates further complicate the matter.

It is also important to note that countries use a variety of methods to control prices (more detailed analysis of international price control systems can be found in Annex A). In France, for instance, prices are determined through a "contract system" where firms, when applying for a reimbursement price, draw up a "contractual letter" that details the company's commitments relating to turnover, investments and exports. Similarly, in Sweden prices must be negotiated with the government as a precondition to marketing. On the other hand, the UK does not control the prices of individual drugs, but rather controls the profits of the British activities of the 65 firms that have a turnover of more than 4 million pounds sterling. It is evident that such diverse methods of price control will make it somewhat difficult to compare and contrast international pharmaceutical prices yet the process is still quite useful.

For this reason no direct comparisons of price levels across countries will be attempted in situations where price control systems are widely different. The main international price comparison will be with the U.S.. This is of special interest since it was the relationship between American and Canadian prices during the 1960's that prompted the analysis and eventual implementation of legislative changes to the Patent Act in 1969.

Data on the CPI and IPPI (all items and drug components) for the USA were collected for the years 1981-1990. While direct comparisons of these indices are not without problems their levels, and growth over time, will be compared to the equivalent Canadian numbers. The following graphs highlight the similar changes in the price of pharmaceuticals in both countries at the retail and wholesale level.

Figure 10 shows the real rate of growth in drug prices. These real growth rates were obtained by discounting each price index

by the value of the appropriate general price index in each year. As one can see, the rate of growth in the wholesale price level of pharmaceuticals was greater in the U.S. than it was in Canada for the time period 1981-1988. The average annual rate of growth in this index for the U.S. was 5.7 per cent versus 4.0 per cent in Canada. Figure 11 shows that the situation is very much the same at the retail level. For the time period of 1981-1990 the average annual rate of growth in the real retail drug price index for the U.S. was 5.6 per cent as compared to only 3.3 per cent in Canada.

Figure 10

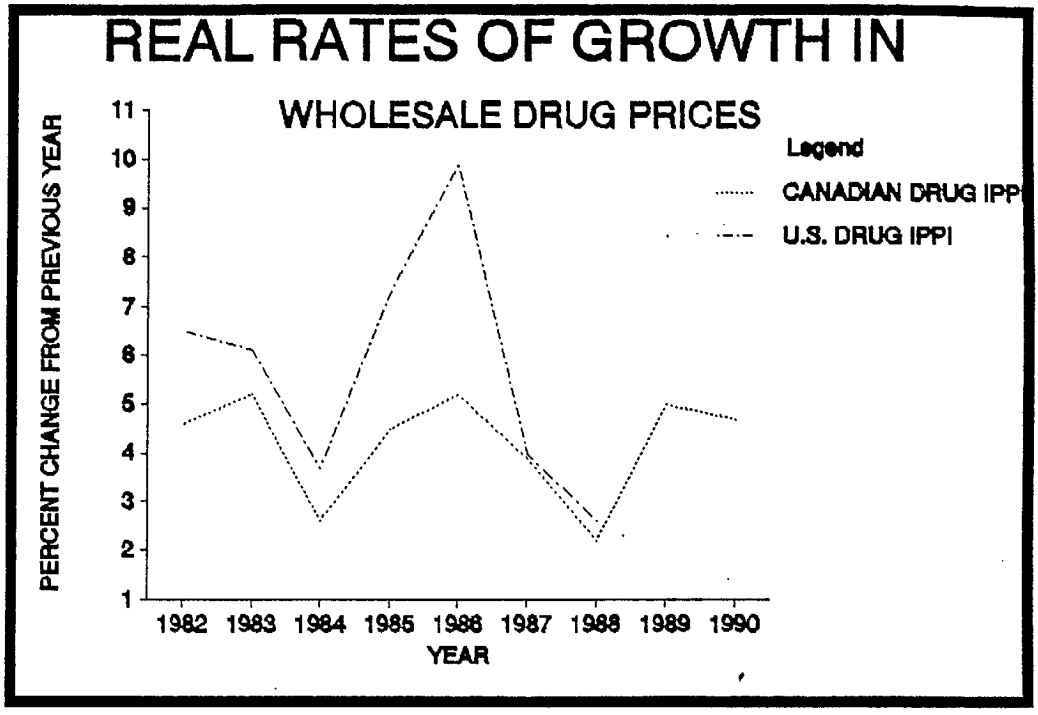
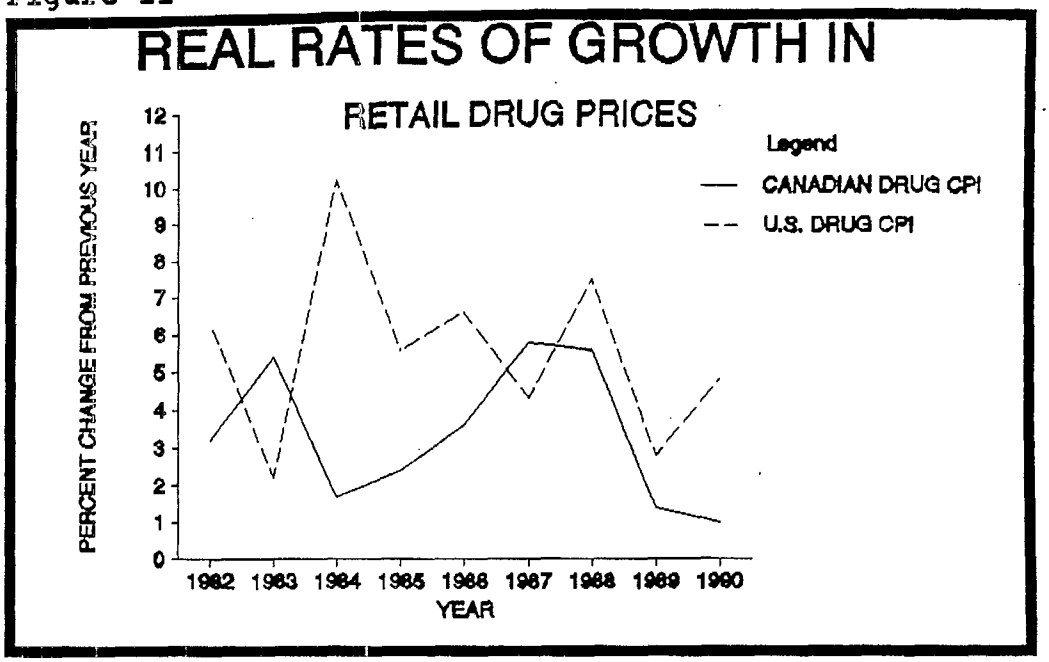
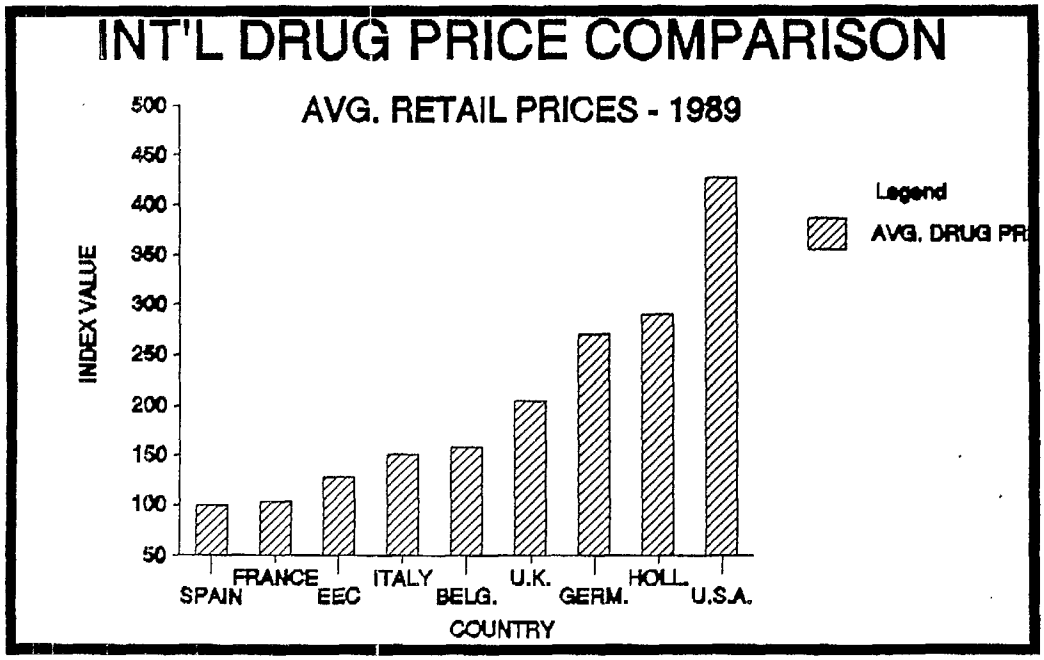


Figure 11



Evidently, the lack of any price control mechanism in the United States is reflected in this evidence. Further support of this hypothesis lies in other international price data that has been collected from several sources. This price data (see next graph) indicates that Americans pay much more for drugs than do Europeans or Canadians.

Figure 12



iii. Introductory Prices for New Drugs

A major problem with the price indices for a large number of commodity groups is the difficulty of accounting for changes in the quality of products. This is an especially troublesome problem for the pharmaceutical industry where, in each year, several new products are introduced in the marketplace as fairly direct competitors with an existing array of products or as completely new entrants that may create their own therapeutic class. In Canada, as well as in most countries, the normal procedure for constructing the pharmaceutical price index treats such newly introduced products as distinctly new products. Thus, the price index only captures any increase in the price of the new product relative to the old product when the basket is updated. Even in those frequently encountered situations in which the old and the new product have roughly the same therapeutic value to the prospective patient and thereby are for practical purposes the same product.

In an attempt to deal with this problem and to facilitate its analysis of introductory prices of new patented medicines the Board has, based on the advice of an independent advisory panel, separated new drug products into three categories:

(1) Line extension
(2) Breakthrough/Substantial Improvement
(3) Other (Moderate, Little or No Improvement)

The Board is currently in the process of comparing the introductory prices of Canadian new chemical entities (NCEs) to the prices for the same medicine in the seven countries listed in the Patented Medicine Regulations. This is being done for the time period of December 1987 to December 1990. The foreign prices will be those in effect at the time of introduction in Canada so they likely will not be the introductory prices for the foreign countries. The analysis will be based on list price data provided by patentees. It will not capture price changes, therefore, current price relationships will not be determined from this analysis.

To date, approximately 50 NCEs have been identified by Board staff. These medicines form the basis of the analysis. The majority of these drugs are human medicines, as opposed to veterinarian drugs. Some NCEs were released in the first half of 1991 and price data was not filed with the Board until the end of July. Price data for the remaining medicines were assembled and reviewed for initial comparative analysis.

The information provided by the Board does not show that Canadian prices for new medicines are systematically set above or below international prices.

4. Impact on R&D

The changes to Canada's Patent Act in 1987 in respect of compulsory licensing of patented medicines were made, amongst other reasons, to bring about greater levels of pharmaceutical research and development (R&D). In response to this legislative change the Pharmaceutical Manufacturers Association of Canada (PMAC) made a public commitment to increase R&D expenditures as a percentage of sales to 8% by the end of 1991, and to 10% by the end of 1996 from the existing level of 4.9% (as established by a PMAC survey of its member companies). The following research makes use of work done by this branch, the PMPRB and the Program Evaluation Division (PED) of CCAC.

i. Domestic R&D Levels

A. PMPRB Data

Companies with active Canadian patents pertaining to a medicine sold in Canada are required by the Patent Act to report R&D expenditures on medicines to the Board. Each company must also report total revenues from the Canadian sales of patented medicines. This data enables the Board's staff to determine the R&D expenditures to sales ratio for each company and the industry as a whole. The results of these calculations for 1988, 1989, and 1990 are presented in Appendix 5, Table 1.

As one can see, total R&D expenditures by reporting patentees have gone from $165.7 million in 1988 to $281.3 million in 1990. At the same time sales revenues increased from $2,718 million in 1988 to $3,203 million in 1990. This means that, for all patentees, the R&D to sales ratio has risen from 6.1% to 8.8% in this space of two years. The largest increase in R&D expenditures came in 1989 when the total amount spent by all patentees rose by 47.7%.

For those companies which reported to the Board that were also members of the PMAC the numbers are slightly different. The R&D to sales ratio for the PMAC patentees went from 6.5% in 1988 to 9.2% in 1990. This is ahead of the promised level of 8% by 1990 so it appears that the commitment to a 10% R&D to sales ratio by 1996 will also be met.

The table on the following page provides an indication of progress by the innovative sector to meeting the overall R&D commitment.

Table 13: Progress on PMAC R&D Commitment

YEAR	PRE-1987 R&D RATE	PRE-1987 AMOUNT	ACTUAL R&D RATE	ACTUAL AMOUNT	DIFFERENCE IN DOLLARS
1988	4.9%	$123.2m	6.1%	$165.7m	$42.5m
1989	4.9%	$145.7m	8.2%	$244.8m	$99.1m
1990	4.9%	$157.0m	8.8%	$281.3m	$124.3m
Total Increment					$265.9m

With regard to the type of research being conducted there is also evidence of improvement. In 1988 only 19% of all R&D reported to the Board was basic research. By 1990 this figure had risen to over 26% to represent an expenditure of approximately $70 million. Applied (clinical) research represents the remainder and the majority of all R&D done in Canada (almost two-thirds) with the balance being classified as other qualifying research.

The groups performing this R&D are, for the most part patentees. However, it seems that other research companies and universities/ hospitals are beginning to perform a greater percentage of the R&D which is conducted in Canada.

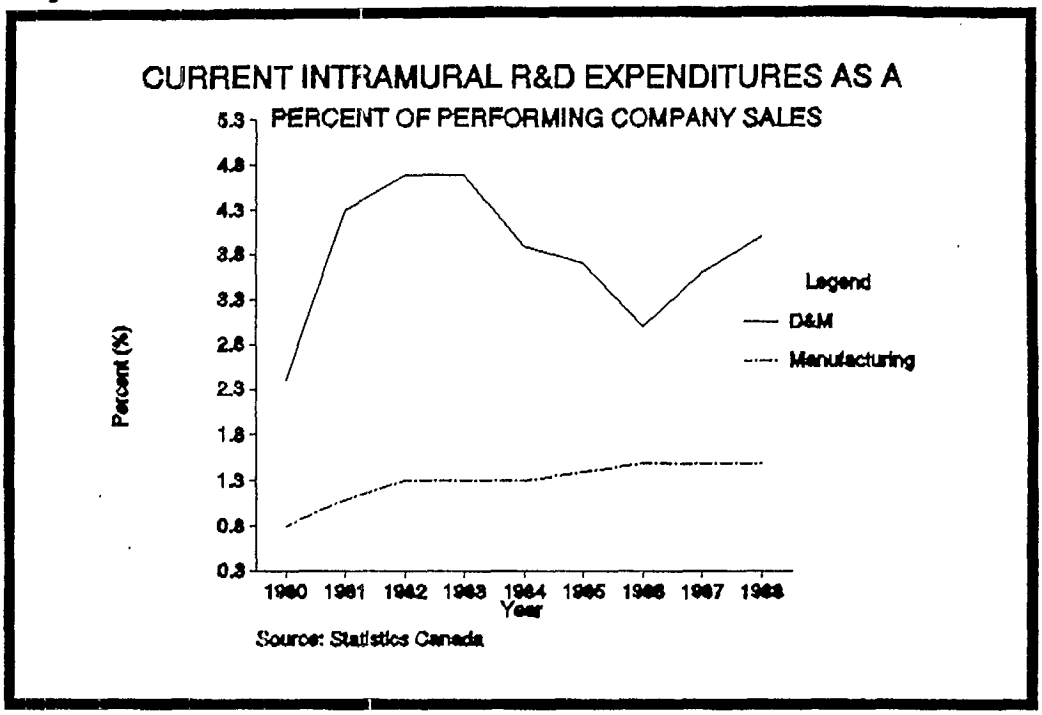
The most striking, but not surprising, aspect of pharmaceutical R&D performed in Canada is the location of this research. Quebec and Ontario consistently attract the greatest amount of R&D. In 1990 these two provinces drew 47.3% and 43.3% per cent of the R&D performed in the country respectively. This makes sense because the large population base these two provinces have together with the associated and very necessary university/research hospital structures provide the infrastructure needed to carry out both basic and applied R&D. See Appendix 5, Table 4 for the exact figures compiled by the PMPRB on R&D.

B. Statistics Canada Data

Since the Board has its own unique definition of the pharmaceutical industry it is not valid to use the data produced by it to compare and contrast the pharmaceutical industry with other domestic manufacturing sectors. However, the data available from Statistics Canada is considered adequate to illustrate inter-sector differences. Statistics Canada data, because different expenditure definitions are used, produces a lower R&D to sales ratio. It should be noted that this is strictly due to the exclusion by Statistics Canada of some expenditures that are in reality, legitimately attributable to corporate R&D in all sectors. In any event, the Statistics Canada data provides consistent information across all sectors and therefore allows the following comparisons to be made.

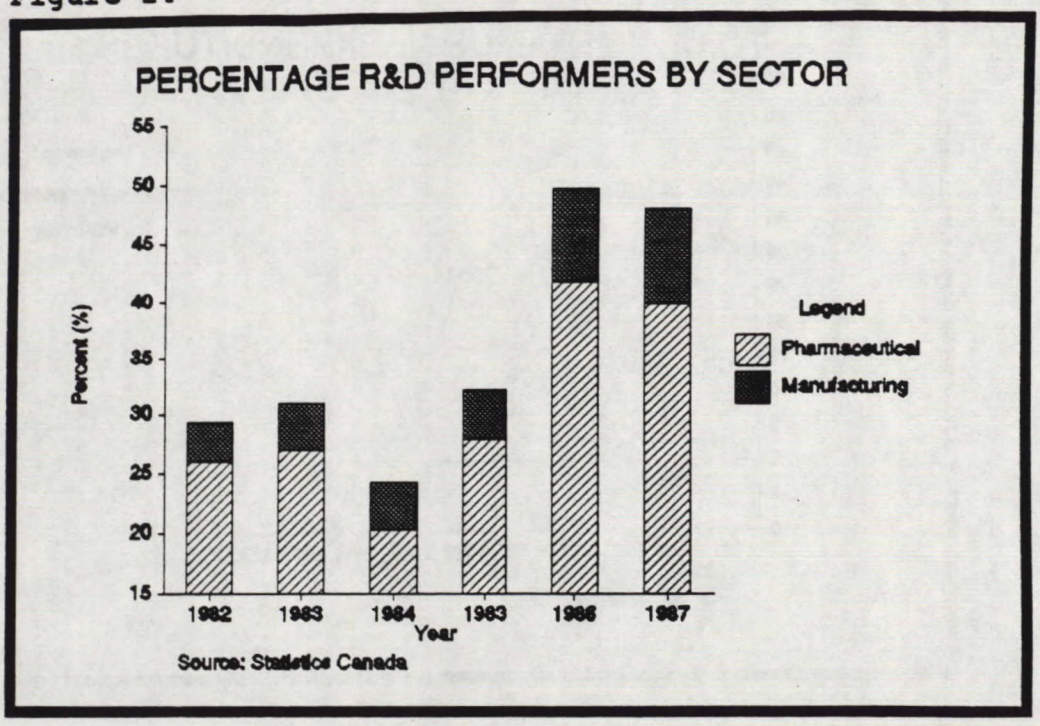
When compared to other manufacturing sectors the pharmaceutical sector is relatively R&D intensive. Throughout the 1980s the drug sector performed two to three times as much intramural R&D when compared with the manufacturing sector as a whole. This is clearly seen in the graph presented below.

Figure 13



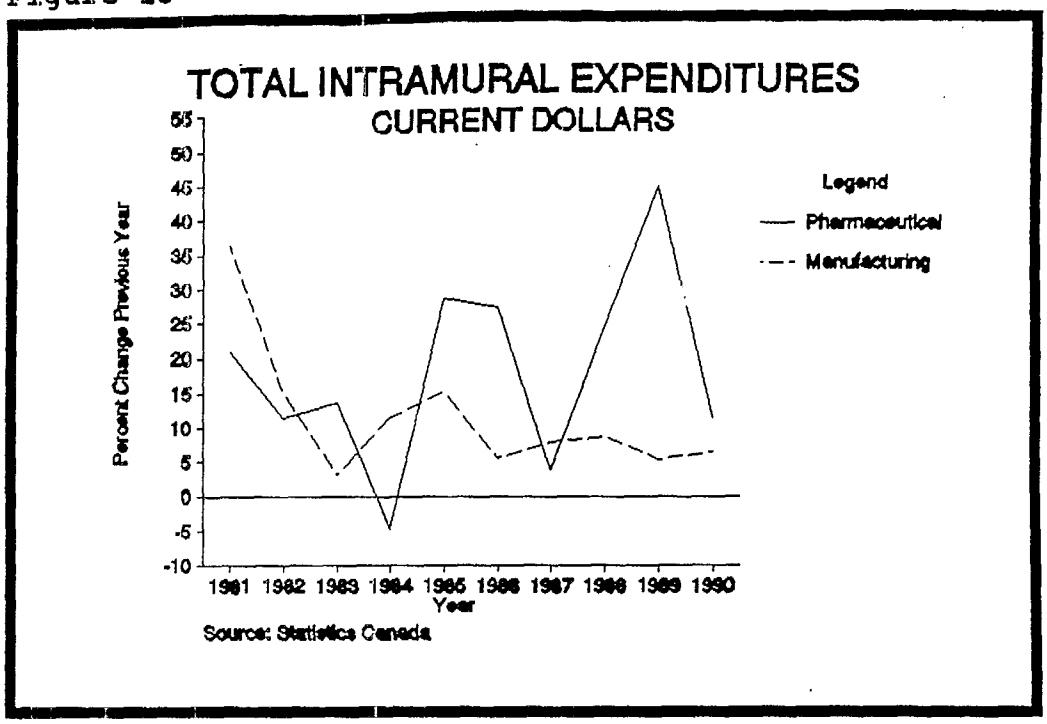
This can also be seen when one studies the percentage of R&D performers by sector. Between 1982 and 1987 the pharmaceutical sector had 30.4% of its firms performing R&D. In contrast, the manufacturing sector only averaged 5.1% over the same time period. These differences would be enhanced of course, if the Statistics Canada definition were such that the extensive clinical trials conducted by the highly regulated pharmaceutical sector could be included.

Figure 14



Another good indicator of the relative importance of R&D across sectors is a comparison of rates of growth in R&D. Between 1981 and 1987 the total expenditures on intramural R&D (in current dollars) in the pharmaceutical sector grew, on average, by 14.48%. For the entire manufacturing sector the equivalent figure is 13.61%. This result indicates that the pharmaceutical sector is ahead of the remainder of the manufacturing sector in both the level and growth of R&D expenditures. The figures after the passage of Bill C-22 show an even starker comparison. Pharmaceutical R&D has increased to a yearly average of 26.71% from 1988-1990, whereas manufacturing intramural R&D has decline to an annual average of 6.96% over the same time span. Overall it seems apparent that the pharmaceutical sector is achieving excellent returns from its R&D efforts and firms will continue, if at all possible, to expand their efforts to develop new chemical entities.

Figure 15



ii. International R&D Levels

The Board is currently conducting a survey on the level of R&D in those countries listed in the Patented Medicine Regulations. These countries are: France, Germany, Italy, Sweden, Switzerland, the United Kingdom, and the United States. Final results should be available before the end of the summer.

The preliminary indication is that differences in definitions, methodology, and the definitions of the universe used between the various international data sources prohibit any statistically meaningful direct comparisons. While these definitional and methodological differences cannot be dismissed, the claims of higher R&D levels in other countries necessitate that the data reported for those countries at least be examined. Such data for 1987/88 was reported by SCRIP, an international periodical on the industry, in one of its publications and referred to by the Canadian Drug Manufacturers Association in a presentation to the National Advisory Council on Pharmaceutical Research. The following table, extracted from the CDMA presentation, indicates where some countries were believed to be in terms of R&D to sales ratios for 1987/88.

Table 14: Country Specific R&D Estimates - 1987/88

Country	Average R&D to Sales %
U.S.	12.4%
Japan	10.4%
EEC	14.4%
West Germany	12.5%
U.K.	10.7%
Switzerland	15.4%
France	14.4%
Italy	11.4%

As noted, these numbers cannot be compared directly to reported Canadian levels for several reasons. It will be necessary to conduct further detailed analyses of the structural differences between these data and that reported for Canada before comments can be provided.

iii. Factors Affecting The Location Of R&D Activities

At this point it is useful to consider some of the underlying factors which affect the R&D decision making processes of firms in the pharmaceutical industry. R&D is highly centralized in order to achieve the synergies of creating multidisciplinary teams and economies of managing such teams. A survey of the location and research facilities of U.S., U.K., German and Swiss pharmaceutical multinationals shows that the largest share of research activity is performed in the home country and a large portion of the remaining R&D is done in another large developed country (Burstall et al, 1981).

In general, R&D is conducted in the corporate headquarter's home country to foster closer linkages with overall corporate policies. It may also be performed at home because of its orientation on basic or applied research which is not directly related to individual product lines. Surveys of pharmaceutical companies indicate that the main factors influencing the location of R&D within a country include:

- proximity to the company's headquarters
- proximity to the main pharmaceutical production unit
- attractiveness of the location for research staff, and
- the availability of suitable premises and site (Howells, 1983).

This study illustrates that the most important factors determining the location of R&D are related to internal characteristics of the firm.

Usually, the original function of an affiliate R&D facility is adaptive research design of dosage forms, supply of analytical methods and standards, and technical support to manufacturing facilities. The functional progression from adaptive research to creation of new technology of a pharmaceutical product is predetermined by the scope of the research activity in the home country. The past profitability of research conducted by affiliates, demonstrated ability to undertake research and its self-financing capabilities are crucial in accessing corporate funds for basic and applied research.

Clinical research is the most widely distributed form of R&D internationally. The location of this work is determined by such factors as relative costs, regulatory approval regimes and legal requirements in certain countries that tests be conducted locally (Pazderka, 1985).

Canada has a number of positive features to attract investments in the pharmaceutical sector but it must be emphasized that these features are not all unique or superior to what is offered in other important locations. In addition there are a number of limitations in Canada that reduce the possibility for innovative potential in the Canadian pharmaceutical sector. Two of these factors are the small size of the Canadian market and the absence of firms with minimum efficient size of laboratories. Furthermore, the extent of foreign ownership in Canada's pharmaceutical sector affects the amount of R&D done in the following ways:

- Invisible imports of technology via the multinational corporation that displaces domestic innovation

- Multinationals react to unfavourable domestic policy (ie. compulsory licensing) by reducing the share of their global R&D done in Canada (Pazderka, 1985).

Two other studies point out the possible limited gains that may be achieved from the use of public funds to support pharmaceutical R&D in Canada. First, McFetridge and Warda (1983) suggest that it may not be rational to support R&D with taxpayers money when the technology can be developed in one location and used without compensation in many others. Second, an OECD study (1984) stated in its summary on the Canadian pharmaceutical industry that " the results of innovation from parent corporations have been so readily available and so economically attractive in the short term that the growth of national innovative technological capacity has been severely inhibited".

These comments must be considered in the light of the level of intellectual property protection provided to pharmaceuticals in Canada and the value of promoting domestic innovative capacity. Suffice it to say that it is not clear that changes in public policy will necessarily draw more funds to Canada in the form of pharmaceutical R&D.

5. Impact of Globalization

The modern pharmaceutical industry is relatively young. It was not until the 1930s that the first of the modern medicines were invented and a series of technological and financial changes since that time can be seen to have shaped the industry to what it has become today.

The period from the 1930s to the mid-50s was, in a sense the infancy of the modern pharmaceutical industry. Compared to today's standards, both research and manufacturing technologies were very basic and did not require large, formal corporate structures for management. Through the mid-50s to the late 60s and early 70s the genesis of the current industry organization occurred as local entities, oriented mainly to national markets were absorbed into larger units with an international marketing focus. In part, this series of events was dictated by the need for companies to specialize in therapeutic classes because of increasing difficulty in finding profitable new medicines. The initial focus of research had produced remedies to the simplest problems to solve; the large marginal costs of further extending the existing technology were becoming difficult for smaller national entities to absorb.

Similarly, the increasing sophistication of manufacturing processes began to make it easier and more cost efficient to concentrate such processes in fewer locations. Additionally, competition among nations in the form of tax breaks and other incentives served to concentrate much of the fine chemical (or active ingredient) manufacturing in a few centres.
In the mid-70s the breakthrough that was to become modern biotechnology began to influence the restructuring of the industry. While solutions to many medical problems remain to be discovered through traditional means, biotechnology opened the door to more specific targeting of medicines and the resolution of many of the more technologically difficult problems.

Driven by these many events and an increased need for development of organizations suitable to modern competition, the industry has in recent years seen a renewed level of activity in intercorporate acquisitions and mergers. The largest of these was the merger of Bristol-Myers and Squibb. Both of these firms were amongst the top twenty largest pharmaceutical companies in the world and their combined sales and assets now make Bristol-Myers Squibb the third largest drug company in the world.
Another merger which is also of great interest is the takeover of Connaught by Institute Merieux in 1990. The loss of control of one of Canada's few domestically owned pharmaceutical companies caused a great deal of controversy. A review of the changes that this restructuring has caused in Canada, in terms of corporate structure and employment, can be found in the Appendices.

B. Consumer Impact Assessment

In this section of the paper the impact that the amendments have had, and may have on Canadians is studied. This analysis will focus on two distinct measures of the impact on consumers.

First, has healthcare improved in Canada as a result of this piece of legislation? The breadth and complexity of this question make it difficult to determine the answer to this question in any absolute manner.

The discussion on this specific issue will centre on the likelihood that new pharmaceutical inventions will arise from the changes in R&D activity which are currently taking place in this country. Given the multinational nature of the industry this review must also include some assessment of increased R&D effort in other countries and the new therapies that have been or may be developed as a result.

Second, the costs that have been or shall be borne by consumers due to the amendments must be estimated. These costs can be seen in the prices that Canadians must pay for pharmaceuticals, relative to the average level of income. In addition, other factors such as the economic value of new therapies need to be addressed.

1. Improved Healthcare in Canada?

i. Demographic Background Information

Prior to any review of the impact that the amendments have had on Canadian consumers it is important to determine what structural changes have occurred in the country's population. This information will aid in understanding the ensuing analysis of issues affecting consumers.

The Canadian population has been growing slowly during the 1980's. From 1980 to 1988 it increased from 24.1 million to 25.9 million (7.8 per cent growth). The most interesting and important statistic on population comes from that segment of the population that is over sixty five. This portion of the population grew by 19 per cent between 1982 and 1988, and now makes up 11.3 per cent of the country's population. If current population trends continue, the number of persons reaching old age will continue to increase until about the year 2030, when the last of those born during the post-war baby boom reach the age of 65. As it is this group which makes the greatest use of the health care system, the growth in their numbers cannot help but have a significant impact on overall drug utilization and expenditure in Canada.

Another valuable piece of information is the average per capita income of Canadians. This enables one to put the price increases faced by consumers into context. The following table shows the average per capita income in constant (1989) dollars as well as the growth in this figure. The average income of families is also provided in this table.

Table 15: Per Capita and Family Incomes (Real) in Canada for 1980-1989

Year	Family Income	Growth	Per Cap. Income	Growth
1980	46,285	NA	14,068	NA
1981	45,759	-1.15	13,994	-0.53
1982	44,690	-2.39	13,751	-1.77
1983	44,001	-1.57	13,665	-0.63
1984	44,014	0.03	13,797	0.97
1985	45,087	2.44	14,223	3.09
1986	45,995	2.01	14,555	2.33
1987	46,640	1.40	14,806	1.72
1988	47,599	2.06	15,305	3.37
1989	48,992	2.93	15,804	3.26
Average		0.64		1.31

ii. Health Care Statistics

One must realize that pharmaceuticals are only one component of the Canadian health care system. Other elements include institutional and related services, medical appliances and related services. To assess the role that pharmaceuticals play in this system it is important to place them within the overall health care framework.

Total health care expenditures in 1990 (most recent data) were 60.2 billion, almost 9.3 per cent of the gross national product for that year. On a per capita basis, 1987 health care costs amounted to $2259.00 including drug costs of $215.00. The expenditure on drugs at the consumer level, according to Health and Welfare, was approximately $8.5 billion in 1987. This represents over 14 per cent of the 1990 health care cost estimate. When expressed in this manner prescription drug related costs over the years appear acceptable. However, prescription drug costs are rising at a much higher rate than are the other major elements of the health care system.

Research at HWC also shows that the per capita cost of drug materials in retail pharmacies (excluding dispensing fees and retail mark-ups) was $120.00 in 1988. This contrasts sharply with the data from provincial drug reimbursement programs for

senior citizens which suggest that the average corresponding drug materials cost for those aged 65 or more was $255.00. Additional health care statistics are provided in Appendix 6.

iii. Impact of Bill C-22 on Health Care

There are a variety of possible effects on the health care system as a result of the passage of the amendments. Briefly they are as follows:

- the amendments may reduce the overall level of expenditures on drugs in Canada thereby increasing the funds available for other portions of the health care system
- the amendments may increase the overall level of expenditures on drugs in Canada thereby decreasing the funds available for other portions of the health care system
- the amendments have increased the level of expenditures on R&D in Canada and this may well lead to improvements in existing pharmaceutical products and/or the development of new therapies
- the amendments have increased the level of expenditures on R&D in Canada and this may lead to the development of new drugs which do not provide significant advantages over other products already available to consumers

Since the amendments were passed four years ago it is hard to determine what impact it has had on the level of expenditures for pharmaceuticals. The main problem is that the impact on the generic sector of the market as a result of the amendments is incomplete. The seven or ten years of market exclusivity that the amendments provide will only begin to affect the generic sector during the next three to four years. This is because generic products took, on average, five to ten years to appear on the market prior to 1987 and there is no evidence that this has changed. The increased costs that will be borne by provincial governments as a result of later introductions of generic copies of pharmaceuticals are very difficult to forecast. The fact of the matter is that the date on which a generic would have been introduced in the absence of the amendments can not be determined with any degree of certainty. Therefore, one can, at best, make an educated guess at the expected date of generic introduction.

The increase in expenditures on pharmaceutical R&D that occurred after 1987 are a part of a general trend in this sector of the economy. As stated in an earlier section, the initial focus of pharmaceutical research in the 1950's and 1960's had produced remedies to the simplest problems to solve while biotechnology opened the door to more specific targeting of medicines and the resolution of many of the more technologically difficult problems

in the 70's and 80's. Therefore, more money is now needed to develop pharmaceuticals for those diseases and illnesses that are not currently treatable. Nevertheless, the growth in R&D spending after 1987 was significantly greater than it was before 1987. Therefore, it seems clear that some of this "extra" growth can be attributed to the amendments.

Given the increased difficulty involved in developing "break-through" remedies it is not surprising that much of the funds going into pharmaceutical R&D do not necessarily result in important new drugs. According to research conducted by the U.S. Senate Special Committee on Aging "Eighty-four per cent of the 348 new drugs brought onto the [U.S.] market by the 25 largest U.S. drug manufacturers between 1981 and 1988 were evaluated by the Federal Food and Drug Administration (FDA) as "C"-rated, having little or no potential for therapeutic gain over existing drug therapies." This information points out the need to assess any increase in R&D spending in Canada within the context of the downstream impact that new discoveries developed by this research will have. One must also consider the need for "innovative" companies to maintain competitive products in existing therapeutic classes in order to maintain the revenue stream required to support the R&D necessary to produce "new" drugs in new therapeutic classes.

Further research in the U.S., based upon the American industry's published figure for R&D costs for a new drug, found that between 1981-88 the top 25 U.S. drug makers spent about $37 billion for R&D to produce 292 new drugs with "little or no potential for therapeutic gain" over existing drug therapies. Of this total, approximately $7 billion was spent to bring to market 54 new chemical entities with "little or no potential for therapeutic gain" over existing drugs. Such figures raise a very important question. Do the health and economic benefits of these new therapies outweigh the expenditures themselves?

Another piece of information which further clouds this question is a survey of American physicians and pharmacists. Many of these health care practitioners, in over 90 per cent of the U.S.A.'s hospitals and at least 42 per cent of U.S. health maintenance organizations, have independently concluded that many prescription drugs are therapeutically interchangeable when used to treat patients suffering from the same ailment.

Surveyed health care institutions generally agreed that many interchangeable drug products exist in the following therapeutic categories:

- Anti-ulcer drugs
- Anti-arthritis pain drugs
- Antibiotics
- Antihistamines

Even though these results are American, their presentation is of value to this review process. Drugs which are introduced in Canada are, for the most part, the same as those introduced in the U.S. Furthermore, the criteria used by the FDA to assess the quality and efficacy of drugs are very similar to those used by HWC. Therefore, the figures listed above are relevant to a discussion of the impact that new therapies in Canada have in relation to changes in Canadian IP legislation.

The results seem to paint a somewhat negative picture of pharmaceutical innovation and, therefore, the value of R&D expenditures aimed at discovering new chemical entities. However, there are some facts about the value of R&D in this sector that the American research fails to recognize. Innovation is a stream of small modifications and alterations: there are very few, or no, huge leaps in pharmaceutical product development. This means that many of the new drugs which are introduced in a specific therapeutic category build on older treatments in a manner that will lead to improved efficacy of a particular therapy over an extended period of time.

The real problem with drugs which provide "little or no potential for therapeutic gain over existing drug therapies" is the money spent to market them. In general, pharmaceutical companies spend twice as much on marketing as they do on R&D. There is a concern that these marketing expenditures are of uncertain social value and that the total costs of pharmaceuticals could be reduced if more control was exerted by governments over marketing expenditures.

2. The Costs and Benefits of Bill C-22 for Canadians

An obvious benefit that is directly attributable to the amendments is the increased employment opportunities for Canadian science, medical and research graduates. Estimates made in 1987 on the employment opportunities that would arise from the PMAC's commitment to increase R&D spending by more than $1 billion between 1987 and 1996, were put at about 3000 jobs. However, this figure must be combined with the job losses that are associated with the current rationalization process occurring in the industry. Based upon the employment statistics provided by the CDMA and the PMAC employment has grown with gains in the R&D sector outweighing losses in the manufacturing and formulating sector.

The main impact the amendments have on consumers is transmitted via the legislation's effect on the price of pharmaceuticals. There are two aspects to the price impact of the amendments:

1 Longer periods of marketing exclusivity will increase the length of time before generic competition can occur. Therefore, consumers will have to pay more for drugs over time (even if prices remain fixed).

2 The PMPRB exerts downward pressure on the prices of patented drugs. Therefore, consumers are paying less for some drugs than they might have without the amendments.

Consumers are also affected by the impact that the amendments have had on the health care system as a whole. The costs associated with this impact have been outlined in the previous section but now they must be quantified. Prior to this the two opposing price impacts will be assessed and quantified.

To determine the cost for consumers of the increased period of market exclusivity a somewhat ad hoc method must be used. The 1969 changes to the Patent Act brought about a reduction in prices via generic competition (a shorter period of exclusivity). By looking at the savings realized by consumers as a result of the 1969 legislation one can get some idea of how great the costs may be due to the partial reversal of this situation in 1987.

The Eastman Report estimated that the total value of the savings in drug costs resulting from the creation of the generic drug industry was some $211 million in 1983 alone. Sales of compulsory licensed drugs totalled $28.4 million in that year but by 1990 this total had reached $167.4 million. In addition, the overall generic market in 1983 was fairly small with sales only totalling $88.5 million or 5.5 per cent of the total market. By 1990 the market for all generic drugs had reached approximately $390 million and their market share had risen to 9.3 per cent. This growth, coupled with the rising prices for new medicines, means that the potential benefits from the 1969 compulsory licensing regime would be much higher in 1990 than the actual benefits realized in 1983. Annual savings from a return to the pre-1987 regime could be in excess of $300 million.

The second price effect of the amendments can be addressed by simply looking at the price level of pharmaceuticals before and after it came into effect. This must be coupled with data on the average earnings of Canadians in order to determine what proportion of average personal income is being spent on pharmaceuticals.

The section on the price impact of the amendments indicated that price increases have been moderated since 1987. This is, of course, mainly due to the fact that patented drug product price increases have been below the rate of inflation. This has been the case over the past three years but non-patented drug prices have risen by more than the CPI. Therefore, the price level of all pharmaceuticals is roughly in accordance with the general price level in the economy. Unfortunately, the same cannot be said for the per capita income of Canadians or the average family income in Canada. These figures had average annual rates of growth between 1980 and 1989 that were 1.31 per cent and 0.64 per cent respectively. This evidence shows that Canadians have less

money at their disposal to purchase goods, including pharmaceuticals, at the end of the 1980's than they did at the beginning of that decade. On the other hand pharmaceutical prices grew at an annual average rate of growth of 9.14 per cent over the same time period. Clearly, the average Canadian needs to see a reduction in the price of drugs and not a drop in the rate of price increases before one can say that consumers are better off.

Nevertheless, the moderation of drug prices, due to the introduction of the Board, have produced savings for Canadians. Unfortunately, the savings due to this moderation in prices are difficult to estimate since one cannot say what prices would have been in the absence of the amendments. If one makes the following assumptions an estimate of the cost savings due to the passage of Bill C-22 can be calculated.

Assumption 1: Manufacturers' prices for drugs would have continued to grow at a rate equal to the average of the previous seven years for 1988, 1989 and 1990 if the amendments had not been passed.

Assumption 2: The consumption of drugs would not have changed as a result of these higher prices.

Based upon these assumptions the total expenditures on pharmaceuticals in Canada would have been $3.49 billion in 1988 instead of $3.44 billion. In 1988, the figures are $3.91 billion versus $3.84 billion, and in 1990 the numbers are $4.40 billion and $4.20 billion respectively. This means that Canadians would have spent an extra $322 million on drugs over that three year period. Needless to say, this estimate is a very rough guess at the savings that can be attributed to the price control mechanisms that are a part of the amendments.

V. THE FIVE PILLARS

A. Review of the Five Pillars

The Commission of Inquiry on the Pharmaceutical Industry, other departmental reviews of compulsory licensing, and the work that was required to develop Bill C-22 brought to light the major policy issues related to the Patent Act. These are the principles of intellectual property, the relationship to industrial policy, Canada's multilateral relations, issues of consumer protection, and the health care of Canadians. The following material reviews each of these policy considerations in greater detail.

1. Intellectual Property

Patents are used to allow individuals to retain property rights for their creations. They are an incentive to create and invent, promoting progress and development in our economy. In the absence of patents there would be less incentive to produce innovations. This is especially true in the area of pharmaceuticals. Once a new chemical entity has been developed it is relatively easy to copy this medicine. Therefore, patents are an integral component of a pharmaceutical firm's ability to recoup its R&D investment.

2. Industrial Benefits

The issues surrounding the industrial benefits derived from patent protection are quite complex. Improved patent protection has led to increased levels of R&D in the Canadian pharmaceutical industry. However, the Eastman Report stated that the removal of compulsory licensing as such would not necessarily place Canada on a world scale in the R&D of pharmaceuticals. While this may or may not be true, one must realize that Canadians accrue significant benefits from any sector of the economy which undertakes significant levels of basic R&D. The Government, by exacting a commitment from the innovative companies of Canada to raise the R&D-to-sales ratio to ten per cent by 1995, has generated more investment in Canada. In turn, this has lead to increased employment opportunities for Canadian science, medical and research graduates.

These factors must be balanced against the need for a country to have some indigenous capacity to provide its citizens with the medicines they need. At present, there is no significant chemical manufacturing in Canada. The amendments have provided an incentive to the generic companies to enter that sector on a larger scale. Finally, an improved investment climate is helping independent research labs raise capital for new projects.

3. Multilateral Relations

It was alleged that the passage of the amendments was tied to the trade negotiations with the United States. This statement is not supported by the evidence. The process of review of the compulsory licensing sections of the Patent Act began with a discussion paper issued in 1983 - long before Canada began any discussions on a free trade agreement with the United States. In 1985 a Royal Commission on the pharmaceutical industry was undertaken, obviously with the possibility of legislative action in mind. That process led to Bill C-22, which builds on the results and recommendations of the Eastman inquiry.

Most countries treat pharmaceuticals as a special product. However, few countries use compulsory licensing and the patent system as a way of controlling drug prices. Under the amendments, patented pharmaceuticals enjoy a "special" status through the full monitoring of the PMPRB. Notwithstanding the commitment to restore intellectual property rights, this Bill did not abolish compulsory licensing - it has continued.

4. Consumer Protection

In the restoration of patent protection for pharmaceuticals the implications for consumers were studied in depth. The factors which influence the impact of changes in the patent system include:

- 85 per cent of all consumers are covered by a drug plan
- All seniors are covered by a provincial drug plan
- Under Bill C-22, all generic products on the market in 1987 stayed on the market and their prices were not affected
- The PMPRB looks at both the introductory price and the continuing market prices of all patented drugs

Parliament is obliged to review the legislation's performance in the tenth year and this will likely include a thorough analysis of the impact on consumers.

5. Health Care

When one talks about the introduction of new drugs, and the R&D needed to find new therapeutic uses and to improve existing products, as well as develop new ones, this certainly qualifies as a discussion of the quality of health care for Canadians. The amendments ensured that there would be increased levels of R&D in Canada which will improve the odds that new drugs and new therapeutic uses for old drugs will be discovered.

The discovery of new and improved pharmaceuticals ultimately leads to reduced hospitalization for treatment of some diseases

and illnesses. Our current policy stimulates research into new drugs in Canada and it may also result in the discovery of new cures and treatments.

B. Current Status of These Goals

This section will provide a brief overview of the current status of these five policy goals. The analysis will include a comparison of Canadian policy with that of our major trading partners.

1. Intellectual Property

Canada attempted to bring its intellectual property protection more into line with the international norm in 1987. Since that time there have been changes in the level of patent protection afforded to pharmaceuticals in a number of countries. Australia, Japan, France, Italy and the EC have either implemented or proposed patent term extension legislation. The United States already had patent term extension legislation in 1987. These changes mean that Canada is, once again, providing relatively less patent protection for pharmaceuticals.

2. Industrial Benefits

There have been significant industrial benefits since the amendments. Pharmaceutical R&D spending has gone from $165.7 million in 1988 to $281.3 million in 1990. A number of firms have also opened new research centres. Merck-Frosst opened a $200 million facility in Quebec this summer and Boehringer-Ingelheim is in the process of building research laboratories in Ontario. More information on current and proposed R&D expenditures can be found in Appendix 5.

3. Multilateral Relations

Canada is currently involved in trilateral trade talks with the United States and Mexico. Pharmaceutical patent protection is a central topic in these talks given the importance placed on patent protection by the American pharmaceutical industry. The GATT negotiations are about to resume and TRIPs is one of the remaining unsettled areas. The timing and probable outcome of a GATT agreement still depends heavily on the agricultural negotiations but Canada can expect further pressure to eliminate our compulsory licensing regime for pharmaceuticals in the TRIPs meetings.

4. Consumer Protection

Consumers have gained some benefits since the amendments. The PMPRB is achieving the goals set out for it in that the price level of patented pharmaceuticals are increasing in line with the CPI. However, the price of non-patented drugs are experiencing much greater price increases and this fact will have to be monitored closely.

Introductory prices of new medicines are another area of concern for consumers. To date, the Board has ensured that firms are meeting their guidelines for introductory prices. Therefore, the legislation is ensuring that the prices for these medicines does not exceed the median price of the medications in other countries. There is considerable concern at the provincial level that the 1987 legislation (and the Board's Guidelines) permit higher introductory price levels than should be the case.

5. Health Care

The benefits (costs) for the healthcare system which should be attributed to the amendments cannot, for the most part, be ascertained at this point in time. As discussed previously, the full impact which the amendments may have on the generic industry has not yet been realized. Provincial governments will have to reimburse patients for the cost of innovative pharmaceuticals for some longer period than they currently do. This financial burden comes at a time when provinces claim that their spending on healthcare is growing at an alarming rate. Furthermore, it is not totally clear that the full price effects of the amendments will be positive. Many provinces have complained about the high introductory price of new medicines. If these products come onto the market at a price level that seriously impairs the provinces' abilities to cover this expense it does not matter that further price increases will be below the rate of inflation.

With regard to employment, the positive benefits have been, to some extent, neutralized by the rationalization process occurring in the industry. However, overall employment in both portions of this sector has gone up. In terms of new therapies/medicines that the amendments may bring about via their effect on R&D, the probable costs and benefits cannot be assessed. While it is true that basic research has risen substantially in Canada since 1987, it is unclear what the long term effects of this change will be. New products may come out of this research but there is no way of knowing what their therapeutic value will be or of estimating their impact on the viability of the Canadian based drug firms. If they are of little or no potential therapeutic gain over existing drug therapies then the economic and social value of these products is unclear.

s. 21(1)(c) & (b)

The pressure in the GATT and NAFTA negotiations to remove the compulsory licensing provisions from our Patent Act is coming from many countries. The demand is based on both economics and politics. These countries see Canada's current intellectual property regime as a threat to their economic prosperity in that many developing countries are considering Canada's system for themselves. Obviously, this would provide a lower cap on the revenues of pharmaceutical companies than would be the case if compulsory licensing were completely eliminated. The point that is often ignored, however, is that by implementing a system comparable to Canada's, those countries would be implementing much higher IP standards than they currently have and the companies revenue picture would be improved considerably over what it is now. In any event, the government is being asked to change

VI. CONCLUSIONS

This paper set out to describe the structural nature of the Canadian pharmaceutical industry, its salient economic features, and the impact that the amendments have had on the innovative and generic sections of this industry. In addition, the paper has looked at the impact of the legislation on the Canadian consumer and the current policy implications of the 1987 changes in the Patent Act. The following paragraphs attempt to summarize the most important findings of this research.

The structure of the Canadian industry is similar to other sectors of our economy in that it is mainly comprised of branch plants of foreign owned companies. The quantity of R&D done plus the high value of patent protection makes the pharmaceutical industry somewhat unique. These facts have, of course, been central to the long term intellectual property policy debate on pharmaceuticals in Canada. The use of the Patent Act's compulsory licensing provisions has been significant and generic firms rely more heavily on revenues derived from compulsory licences now than ten years ago.

In terms of sales, investment, manufacturing and other general economic indicators this sector of the Canadian economy is very healthy. The simple fact that pharmaceuticals are very price inelastic - people will buy them at almost any price - has ensured, and will continue to ensure, that this industry will realize significant economic returns.

This observation is backed up by the financial research conducted for this review. Both sections of this industry are extremely profitable. In this regard, the calls from both the innovative and generic companies for greater protection of "their intellectual property interests" have been questioned by provincial and consumer interests. The evidence clearly indicates that both groups have done very well under the old system of compulsory licensing. The generic companies will most likely experience some economic losses as a result of the amendments but for Apotex and Novopharm (the two largest generics) the impact won't threaten their profitable existence. Only the smaller generic companies need be worried. As for the innovative companies their profits can only rise.

its legislation once again. However, this request must be considered alongside the other policies that are integrally tied to this intellectual property issue. Hopefully this document has provided some of the information needed for the government to formulate policy initiatives that best match Canadians needs.

APPENDICES: DATA UTILIZED IN THE PREPARATION OF THIS REPORT

APPENDIX 1: International Price Control Systems

France

France is planning to institute a new pricing system that will bring it more in line with the EC Pricing Guidelines. In addition, the new system has been developed in order to allow companies limited pricing freedom within an overall ceiling or pricing envelope. New products will be treated differently than medicines that are already on the market. The aim of the new policy, says the government, is to have a negotiated, contractual pricing system with transparent rules that fit into the objective of fighting inflation (SCRIP No. 1649). This is a continuation of the French government's commitment to cost control in this area: pharmaceutical prices have risen, on average, by 5.9 per cent per year between 1980 and 1990 (SCRIP No. 1556).

It is certain that prices in France will continue to be set by the government via negotiations with companies. These price levels will also still be subject to price/volume limits. If these are exceeded a rebate would be payable, or if necessary a price cut would be instituted.

French doctors are increasingly prescribing generics and more are coming on to the market following the publication of generic prescribing lists. Generic substitution by pharmacists is not prohibited. Compared to other EEC nations, prices are low.

Germany

German prices have long been amongst the highest in the world because of the relatively "free" market they have existed in. Although prices still remain relatively high, the German government has introduced a new reference pricing system that limits the price the government will reimburse the consumer. There are reference prices for three different categories of drugs and these prices are based on retail pharmacy prices (which reflect the lower prices of parallel imports). As well, ceilings have been put on the cost of prescriptions written by doctors, generic substitution has been increasingly encouraged, and negative lists have been extended to eliminate a greater number of drugs eligible for reimbursement. It is expected that all of these measures will put pressure on prices to decrease.

Italy

Italy is quite similar to France in that it has recently implemented a new pricing system. The new method is intended to give more weight to the research component of new products, and less to the cost and amount of active ingredient contained in the product. It is expected to give more encouragement to innovative drugs and less to generics, and to bring prices in Italy more in line with those in the rest of the EC (SCRIP No. 1556). Currently, drug prices in Italy are low relative to the rest of the EEC.

The new pricing method will see "me-toos" discouraged. The government is fully aware of the additional costs the state must bear as a result of "me-toos" and their promotion under various brand names (SCRIP No. 1600). There also appears to be room within the system to allow the government to reduce the price of a drug. This would probably only occur if the increase in sales revenue was judged by the government to be excessive, due to factors such as over-promotion.

Japan

Prices are negotiated with companies and are the highest in the world. It seems that Japan annually announces reductions in pharmaceutical reimbursement prices. For 1988 the Ministry of Health and Welfare announced that the average reduction would be 10.2%. Companies have the right to appeal against the level of reduction although this right is mainly token.

Sweden

Prices must be negotiated with the government as a precondition to marketing. Foreign companies negotiate individually whereas domestic firms negotiate through one body. The Board of Health can establish prices if negotiations are not completed.

Switzerland

Prices are controlled by the government. The manufacturer's price is based on the following cost components: manufacturing 40%; R&D and registration 15%; medical information 11%; sales 9%; advertising 4%; administration 11%, and; business risk and profit 10%. Price increases are awarded on the basis of a 1982 agreement between industry and federal health insurance agencies which allows for inflation and a deduction for productivity.

United Kingdom

The UK does not control the prices of individual drugs, but rather controls the profits of the British activities of the 65 firms that have a turnover of more than 4 million pound sterling. The body overseeing prices is called the Pharmaceutical Price Regulation Scheme (PPRS) and its goal is to achieve "reasonable" prices as well as to encourage a strong R&D-based industry. The allowed profitability had some interpretive aspects which gave the most benefit to those companies that made the greatest relative contribution to the nation's economy in terms of investment, job opportunities and added value arising from domestic manufacturing. It seems, however, that since 1986 this type of merit system has been scaled down.

The government also makes use of a negative list and encourages doctors to prescribe more rationally. The Minister of Health has given assurances that mandatory substitution will not be implemented.

United States

The U.S. does not formally place limits on drug prices. Generic substitution does put some downward pressure on the prices of off-patent drugs. It is likely that generic substitution will become even more popular in the future as the recent catastrophic health care bill limits drug reimbursements under the Medicare program and some insurance companies (eg. Blue Cross) are giving financial incentives to pharmacists to use less costly generics. Additionally, large users of drugs such as hospitals, government agencies, etc. can obtain price discounts by buying large quantities.

APPENDIX 2: General Economic Indicators

Table 1: PMAC Employment Figures

Area of Employment	1987	1990	Change	Per Cent
Medical R&D	925	1372	447	48%
Manufacturing	4991	4937	(54)	(1%)
Distribution	942	996	54	6%
Marketing & Sales	5294	6073	779	15%
Administration	2369	2529	160	7%
Total	14521	15907	1386	10%

Table 2: Generic Employment Figures

Area of Employment	1982	1990	Change	Per Cent
Medical R&D	42	210	168	400%
Manufacturing	530	NA	NA	NA
Quality Control	125	NA	NA	NA
Marketing & Sales	217	NA	NA	NA
Administration	125	NA	NA	NA
Total	1039	2600	1561	150%

Table 3: Employment in Pharmaceutical and Manufacturing Sectors

YEAR	PHARMA SECTOR	GROWTH	ALL MANUFACTURING	GROWTH
1982	15 268	na	1 708 850	na
1983	15 300	2.0 %	1 788 300	4.6 %
1984	15 184	- 0.8 %	1 714 600	- 4.1 %
1985	16 704	10.0 %	1 752 400	2.2 %
1986	17 127	2.5 %	1 758 300	0.3 %
1987	18 578	8.5 %	1 878 100	6.8 %
1988	19 319	4.0 %	1 951 700	4.2 %
1989	21 205	9.8 %	1 981 600	1.2 %
1990	22 200	4.7 %	1 824 900	- 8.6%
AVERAGE		5.2 %		2.1 %

Table 4: Pharmaceutical Employment Provincial Breakdown

YEAR	TOTAL EMPLOYMENT	QUEBEC empl./ %	ONTARIO empl./ %	OTHER %
1983	17	7.2 / 42.0 %	9.6 / 56.5 %	1.5 %
1984	18.8	7.9 / 42.0 %	10.6 / 56.4 %	1.6 %
1985	20.2	8.0 / 39.6 %	11.8 / 58.4 %	2.0 %
1986	19.6	7.7 / 39.3 %	11.3 / 57.7 %	3.0 %
1987	17.8	6.7 / 37.6 %	10.3 / 57.9 %	4.5 %
1988	19.0	7.0 / 36.8 %	11.1 / 58.4 %	4.6 %
1989	22.1	7.7 / 34.8 %	13.5 / 61.1 %	4.1 %
1990	22.2	7.9 / 35.6 %	13.4 / 60.4 %	4.0 %
AVERAGE		38.5 %	58.4 %	3.9 %

Table 5: Canadian Pharmaceutical Sales Figures - All Sectors

YEAR / GROUPING	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
PMAC SALES ('000)	800.8	930.0	1095.0	1287.0	1569.6	1785.7	2130.4	2564.6	2945.8	3236.4	3487.4
GROWTH IN SALES	NA	16.1	17.7	17.5	22.0	13.8	19.3	20.4	14.9	9.9	7.8
SHARE OF MARKET	80.3	80.5	83.1	80.6	84.6	85.4	87.4	86.7	85.7	84.4	83.1
GENERIC SALES ('000)	44.1	54.0	73.1	88.5	110.9	119.5	131.5	173.9	246.6	348.4	390.0
GROWTH IN SALES	NA	22.3	35.4	21.1	25.4	7.8	10.0	32.3	41.8	41.2	11.9
SHARE OF MARKET	4.4	4.7	5.6	5.5	6.0	5.7	5.4	5.9	7.2	9.1	9.3
TOTAL SALES ('000)	997	1156	1316	1596	1855	2090	2438	2957	3438	3835	4198

Table 6: Gross Domestic Product (1981=100)

YEAR	TOTAL ECONOMY	MFG. INDUSTRIES	PHARMA-CEUTICALS
1981	319 538.1	61 648.0	624.3
1982	307 863.5	53 702.2	600.9
1983	317 858.6	57 168.7	654.8
1984	336 941.4	64 541.4	686.2
1985	352 821.1	68 180.8	809.8
1986	364 265.7	68 968.2	826.0
1987	381 794.5	72 951.8	870.0
1988	400 142.9	77 379.8	901.3

Table 7: Percent Change GDP

YEAR	TOTAL ECONOMY	MFG. INDUSTRIES	PHARMA-CEUTICALS
81/82	- 3.8 %	- 14.8 %	-3.9 %
82/83	3.2 %	6.5 %	9.0 %
83/84	6.0 %	12.9 %	4.8 %
84/85	4.7 %	5.6 %	18.0 %
85/86	3.2 %	1.2 %	2.0 %
86/87	4.8 %	5.8 %	5.3 %
87/88	4.8 %	6.1 %	3.6 %
AVERAGE	3.3 %	3.3 %	5.5 %

Table 8: Pharmaceutical Trade Statistics

YEAR	EXPORTS	GROWTH	IMPORTS	GROWTH
1980	74 446	na	69 274	na
1981	81 336	9.3 %	79 129	14.2 %
1982	81 829	0.6 %	67 355	- 17.5 %
1983	88 426	8.1 %	75 694	12.4 %
1984	109 437	23.8 %	95 460	26.1 %
1985	113 822	4.0 %	94 442	- 1.1 %
1986	117 822	3.5 %	101 513	7.5 %
1987	126 399	7.3 %	110 707	9.1 %
1988	139 052	10.0 %	126 877	14.6 %
1989	138 112	- 0.7 %	136 447	7.5 %
AVERAGE	--	7.3 %	--	8.1 %

Table 9: Percent Change Pharmaceutical Trade

YEAR	EXPORTS GROWTH	AVERAGE ANNUAL GROWTH	IMPORTS GROWTH	AVERAGE ANNUAL GROWTH
82/83	22.0 %		15.6 %	
83/84	3.5 %		5.5 %	
84/85	6.0 %		- 5.9 %	
85/86	14.6 %	11.1 %	26.4 %	8.9 %
86/87	11.2 %		7.8 %	
87/88	- 14.7 %		13.4 %	
88/89	3.4 %		- 0.5 %	

Table 10: Top Twenty Drug Companies in Canada, by Sales: 1990

Company Name	Type of Firm	Country of Control	Canadian Sales ($000)	Worldwide Sales (mill)
Total Sales				

Source: IMS Canada & SCRIP Pharmaceutical League Tables, 1990

*These firms are subsidiaries of other firms within Canada.

Table 11: Concentration of Pharmaceutical Sales Among the Top Four, Twelve and Thirty Firms

Year	C4	C12	C30
1984	23.04	48.21	78.65
1985	23.50	46.15	76.18
1986	23.96	48.34	80.40
1987	23.73	48.37	80.06
1988	22.68	47.82	79.76

Source: IMS Canada

Table 12: Concentration of Sales Among the Four Largest Firms in Eleven Major Therapeutic Classes of Ethical Drugs for Canada, 1964, 1974 and 1984-1988 (%)

Therapeutic Class	1974	1984	1985	1986	1987	1988	Class Trend	Generic Products
Ethical Analgesics	66.70	59.36	59.50	57.17	53.48	50.91	DOWN	YES
Antibiotics *	54.70	49.34	49.43	49.64	47.90	49.64	DOWN	YES
Bronchial Therapy	65.20	83.94	86.10	87.62	87.78	88.91	UP	
Antihyper - tensives	NA	76.88	79.21	80.26	83.22	79.52	EVEN	
Cough/Cold Remedies	52.00	48.07	49.56	50.90	45.83	47.43	EVEN	YES
Hemantics	35.50	41.16	42.61	46.27	44.85	46.65	UP	
Plain ** Corticoids	68.10	61.85	60.55	61.01	60.48	61.35	DOWN	YES
Corticoid ** Combinations	63.10	55.81	58.09	58.00	58.63	60.09	DOWN	
Laxatives, Innovative	49.00	51.38	51.40	50.43	44.41	45.50	EVEN	NO
Tranquilizers	67.00	59.13	57.43	56.99	52.55	52.07	DOWN	YES
Vitamins, Innovative	32.90	37.14	38.71	37.05	39.11	40.12	UP	NO

Source: Eastman (1985) and IMS Canada.
*Antibiotics in this class are of the broad and medium spectrum.
**These are specific types of hormones.

Table 13: Sales of Compulsory Licenced Drugs in Canada: 1983 - 1990

Year	Sales ($000)	% Change-Year
1983	28,373	NA
1984	43,800	54%
1985	42,909	-2%
1986	43,686	2%
1987	70,713	62%
1988	118,225	67%
1989	162,186	37%
1990	167,411	3%

Source: Patent Office and IMS Canada

Table 14: Comparison Between the Pharmaceutical and Total Manufacturing Sectors - Various Economic Indicators

Economic Indicator	Numerical Value	Total Share of All Manufacturing Industries
Factory Shipments(89)	$2120.5 million	1.0 per cent
Imports(89)	$785.0 million	3.1 per cent
Exports (89)	$175.4 million	0.4 per cent
Investment(89)	$182.7 million	0.6 per cent
Employment(88)	19,319	1.0 per cent
Gross Dom. Prod.(89)	$963.4 million	1.2 per cent
Establishments(88)	148	0.4 per cent
Value Added(86)	$1737.3 million	1.7 per cent

Table 15: Percentage of Compulsory Licence Sales of Total Sales in Generic Market

YEAR	C.L. PROD. SALES AS % OF TOTAL SALES OF GENERICS	GROWTH
1983	32.1 %	na
1984	39.5 %	23.1 %
1985	35.9 %	-10.0 %
1986	33.2 %	- 8.1 %
1987	40.7 %	22.6 %
1988	47.9 %	17.7 %
1989	46.6 %	- 2.8 %
1990	42.9 %	- 8.6 %
AVERAGE	39.9 %	4.8 %

Table 16: Cross-Sectoral Comparison of Value Added by Production Workers - 1980 and 1986

Industry	Value Added per Worker (1980)	Value Added per Worker (1986)	Growth in Value Add.
Petroleum Ref.	224.1	314.4	40.1%
Industrial Chem.	138.6	228.1	64.6%
Pharmaceuticals	107.0	224.4	109.7%
Communications	51.6	82.6	60.1%
Industrial Elec.	48.6	71.6	47.3%
Sci/Prof. Equip.	39.0	65.4	67.7%
Manufacturing	48.9	75.8	55.0%

APPENDIX 3: Financial Data

Table 1: Pharmaceutical Sector: After-Tax Profits

Year	Return on Income (%)	Return on Assets (%)	Return on Equity (%)	$ Volume of Prof.(mill)
1979	6.3	9.2	17.1	85.3
1980	7.3	10.4	19.2	104.5
1981	7.0	10.0	18.5	114.8
1982	7.3	10.5	18.4	132.9
1983	8.6	12.9	22.9	180.3
1984	10.2	16.0	28.9	248.5
1985	10.3	15.8	26.7	275.5
1986	9.6	14.1	27.9	286.7
1987	8.3	11.6	27.6	305.2
AVERAGE	8.3	12.3	23.0	192.6

Source: Statistics Canada Catalogue 61-207

Table 2: Electric, Gas & Other Utilities Sector: After-Tax Profits

Year	Return on Income (%)	Return on Assets (%)	Return on Equity (%)	$ Volume of Prof.(mill)
1979	10.4	2.7	13.4	1401.6
1980	9.8	2.5	11.5	1528.5
1981	11.3	2.8	13.7	1853.2
1982	10.2	2.7	13.6	2052.5
1983	9.0	2.3	11.3	1928.1
1984	7.8	2.1	10.2	1910.2
1985	6.1	1.6	8.1	1578.6
1986	5.1	1.3	6.5	1323.9
1987	6.3	1.6	7.6	1656.6
AVERAGE	8.5	2.2	10.7	1692.6

Source: Statistics Canada Catalogue 61-207

Table 3: Petroleum Refineries Sector: After-Tax Profits

Year	Return on Income (%)	Return on Assets (%)	Return on Equity (%)	$ Volume of Prof.(mill)
1979	8.2	8.9	16.1	1760.3
1980	7.5	8.4	14.8	1921.5
1981	5.5	5.8	12.1	1632.0
1982	3.7	3.5	7.7	1079.5
1983	1.1	1.2	2.5	349.6
1984	4.7	5.3	9.9	1793.0
1985	2.0	2.0	4.1	770.4
1986	10.8	8.8	16.0	3409.0
1987	5.1	4.4	7.5	1533.4
AVERAGE	5.4	5.4	10.1	1583.2

Source: Statistics Canada Catalogue 61-207

Table 4: Communications Equipment SectorAfter-Tax Profits

Year	Return on Income (%)	Return on Assets (%)	Return on Equity (%)	$ Volume of Prof.(mill)
1979	6.7	7.2	12.4	164.1
1980	5.6	5.4	10.9	162.2
1981	5.8	6.2	12.9	216.2
1982	4.0	4.3	8.3	169.7
1983	6.6	6.7	11.4	286.2
1984	6.7	6.3	10.3	338.2
1985	4.6	4.4	7.1	248.0
1986	5.6	4.6	8.1	305.4
1987	4.9	4.1	7.6	315.4
AVERAGE	5.6	5.5	9.9	245.0

Source: Statistics Canada Catalogue 61-207

Table 5: Scientific & Professional Equipment Sector: After-Tax Profits

Year	Return on Income (%)	Return on Assets (%)	Return on Equity (%)	$ Volume of Prof.(mill)
1979	4.8	8.0	15.6	68.6
1980	5.5	9.1	17.9	87.8
1981	5.2	8.7	17.1	91.5
1982	4.3	7.1	13.6	84.5
1983	3.8	6.3	12.0	80.5
1984	4.0	6.6	12.3	91.9
1985	4.1	6.6	12.0	93.2
1986	3.6	5.4	10.1	89.5
1987	3.6	5.3	9.6	95.5
AVERAGE	4.3	7.0	13.3	87.0

Source: Statistics Canada Catalogue 61-207

Table 6: Industrial Chemicals Sector: After-Tax Profits

Year	Return on Income (%)	Return on Assets (%)	Return on Equity (%)	$ Volume of Prof.(mill)
1979	8.4	7.7	22.6	266.5
1980	7.2	7.4	18.9	287.3
1981	8.6	8.4	23.3	409.5
1982	1.6	1.4	4.1	77.7
1983	3.1	2.7	8.6	158.0
1984	3.1	2.6	8.3	171.4
1985	-0.2	-0.1	-0.4	-9.5
1986	0.0	0.0	-0.1	-1.0
1987	8.3	7.6	22.7	556.7
AVERAGE	4.5	4.2	12.0	213.0

Source: Statistics Canada Catalogue 61-207

Table 7: Industrial Electrical Equip. Sector: After-Tax Profits

Year	Return on Income (%)	Return on Assets (%)	Return on Equity (%)	$ Volume of Prof.(mill)
1979	4.2	6.2	12.7	97.5
1980	4.7	7.2	14.5	126.2
1981	4.2	6.6	13.2	128.8
1982	2.7	4.4	8.1	83.6
1983	3.6	4.9	8.4	89.0
1984	3.7	5.1	9.5	110.3
1985	3.7	5.4	10.4	128.9
1986	3.3	4.9	9.9	120.6
1987	4.5	6.6	12.4	164.2
AVERAGE	3.8	5.7	11.0	116.6

Source: Statistics Canada Catalogue 61-207

Table 8: Total Manufacturing Sector: After-Tax Profits

Year	Return on Income (%)	Return on Assets (%)	Return on Equity (%)	$ Volume of Prof.(mill)
1979	5.0	7.2	16.2	9064
1980	4.7	6.6	14.9	9498
1981	4.1	5.5	13.5	9148
1982	1.3	1.7	4.2	2844
1983	2.4	3.3	7.9	5715
1984	3.9	5.5	12.7	10704
1985	3.1	4.2	9.6	9172
1986	4.3	5.6	12.3	12988
1987	4.4	5.6	12.4	14128
AVERAGE	3.7	5.0	11.5	9251

Source: Statistics Canada Catalogue 61-207

Table 9: All Sectors, Average 1979-1987: After-Tax Profits

Sectors	Return on Income (%)	Return on Assets (%)	Return on Equity (%)	$ Volume of Prof.(mill)
Pharm.	8.3	12.3	23.0	192.6
Util.	8.5	2.2	10.7	1692.6
Petrol Ref	5.4	5.4	10.1	1583.2
Comm.	5.6	5.5	9.9	245.0
Sci. Eq.	4.3	7.0	13.3	87.0
Ind. Chems	4.5	4.2	12.0	213.0
Ind. Elec.	3.8	5.7	11.0	116.6
Aircraft	(3.1)	(3.5)	NA	(123.2)
Total Mfg.	3.7	5.0	11.5	9251.2

Source: Statistics Canada Catalogue 61- 207

Table 10: Comparative Financial Ratios - Pharmaceuticals & Total Manufacturing

Financial Ratios	Pharma-ceuticals	Total Manufacturing	Col 2 as % of Col 1
Profit (Before Tax) on Total Income	14.3%	5.4%	37.8%
Profit (Before Tax) on Assets	21.1%	7.4%	35.1%
Profit (Before Tax) on Equity	39.6%	17.0%	42.9%
Profit (After Tax) on Total Income	8.3%	3.7%	44.6%
Profit (After Tax) on Assets	12.3%	5.0%	40.7%
Profit (After Tax) on Equity	23.0%	11.5%	50.0%

Source: Statistics Canada Catalogue 61- 207

Table 11: After-Tax Return on Revenues for the Pharmaceutical, Petroleum Refining and Total Manufacturing Sectors

Year	Pharmaceutical Sector	Manufacturing Sector	Petrol. Ref. Sector
1979	6.3	5.0	8.2
1980	7.3	4.7	7.5
1981	7.0	4.1	5.5
1982	7.3	1.3	3.7
1983	8.6	2.4	1.1
1984	10.2	3.9	4.7
1985	10.3	3.1	2.0
1986	9.6	4.3	10.8
1987	8.3	4.4	5.1
AVERAGE	8.3	3.7	5.4

Source: Statistics Canada Catalogue 61-207

Table 12: After-Tax Return on Income, Assets and Equity for the Member Companies of the PMAC

Year	Return on Income	Return on Assets	Return on Equity	$ Volume of Profits(000)
1980	9.4	13.6	17.8	161,425
1981	5.8	8.6	11.1	110,446
1982	6.6	9.5	12.1	133,726
1983	10.9	15.7	19.1	256,162
1984	12.8	18.0	21.6	328,856
1985	9.3	13.1	15.5	263,302
1986	12.2	18.5	20.8	387,984
1987	12.9	20.8	22.9	418,032
AVERAGE	10.0	14.7	17.6	257,492

Source: Statistics Canada - Special Data Run by CALURA

Table 13: After-Tax Return on Income, Assets and Equity for Generic Drug Companies*

Year	Return on Income	Return on Assets	Return on Equity	$ Volume of Profits
1980	6.7	15.1	21.4	2,764
1981	11.3	22.8	29.3	5,079
1982	12.8	9.5	31.9	7,177
1983	15.9	15.7	35.5	10,551
1984	17.5	18.0	31.5	14,273
1985	11.7	13.1	23.0	10,851
1986	7.8	18.5	16.3	8,880
1987	4.0	18.3	23.4	13,257
AVERAGE	11.0	16.4	26.5	9,104

Source: Statistics Canada - Special Data Run by CALURA

*The number of firms in this sample goes from eight in 1980 to twelve in 1987.

Table 14: Comparative Financial Indicators: Debt/Equity Ratios, 1979-1987

Sector of the Economy	Avg. Debt/ Equity Ratio	Low Debt/ Equity Ratio	High Debt/ Equity Ratio
Pharmaceutical Sector	6.3%	3.0%	10.6%
Scientific & Prof. Equip. Sector	7.4%	4.9%	11.2%
Industrial Elec. Equip. Sector	7.4%	7.4%	10.0%
Communications Equip. Sector	12.8%	12.8%	19.8%
Petroleum Refineries Sector	21.2%	12.9%	29.0%
Total Manufacturing Sector	31.8%	25.5%	40.6%
Industrial Chemicals Sector	76.6%	55.4%	99.3%
Electric, Gas and Other Utilities	307.8%	283.3%	326.7%

Source: Statistics Canada Catalogue 61- 207

Table 15: World's Top Companies - 1989

Company	World Rank	Pharma Sales (millions)	Country of Origin

Source: Pharmaceutical Company League Tables, 1989, PJB Publ.

*These are new firms which are all the result of mergers in 1989 and 1990.

Table 15B: World's Top Companies - 1990

Company	World Rank	Pharma Sales (millions)	Country of Origin

Source: Pharmaceutical Company League Tables, 1990, PJB Publ.

Table 16: Multinational Profit Levels - 1989

Company	World Rank	Profit ($ million)	Sales ($ million)	ROI (%)

Source: Pharmaceutical Company League Tables, 1989, PJB Publ.

Table 16B: Multinational Profit Levels - 1990

Company	World Rank	Profit ($ million)	Sales ($ million)	ROI (%)

Source: Pharmaceutical Company League Tables, 1990, PJB Publ.

Table 17: Multinational Profit Levels: Individual Company Comparisons - 1989

Company	Profit Ranking*	Pharmaceutical Profits[1] (%)	Total Company Profits[2] (%)

Source: Pharmaceutical Company League Tables, 1989, PJB Publ.

* The first figure lists the rank of the firm's pharmaceutical division while the second figure lists the rank of the entire firms operations.

1 The profit measure for each firm is not the same. For some companies the measurement is ROI while for others it may be ROA or ROE.

2 Total company profits are the same rate of return as the pharmaceutical profits in almost all cases.

Table 17B: Multinational Profit Levels: Individual Company Comparisons - 1990

Company	Profit Ranking*	Pharmaceutical Profits[1] (%)	Total Company Profits[2] (%)

Source: Pharmaceutical Company League Tables, 1990, PJB Publ.

* The first figure lists the rank of the firm's pharmaceutical division while the second figure lists the rank of the entire firms operations.

1 The profit measure for each firm is not the same. For some companies the measurement is ROI while for others it may be ROA or ROE.

2 Total company profits are the same rate of return as the pharmaceutical profits in almost all cases.

Table 18: Multinational R&D Levels - 1989

Company	World R&D Ranking*	R&D Expend. ($ million)	R&D to Sales Ratio (%)

Source: Pharmaceutical Company League Tables, 1989, PJB Publ.

* The figures listed in this table may refer to either:

1. The R&D performed by the pharmaceutical portion of the company (denoted by P)
2. The R&D performed by the entire company (denoted by T).

Table 18B: Multinational R&D Levels - 1990

Company	World R&D Ranking*	R&D Expend. ($ million)	R&D to Sales Ratio (%)

Source: Pharmaceutical Company League Tables, 1990, PJB Publ.

* The figures listed in this table may refer to either:

1. The R&D performed by the pharmaceutical portion of the company (denoted by P)
2. The R&D performed by the entire company (denoted by T).

APPENDIX 4: Price Data

Figure 1

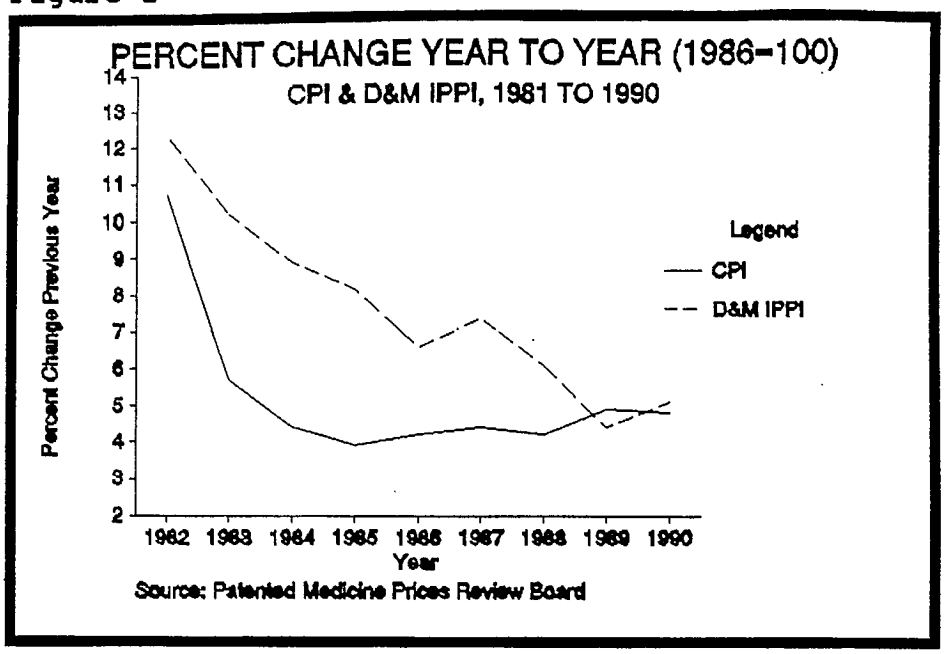


Figure 2

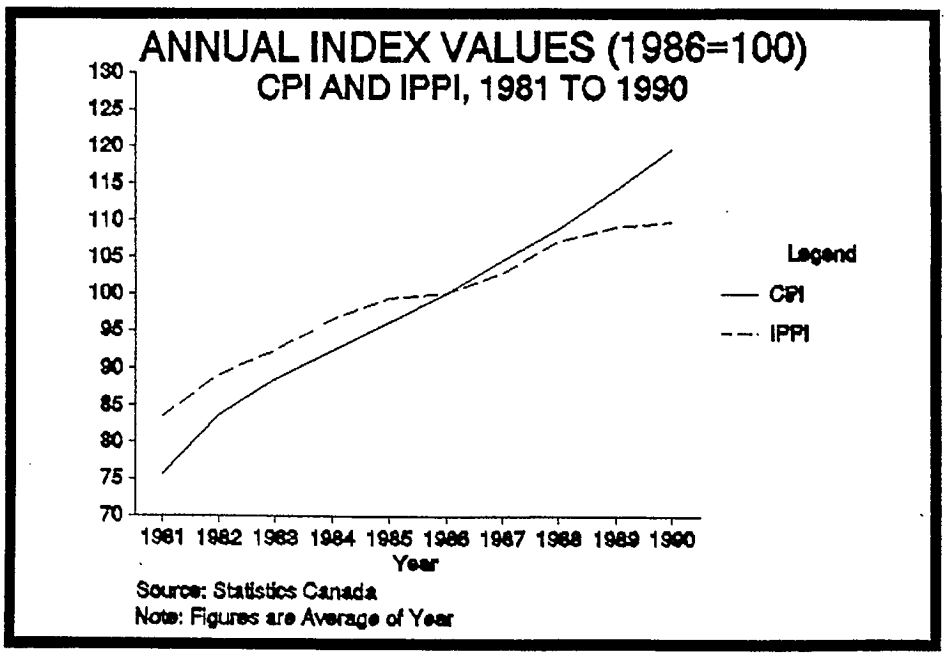


Figure 3

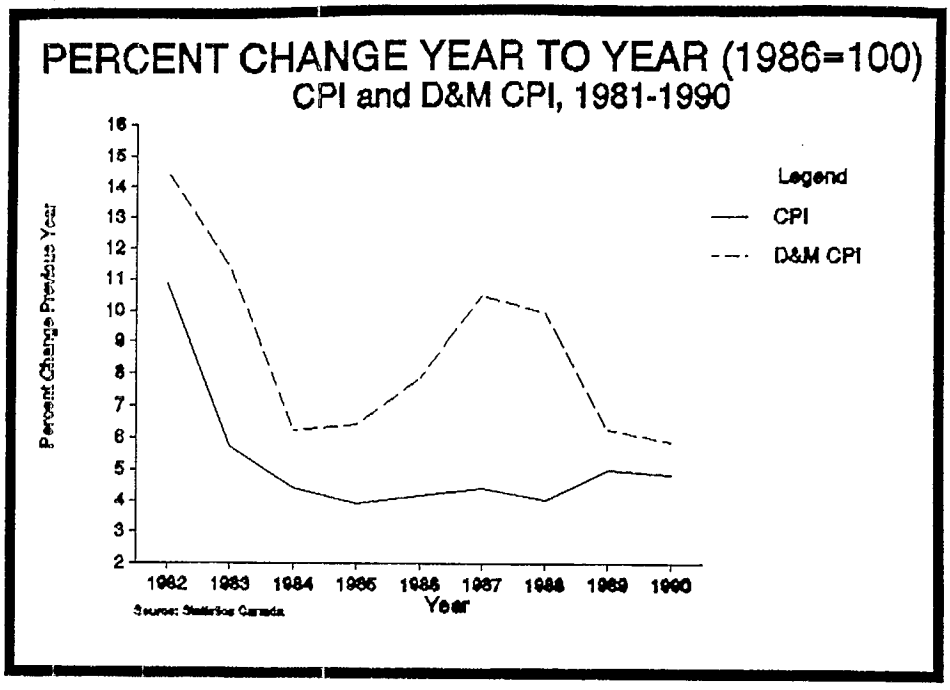


Figure 4

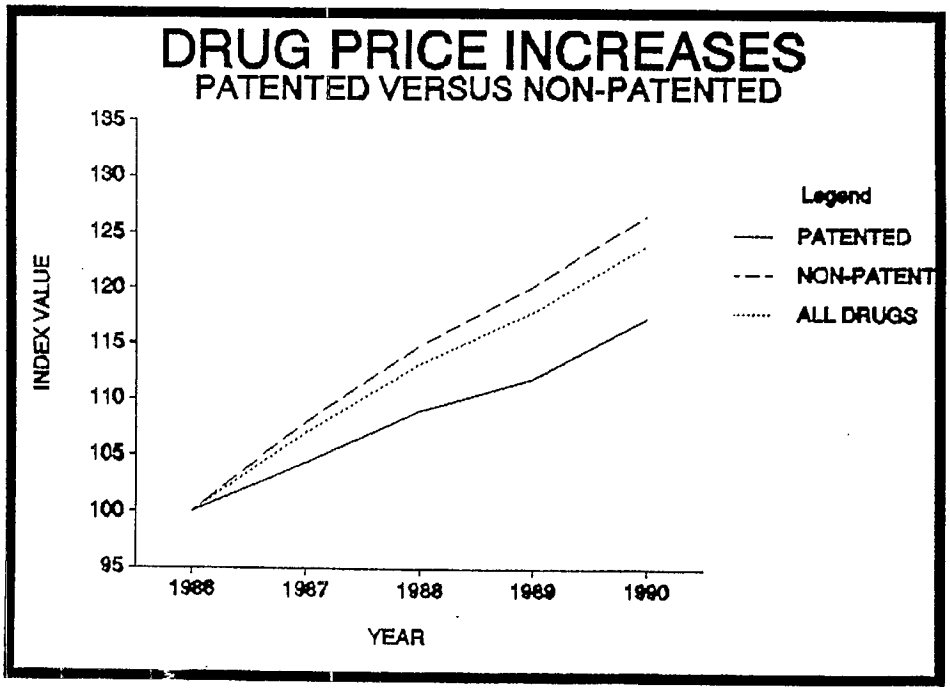


Figure 5

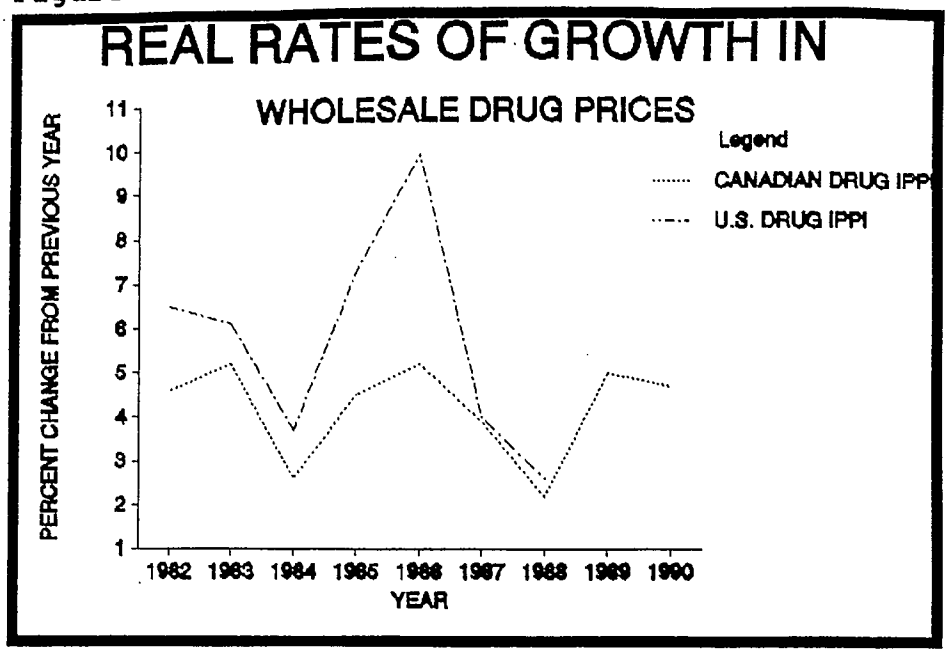


Figure 6

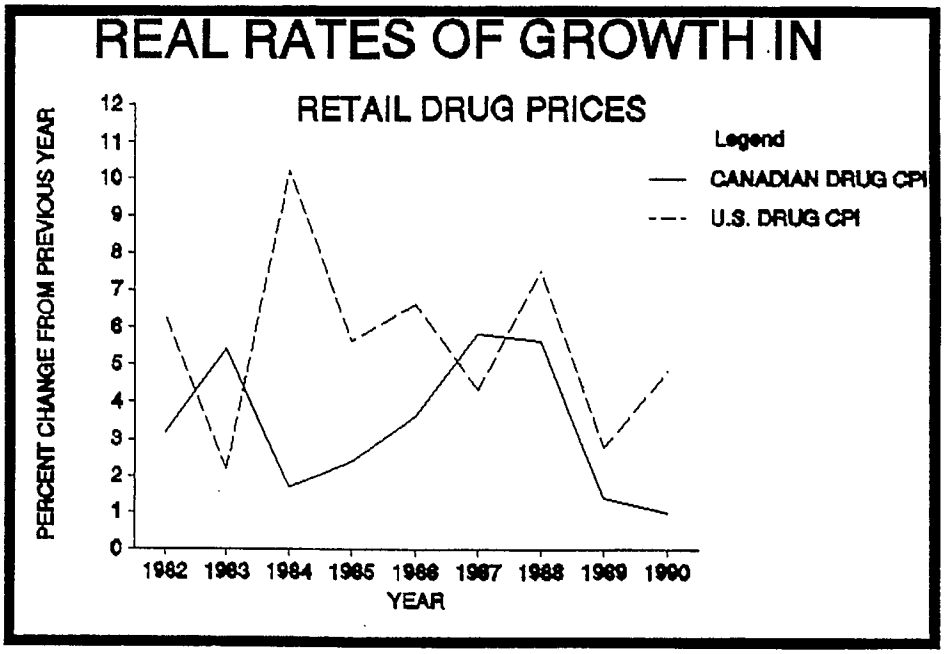


Figure 7

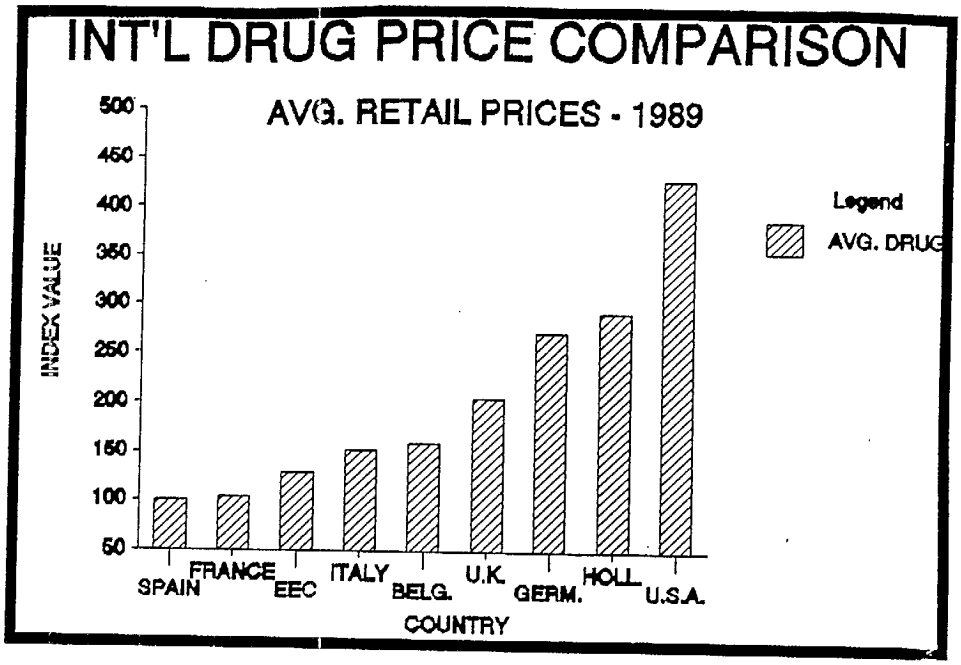


Figure 8

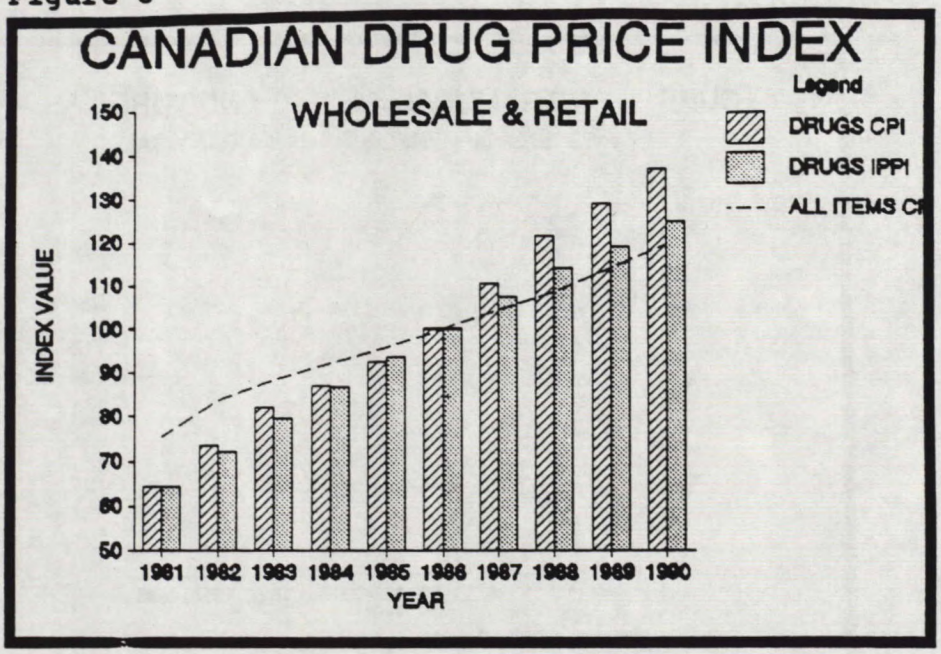
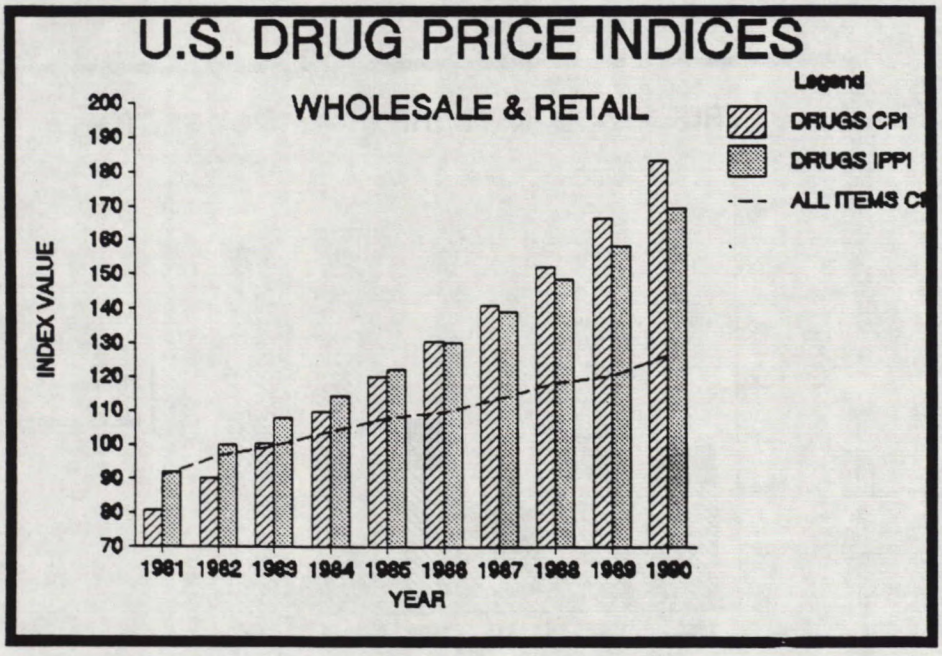
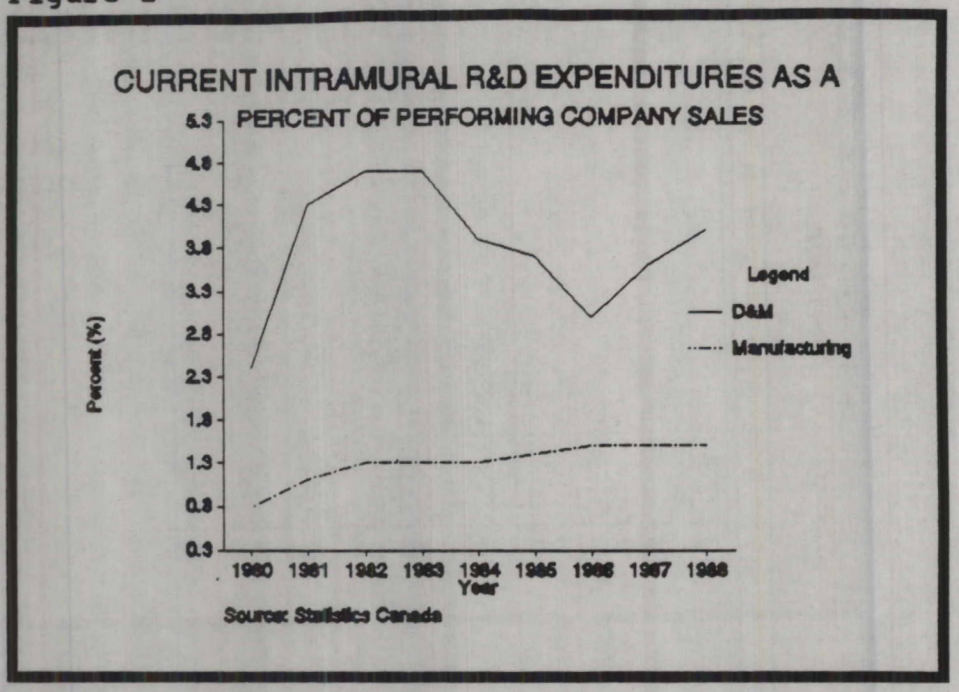


Figure 9



APPENDIX 5: R&D Data

Figure 1



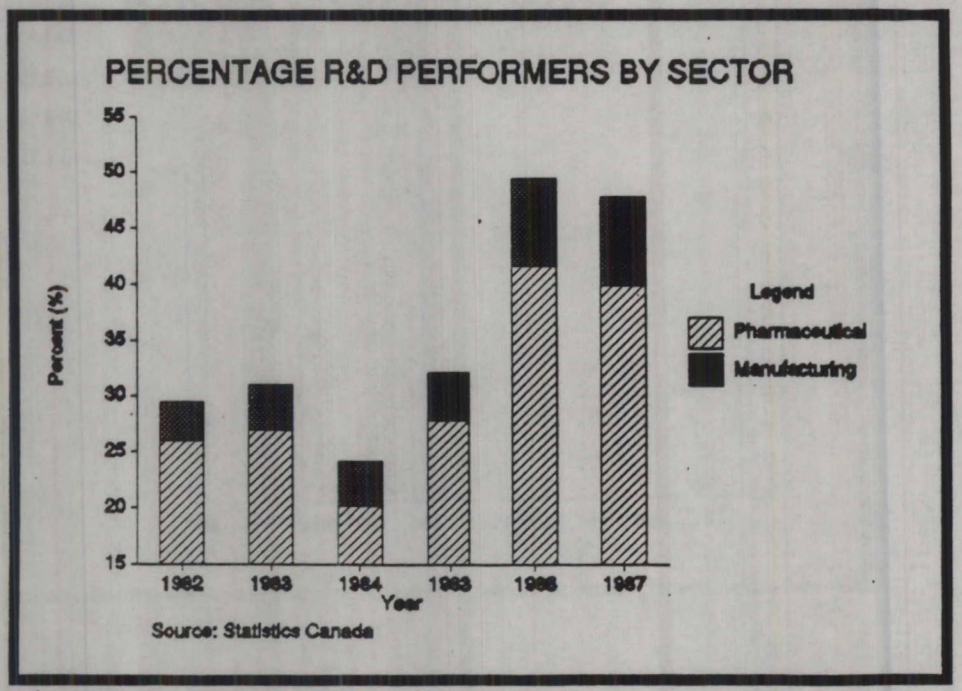


Figure 2

Figure 3

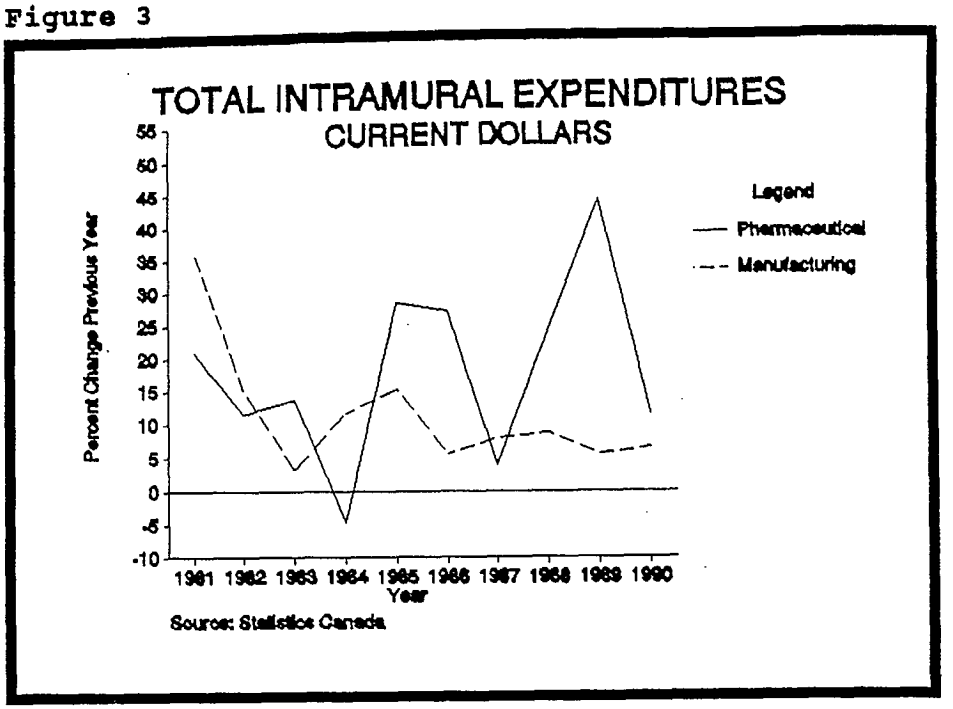


Table 1: International R&D-to-Sales Ratios

Country	Average R&D to Sales %
U.S.	12.4%
Japan	10.4%
EEC	14.4%
West Germany	12.5%
U.K.	10.7%
Switzerland	15.4%
France	14.4%
Italy	11.4%

Table 2: Canadian Generic R&D-to-Sales Ratios

YEAR	R&D Spending	R&D-to-sales Ratio
1980	$2.2 million	per cent
1981	$2.7 million	per cent
1982	$3.4 million	per cent
1990	$ million	11 per cent

Table 3: Progress on PMAC R&D Commitment

YEAR	PRE-1987 R&D RATE	PRE-1987 AMOUNT	ACTUAL R&D RATE	ACTUAL AMOUNT	DIFFERENCE IN DOLLARS
1988	4.9%	$123.2m	6.1%	$165.7m	$42.5m
1989	4.9%	$145.7m	8.2%	$244.8m	$99.1m
1990	4.9%	$157.0m	8.8%	$281.3m	$124.3m
Total Increment					$265.9m

PMPRB R&D Data

TABLE 1: Total R&D Expenditures and R&D to Sales Ratios

Year	Companies Reporting	Total R&D Expenditures	% Change from Previous Year	Total Sales Revenues ($M)	% Change from Previous Year	R&D to Sales Ratio	
						All Patentees	PMAC Patentees
1988	63	281.3	14.9	3,203.6	7.7	8.8%	9.2%
1989	66	224.8	47.7	2,973.0	9.4	8.2%	8.1%
1990	66	165.7	NA	2,718.0	NA	6.1%	6.5%

Note: Total expenditures include capital equipment expenditures and allowanble depreciation expenses.
Source: Patented Medicine Prices Review Board, first, second and third annual report.

TABLE 2: Current R&D Expenditures* by Type of Research

Type of Research	1990		1989		1988		% Change 1990/1989	% Change 1989/1988
	($M)	(%)	($M)	(%)	($M)	(%)		
Basic Research	70.1	26.3	53.5	23.4	30.3	19.1	30.9	76.6
Applied Research	161.1	60.6	143.3	62.7	106.6	67.2	10.9	34.4
Other Qualifying Research	34.7	13.1	31.8	13.9	21.7	13.7	7.5	46.5
Total	265.9	100.0	228.6	100.0	158.6	100.0	16.3	44.1

Source: Patented Medicine Prices Review Board, second and third annual report.
Note *: Current expenditures exclude capital and depreciation expenses

TABLE 3: Current R&D Expenditures* by R&D Performers

Number of Performers	1990		1989		1988		% Change 1990/1989	% Change 1989/1988
	($M)	(%)	($M)	(%)	($M)	(%)		
Patentees	134.3	50.5	134.0	58.6	95.8	60.4	0.2	39.9
Universities & Hospitals	67.5	25.4	55.1	24.1	37.4	23.6	22.5	47.3
Other Companies	47.5	17.8	NA	NA	NA	NA	117.9	NA
Others	16.6	6.3	39.5	17.3	25.4	16.0	(6.3)	55.5
Total	265.9	100.0	228.6	100.0	158.6	100.0	16.3	44.1

Source: Patented Medicine Prices Review Board, second and third annual report.
Note *: Current expenditures exclude capital and depreciation expenses.
Number in parentheses represent negative values.

TABLE 4: Currnet R&D Expenditures* by Location of R&D

Location of R&D	1990		1989		1988		% Change 1990/1989	% Change 1989/1988
	($M)	(%)	($M)	(%)	($M)	(%)		
Atlantic Provinces	3.4	1.2	3.1	1.4	1.9	1.2	9.6	63.2
Quebec	126.0	47.3	98.3	43.0	71.8	45.3	28.2	36.9
Ontario	114.6	43.3	106.7	46.7	72.2	45.5	7.4	47.8
Western Provinces	21.9	8.2	20.5	9.0	12.7	8.0	6.8	61.4
Canada	265.9	100.0	228.6	100.0	158.6	100.0	16.3	44.1

Source: Patented Medicine Prices Review Board, second and third annual.
Note *: Curent expenditures exclude capital and depreciation expenses.

APPENDIX 6: Consumer Impact Assessment Data

Table 1: Per Capita and Family Incomes (Real) in Canada for 1980-1989

Year	Family Income	Growth	Per Cap. Income	Growth
1980	46,285	NA	14,068	NA
1981	45,759	-1.15	13,994	-0.53
1982	44,690	-2.39	13,751	-1.77
1983	44,001	-1.57	13,665	-0.63
1984	44,014	0.03	13,797	0.97
1985	45,087	2.44	14,223	3.09
1986	45,995	2.01	14,555	2.33
1987	46,640	1.40	14,806	1.72
1988	47,599	2.06	15,305	3.37
1989	48,992	2.93	15,804	3.26
Average		0.64		1.31

Table 2: Canadian Population

YEAR	CANADA	GROWTH	+65	PERCENT
1980	24 070.1	na		
1981	24 362.1	1.2 %		
1982	24 603.5	1.0 %	2.46 %	10.0 %
1983	24 803.3	0.8 %		
1984	24 995.1	0.8 %		
1985	25 181.3	0.7 %		
1986	25 372.9	0.8 %		
1987	25 643.9	1.1 %		
1988	25 938.6	1.1 %	2.93 %	11.3 %
AVERAGE		0.94 %		

APPENDIX 7: The Impact of Globalization/Rationalization

YEAR	ACTION-MERGER/RATIONALIZATION	CONSEQUENCES
1988/89	Allergan closes plant in Mtl.	62 jobs lost
1989	Warner Lambert Line Closure	35 jobs lost
1989	Alcon Plant Closure	48 jobs lost
1989	Institut Merieux buys Connaught	Loss of Cdn. Control
1989	Rhone-Poulenc Buys Rorer *	Unknown
1989	Merrell Dow Merger	Unknown
198990	SmithKline Beecham Merger	Two Plant Closures
1990	Sterling Drug Plant Closure	180 jobs lost
1990	Bristol Myers Squibb Merger	Plant Closures
1990	Webber Bought by Ciba-Geigy	Plant To Be Closed
1990	Whitehall Facility Closed	75 jobs lost
1991	McNeil Plant Closure	80 jobs lost
1992	A.H. Robins Bought by Ayerst	Plant Closure Expect.

* It is important to note that Institut Merieux is controlled by Rhone-Poulenc (50.5%). In fact, Rhone-Poulenc is quickly becoming one of the largest pharmaceutical firms in the world. The acquisition of Rorer would put the firm in fifth or sixth position in the world pharmaceutical company rankings. The healthcare sector accounted for almost 25% of the company's total 1989 sales of $12,807 million. The combined sales of these companies are estimated at somewhere in the region of $2,000 million.

GLOSSARY OF ACRONYMS AND ABBREVIATIONS
(in alphabetical order)

CDMA	:	Canadian Drug Manufacturer's Association
CPI	:	Consumer Price Index
CCAC	:	Department of Consumer and Corporate Affairs Canada
DNR	:	Department of National Revenue
EC	:	European Community
EEC	:	European Economic Commission
FDA	:	U.S. Food and Drug Administration
FTA	:	Free Trade Agreement (between Canada and the U.S.)
GATT	:	General Agreement on Tariffs and Trade
GDP	:	Gross Domestic Product
HWC	:	Health and Welfare Canada
IP	:	Intellectual Property
IPPI	:	Industrial Product Price Index
MNE	:	Multi-National Enterprise
NAFTA	:	North American Free Trade Agreement
NCEs	:	New Chemical Entities
OECD	:	Organization for Economic Development
PED	:	Program Evaluation Division
PMAC	:	Pharmaceutical Manufacturers Association of Canada
PMPRB	:	Patented Medicine Prices Review Board
R&D	:	Research and Development
ROA	:	Return on Assets
ROE	:	Return on Equity
ROR	:	Return on Revenues
TRIPs	:	Trade-Related Intellectual Property (Multilateral Trade Negotiation Group)
U.S.A	:	United States of America
U.K.	:	United Kingdom

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