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A Comparison of Pharmaceutical

Research and Development Spending



in Canada and Selected Countries (2002)

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Canada

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Highlights

A Comparison of Pharmaceutical R&D Spending in Canada and Selected Countries

- This paper compares Research and Development (R&D) spending by the brand name pharmaceutical industry in Canada to spending in other major industrialized countries.
- Total R&D spending in Canada by the brand name pharmaceutical industry increased from \$626 million in 1995 to \$945 million in 2000, an increase of 51%. Total pharmaceutical sales grew by 75% over the same period to \$9.3 billion.
- Despite the growth in R&D spending, Canada still ranked behind other major industrialized countries in R&D spending by several measures.
- Most importantly, the ratio of R&D to domestic sales in Canada remains well below values observed in Europe and the United States (US). The Canadian ratio stood at 10.1% in 2000, whereas the aggregate ratio for the seven countries used for price comparison purposes was 19.0%. Among these countries, only Italy had a lower ratio than Canada in 2000.
- Measures of R&D spending relative to population and GDP also indicate low levels of pharmaceutical research investment in Canada compared to other developed countries.
- Among major industrialized countries, Canada accounts for a share of total pharmaceutical R&D that is roughly one-half of its share of total pharmaceutical sales.

Executive Summary

This paper compares Research and Development (R&D) spending by the brand name pharmaceutical industry in Canada to spending in other major industrialized countries. The emphasis is on comparisons with France, Germany, Italy, Sweden, Switzerland, the United Kingdom (UK) and the United States (US), the seven countries listed in the *Patented Medicines Regulations* (Regulations) which the Patented Medicine Prices Review Board (PMPRB) is required to use for the purpose of carrying out its regulatory mandate under the *Patent Act* (Act). The analysis covers the period 1995 to 2000.

R&D spending for Canada is based on information filed by patentees with the PMPRB, pursuant to section 88 of the *Act* and the Regulations. For the purposes of the *Act* and Regulations, “research and development” means expenditures that would have been eligible for an investment tax credit for scientific research and experimental development under the provisions of the *Income Tax Act* that were in effect on December 1, 1987.

Total R&D spending in Canada increased from \$626 million in 1995 to \$945 million in 2000, an increase of 51%. Despite this growth Canada still ranked behind the other industrialized countries in R&D spending. Italy had the next lowest total R&D spending at \$964 million. The US ranked first over the entire period, with R&D spending in 2000 of \$32.5 billion. The UK ranked second with \$6.4 billion.

Total sales by pharmaceutical patentees rose by almost 75% from 1995 to \$9.3 billion in 2000. As a result, the average R&D-to-domestic sales ratio in Canada decreased from 11.7 % in 1995 to 10.1% in 2000. Italy, Sweden and France saw similar declines. Switzerland, the UK and Germany saw substantial increases in their R&D-to-sales ratios. There was virtually no change in the US ratio.

The PMPRB reports annually on current R&D expenditure by type of pharmaceutical research, i.e., basic, applied, and other qualifying R&D. The PMPRB has reported that basic R&D increased from \$132 million in 1995 to \$156 million in 1999. The proportion of basic R&D accounted for between 18.4% and 27.2% of current R&D spending over the period from 1988 to 1999. In 1999, basic R&D accounted for approximately 18.4% of current R&D spending, down from 22.2% from 1995.

Information on basic pharmaceutical R&D spending is also available for the US and UK. In 1999, expenditures on basic research in the UK were approximately 24.5% of total spending, down slightly from the previous years. Spending on basic research in the US increased to 36% in 1999.

In 2000, total R&D spending by pharmaceutical patentees in Canada accounted for 1.8% of the pharmaceutical R&D spending of \$53.4 billion in the eight countries. Total Canadian brand name sales accounted for 3.4% of total sales in eight countries of \$275 billion.

1. INTRODUCTION

It has been estimated that the leading research-based pharmaceutical companies spent approximately \$53.4 billion¹ on pharmaceutical research and development (R&D) in 2000. The global sales of these companies were approximately \$275 billion in 2000.²

This represented an overall ratio of R&D spending to sales of about 19.5%. Most of these leading companies have subsidiaries and hold pharmaceutical patents in Canada.

The PMPRB is mandated to report annually on R&D spending by patentees and on R&D-to-sales ratios of the patented pharmaceutical industry as a whole and each patentee.³ The PMPRB does not have regulatory authority over R&D spending by patentees.

The purpose of this paper is to compare R&D spending by the brand name pharmaceutical industry in Canada to that observed in other industrialized countries. Much of the paper concerns comparisons of Canada with the set of seven countries (denoted below as the “C7 countries”) consisting of France, Germany, Italy, Sweden, Switzerland, the UK and the US. These are the seven countries the PMPRB is required to consider in carrying out its regulatory mandate under the *Patent Act* (Act).

It is important to note that international comparisons of R&D spending and sales must take into account differences in definitions of R&D that may be used in different countries. The definitions of pharmaceutical R&D and its components are described in the section entitled, “Definition and Data”.

The paper is organized as follows. Section 2 describes the sources of the R&D information and definitions in the various countries. Section 3 reports on global trends in R&D spending and sales of the largest international pharmaceutical companies. Section 4 reports on R&D spending in Canada and the seven countries. Section 5 reports on alternative measures of pharmaceutical R&D spending in the selected countries.

2. DEFINITION AND DATA

This report is based primarily on information obtained from pharmaceutical industry trade associations and filings by patentees with the PMPRB. (See Appendix II for a listing of data sources.)

¹ All dollar amounts reported here are stated in Canadian dollars. All currency conversions to Canadian dollars have been done using average market rates for the year in question.

² The R&D spending examined here does not include R&D spending in the bio-technology sectors in Canada and other countries.

³ *Patent Act*, s.89

The pharmaceutical R&D spending reported for Canada is based on information filed by patentees with the PMPRB. Section 88 of the *Act*, and the *Patented Medicine Regulations* (Regulations), require patentees to report annually to the PMPRB on their total sales of medicines in Canada and their expenditures on R&D pertaining to medicines. The PMPRB reports annually on these expenditures and the ratios of R&D spending to sales for the industry and for individual patentees.

Only companies with active Canadian patents pertaining to a medicine sold in Canada are required by the *Act* to report on R&D spending to the PMPRB. As new patents are granted and others expire, the group of companies required to file R&D data may change from year to year. Although sales of patented drugs represent about 65% of the total sales by manufacturers of all drugs in Canada, the total sales of all drugs, patented and non-patented, by patent-holding firms represents a proportion closer to 90% of all pharmaceutical sales. There are thus good reasons to believe R&D figures reported to the PMPRB cover most R&D spending by the brand name pharmaceutical industry.

For the purposes of the *Act* and Regulations, "research and development" means expenditures that would have been eligible for an investment tax credit for scientific research and experimental development under the provisions of the *Income Tax Act* that were in effect on December 1, 1987. R&D spending includes current expenditures, capital equipment costs and allowable depreciation expenses. Activities excluded under this definition and not reported to the PMPRB include market research or sales promotion, quality control or routine testing, style changes, commercial production, expenditures made outside Canada, expenditures made to acquire rights such as patent rights, convention expenditures, legal fees, advertising or selling expenses and spending on pharmacoeconomic studies.

Section 2900 (1) of the *Income Tax Regulations* describes "scientific research and experimental development" as systematic investigation or search carried out in a field of science or technology by means of experiment or analysis. Three components are specifically defined:

- (a) basic research, i.e., work undertaken for the advancement of scientific knowledge without a specific practical application in view;
- (b) applied research, i.e., work undertaken for the advancement of scientific knowledge with a specific application in view; and
- (c) other qualifying research (development research), i.e., the use of the results of basic or applied research to create new or improve existing materials, devices, products or processes.

These definitions are similar, but not identical, to the definitions used in surveys of pharmaceutical R&D spending conducted by the trade associations. Table 1 shows the components included in the Canadian definitions of current pharmaceutical R&D spending reported by the PMPRB, and the definitions used by the trade associations of

other countries. Table 2 compares the definitions used by the trade associations and the PMPRB for R&D capital expenditures.

As shown in Table 1, the components included in "Discovery Research" as reported by the trade associations, are similar to the components reported as "Basic Research" in Canada. "Development Research" reported by the trade associations include the same components as "Applied Research" in Canada. While "Post-marketing" research is included in both groups, the trade associations include expenditures on patents and information services which are not included by the PMPRB.

Table 1: Current R&D Spending - Trade Association and PMPRB Definitions

Trade Associations	Patented Medicine Prices Review Board
Discovery Research	Basic Research
Basic Research	Basic Research – chemical
Synthesis and extraction	
Biological screening	Basic Research – biological
Pharmacological screening	
Development Research	Applied Research
Animal Studies:	Preclinical:
(1) Toxicology Safety testing	Preclinical Trials I
(2) Bio-availability Pharmacokinetics	Preclinical Trials II
Pharmaceutical & Chemical Development:	Preclinical:
(1) Dosage, formulation Stability testing	Preclinical Trials I
(2) Chemical and process testing	Preclinical Trials II
Clinical Evaluation:	Clinical:
(1) Human volunteer	Clinical Trials Phase I
(2) Pre-marketing	Clinical Trials Phase I, II & III
	Manufacturing Processes
	Other Qualifying R&D
(3) Post-marketing*	Post-marketing*
Regulatory Affairs	Regulatory requirements for a Notice of Compliance (NOC)
Patents	NOT INCLUDED
Information Services	NOT INCLUDED

* Post-marketing includes expenditures for new dosage strengths and indications. "Other Qualifying R&D" is also referred to as "Development R&D."

Table 2 describes the components of capital expenditures reported by both organizations. Spending on equipment and buildings is treated in a similar fashion. Spending on land devoted to R&D is not included in the PMPRB definition, but is included in the trade association definition.

Table 2: Capital R&D Spending - Trade Association and PMPRB Definitions

Trade Associations	Patented Medicine Prices Review Board
Equipment	Equipment
100% depreciation base rate	100% depreciation base rate
Applicable to equipment devoted substantially to R&D	Applicable to equipment that devotes at least 90% of its useful life to R&D
Buildings	Buildings
100% depreciation base rate	4% straight line over 25 years
Applicable to buildings devoted substantially to R&D	Applicable to the portion of buildings that are devoted to R&D
Land	Land
100% depreciation base rate	Not included
Applicable on land devoted substantially to R&D	

Biotechnology

It is important to note that pharmaceutical R&D spending reported by trade associations does not include spending in the biotechnology sector. Biotechnology R&D spending is included in pharmaceutical R&D spending reported to the PMPRB if the firm in question had sales of patented drugs.

Sales

Total sales of pharmaceuticals reported by the trade associations in each country to the trade associations include ethical and non-ethical sales of research-based pharmaceutical manufacturers.⁴ The US is an exception, reporting ethical pharmaceutical sales only.

⁴ Ethical pharmaceuticals include any medical chemicals, biologicals, products of biotechnology or in vivo diagnostics which are used for the cure, alleviation, treatment, prevention or diagnosis of diseases of humans and are available as "Prescription only Medicines".

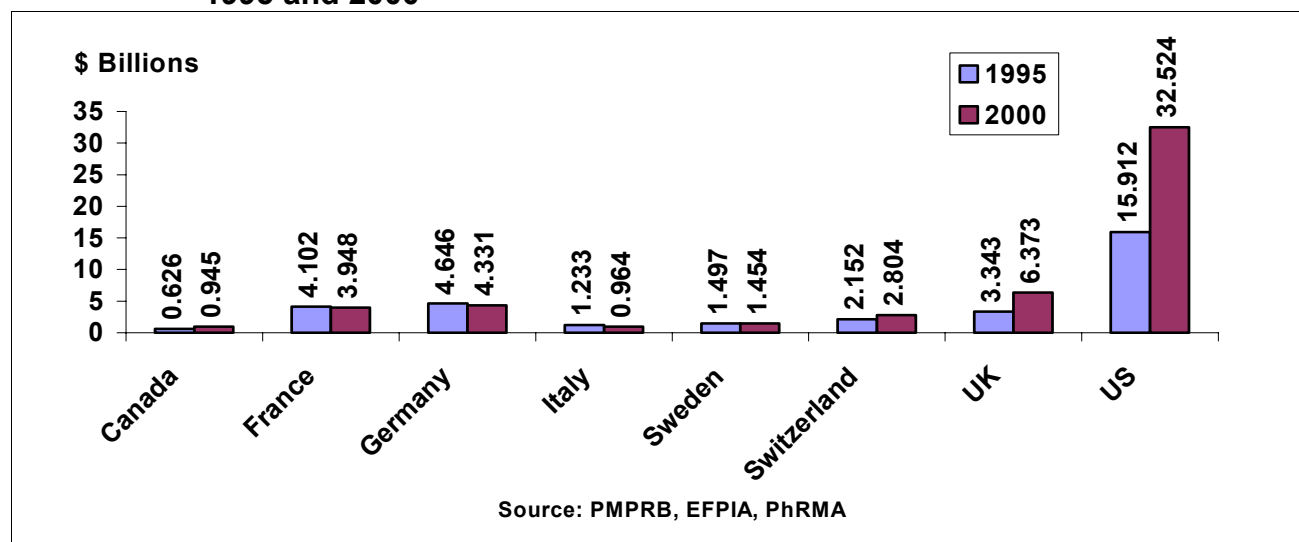
In the case of European countries “domestic sales” include sales of generic drugs, whereas for Canada and the US “domestic sales” include only sales of brand name products. As a result, the R&D-to-sales ratios reported below may be somewhat biased in favour of producing relatively higher Canadian values.

DISTRIBUTION AND LEVELS OF R&D SPENDING: CANADA AND SELECTED COUNTRIES

Levels of R&D Spending

Figure 1 shows the levels of R&D spending for the years 1995 and 2000 in Canada and C7 countries.⁵ R&D spending in Canada by pharmaceutical patentees in 1995 was \$626 million. Although the level of spending in Canada increased to \$945 million by 2000, Canada remained below all other countries. Italy (\$964 million) had the next lowest total R&D spending in 2000. The US ranked first over the entire period, with R&D spending of \$32.5 billion in 2000, up from \$15.9 billion in 1995.

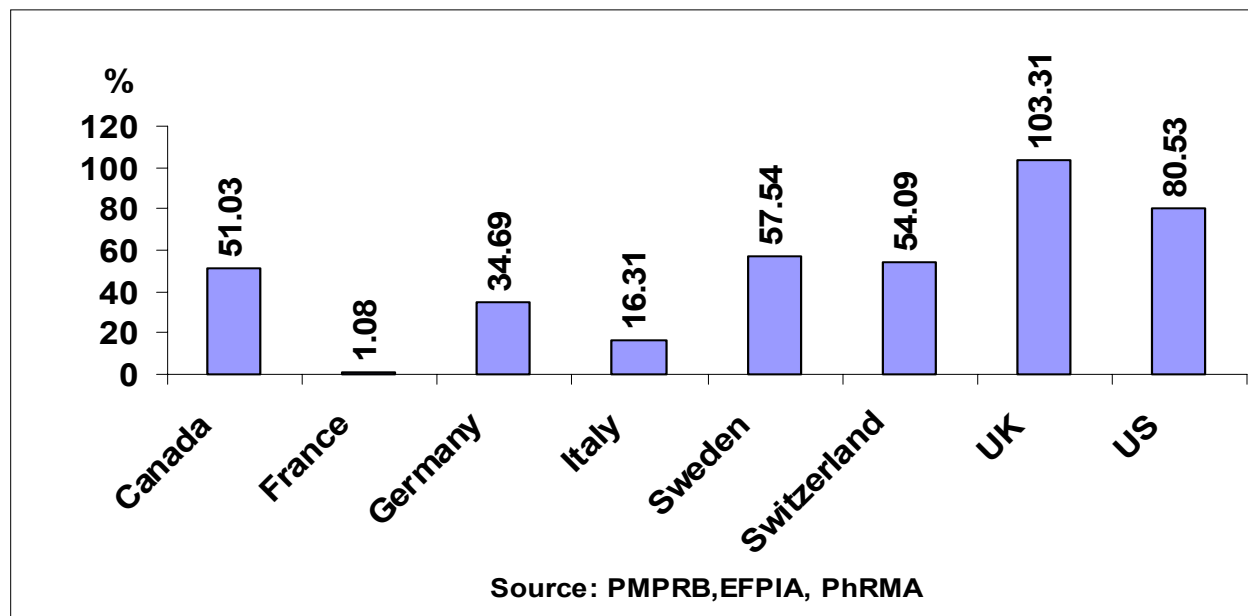
Figure 1: Pharmaceutical R&D Spending, Canada and C7 Countries, 1995 and 2000



⁵ Total pharmaceutical R&D spending include capital expenditure for Italy, France, Switzerland, Germany, Sweden, UK, US and Canada

Figure 2 converts the dollar figures of Figure 1 into corresponding rates of increase. R&D spending in Canada rose by about 51% between 1995 and 2000. By comparison, the UK saw growth of 103%, followed by US at 81% and Sweden at 58%. France, on the other hand, had virtually no growth in R&D spending.

Figure 2: Growth in Pharmaceutical R&D Spending, Canada and C7 Countries, 1995 - 2000



R&D Spending Relative to Domestic Pharmaceuticals Sales

In response to the 1987 changes to the *Act* extending patent protection for pharmaceuticals in Canada, the brand name industry (as represented then by the PMAC - now Rx&D) committed to increasing its R&D spending in Canada to 10% of its Canadian sales by 1996. Table 3 shows that patentees reported total sales of \$5.3 billion in 1995 and \$9.3 billion in 2000, an increase of 74.7%. Table 3 also shows the brand name industry had reached a R&D-to-domestic-sales ratio (RSR) of 11.7% in 1995. This fell to 10.1% in 2000. (A similar decline of 12.5% to 10.6% appears when calculations are restricted to members of the Rx&D.) In 2001, patentees reported a ratio of 9.9% (10.6% for Rx&D members).

Table 3: R&D Spending* and R&D-to-Domestic-Sales Ratios, Canada, 1995–2000

Year	Companies Reporting	Total R&D Spending* (\$M)	Change from Previous Year (%)	Total Sales Revenues (\$M)	Change from Previous Year (%)	R&D-to-Sales Ratio	
						All Patentees (%)	Rx&D Patentees (%)
2000	79	941.8	5.3	9,309.6	12.0	10.1	10.6
1999	78	894.6	12.0	8,315.5	19.2	10.8	11.3
1998	74	798.9	10.2	6,975.2	10.9	11.5	12.7
1997	75	725.1	9.0	6,288.4	7.4	11.5	12.9
1996	72	665.3	6.4	5,857.4	9.9	11.4	12.3
1995* *	71	625.5	11.5	5,330.2	7.5	11.7	12.5

* Total expenditure includes federal and provincial government grants, capital equipment expenditures and allowable depreciation expenses.

** source: PMPRB Annual Report 2001

There is considerable variation in Canadian RSRs at the individual company level.⁶ Table 4 gives a breakdown by range of company-level ratios reported for the year 2000. While 39 of the 79 reporting patentees had ratios below 5%, 12 patentees reported R&D spending exceeding 15% of pharmaceutical sales.

Table 4: Distribution of RSRs, Canada, 1995 and 2000

Year	Range of R&D-to-Sales Ratios by Number of Companies			
	0 - 4.99%	5% - 9.99%	10% - 14.99%	15% +
2000	39	16	12	12
1995	30	18	10	13

Figure 3 compares Canadian RSRs to those observed in the C7 countries over the period 1995 and 2000.⁷ As noted above, Canada's ratio stood at 11.7% in 1995. Only Italy (9.0%) had a lower ratio in that year. Switzerland had the highest RSR at 89.9%, followed by Sweden at 47.2%. The aggregate RSR for the C7 countries (Figure 6) was 21.5% in 1995, nearly double the Canadian ratio.

⁶ PMPRB, Annual Reports

⁷ Sales in Figure 5 represent domestic sales and do not include exports.

A very similar pattern emerges in the RSRs for 2000. Italy (6.2%) remained at the bottom of the range, with Canada second lowest at 10.1%. The ratios of all other C7 countries were again above Canada's, and the aggregate C7 RSR (19.0%) remained almost twice that observed in this country.

Figure 3: RSRs, Canada and C7 Countries, 1995 and 2000

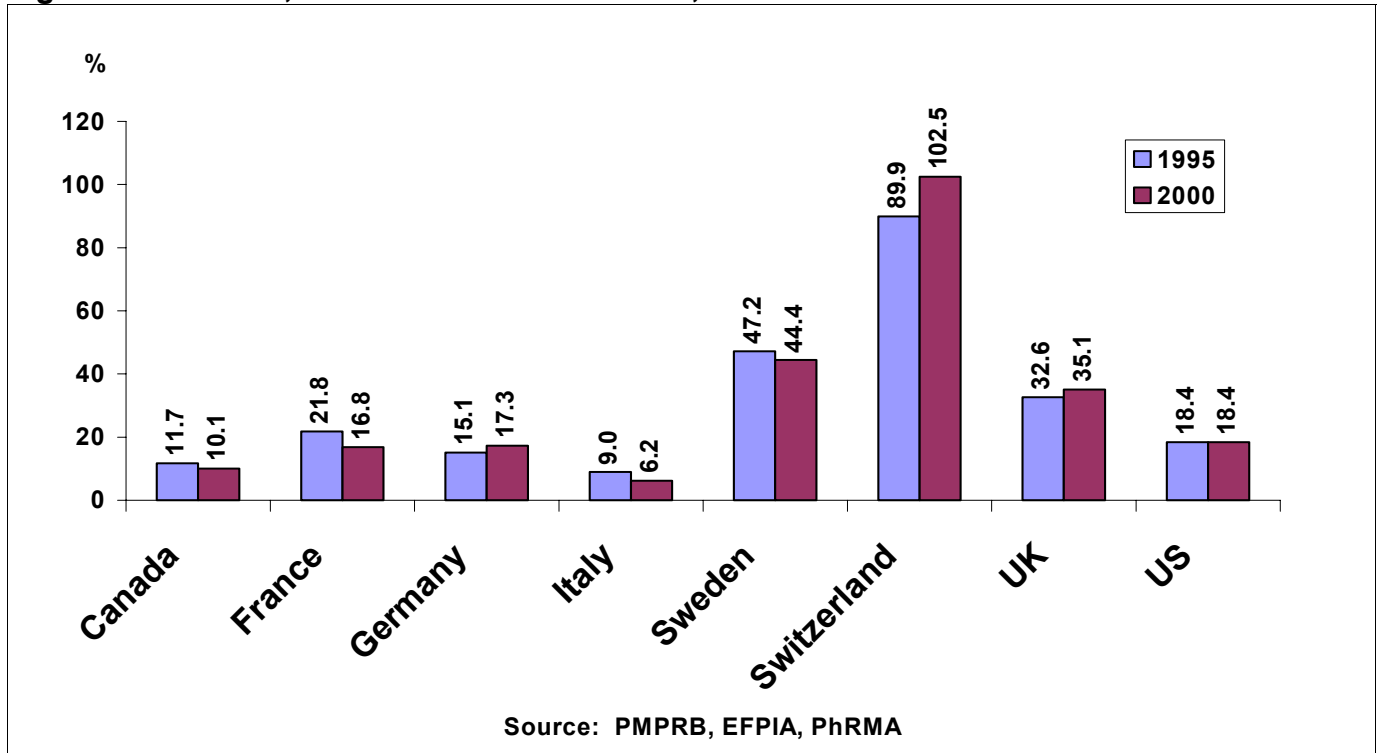


Figure 4: RSRs, Canada and C7 Group, 1995 and 2000

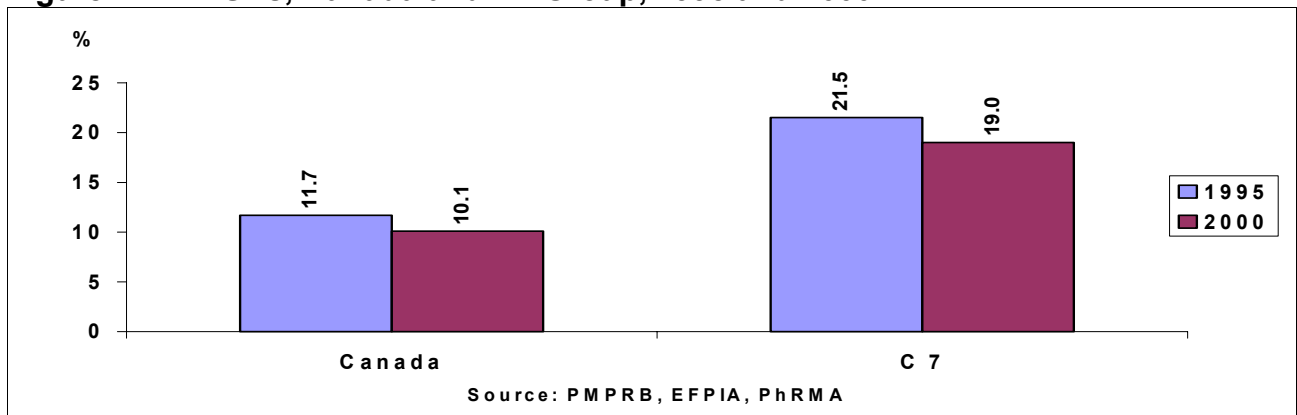


Figure 5 gives 1995 and 2000 RSRs for a set of smaller European countries. Among these countries only Spain had a RSR in 2000 notably less than Canada. Belgium and the Netherlands, in contrast, recorded ratios of 28.6% and 16.4%, respectively.

Figure 5: RSRs, Canada and Small European Countries, 1995 and 2000

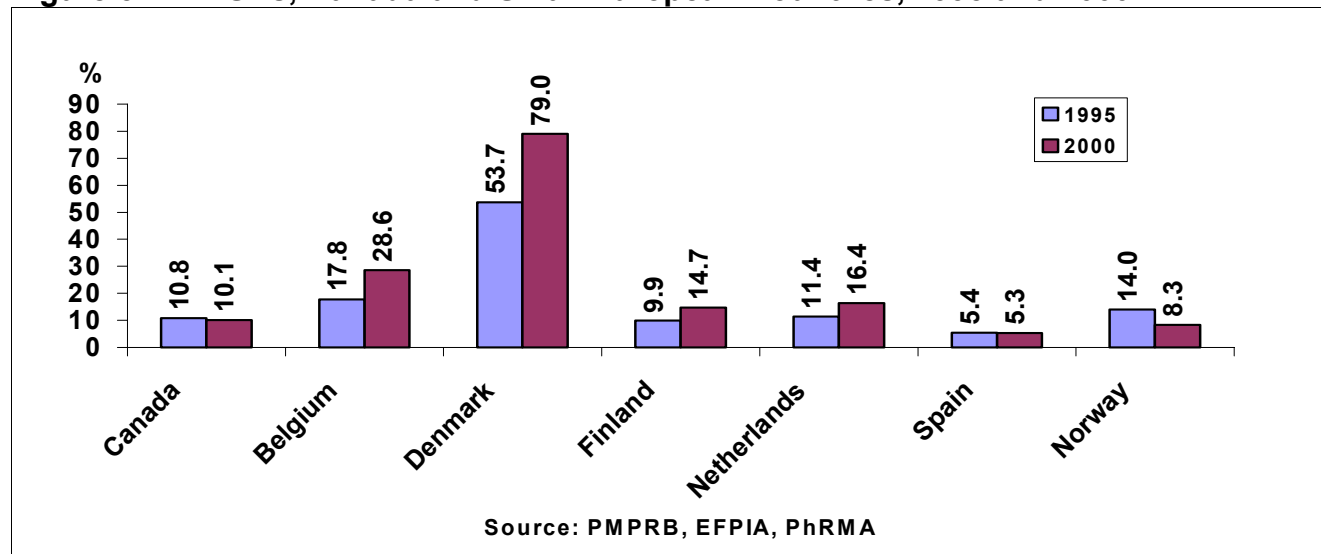
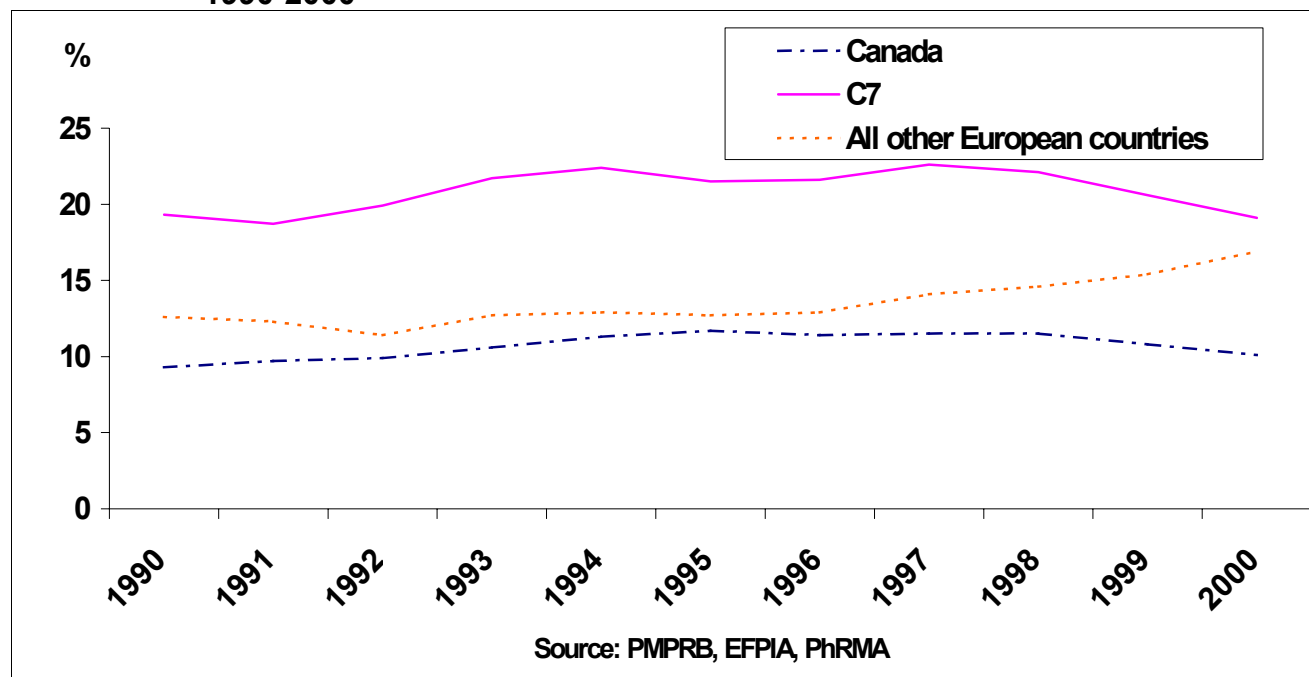


Figure 6 provides a time series comparison of the RSRs in Canada, the C7 countries and smaller European countries (taken as a group) for the period 1990 to 2000. Over this period of time Canada’s RSR remained consistently below the aggregate ratio for the C7 countries, with the difference remaining remarkably constant. The aggregate ratio for the smaller European countries ran slightly above Canada’s until the mid-1990s, when the difference began to grow steadily larger, with the small country ratio moving toward the C7 value.

Figure 6: RSRs, Canada, C7 Group and Small European Country Group 1990-2000



OTHER COMPARISONS

The previous section demonstrated that, although Canada has seen substantial growth in pharmaceutical R&D spending in recent years, this country continues to lag other C7 countries in regard to reinvestment of pharmaceutical sales revenue. This section reports on additional measures of relative R&D performance.

R&D Spending Per Capita

Figure 7 compares pharmaceutical R&D spending per capita in Canada and the C7 countries.⁸ In 1995 Canada's R&D per capita was \$20.9 per person, lower than any of the C7 countries, including Italy (\$21.5). Switzerland had by far the highest per capita spending (\$300.4) followed by Sweden (\$169.3) and France (\$70.9).

The situation had changed somewhat by 2000. In 2000, R&D spending in Canada increased to \$30.2 per person. This put Canada above Italy (\$16.8). Per capita spending in Canada nonetheless remained well below all other C7 countries and well below the aggregate C7 value of \$90.

⁸ Population estimates for each country were obtained from the US Census Bureau Census. Total R&D spending for each country was then divided by the corresponding population to arrive at R&D per capita.

Figure 7: Pharmaceutical R&D Spending per Capita, Canada and C7 Countries, 1995 and 2000

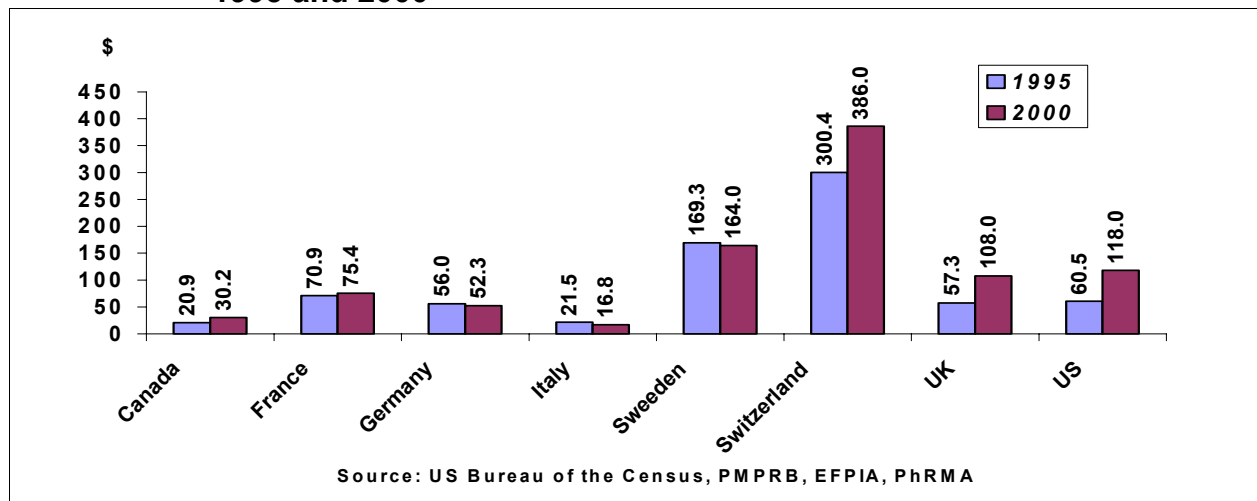


Figure 8 gives pharmaceutical R&D spending as a share of GDP in Canada and the C7 countries.⁹ In 1995 Canada had the lowest R&D-to-GDP ratio (0.09%) within this group. Only Italy (0.11%) had a comparable ratio. All other countries had R&D-to-GDP ratios three or more times Canada's. Switzerland led the group with a ratio of 0.93% followed by Sweden 0.65% and France 0.32%.

Canada's R&D-to-GDP ratio had decreased slightly to 0.08% by 2000. There were more pronounced declines in all countries except the US and UK. Canada now ranked above Italy (0.06%) by this measure, but still lagged all other C7 countries.

⁹ Information on GDP was collected from the OECD. Total R&D spending for each country was divided by the corresponding GDP to arrive at R&D per GDP.

Figure 8: Ratio of Pharmaceutical R&D Spending to GDP, Canada and C7 Countries, 1995 and 2000

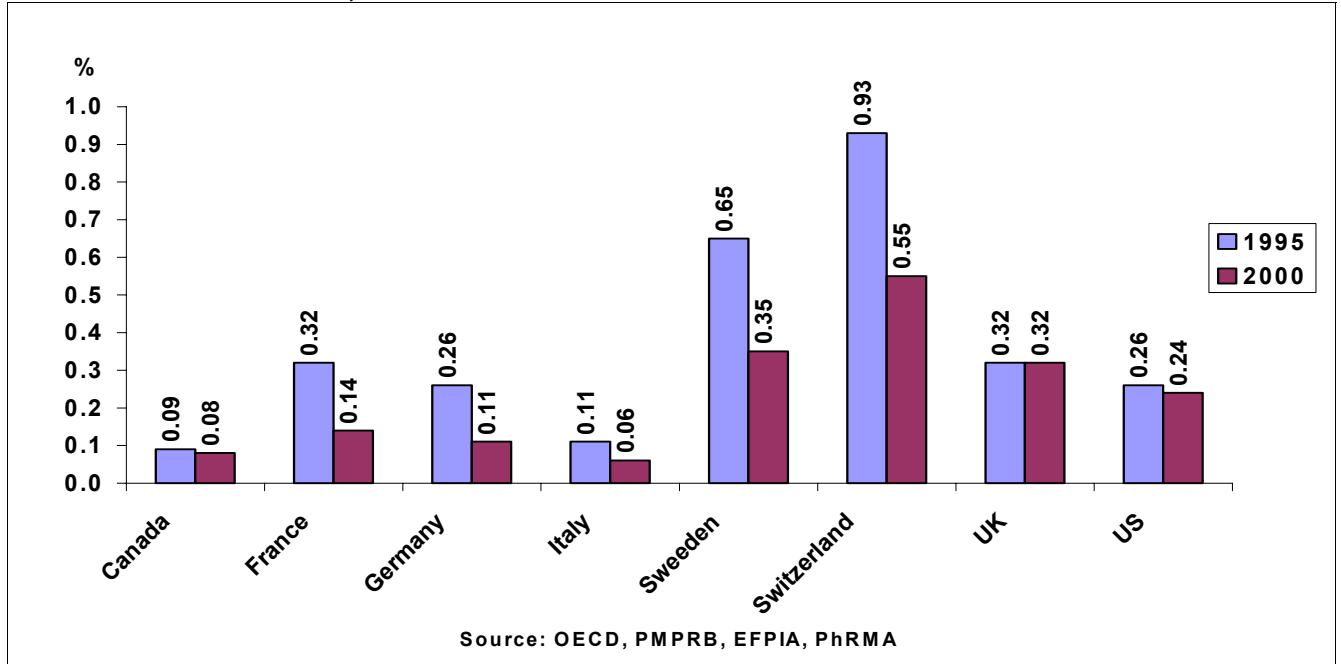
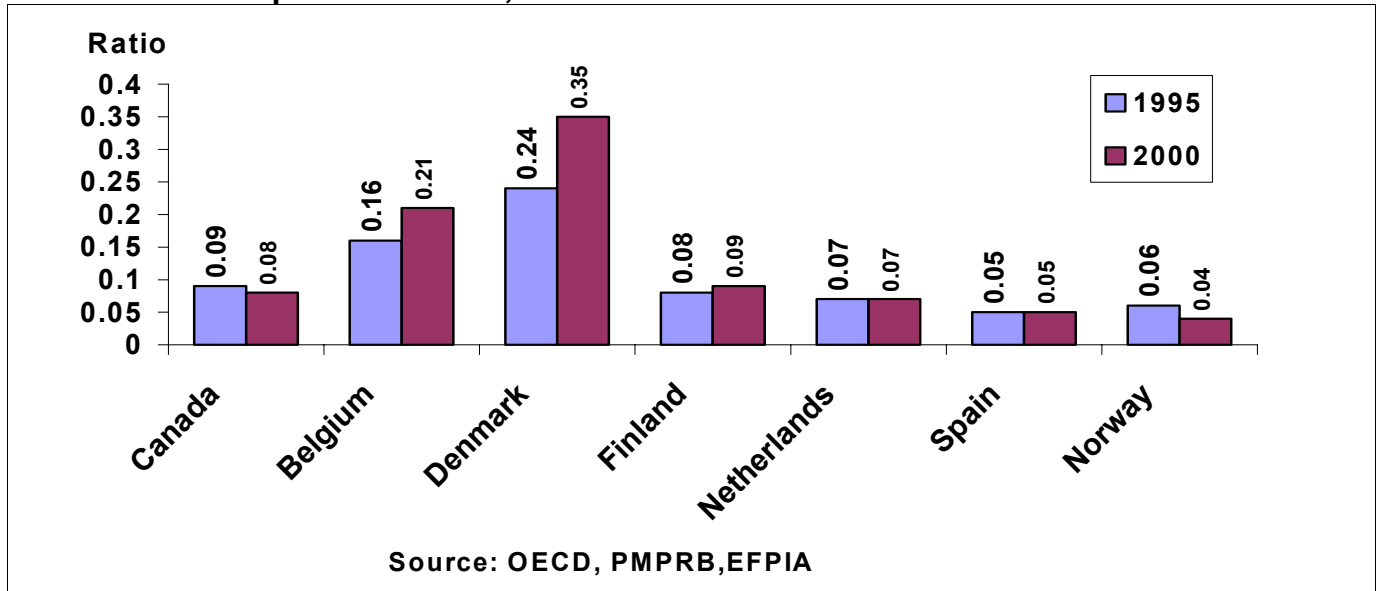


Figure 9 compares Canada’s R&D-to-GDP ratio to those of smaller European countries. Although Canada’s ratio is comparable to values observed in Finland and the Netherlands, it is much below values recorded in Belgium and Denmark.

Figure 9: Ratio of Pharmaceutical R&D Spending to GDP, Canada and Small European Countries, 1995 and 2000



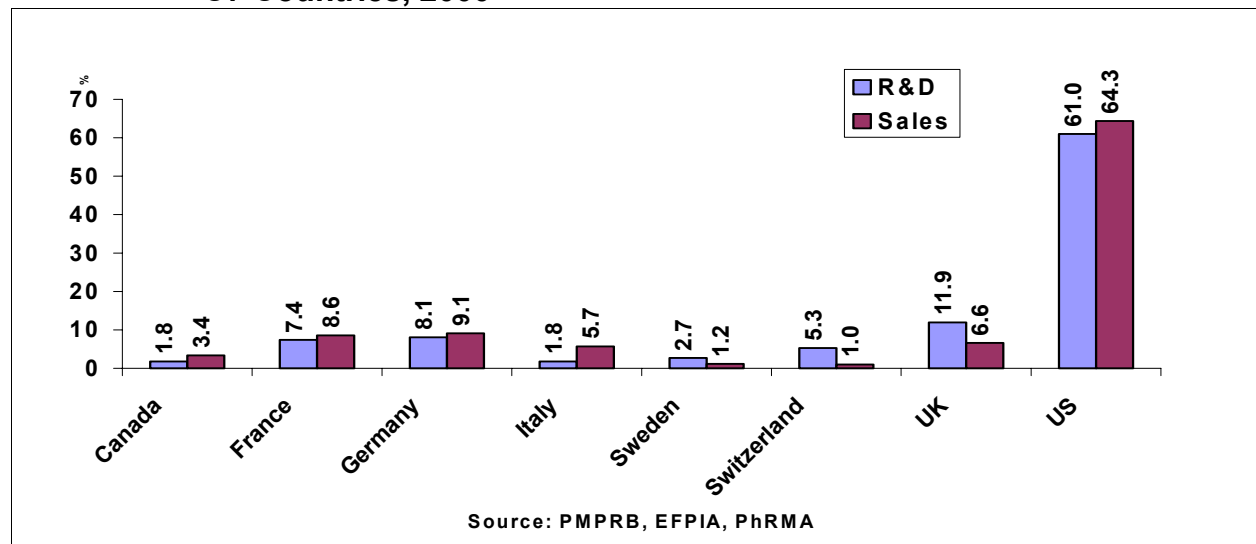
Shares of World Pharmaceutical Sales and R&D Spending

Comparing world shares of R&D spending and sales offers another way of assessing R&D performance. To the extent sales revenue earned in a particular country governs the pharmaceutical industry's ability to conduct research in that country, one might expect a rough equality between world shares of research investment and sales.

To this end, Figure 10 shows the distribution of R&D spending and domestic pharmaceutical sales in 2000 within the group consisting of Canada and the C7 countries.

Sales in Canada accounted for 3.4% of the group sales total (\$275 billion) in 2000. R&D spending in Canada, by comparison, accounted for only 1.8% of total R&D spending. Only Italy's R&D-share was small in comparison to its sales-share. Notably, Sweden, Switzerland and the UK all recorded R&D-shares substantially exceeding their sales-shares, while R&D- and sales-shares were nearly equal in France, Germany and the US.

Figure 10: Distribution of Pharmaceutical R&D Spending and Sales, Canada and C7 Countries, 2000



R&D by Type of Activity

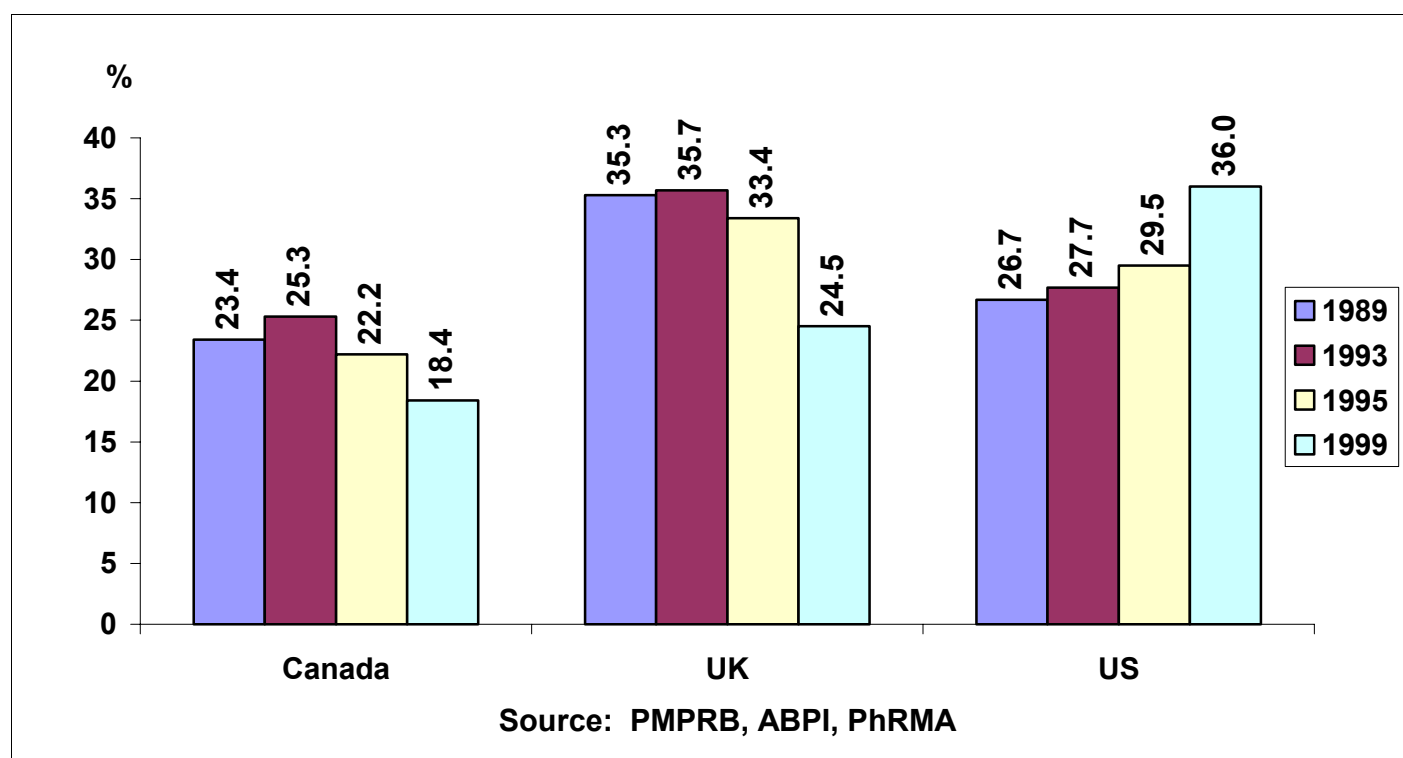
Information obtained from the PMPRB and some national pharmaceutical trade associations permit a comparison of the allocation of R&D spending to the major categories of R&D in some countries.

The PMPRB reports annually on expenditures by type of pharmaceutical research, i.e., basic, applied and other. The PMPRB has reported that expenditures on basic R&D increased from \$132 million in 1995 to \$155.9 million in 1999. Nonetheless, the share

of R&D accounted for by basic research declined from 27.2% in 1990 to 22.1% in 1995 and to 18.4% in 1999.¹⁰

Information on basic pharmaceutical R&D spending is also available for the US and the UK. Figure 11 shows the share of current R&D spending allocated to basic research for the years 1989, 1993, 1995 and 1999. In 1999, spending on basic research in the UK was approximately 24.5% of total spending, down from the previous years. Spending on basic research in the US increased slightly to 36.0% in 1999. The share of basic research in Canada was consistently below UK and US values throughout this period, although the Canada-UK difference narrowed.

Figure 11: Share of R&D Spending to Basic Research in Selected Countries, Various Years



Summary and Conclusions

This paper compares R&D spending by the brand name pharmaceutical industry in Canada to spending in other major industrialized countries.

Total R&D spending in Canada by the brand name pharmaceutical industry increased from \$626 million in 1995 to \$945 million in 2000, an increase of 51%. Despite this growth Canada still ranked behind other industrialized countries in R&D spending by all

¹⁰ PMPRB, 1999 Annual Report

measures considered here. Most importantly, the ratio of R&D to domestic sales in Canada remains well below values observed in Europe and the US. Measures of R&D spending relative to population and GDP also indicate low levels of research investment compared to other developed countries. Finally, Canada accounts for a share of world pharmaceutical sales that is roughly twice its share of world R&D spending.

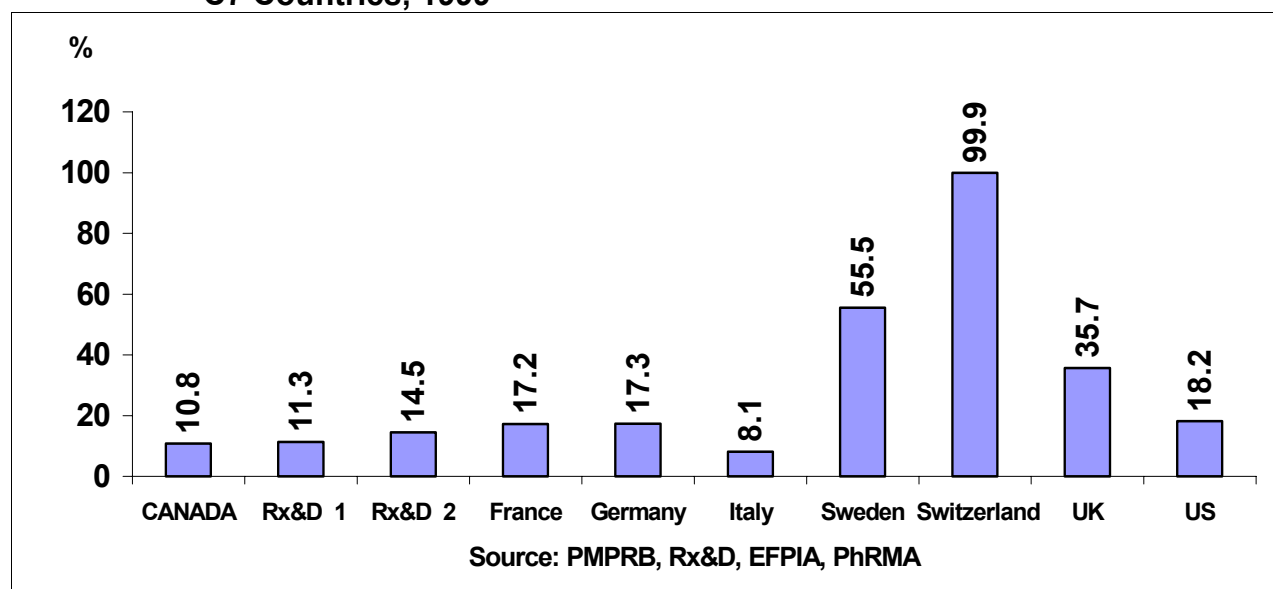
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APPENDIX 1: Extended RSR Analysis

The PMPRB reported RSRs of 10.8% for all patentees and 11.3% for Rx&D members in 1999. These figures are based on R&D spending reported to the PMPRB. Rx&D has reported a somewhat greater estimate of 1999 R&D spending for its members. Using this estimate instead of the PMPRB's reported total gives an overall RSR of 14.5% for Rx&D members in 1999 (represented as Rx&D 2 in Figure A1). Note that using these ratios does not materially change the situation described above. In particular, Canada's RSR is still well below the ratio in all other C7 countries except Italy.

Figure A1.1: Ratio of R&D Spending to Domestic Sales, Canada and C7 Countries, 1999



APPENDIX 2: OECD Measurement of Expenditure on R&D

The OECD publishes its own estimates for pharmaceutical R&D. These cover three activities: “basic research”, “applied research” and “experimental development”.

“Basic research” is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts without any particular applications or use in view.

“Applied research” is original investigation undertaken in order to acquire new knowledge. It is however, directed primarily towards a specific aim or objective

“Experimental development” is systematic work drawing on existing knowledge gained from research and practical experience that is directed to producing new materials, products and devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

OECD Methodology

The concept of “intramural expenditure” is central to the OECD approach. “Intramural expenditure” includes all R&D performed within a statistical unit or sector of the economy, whatever the source of funds. Expenditure made outside the unit or sector but in support of intramural R&D (e.g., the purchase of supplies for R&D) is also included.

Both current and capital expenditure are included in OECD estimates. The following table compares the PMPRB and OECD definition of R&D with respect to the particular elements of expenditure they include.

Table A2.1 Capital and Current R&D Spending - OECD and PMPRB Definitions:

<u>Current Expenditures</u>		
Category	PMPRB	OECD
Labor costs of R&D Personnel	Include	Include
Material and Supplies	Include	Include
Minor Equipment	Include	Include
Rental Expense of Buildings	Include	Include
Administrative & overhead Costs	Include	Include
Arm's Length & Non-arm's Lengths Extramural R&D Contracts	Include	Exclude
<u>Capital Expenditures</u>		
100% of Cost Attributable to R&D Unless Otherwise Indicated		
Major Equipment	Include only Major Equipment Used all or Substantially all* for R&D	Include
Original Cost of Buildings, Conversion of Buildings or Parts of Buildings	Exclude	Include
Depreciation on Buildings and Conversion of Buildings or Parts of Buildings	Include Depreciation of Buildings Used all or Substantially all* for R&D(4% of cost for 25 Years)	Exclude
Land	Exclude	Include
* All or substantially all is taken to mean 90% or more of the cost is attributable to R&D		

The so-called "Frascati Manual" provides the basis for OECD estimates of R&D spending. Given that all OECD countries participate in the ongoing development of the Frascati Manual, there is close adherence to its concepts among the statistical agencies of member countries. Differences mainly arise due to practical considerations, such as the availability of data and the cost of its compilation.

Estimates

There is a fairly close correspondence between R&D spending by patentees reported by the PMPRB and OECD estimates of pharmaceutical R&D spending in Canada. On

the other hand, OECD estimates for most other major countries are substantially below trade association estimates. As a result, Canadian R&D performance tends to compare more favorably to that abroad when OECD estimates of pharmaceutical R&D are used. Nonetheless, a situation in which Canada R&D performance lags other major countries still emerges.

Figure A2.1 gives OECD estimates of R&D spending for Canada and the C7-less-Switzerland (which is not a member of the OECD) countries for 1995 and 1999. According to these estimates, R&D spending in Canada in 1995 was \$602 million. Although the level of spending in Canada increased to \$881 million by 1999, Canada remained below all other countries. Italy (\$785 million) had the next lowest total R&D spending in 1999. The US ranked first over the entire period, with R&D spending of \$18.1 billion in 1999, up from \$13.9 billion in 1995.

Figure A2.2 converts the dollar figures of Figure A2.1 into corresponding rates of increase. R&D spending in Canada rose by about 46.3% between 1995 and 1999. By comparison, Germany saw growth of 85%, followed by the UK at 51.4% and the US at 29.6%. France (15.3%) had the least growth.

Figure A2.1: Pharmaceutical R&D Spending, Canada and C7-Less-Switzerland, 1995 and 1999

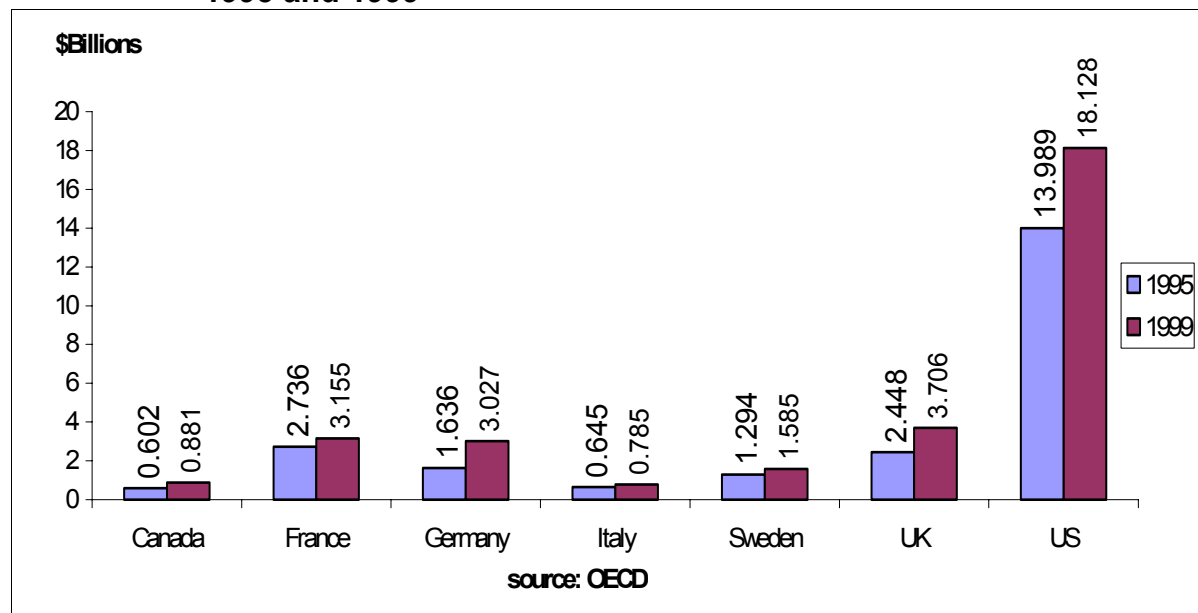


Figure A2.2: Growth in Pharmaceutical R&D Spending, Canada and C7-Less Switzerland, 1999/1995

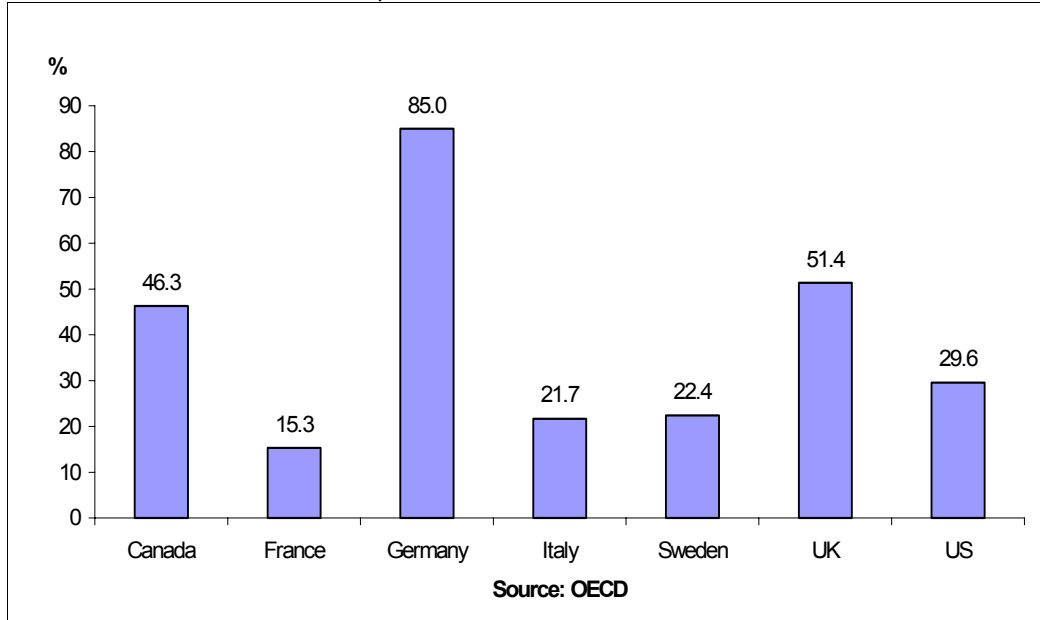
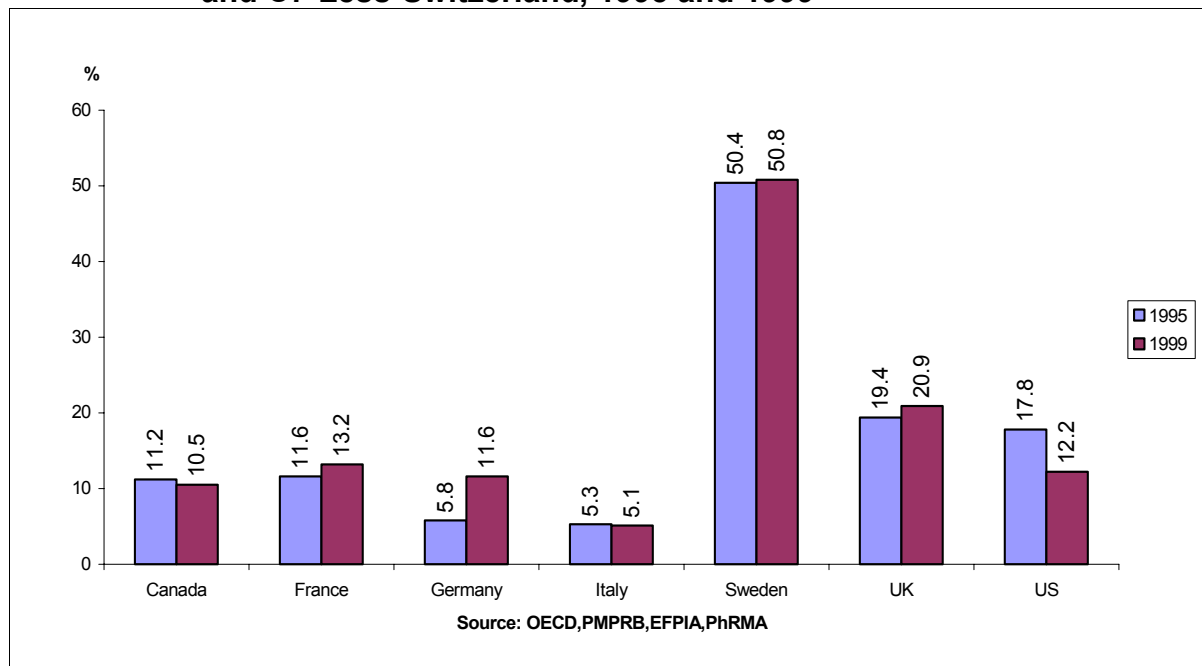


Figure A2.3 uses the OECD estimates to construct ratios of pharmaceutical R&D to domestic sales for 1995 and 1999¹¹. Canada's RSR stood at 11.2% in 1995. Only Italy (5.3%) had a lower ratio in that year. Sweden had the highest RSR at 50.4%, followed by UK at 19.4%. The aggregate RSR for the C7-less-Switzerland (Figure A2.4) was 14.4% in 1995.

¹¹ Sales in figure 5 represent domestic sales and do not include exports.

Figure A2.3: Ratio of Pharmaceutical R&D Spending to Domestic Sales, Canada and C7-Less-Switzerland, 1995 and 1999



A very similar pattern emerges in the results for 1999. Italy (5.1%) remained at the bottom of the range, with Canada second lowest at 10.5%. The ratios of all other C7 countries were again above Canada's, as was the aggregate RSR for the C7-less-Switzerland (12.9%).

Figure A2.4: Pharmaceutical R&D Spending to Domestic Sales, Canada and C7-Less-Switzerland, 1995 and 1999

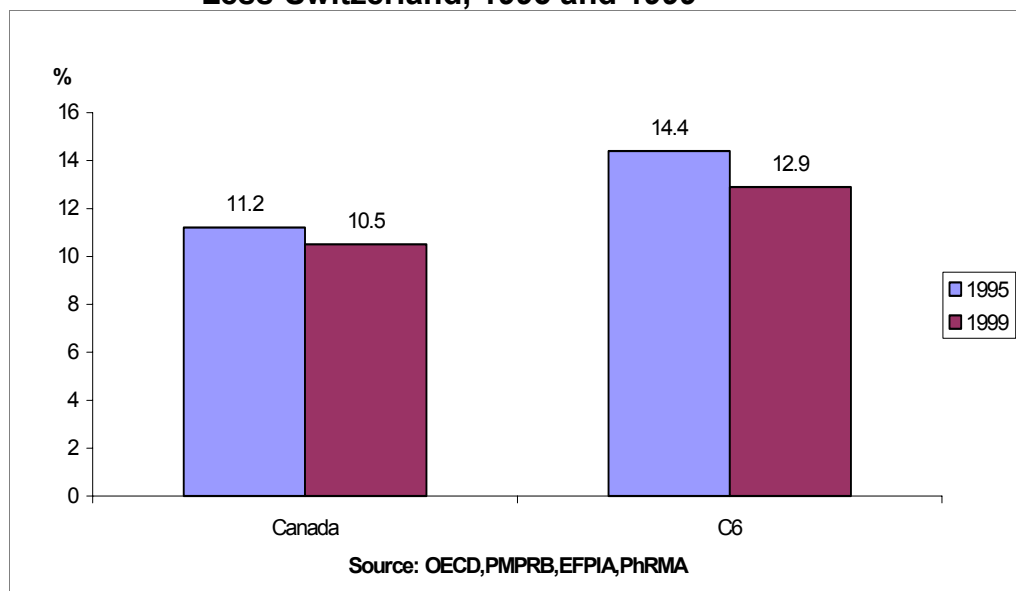


Figure A2.5 compares pharmaceutical R&D spending per capita in Canada and other C7 countries using OECD estimates¹². In 1995 Canada's R&D per capita was \$20.2 per person, lower than any other OECD countries, except Italy (\$11.3). Sweden had by far the highest per capita spending (\$146.6) followed by US (\$53.1) and UK (\$42.5). R&D spending per capita in Canada (\$28.4) remained substantially below that in all countries except Germany (\$36.7) and Italy (\$13.6).

Figure A2.5: Pharmaceutical R&D Spending per Capita, Canada and C7- Less-Switzerland, 1995 and 1999

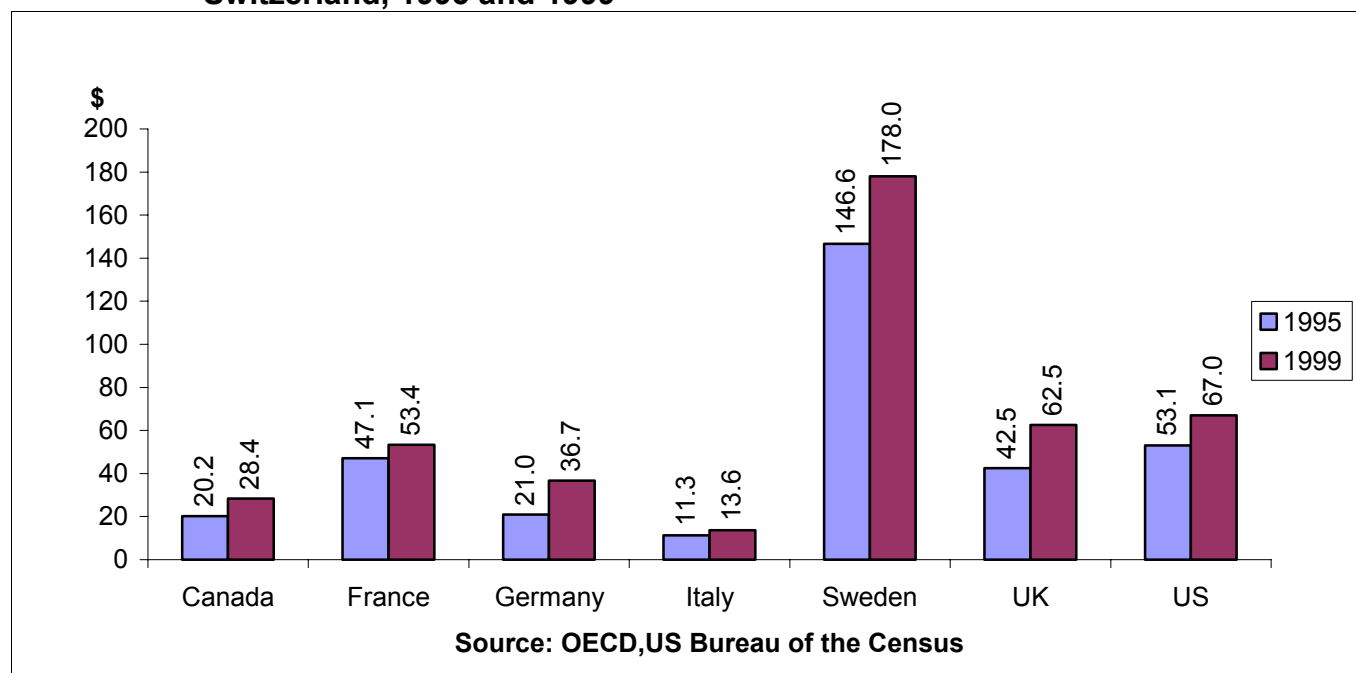


Figure A2.6 gives pharmaceutical R&D spending as a share of GDP in Canada and the other OECD countries¹³. In 1995 Canada had an R&D-to-GDP ratio of 0.1%. France, Sweden and the UK all had R&D-to-GDP ratios well above this value. The situation was much the same in 1999.

¹² Population estimates for each country were obtained from the US Census Bureau.

¹³ Information on GDP was collected from the OECD.

Figure A2.6: Ratio of Pharmaceutical R&D Spending to GDP, Canada and C7-Less-Switzerland, 1995 and 1999

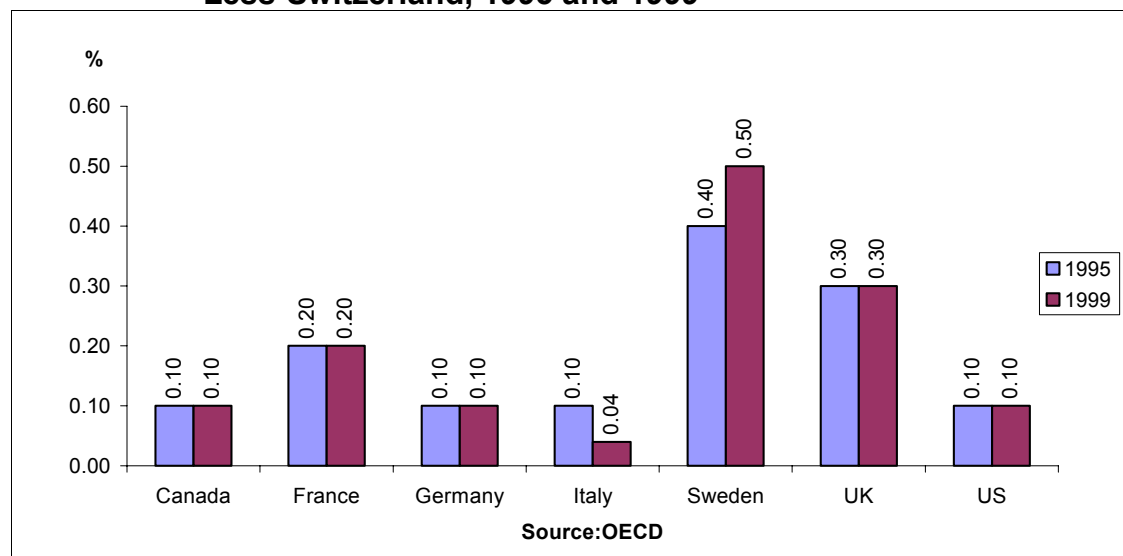
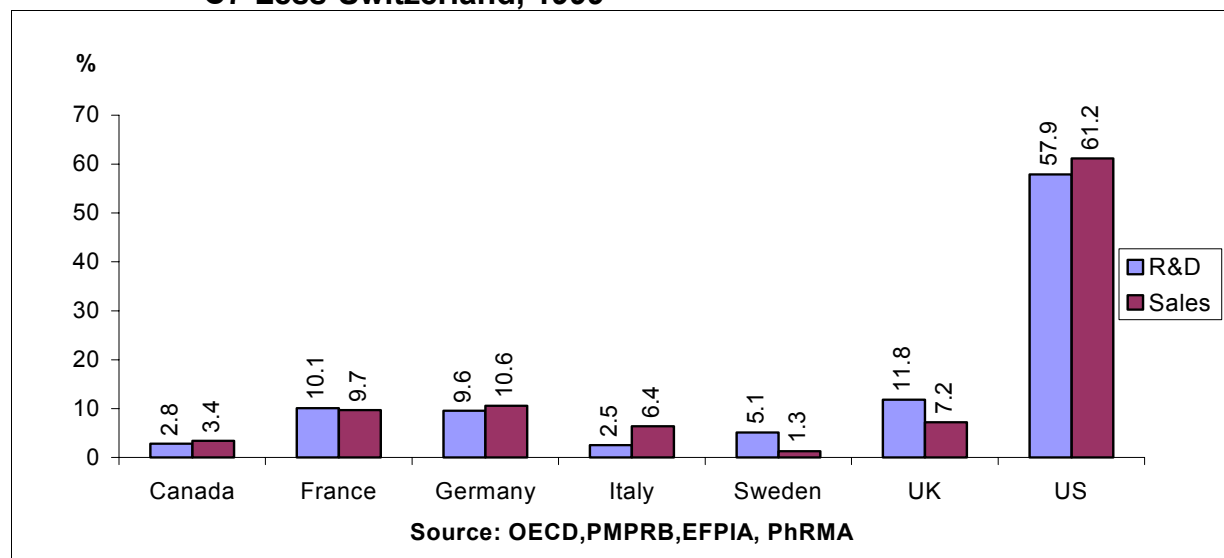


Figure A2.7 shows the distribution of R&D spending, as measured by the OECD, and domestic pharmaceutical sales in 1999 within the group consisting of Canada and the C7-less-Switzerland. Sales in Canada accounted for 3.4% of the group total sales in 2000. R&D spending in Canada, by comparison, accounted for only 2.8% of the group total in this category. Germany and Italy were the only other C7 countries with R&D-shares less than sales-share. Sweden and the UK both recorded R&D-shares substantially exceeding their sales-shares, while shares were roughly equal in France and the US.

Figure A2.7: Distribution of Pharmaceutical R&D Spending and Sales, Canada and C7-Less-Switzerland, 1999



APPENDIX 3: Data Sources

R&D Spending (PMPRB Estimates) and Domestic Sales, Canada:
PMPRB, *Annual Report 2001*.

R&D Spending (Rx&D Estimates), Canada:
Rx&D web site: <http://www.canadapharma.org>

R&D Spending and Domestic Sales, Europe:
European Federation of Pharmaceutical Industries and Associations (EFPIA),
The Pharmaceutical Industry in Figures 2002.

R&D Spending, Basic R&D Spending and Domestic Sales, US
PhRMA, *Annual Membership Survey*, various years.

Share of Basic R&D, UK
Association of the British Pharmaceutical Industry (ABPI)

Exchange Rates:
Bank of Canada

GDP:
Organization for Economic Co-operation and Development (OECD)

Population:
US Bureau of Census