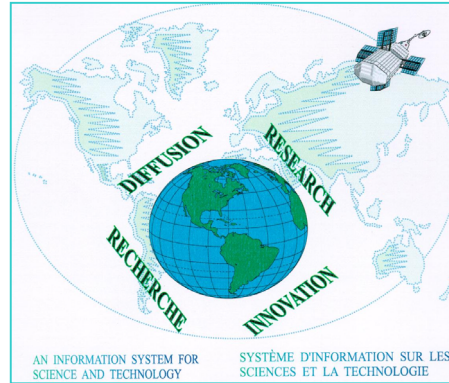




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## Estimation of Research and Development Expenditures in the Higher Education Sector, 1999 - 2000<sup>e</sup>



**ESTIMATION OF  
RESEARCH AND DEVELOPMENT EXPENDITURES  
IN THE HIGHER EDUCATION SECTOR, 1999-2000**

**88F0006XIE No. 15**

Prepared by:

Janet Thompson  
Science and Innovation Survey Section  
Science, Innovation and Electronic Information Division (SIEID)  
Statistics Canada

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**Symbols**

-	nil or zero
r	revised numbers
AUCC	Association of Universities and Colleges of Canada
CAUBO	Canadian Association of University Business Officers.
CFI	Canada Foundation for Innovation
CIHR	Canadian Institutes of Health Research
CIHI	Canadian Institute for Health Information
GERD	Gross Expenditures on Research and Development
HERD	Higher Education Research and Development
Health GERD	Gross Expenditures on Research and Development in the Health Field
MRC	Medical Research Council
NSE	Natural Sciences and Engineering
NSERC	Natural Sciences and Engineering Research Council
R&D	Research and Development
SIEID	Science, Innovation and Electronic Information Division
SSH	Social Sciences and Humanities
SSHRC	Social Sciences and Humanities Research Council

**Note**

Due to rounding of data, the tables may not add to the sum of their components.

## Working Paper on Estimation of Higher Education R&D Estimates

### Introduction

In the spring of 1999, the Science, Innovation, and Electronic Information Division of Statistics Canada (SIED) decided to review the methods it uses to estimate Higher Education R&D Expenditures (HERD) and Gross Expenditures on R&D in the health field (Health GERD). Both HERD and Health GERD are components of a larger ongoing statistical series maintained by SIED to measure Canadian expenditures on R&D as reported by the main R&D performing sectors. In constructing the GERD (Gross Expenditures on Research and Development) series, SIED conducts actual surveys of all of the main R&D performing sectors<sup>1</sup> except for Higher Education whose R&D performance figures are estimated. The manner in which research is performed and funded in Canadian universities and research hospitals has evolved in recent years, and current estimation methodologies may not take these changes into account.

More and more, budget allocation decisions are based on the research performance of higher education institutions (measured in large part by national statistics). Also, with the transition to a knowledge-based economy, the way knowledge is generated has changed; more university research is performed outside traditional academic departments in affiliated centres, institutes, or hospitals, often by full time researchers who do not hold a traditional academic appointment and whose research activities may not be fully captured in current data. Thus, quality estimates of R&D activities in the Higher Education sector are of increasing importance to policy developers, to the major funders of these activities, and also to the performing institutions.

Funders of HERD include the Federal Government through the three major granting councils<sup>2</sup>, the Canada Foundation for Innovation, and other federal departments and agencies; the provincial governments and provincial research organizations; the business sector; the private non-profit sector; foreign sources; and of course the universities and affiliated institutions (such as teaching hospitals) themselves. The HERD portion of the GERD series may be of assistance in answering various questions for policy analysts, HERD funders and others. These questions include: Is our national or provincial university research effort expanding or declining? What proportion of R&D is performed by this sector compared to other sectors (business, government, and private non-profit)? In what proportions under the major science fields, and by source of funds, are R&D being performed?

Following an initial study<sup>3</sup> and a positive reaction to its recommendations from a group of professionals in the university and health research fields in September 1999, SIED created a Working Group and hired a facilitator<sup>4</sup> to examine current HERD and health GERD estimation methods, to recommend revisions where appropriate, and to produce a framework for an improved estimation program. This work was completed in April 2000 and based upon it, SIED developed a three-year Operational Plan to see to the implementation of as many recommendations as possible, with financial and consultation help from a partnership of interested data users.<sup>5</sup>

This Working Paper, which outlines a new method for calculating higher education R&D expenditures, is part of the initiative to improve estimates in an area that also includes estimates of the numbers of personnel engaged in higher education R&D, health GERD, and U.S. and international comparisons.

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<sup>1</sup> The performing sectors are the federal government, the provincial governments, provincial research organizations, business enterprise, higher education, and private non-profit organizations.

<sup>2</sup> In the past, the three federal granting councils were the Medical Research Council (MRC), the Natural Sciences and Engineering Research Council (NSERC), and the Social Sciences and Humanities Research Council (SSHRC). Now the Canadian Institutes of Health Research (CIHR) have assumed the programs and responsibilities of the MRC but CIHR is technically not a "Council". Even so, references in this paper to the three federal granting councils will be to CIHR, NSERC, and SSHRC.

<sup>3</sup> Statistics Canada 1999. Review of HERD and Health GERD--Report to Statistics Canada, Mireille Brochu.

<sup>4</sup> Mireille Brochu

<sup>5</sup> CIHR, NSERC, SSHRC, Industry Canada, the Association of Universities and Colleges of Canada(AUCC), and the Canadian Association of University Business Officers.

## 1. Estimation of Total R&D Expenditures in Higher Education

The material which follows is an explanation of a) the estimation procedures used to calculate 1999-2000 R&D expenditures in the Higher Education sector b) further refinements based upon investigations. These areas of further investigation will be summarized in the section "Future Work" toward the end of this paper. Plans to maintain continuity in the historical series will also be presented in the closing section.

The new estimation technique, proposed by a Working Group and applied for the first time to the 1998-99 HERD data assumes that the sponsored research value is the first ingredient of the total, with additional estimations of expenditures added to this value. Thus, total expenditures are equal to:

- a) sponsored research expenditures (available from CAUBO sources);
- b) indirect expenditures on sponsored research (those not reimbursed by sponsors);
- c) a value for the fraction of faculty members' time assumed to be devoted to sponsored and non-sponsored research (correcting for cases where sponsored research covers salaries of principal investigators);
- d) indirect expenditures related to faculty members' time on research (c above); and
- e) hospitals not included in CAUBO sources.

### 1.1 HERD Matrix

Before detailed explanations of the methodology are offered, it is necessary to understand the traditional format requirement for HERD data, called the HERD matrix, presented in Table 1 below.

**Table 1. Higher Education Expenditures on R&D by Source of Funds and Major Teaching Field, 1999-2000**

Source of funds	Social Sciences & Humanities	Health Sciences	Other Natural Sciences & Engineering	Total
		millions of dollars		
Federal Government	141.6	362.0	578.9	1,082.5
Provincial Government	96.1	144.1	240.2	480.4
Business Enterprise	20.3	166.7	269.7	456.7
Higher Education	735.0	997.8	996.1	2,728.9
Private Non-Profit Organizations	63.7	218.7	66.8	349.2
Foreign	-	22.6	34.0	56.6
<b>Total</b>	<b>1,056.7</b>	<b>1,911.9</b>	<b>2,185.7</b>	<b>5,154.3</b>

Two of the main areas of interest in HERD are the sectors funding R&D and the fields of science being funded. In the sections below are described the methods by which **source of fund** allocations are made and also those by which allocations to the three fields of science are determined. There are no surveys of these sectors designed precisely to meet the needs of the HERD matrix, but the methodologies described below are an initiative to make reasonable allocations.

## 1.2 Sponsored Research

Sponsored research accounts for more than half of all higher education R&D in most universities and affiliated institutions in Canada. For sponsored research, the principal source of data are the annual tables prepared by Statistics Canada (Centre for Education Statistics) from data collected and provided to CAUBO. The CAUBO survey provides revenue data on sponsored research for member institutions and classified by source of funds as follows:

- Federal Government:
  - Social Sciences and Humanities Research Council
  - Health Canada
  - Natural Sciences and Engineering Research Council
  - Medical Research Council (Now Canadian Institutes of Health Research)
  - Canada Foundation for Innovation (CFI)
  - Other
- Provincial Governments
- Municipal Governments
- Foreign
- Donations, including bequests (subdivided into:
  - a) Individuals, b) Business enterprises, c) Foundations, and d) Not-for-profit organizations)
- Non-government grants and contracts (subdivided into:
  - a) Individuals, b) Business enterprises, c) Foundations, and d) Not-for-profit organizations)
- Investment income
- Sale of services and products
- Miscellaneous

Most of these revenue data may be used to create the funding distribution needed to complete the HERD matrix. There are five funding categories in the matrix into which these CAUBO revenue data may be allocated by making certain assumptions: the categories are federal government; provincial governments; business enterprise; private non-profit organizations; and foreign sources. The sixth funding category, higher education, is estimated by using a combination of CAUBO data and faculty data provided by the Centre for Education Statistics at Statistics Canada.

First, it is assumed that there is exact correspondence between HERD funding sources and CAUBO revenues for the following three HERD areas:

<b>HERD Funding Source</b>	<b>CAUBO Reported Revenues</b>
Federal Government	Federal Government
Provincial Governments	Provincial Governments Municipal Governments
Foreign	Foreign

The challenge is to allocate by **source of funds** the remaining sponsored research funds reported to CAUBO. "Donations (including bequests) and non-government grants and contracts" are now relatively easily allocated because of the use of reporting subdivisions. Funds reported to CAUBO under "individuals" and "business enterprises" are allocated to "business enterprises" in Table 1; and "foundations" and "not-for-profit" are reported under "private non-profit" in Table 1. Further, CAUBO reported "sale of services and products" is not relevant to research and is not distributed. Similarly, CAUBO reported "investment income" is not allocated. Finally, CAUBO reported "miscellaneous" funds are allocated to Business Enterprise and Private Non-Profit categories (Table 1) in the same ratio as that used for "Donations (including bequests) and non-government grants and contracts".

Having distributed sponsored research by funding source, the next goal is to estimate which fraction of sponsored research funds should be assigned to the three major **fields of science**. A number of assumptions, based upon those used in the current method, are employed as follows:

- NSERC funding is in the Natural Sciences and Engineering (NSE);
- SSHRC funding is in the Social Sciences and Humanities (SSH);
- CIHR (which now includes MRC) are in Health;
- CFI funding is prorated to NSE, SSH and Health based on the same ratio as NSERC, SSHRC and CIHR funds each individual institution.
- Other federal funding is estimated to be: 60% in the NSE, 30% in the SSH and 10% in health (based on survey of federal expenditures);
- Provincial funding is estimated to be: 50% in the NSE, 20% in the SSH and 30% in Health (based on data reported by provincial governments);
- Business and not-for-profit funding and miscellaneous funding (this is estimated using data supplied by CIHR, SSHRC and NSERC, based on the 1989-90 university reports on "matching funding");
- Foreign (60% to health and 40% to NSE, based on National Science Foundation U.S.A. data).

These allocations of funds address our HERD needs only for the sponsored research component of higher education R&D. To complete the HERD expenditure estimates, we now have to turn to the formula components dealing with the contributions of the higher education institutions themselves to HERD. The first of these is the indirect expenditures generated by sponsored research revenues.

### 1.3 Indirect Expenditures for Sponsored Research

There are two terms of special note that the reader should be familiar with to better understand the detail that follows. They are **direct** and **indirect** expenditures. **Direct** expenditures are those that can be directly attributed to a research project or activity. Examples include salaries of researchers and research assistants, equipment, supplies, travel costs, fees for services, publication and patenting expenditures, and the like. **Indirect** expenditures are those that are incurred by an institution by virtue of the fact that researchers conduct sponsored or intramural research with the support of the institution. They are expenditures that cannot be identified readily and specifically with a particular project, instructional or other activity of the institution. Examples include the costs of the office of research or intellectual property management services, departmental administration, utilities, physical plant operation and maintenance, library, laboratory furniture and permanent equipment.

The steps below describe the methodology for arriving at a direct to indirect expenditure ratio for operating a university which is then applied to sponsored research to obtain a value for the additional expenditures required of a university when it conducts this research. It is generally recognized that the bulk of sponsored research funds is direct in nature. Our working assumption is that only about 5% of reported sponsored research are reimbursements for indirect expenditures. Institutions do receive some indirect cost reimbursements from industry, some provincial governments and other sources, but they are not generally reported under sponsored research.

The first step in the calculation, using a CAUBO methodology going back to 1982, is to come up with a satisfactory ratio of indirect to general operating expenditures for the institution. The CAUBO data on university expenditures break out "general operating" from "other" expenditures as follows:

General Operating Expenditures:

- Instruction and non-sponsored research (the largest of all categories and consisting mainly of academic and support salaries)
- Non-credit instruction
- Library
- Computing
- Administration
- Physical plant
- Student services



Other Expenditures:

- Sponsored research
- Special purpose and trust
- Ancillary enterprises (this is a separate, self-supporting activity)
- Plant (these are one time as opposed to ongoing costs).

Of general operating expenditures, the following are deemed under the new estimation model to be indirect expenditures:

- 11% of instruction and non-sponsored research and non-credit instruction (based on the assumption that 11% of the time of academic and support staff is for various administrative duties that support teaching and research)
- 100% of Library
- 100% of Computing
- 100% of Administration
- 100% of Physical plant

While it is believed that some of "Student Services" can be considered as "indirect", it is not known how much. So this item is removed from the calculation for the moment. The ratio of the above five indirect expenditures over general operating expenditures (minus "Student Services") gives an indirect to total expenditure ratio for general operating expenditures (again minus "Student Services").

The next step is to apply this ratio to the "Special purpose and trust" portion of "other" expenditures, based on the assumption (in the absence of survey data) that the indirect portion here is the same as that for general operating expenditures. Also, we reintroduce "Student Services" at this point and apply the same ratio, in the absence of better information about what this ratio might be.

"Ancillary" (includes "sales producing" operations ancillary to the normal university functions of instruction and research) and "capital" are excluded from total expenditures, the former because they are self-supporting, and the latter because they are not ongoing.

By adding together the estimates of indirect expenditures for each of sponsored research (5%), general operating, special purpose and trust, and student services, we now have a value for indirect expenditures for operating a university. Subtracting this total value from total operating expenditures gives us a total direct expenditure value. The end result is a total indirect to total direct expenditure value for operating a university.

The above calculation is not made on an individual university basis but made, rather, for three clusters of universities – small, medium, and large institutions – by aggregating the appropriate values in each of the categories of expenditure discussed above by university size. In this manner we arrive at a working ratio by university size for the next step in the calculation (the assumptions used to classify universities by size are described in Section 1.4 below).

To estimate the additional indirect expenditures an institution likely makes in performing sponsored research, one simply removes that small portion (estimated at 5%) of indirect costs included in reported sponsored research funds (so as not to double count), and multiplies the remainder by the total indirect to total direct expenditure ratio referred to above, based on university size. This gives us an estimated value for those indirect expenditures picked up by the university in the performance of sponsored research.

A question may be asked about why a cluster direct-to indirect expenditure ratio for small, medium, and large institutions (university size) was used rather than individual institution ratios in this step. The answer has two parts. First, the estimated ratio for indirect expenditures using the above method shows a strong correlation to university size. We use the three university sizes to estimate the costs of the time faculty members spend on research, backed by studies that show that time spent on research is proportional to discipline and size of institution. So, the first reason is to remain consistent in our estimation approach throughout. The second reason is that using the cluster values for each group of institutions should make it much easier for readers to reproduce our results since they are accessible while individual institutional numbers may not be so.

Concerning the distribution of this value across the three major fields of science (in Table 1 above), it is assumed that the same percentages should apply as one has calculated above for sponsored research.

#### 1.4 Estimation of Faculty Time on R&D

This part of the HERD estimation formula has been changed from that used in previous years.

It is generally accepted that higher education faculty divide their time among the three main missions of a university: teaching, research, and community service work. In order to estimate the value in dollar terms of the research fraction, it is necessary to have data on the numbers and salaries of faculty in Canada's universities and affiliated institutions, and if possible, estimates of the research fraction. The faculty counts by each of the eight teaching disciplines in the three major fields of science are available from the University and Colleges Annual Staff Survey conducted by the Centre for Education Statistics at Statistics Canada. Also, academic salary data are available from the annual CAUBO Survey.

During the past year Statistics Canada hired a consultant to conduct a telephone survey directed at improving estimates of the time spent on research by the faculty members of Canadian universities.

The survey had 10 questions and was answered by 2,173 faculty members at 36 Canadian universities between April and June, 2001. A report on the survey results is available to interested readers.

Statistics Canada analysed the results of the survey and modified the faculty time coefficients for research activities that are used in our HERD estimates. Because we feel that the new coefficients better reflect current research activity levels at the universities, we have revised the 1998-99 HERD estimates by applying the new coefficients.

**Table 2. Faculty Time Coefficients for Research**

Institution Size	Education	Fine Arts	Humanities	Social Sciences	Agriculture and Biological Sciences	Engineering and Applied Sciences	Health Professions	Mathematics and Physical Sciences
Small	0.20	0.20	0.25	0.25	0.30	0.35	0.30	0.30
Medium	0.25	0.20	0.25	0.30	0.40	0.35	0.40	0.35
Large	0.25	0.20	0.30	0.35	0.45	0.40	0.45	0.45

Table 2 reflects the assumption that, depending on the size of the university, some universities spend relatively more time on R&D than others, and also that R&D is a more important activity in some teaching fields than in others.

As an example of how the coefficients are applied, take a professor of health sciences from a medium size university who probably works in an affiliated teaching hospital. Table 2 is based on the assumption that for every \$1,000 in salary, 40% of that amount is paid for R&D activities. Were he/she to work in a large institution, the amount would be 45%, and in a small institution, 30%. These coefficients are applied against the number of faculty in each of the eight teaching disciplines and the total salaries reported by CAUBO for each institution. It is further assumed that all faculty members are at the same salary levels in the absence of more detailed salary information from existing sources.

The classification of universities into three categories of size is based on the following criteria: 1) the amount of expenditures on sponsored research (reported by CAUBO); 2) the proportion of sponsored R&D expenditures as a percentage of general operating expenditures; and 3) the number of doctoral programs. A university is classified as **small** if its expenditures on sponsored R&D are less than \$10 million and less than 10% of general operating, and whose doctoral programs are less than ten in number. A **medium** size university is one in which the dollar range is between \$10-30 million, the percentage of general operating is from 10% to less than 20%, and whose doctoral program counts are between 10 and 30. A **large** university is one whose sponsored research

dollar value is greater than \$30 million, whose general operating percentage is more than 20%, and whose doctoral programs are greater than 30. It is worthy of note that the final objective is not to create an individual ranking for universities but rather to group them into three size groups to make possible R&D expenditure estimates at the aggregate level.

In applying the above assumptions to the teacher counts to arrive at values for teacher time spent on R&D, it should be noted that, where the salaries of primary researchers are already reported by CAUBO as part of sponsored research, they are removed from the estimate to avoid double counting. Also, regarding the distribution of teacher salary values across the three science fields in the HERD matrix, this is done by attributing the R&D portion of salaries of teachers found in each field to that field.

Other sources of information for the distribution of faculty time include the National Science Foundation in the United States which reported in a 1984<sup>6</sup> that for the U.S. institutions surveyed, R&D accounted for 22% of the total faculty time in engineering, 23% for physical scientists, 33% for agricultural and biological scientists, 26% for medical scientists, 8% for psychologists and social scientists, and 6% for mathematicians.

The Australian Bureau of Statistics estimated in 1990 that HERD was 32.6% of total higher education expenditures.

A more recent technical paper produced for the Ontario Council on University Affairs and published in 1994 set out a model, using existing financial information on revenues and expenses in the Ontario university system, that distributed the university functions of teaching, research, and community service in the proportions of 53%, 36%, and 11% respectively. Finally, a faculty workload study conducted by the University of Western Ontario in 1996 found that R&D activities corresponded to an R&D coefficient of 31.9%. Variations by faculty included 10% for business, about 20% for education, journalism and nursing, and about 38% for medicine.

## **1.5 Indirect Expenditures Related to Faculty Time**

Similar to the assignment of a value for indirect expenditures connected with sponsored research, a value must now also be calculated for the indirect expenditures connected with faculty time spent on R&D within the institutional setting. The time of faculty spent on sponsored research is netted out of this calculation. To make this calculation, it is assumed that the same direct-to-indirect ratio used to calculate the indirect values for sponsored research will apply in this case. Also, the distribution of this estimate across the three science fields in Table 1 will be in the same proportion as that found for the salary component above.

## **1.6 Teaching Hospitals not Included in CAUBO Data.**

The inclusion in CAUBO statistics sponsored research activities performed in teaching hospitals is constantly reviewed as some teaching hospitals are included and some are not. For those that are not included, estimates are made using information from the Annual Hospital Survey, collected by The Canadian Institute for Health Information (CIHI).

At the time when the 1999-2000 HERD data was ready for publication, new data for hospitals had not yet been received from CIHI so we included in the new estimates, the same values used for 1998-99.

## **1.7 HERD Total**

It is now possible to calculate the national and provincial values for higher education R&D as follows:

- a) sponsored research, plus
- b) (sponsored research minus 5% for indirect) multiplied by (average ratio by university size of indirect to direct total operating expenditures), plus
- c) faculty salaries devoted to sponsored and non-sponsored research (correcting for cases where sponsored research covers salaries of principal investigators), plus

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<sup>6</sup> Academic Science/Engineering: Scientists and Engineers, January 1983, National Science Foundation, Washington D.C., 1984, page 16 (Table B-18 divided by Table B-17).

- d) indirect expenditures related to faculty time (c above multiplied by the ratio by university size of indirect to direct total operating expenditures),
- e) hospitals not included in CAUBO sources.

It is also possible, based on the above estimates, to complete all cells of both the HERD matrix and the GERD matrix appropriate to Higher Education. These data together with those of the other performing and funding sectors make it possible to compare HERD performance with that of other R&D activity centres (business; private non-profit; government) and to identify the flow of funds among them.

## **2. Selection of Institutions**

A list of the institutions retained for the estimation of R&D expenditures for 1999-2000 is presented in Appendix List 1. Selection is based on payments (grants and contracts) awarded to institutions or their faculty for sponsored research and reported in the annual CAUBO survey.

## **3. Future Work**

### **3.1 Sponsored Research:**

Statistics Canada will work closely with CAUBO in its efforts to improve the reporting of financial information, particularly with respect to sponsored research funding and inter-institutional awards. The latter is necessary to avoid double counting where several institutions working on the same project may report the same funds.

### **3.2 Indirect Expenditures:**

The assumptions concerning what constitutes indirect expenditures and also the assumption that sponsored research expenditures include 5% in indirect cost reimbursement will remain open to discussion, particularly among the established users of these data and those who have constituted the review and support partnership. The 5% estimate is particularly arbitrary because CAUBO does not have any information on the amount of indirect costs covered by reported sponsored research grants and contracts. These may be reported by universities as sponsored research or elsewhere under other types of expenditures. It is known that some of the indirect costs are covered by business and private not-for-profit awards and that Québec covers 15% of indirect costs in its awards (but universities do not necessarily report these funds under sponsored research). The Québec figure suggests that the 5% estimation overall for that province is likely low. Project staff will work more closely with CAUBO and the universities and related associations in the future to improve estimates in this area.

### **3.3 Historical Continuity of Data Series:**

This working paper contains eleven years of HERD estimates based on the revised estimation procedure first used for 1998-99 estimates. During the 1999-2000 estimation procedure, revised faculty time coefficients on research were used. These new coefficients were then applied to the 1998-99 estimates as we feel those new coefficients better reflect university research activity levels.

## **Appendix Tables**

**TABLE 1. Estimated Costs of R&D in the Higher Education Sector, by Source of Funds and by Major Teaching Field, 1999-2000**

Source of funds	Social Sciences and Humanities	Health Sciences	Other Natural Sciences and Engineering	Total
millions of dollars				
Federal Government	141.6	362.0	578.9	1,082.5
Provincial Governments	96.1	144.1	240.2	480.4
Business Enterprise	20.3	166.7	269.7	456.7
Higher Education	735.0	997.8	996.1	2,728.9
Private Non-Profit Organizations	63.7	218.7	66.8	349.2
Foreign	-	22.6	34.0	56.6
<b>Total</b>	<b>1,056.7</b>	<b>1,911.9</b>	<b>2,185.7</b>	<b>5,154.3</b>

**TABLE 2. Estimated Costs of R&D in the Higher Education Sector, by Source of Funds, 1988-89 to 1999-2000**

Year	Federal Government	Provincial Governments	Business Enterprise	Higher Education	Private Non-Profit Organizations	Foreign	Total
millions of dollars							
1988-89	624.9	261.2	115.1	1,481.5	172.8	13.2	2,668.7
1989-90	669.4	285.5	139.7	1,571.9	165.2	11.8	2,843.5
1990-91	782.9	282.7	151.1	1,618.4	185.8	12.1	3,033.0
1991-92	813.3	288.9	229.3	1,734.6	215.2	11.0	3,292.3
1992-93	848.7	294.2	293.1	1,886.2	196.2	20.1	3,538.5
1993-94	872.7	312.4	313.9	1,866.1	248.3	20.3	3,633.7
1994-95	869.8	314.7	296.1	1,881.9	259.2	21.3	3,643.0
1995-96	854.8	323.2	296.7	1,935.4	265.7	24.3	3,700.1
1996-97	809.0	297.6	335.6	1,927.1	312.7	36.4	3,718.4
1997-98	792.7	369.9	381.0	2,032.1	324.5	39.5	3,939.7
1998-99 <sup>f</sup>	861.1	369.9	407.7	2,347.4	334.7	49.5	4,370.3
1999-2000	1,082.5	480.4	456.7	2,728.9	349.2	56.6	5,154.3

**TABLE 3. Estimated Costs of R&D in the Higher Education Sector, by Source of Funds and by Province, 1999-2000**

Province	Federal Government	Provincial Governments	Business Enterprise	Higher Education	Private Non- Profit Organizations	Foreign	Total
millions of dollars							
Newfoundland	21.5	0.3	4.2	49.1	1.9	1.5	78.5
Prince Edward Island	1.1	0.2	0.2	9.2	0.8	-	11.5
Nova Scotia	39.0	7.6	23.8	127.3	5.6	7.1	210.4
New Brunswick	15.8	4.0	4.9	57.8	5.6	1.0	89.1
Québec	326.7	147.3	134.6	776.5	94.8	15.6	1,495.5
Ontario	392.1	177.1	194.0	1,060.0	164.6	23.3	2,011.1
Manitoba	34.0	15.2	4.7	89.0	13.7	0.9	157.5
Saskatchewan	39.5	19.9	9.4	100.0	6.0	0.9	175.7
Alberta	106.2	83.0	37.9	227.3	28.7	1.1	484.2
British Columbia	106.6	25.8	43.0	232.7	27.5	5.2	440.8
<b>Canada</b>	<b>1,082.5</b>	<b>480.4</b>	<b>456.7</b>	<b>2,728.9</b>	<b>349.2</b>	<b>56.6</b>	<b>5,154.3</b>

**TABLE 4. Estimated Costs of R&D in the Higher Education Sector, by Province, 1988-89 to 1999-2000**

Year	Province										Canada
	Nfld.	P.E.I.	N.S.	N.B.	Qué.	Ont.	Man.	Sask.	Alta.	B.C.	
millions of dollars											
1988-89	50.9	3.9	116.8	41.3	707.6	1,044.3	110.7	84.9	264.3	244.0	2,668.7
1989-90	52.8	4.0	117.3	43.4	788.4	1,108.2	110.8	89.0	270.6	259.0	2,843.5
1990-91	54.8	4.1	117.9	45.7	878.5	1,176.1	110.8	93.2	277.0	274.9	3,033.0
1991-92	57.5	5.1	127.5	49.7	1,033.7	1,211.3	113.8	100.7	290.4	302.6	3,292.3
1992-93	60.5	4.8	121.2	53.2	1,169.4	1,280.1	116.8	103.3	294.7	334.5	3,538.5
1993-94	60.9	4.4	119.0	52.5	1,169.0	1,390.6	110.7	116.3	296.8	323.6	3,633.8
1994-95	58.5	3.8	113.1	53.8	1,136.1	1,409.5	114.8	108.2	309.0	336.2	3,643.0
1995-96	58.4	3.7	117.0	56.2	1,107.6	1,443.7	113.5	113.9	238.5	357.6	3,700.1
1996-97	56.6	4.2	117.6	56.2	1,095.3	1,479.3	111.3	113.6	330.2	354.1	3,718.4
1997-98	61.2	5.9	124.9	57.4	1,163.7	1,578.1	108.3	118.9	359.4	362.1	3,939.7
1998-99 <sup>f</sup>	72.0	11.4	164.3	80.5	1,221.1	1,747.6	130.8	138.5	409.8	394.3	4,370.3
1999-2000	78.5	11.5	210.4	89.1	1,495.5	2,011.1	157.5	175.7	484.2	440.8	5,154.3

**TABLE 5. Estimated Costs of R&D in the Higher Education Sector, on Social Sciences and Humanities, by Source of Funds and by Province, 1999-2000**

Province	Federal Government	Provincial Governments	Business Enterprise	Higher Education	Private Non- Profit Organizations	Foreign	Total
millions of dollars							
Newfoundland	3.6	0.1	-	15.5	1.3	-	20.5
Prince Edward Island	0.2	-	-	3.1	0.4	-	3.7
Nova Scotia	6.5	1.6	0.2	39.8	0.2	-	48.3
New Brunswick	2.9	0.9	-	23.8	0.3	-	27.9
Québec	40.0	29.4	9.7	190.4	20.3	-	289.8
Ontario	51.5	35.4	8.4	279.5	26.6	-	401.4
Manitoba	5.4	3.0	0.3	29.5	2.2	-	40.4
Saskatchewan	3.9	4.0	0.1	28.5	0.3	-	36.8
Alberta	13.0	16.6	0.6	51.2	4.9	-	86.3
British Columbia	14.6	5.1	1.0	73.7	7.2	-	101.6
<b>Canada</b>	<b>141.6</b>	<b>96.1</b>	<b>20.3</b>	<b>735.0</b>	<b>63.7</b>	<b>-</b>	<b>1,056.7</b>

**TABLE 6. Estimated Costs of R&D in the Higher Education Sector, on Social Sciences and Humanities, by Province, 1988-89 to 1999-2000**

Year	Province										Canada
	Nfld.	P.E.I.	N.S.	N.B.	Qué.	Ont.	Man.	Sask.	Alta.	B.C.	
millions of dollars											
1988-89	13.7	1.0	24.8	11.7	158.7	227.5	23.8	17.8	58.1	56.6	593.7
1989-90	15.8	1.0	24.6	12.4	173.8	239.7	23.8	19.0	56.1	59.8	626.0
1990-91	15.9	1.1	23.8	13.0	188.6	256.4	23.6	19.0	56.9	56.1	654.4
1991-92	17.2	1.4	26.1	13.2	198.5	265.4	24.8	20.7	59.8	60.8	687.9
1992-93	15.9	1.3	27.6	13.2	211.3	287.5	25.5	21.2	60.3	74.8	738.6
1993-94	15.6	1.1	25.1	14.2	216.6	282.6	23.8	21.1	61.3	69.1	730.5
1994-95	15.6	0.9	23.5	13.9	217.5	278.9	24.2	21.9	58.7	70.4	725.5
1995-96	15.4	0.9	23.0	13.8	213.5	269.1	24.7	23.8	64.5	76.0	724.7
1996-97	15.2	1.1	21.3	13.2	204.9	259.6	24.5	23.9	61.1	80.4	705.2
1997-98	14.7	1.5	21.9	12.8	203.6	285.6	23.8	26.9	62.2	78.7	731.7
1998-99 <sup>f</sup>	16.5	3.5	41.0	25.4	236.7	344.5	33.6	32.6	71.6	94.0	899.4
1999-2000	20.5	3.7	48.3	27.9	289.8	401.4	40.4	36.8	86.3	101.6	1,056.7



**TABLE 7 Estimated Costs of R&D in the Higher Education Sector, on Health Sciences, by Source of Funds and by Province, 1999-2000**

Province	Federal Government	Provincial Governments	Business Enterprise	Higher Education	Private Non-Profit Organizations	Foreign	Total
millions of dollars							
Newfoundland	3.0	0.1	2.7	13.1	0.5	0.6	20.0
Prince Edward Island	0.1	0.1	-	0.4	-	-	0.6
Nova Scotia	9.6	2.3	17.5	45.8	4.4	2.8	82.4
New Brunswick	0.8	1.2	-	4.7	-	0.4	7.1
Québec	135.0	44.2	42.7	294.6	55.6	6.2	578.3
Ontario	128.9	53.1	71.7	431.7	113.7	9.4	808.5
Manitoba	12.0	4.5	1.0	27.1	8.7	0.3	53.6
Saskatchewan	7.3	5.9	-	25.7	3.7	0.4	43.0
Alberta	35.5	24.9	19.4	94.2	18.4	0.4	192.8
British Columbia	29.8	7.8	11.7	60.5	13.7	2.1	125.6
<b>Canada</b>	<b>362.0</b>	<b>144.1</b>	<b>166.7</b>	<b>997.8</b>	<b>218.7</b>	<b>22.6</b>	<b>1,911.9</b>

**TABLE 8 Estimated Costs of R&D in the Higher Education Sector, on Health Sciences, by Province, 1988-89 to 1999-2000**

Year	Province										Canada
	Nfld.	P.E.I.	N.S.	N.B.	Qué.	Ont.	Man.	Sask.	Alta.	B.C.	
millions of dollars											
1988-89	12.8	0.4	35.6	2.0	248.3	367.0	44.2	22.4	93.8	68.6	895.1
1989-90	12.5	0.5	36.7	3.1	279.3	403.2	44.0	24.7	103.2	72.9	980.1
1990-91	12.9	0.6	32.9	3.4	324.8	417.1	44.3	25.1	103.9	84.3	1,049.3
1991-92	14.6	0.7	36.6	3.3	404.5	429.2	44.2	26.9	110.7	88.8	1,159.5
1992-93	13.8	0.5	34.7	3.1	462.6	448.6	46.4	27.3	115.7	95.3	1,248.0
1993-94	15.3	0.5	39.1	3.6	466.4	529.8	44.2	28.0	120.0	94.0	1,340.9
1994-95	15.6	0.3	38.8	3.6	458.6	539.5	44.9	27.8	123.7	97.4	1,350.2
1995-96	15.3	0.3	45.7	4.7	448.5	617.1	43.8	30.4	127.5	103.9	1,437.2
1996-97	15.0	0.3	46.3	4.6	445.0	637.3	42.7	27.3	131.4	102.2	1,452.1
1997-98	17.3	0.6	52.8	4.8	489.5	685.4	40.8	31.1	148.8	105.6	1,576.7
1998-99 <sup>f</sup>	21.6	0.6	62.2	6.8	473.3	716.2	45.6	36.1	168.2	112.9	1,643.5
1999-2000	20.0	0.6	82.4	7.1	578.3	808.5	53.6	43.0	192.8	125.6	1,911.9

**TABLE 9 Estimated Costs of R&D in the Higher Education Sector, on Natural Sciences and Engineering <sup>(1)</sup>, by Source of Funds and by Province, 1999-2000**

Province	Federal Government	Provincial Governments	Business Enterprise	Higher Education	Private Non-Profit Organizations	Foreign	Total
millions of dollars							
Newfoundland	17.9	0.2	4.2	33.6	0.6	1.5	58.0
Prince Edward Island	0.9	0.2	0.2	6.1	0.4	-	7.8
Nova Scotia	32.5	6.1	23.6	87.5	5.3	7.1	162.1
New Brunswick	12.9	3.2	4.9	33.9	5.3	1.0	61.2
Québec	286.7	117.9	124.9	586.1	74.5	15.6	1,205.7
Ontario	340.6	141.6	185.6	780.5	138.0	23.4	1,609.7
Manitoba	28.6	12.1	4.4	59.6	11.6	0.8	117.1
Saskatchewan	35.6	15.9	9.3	71.5	5.7	0.9	138.9
Alberta	93.2	66.4	37.3	176.1	23.8	1.1	397.9
British Columbia	92.0	20.7	42.0	159.0	20.3	5.2	339.2
<b>Canada</b>	<b>940.9</b>	<b>384.3</b>	<b>436.4</b>	<b>1,993.9</b>	<b>285.5</b>	<b>56.6</b>	<b>4,097.6</b>

<sup>1)</sup> Includes "Health" and "Other Natural Sciences and Engineering".

**TABLE 10 Estimated Costs of R&D in the Higher Education Sector, on Natural Sciences and Engineering <sup>(1)</sup>, by Province, 1988-89 to 1999-2000**

Year	Province										Canada
	Nfld.	P.E.I.	N.S.	N.B.	Qué.	Ont.	Man.	Sask.	Alta.	B.C.	
millions of dollars											
1988-89	37.2	2.9	92.0	29.6	548.9	816.8	86.9	67.1	206.2	187.4	2,075.0
1989-90	37.0	3.0	92.8	31.1	614.6	868.6	86.9	69.9	214.5	199.1	2,217.5
1990-91	38.8	3.1	94.1	32.7	689.9	919.6	87.2	74.2	220.2	218.8	2,378.6
1991-92	40.4	3.7	101.3	36.5	835.2	945.9	89.0	80.0	230.7	241.7	2,604.4
1992-93	44.6	3.6	93.6	39.9	958.0	992.6	91.3	82.2	234.4	259.7	2,799.9
1993-94	45.3	3.3	93.9	38.3	952.4	1,108.0	86.9	85.1	235.5	254.5	2,903.2
1994-95	42.9	3.0	89.7	39.8	918.6	1,130.6	90.5	86.3	250.3	265.7	2,917.4
1995-96	43.0	2.8	94.0	42.3	894.1	1,174.7	88.8	90.1	264.0	281.6	2,975.4
1996-97	41.4	3.1	96.3	43.0	890.4	1,219.7	86.8	89.7	269.1	273.7	3,013.2
1997-98	46.5	4.3	103.1	44.5	960.2	1,292.5	84.5	92.1	297.0	283.4	3,208.1
1998-99 <sup>1)</sup>	55.5	7.9	123.3	55.1	984.4	1,403.1	97.2	105.9	338.2	300.3	3,470.9
1999-2000	58.0	7.8	162.1	61.2	1,205.7	1,609.7	117.1	138.9	397.9	339.2	4,097.6

<sup>1)</sup> Includes "Health" and "Other Natural Sciences and Engineering".

**List 1. Classification of Universities, by Size, 1999-2000**

<b>Province</b>	<b>Institution</b>	<b>Size</b>
<b>Newfoundland</b>	Memorial University of Newfoundland	Medium
<b>Prince Edward Island</b>	University of Prince Edward Island	Small
<b>Nova Scotia</b>	Acadia University	Small
	University College of Cape Breton	Small
	Dalhousie University	Large
	Kings College	Small
	Mount Saint Vincent University	Small
	Nova Scotia Agricultural College	Small
	Nova Scotia College of Art and Design	Small
	Université Sainte-Anne	Small
	St. Francis Xavier University	Small
	Saint Mary's University	Small
<b>New Brunswick</b>	Université de Moncton	Small
	Mount Allison University	Small
	St. Thomas University	Small
	University of New Brunswick	Medium
<b>Québec</b>	Bishop's University	Small
	Concordia University	Medium
	Université Laval	Large
	McGill University	Large
	École des Hautes Études Commerciales	Small
	École Polytechnique de Montréal	Medium
	Université de Montréal	Large
	École de Technologie Supérieure	Small
	Université du Québec en Abitibi-Temis.	Small
	Université du Québec à Hull	Small
	Université du Québec à Montréal	Medium
	Université du Québec à Rimouski	Small
	Université du Québec à Trois-Rivières	Small
	École nationale d'administration publique	Small
	Télé-Université	Small
	Université de Sherbrooke	Large
<b>Ontario</b>	Brock University	Small
	Carleton University	Medium
	University of Guelph	Large
	King's College	Small
	Lakehead University	Small
	Laurentian University of Sudbury	Small
	McMaster University	Large
	Nipissing University	Small
	University of Ottawa	Large
	Queen's University at Kingston	Large
	Redeemer College	Small
	St. Jerome's University	Small
	St. Michael's College	Small
	Ryerson Polytechnic University	Small
	University of Toronto	Large
	University of Sudbury	Small
	University of Trinity College	Small
	Université Saint Paul	Small
	Trent University	Small
	University of Waterloo	Large
	University of Western Ontario	Large
	Victoria University	Small
	Wilfrid Laurier University	Small
	University of Windsor	Medium
	York University	Medium

**Classification of Universities, by Size, 1999-2000** (continued)

<b>Manitoba</b>	Brandon University	Small
	The University of Manitoba	Large
	The University of Winnipeg	Small
<b>Saskatchewan</b>	The University of Regina	Medium
	St. Thomas More College	Small
	University of Saskatchewan	Large
<b>Alberta</b>	The University of Alberta	Large
	The University of Calgary	Large
	The University of Lethbridge	Small
	The King's College	Small
<b>British Columbia</b>	The University of British Columbia	Large
	Simon Fraser University	Medium
	University of Northern British Columbia	Small
	University of Victoria	Medium

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