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des Provinces maritimes

Report on Post-Secondary Research Trends in Atlantic Canada

August 2000

The Council of Maritime Premiers

Le Conseil des premiers ministres des Maritimes

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PREFACE

This report on Post-Secondary Research in the Atlantic Provinces provides an analysis of Atlantic Post-Secondary Research trends to 1998-1999. It is intended to provide a snapshot of "where we are coming from" in Atlantic Canada. It is also intended to provide a base for collaborative strategies to strengthen Atlantic post-secondary research as outlined in the separate document entitled *Securing our Future: A Renewal Strategy for Post-Secondary Research in Atlantic Canada.*

The report was prepared by Dr. G. "Mac" Weaver of Cornwallis Technologies under a contract and with data and other support from officials in the Maritime Provinces Higher Education Commission (MPHEC), notably Ms. Catherine Brown and Dr. Dawn Gordon. The project was funded in part by the Atlantic Canada Opportunities Agency (ACOA). Direction was provided through a Steering Committee that included Vice-Presidents and other senior research administrators of Atlantic universities and institutions. These included:

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Emphasis in this report is on: (1) Atlantic Canada's post-secondary research strengths; (2) the region's position in the national and international context; (3) levels and sources of investment in Atlantic Canada's post-secondary research effort; (4) "people" opportunities and challenges and (5) research infrastructure support.

The project also includes development of University Research Profiles which will be made available under separate cover. The MPHEC is also planning to include Atlantic Canadian research data on the web-site that it is developing in the context of its new Maritime Information Framework Initiative (www.mphec.ca).

Ways (and "indicators") for the assessment of return on investment or "results" are not dealt with in this study. The MPHEC is however working closely with Atlantic Canadian government officials and the Secretariat of the Council of Ministers of Education Canada (CMEC) working group on this issue.

TABLE OF CONTENTS

Data note
Every effort has been made to present up-to-date information in this report. Unfortunately, data limitations and incomplete series prevented the use of a uniform reference period. However, in all cases the data used are the most recent available.

Data by Canadian universities to the Canadian Association of University Business Officers (CAUBO) have not been consistent from year to year as a number of universities are now reporting sources of funding that were not previously report. This may lead to “apparent increases” in reported funding. As a result it is important to keep in mind that trends may be affected by changes in institutional reporting.

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

> *In our new global economy, knowledge and R&D are increasingly seen as a source of competitive advantage. This realization has brought governments in most industrialized countries to commit ever-increasing resources to carry out R&D at home, as well as to develop a capacity to absorb and put to use knowledge generated elsewhere in order to produce innovations.* (AUCC , 1999, p. 80)

Technology and globalization are transforming all of our activities within Canadian society. In a world that is increasingly "without borders," knowledge and innovation are the keys to the economic, social and cultural success of a country. There is an international trend, particularly in the United States and other G-7 countries, to increase the level of investment in research and development (R&D). The primary driver is global competition; however, quality of life, environment, arts and culture are also major considerations.

As a nation, Canada is taking serious measures to strengthen its research capacity relative to other G-7 countries. This national wave of research reinvestment is not reaching Atlantic Canada, however, to the same extent as elsewhere in the country. In fact, according to some observers, "Atlantic Canada is stalled and will soon find itself going backward, unless remedial action is taken."(AAU, 1999, p. 1) Canada cannot afford slippage in any of its regions. This is particularly true of knowledge development and dissemination which is highly sensitive geographically. A strong local or regional base is needed to receive, use and adapt global innovations. As noted by Wolfe (1998, p. 17):

> *The geography of production in the new economy is marked by a "paradoxical consequence of globalization" –the role of knowledge and creativity places a premium on the kind of localized, or regionally--based innovation that is fostered by proximity. Innovative capabilities are frequently sustained through regional communities that share a common knowledge base and interact through common institutions.... Proximity to the source of research is critical in influencing the success with which new product innovations are transferred from the laboratory to commercial exploitation, or process innovations are adopted and diffused across developers and users.... Firms located close to major centres of academic research are deemed to have a "major advantage" over those located at a distance from the academic source of research.*

Canada's universities are key contributors to the knowledge-based society. In fact, Canada is comparatively more reliant on its universities than its G-7 competitors to create and transmit knowledge and innovation. Almost one quarter of Canada's R&D is performed by the university sector, the highest proportion of the G-7 countries. The university sector plays an even bigger role in Atlantic Canada where industry-based research is proportionately smaller than in other regions of the country given the fact that the region's economy is made up primarily of small-to-medium enterprises (SME).

Atlantic universities do excellent research and are a major socio-economic driving force for the region. Atlantic Canada is also an important national contributor. Despite its relative small population (7.8 percent of the Canadian population), Atlantic Canada has 12 percent of the nation's faculty and houses 9.5 percent of the country's university students.

On all fronts however, investment, recruitment, and environmental support, Atlantic Canada has historically faced serious challenges in keeping pace with national reinvestment in university R&D. Despite these efforts, however, the region is rapidly falling behind the rest of the country. The reasons are complex and involve a cumulation of factors each of which needs to be addressed. There is only limited time for action before the slippage becomes devastatingly acute insofar as Atlantic Canada's capacity for socio-economic and cultural growth and development is concerned.

In the tradition of the planner Patrick Geddes, it was decided to "survey before plan". A Steering Committee of Vice-Presidents of Research and equivalents came together to explore the issues as a basis for strategy development. This report reflects their efforts. It documents the scope of Atlantic post-secondary education (PSE) research, its strengths, and the degree of access to both public and private sector funding.

Three key challenges are addressed in this report. The report shows, first of all, that there are serious gaps between national research investment in this region and that taking place elsewhere in the country by any number of measures. These gaps involve all major players in the university research environment: federal, provincial, industrial and non-governmental. Second, the Atlantic region faces serious challenges as it seeks to replace retiring faculty with promising research and teaching "stars". A number of factors, including the design of the new federal Researcher Chair programme, will make it difficult for the Atlantic region to attract and retain the best and brightest against national and even international competition. Third, major difficulties are being experienced by Atlantic Canadian universities in providing infrastructure support to researchers - including equipment and facilities, faculty research time - comparable to that available to faculty elsewhere in Canada. Concerns include national factors such as matching requirements for certain new federal programmes and the relatively limited participation of Atlantic Canadian researchers on specialized peer review committees. In short, Atlantic Canada's universities need strong collaborative strategies to strengthen their regional and national contribution.

The report goes into some detail on current trends. Specifically, it looks at:

- *University strengths* - contribution of universities to Atlantic Canada's economic, social, and cultural well-being;
- *Investment* - relative levels and sources of PSE research support in the Atlantic provinces;
- *People* - current and projected availability of Maritime researchers and innovators;
- *Research infrastructure and support* - relative strengths of support structures and facilities in the Atlantic.

The information within this report is being used to (1) develop strategies to enhance the capacity of Atlantic Canada to carry out leading edge research and compete nationally and globally in the knowledge economy and (2) stimulate collaboration among key federal, provincial, private, and post-secondary partners. These strategies are outlined in a separate document entitled "Securing our Future Together: A Renewal Strategy for Post-secondary Research in Atlantic Canada."

2.0 ATLANTIC CANADA'S UNIVERSITIES

2.1 Important Contributors to National Knowledge Capacity

In Atlantic Canada, there are 17 degree-granting universities that contribute to research and knowledge development in sciences and engineering, health, social sciences, humanities, and arts. Each of these universities has a unique mandate and distinctive areas of research strengths as outlined in a separate document entitled *Post-Secondary Research in Atlantic Canada: Institutional Profiles*. The region has 7.8 percent of the country's population and 12 percent of Canada's post-secondary faculty. It also educates 9.5 percent of the nation's university students and 6.2 percent of the nation's graduate students – making the region an important contributor to the nation's knowledge capacity across a broad range of areas of specialization.

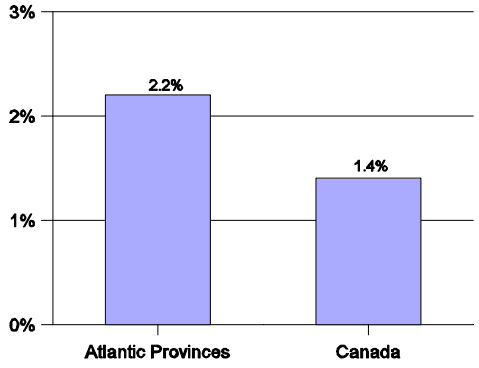
These 17 post-secondary institutions include primarily undergraduate universities as well as a smaller number of regional universities that offer a range of graduate or professional courses (Memorial University, Dalhousie University, University of New Brunswick, Université de Moncton and University of Prince Edward Island). These post-secondary institutions are:

Mount Allison University, Sackville, NB ***(MTA)***
St. Thomas University, Fredericton, NB ***(STU)***
Université de Moncton, Moncton, NB ***(UdeM)***
University of New Brunswick, Fredericton and Saint John, NB ***(UNB)***
Memorial University of Newfoundland, St. John's, NF ***(MUN)***
Acadia University, Wolfville, NS ***(Acad)***
Atlantic School of Theology ***(AST)***
Dalhousie University, Halifax, NS ***(Dal)***
Mount Saint Vincent University, Halifax, NS ***(MSVU)***
Nova Scotia Agricultural College, Truro, Nova Scotia ***(NSAC)***
Nova Scotia College of Art and Design, Halifax, NS ***(NSCAD)***
Saint Mary's University, Halifax, NS ***(SMU)***
St. Francis Xavier University, Antigonish, NS ***(SFXU)***
Université Sainte-Anne, Pointe-de-l'Église, NS ***(USA)***
University College of Cape Breton , Sydney, NS ***(UCCB)***
University of King's College, Halifax, NS ***(UKC)***
University of Prince Edward Island, Charlottetown, PEI ***(UPEI)***

2.2 A Hub for Atlantic Socio-Economic Development

Atlantic Canada's universities play a much more important role in the region's economy than equivalent institutions in other provinces. In Atlantic Canada, universities contribute 2.2 percent of the Gross Domestic Product as compared with 1.4 percent for all universities in Canada (Figure 1). This is due in part to the more limited presence of industry or non-governmental head offices and research establishments and a predominantly small-to-medium enterprise (SME) economy.

Figure 1
Total Direct University Expenditures as a Percent of GDP, 1997-98

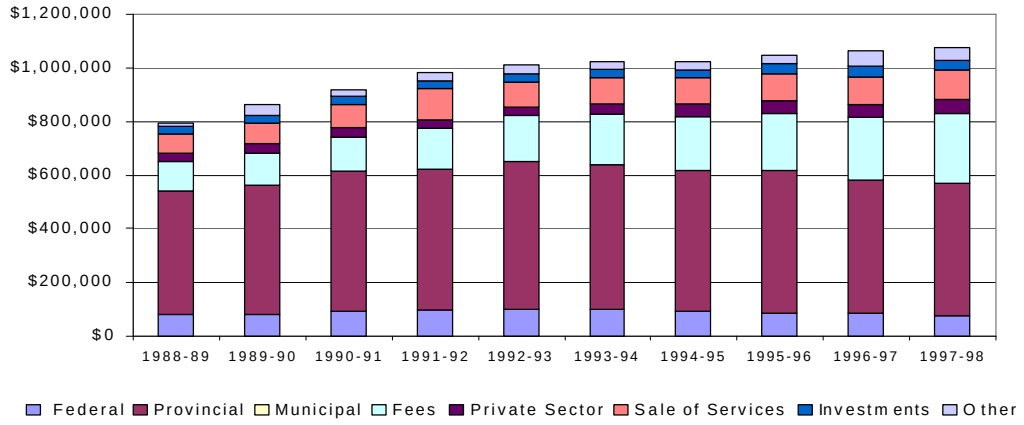


Source: Atlantic Provinces Economic Council, "Atlantic Universities: Fostering a Climate for Economic Growth" (draft report)

2.2.1 Institutional revenues and expenditures

The 17 degree-granting universities located in the Atlantic provinces constitute big business. Annual revenues have grown to $1.07 billion in 1997-98 (Figure 2). Although the growth rate overall is progressive, the level of public funding has declined in recent years and the universities have been obliged to raise the level of student fees to meet their expenses.

Figure 2
Atlantic University Revenues by Source, 1988-89 to 1997-98 ($000)



Source: Canadian Association of University Business Officers (CAUBO)

University expenditures in Atlantic Canada result in significant additional economic outputs in other sectors of the economy. As noted in a recent study:

> *As major employers and purchasers of goods and services, universities are key contributors to local communities across Atlantic Canada. Spending by students and staff, as well as general operating expenditures, create income, revenues and profits in other industries in the region...In addition to spending, universities in Atlantic Canada also contribute to the economy through job creation...In addition to the direct spending by universities and the people they employ, university students also make a significant contribution to economic activity in the region...Universities also attract visitors to the local community either to visit students or to attend conferences, cultural activities or sporting events. In total, the region's universities created an estimated $1.63 billion in direct and induced spending* (APEC and AAU, 2000, p.11-13).

Although more difficult to quantify, Atlantic universities and their faculty and students exert a major influence on the quality of life in each of the four Atlantic provinces. They contribute extensively to social and economic policy development and provide access to reasoned analyses and advice for both the public and the private sectors.

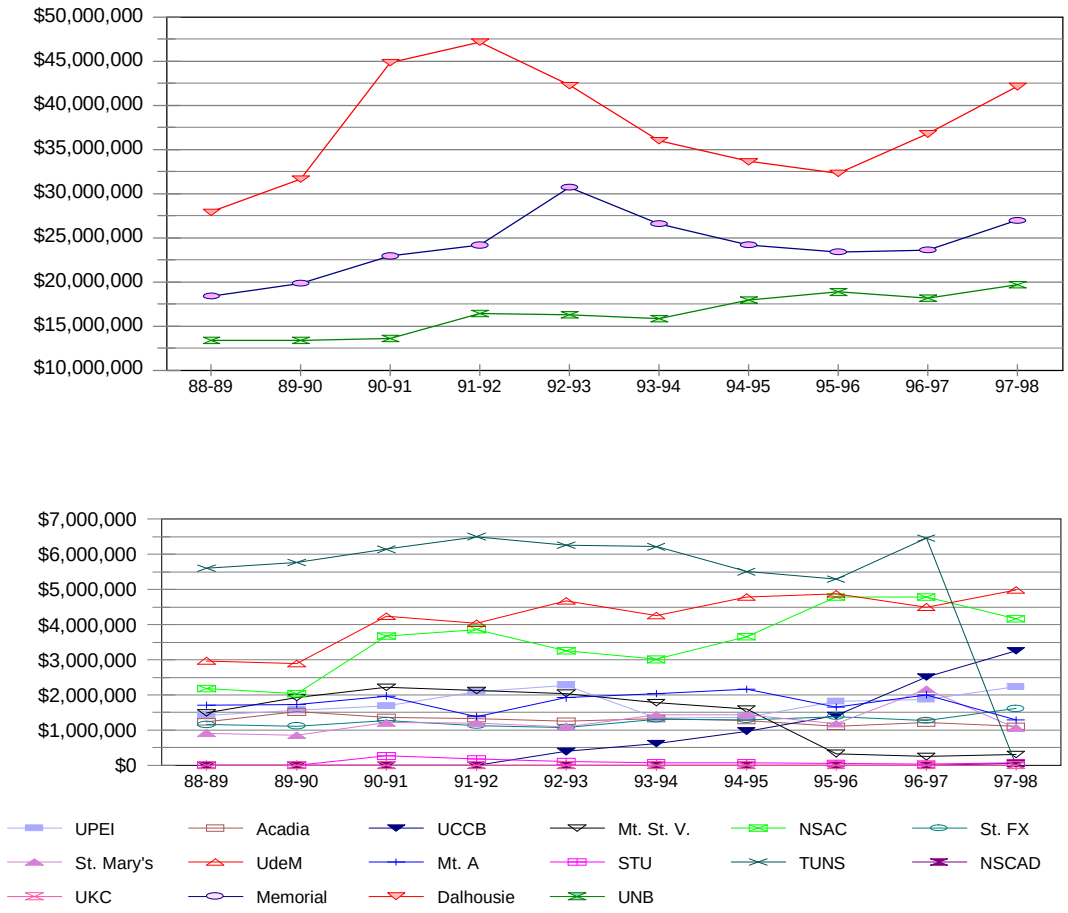
2.2.2 Sponsored research revenues

Revenues from sponsored research[1] in Atlantic Canadian universities approached $108 million in 1997-98. Three universities (Dalhousie University, Memorial University and the University of New Brunswick) constitute the major players, attracting more than 80 percent of the research revenues which are invested annually in the university sector (Figure 3). The Université de Moncton, the Nova Scotia Agricultural College and the University College of Cape Breton attract $3-5 million each annually in external R&D funding and the remaining schools operate with $1-2 million in sponsored research funding.

Trend lines for both Dalhousie University and Memorial University suggest that R&D activities peaked in the early 1990's. The University of New Brunswick, on the other hand, shows continuing growth, as does the Université de Moncton, the Nova Scotia Agricultural College and the University College of Cape Breton. Research activity in the remaining schools has remained relatively static. It should be noted, however, that data were available only to 1997-98 when this report was written.

[1] Sponsored research includes funds to support research paid both in the form of a grant or by means of a contract from sources external to the university, as well as funds transferred from the university's special purpose and trust funds for research purposes.

Figure 3
Atlantic Universities Sponsored Research Revenues, 1988-89 to 1997-98



Note: As of 1997-98, TUNS amalgamated with Dalhousie University and is now known as Daltech.
Source: Canadian Association of University Business Officers (CAUBO)

2.3 A Diverse Source of Knowledge Generation and Applications

2.3.1 Faculty specializations

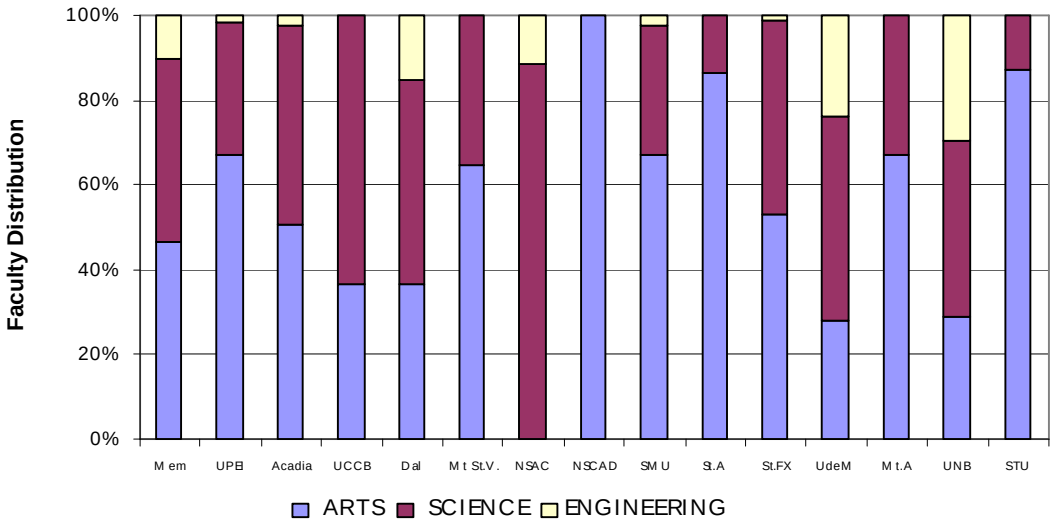
While the Arts represent a common core throughout the region, there are notable concentrations of Science (Dalhousie University, Memorial University and University of New Brunswick) and Engineering (University of New Brunswick, Dalhousie University, Memorial University and Université de Moncton). The relative emphasis of each of the universities in Arts, Sciences and Engineering is more clearly portrayed in Figure 4.

Arts dominate at the Nova Scotia College of Art and Design, St. Thomas University and Université Sainte-Anne. Mount Allison University, Saint Mary's University, Mount Saint Vincent University and the University of Prince Edward Island are strong Arts schools, but the Sciences are also well represented. Both the Arts and Sciences are in balance at Memorial University, Acadia University and St. Francis Xavier University. The Sciences dominate at the University College of Cape Breton,

Dalhousie University, the Nova Scotia Agricultural College, the Université de Moncton and the University of New Brunswick. Engineering faculties are relatively less plentiful, but the respective disciplines are given strong emphasis at University of New Brunswick, Université de Moncton, Dalhousie University, Nova Scotia Agricultural College and Memorial University.

Medical faculties in Atlantic Canada are located at Dalhousie University and Memorial University. In addition, nursing programmes exist at St. Francis Xavier University, the University of Prince Edward Island, Dalhousie University, Memorial University, the University of New Brunswick and Université de Moncton. Dalhousie University also offers a broad range of allied health professional programmes. The University of Prince Edward Island offers Veterinary Medicine to the entire region.

Figure 4
Distribution of Faculty by Key Areas, Arts, Science and Engineering in Atlantic Universities, 1999-00



Source: Individual University Calendars and Websites

2.3.2 Disciplines within Arts, Science and Engineering

Figure 5 presents the distribution of Arts faculty by discipline. The top five in decreasing order include: Sociology, Anthropology and Criminology; Culture and Languages; English; History; and Music. The dominant disciplines in the Science faculties (Figure 6) include: Mathematics, Computer Science and Statistics; Biology; Psychology; and Chemistry. Faculty members in the Engineering disciplines are relatively less numerous when compared with the Arts and Sciences. Major disciplinary strengths (Figure 7) are: Mechanical; Electrical and Electronic; Civil; and Forest and Environmental Engineering.

Figure 5
Arts Faculty Members by Discipline in Atlantic Universities, 1999-00

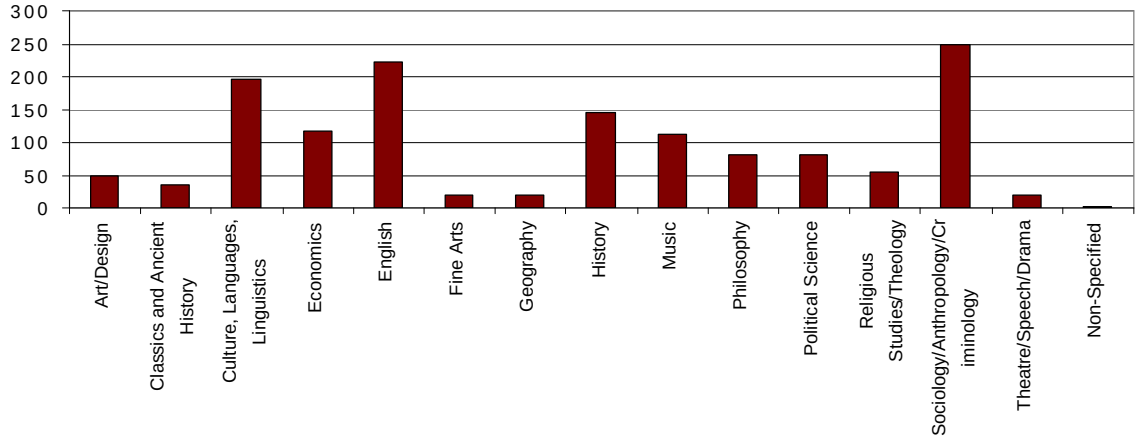


Figure 6
Science Faculty Members by Discipline, Atlantic Universities, 1999-00

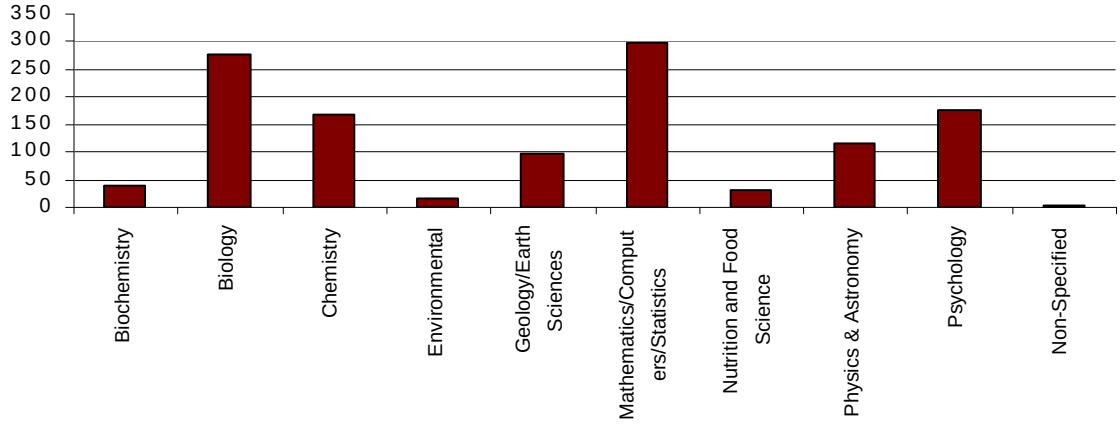
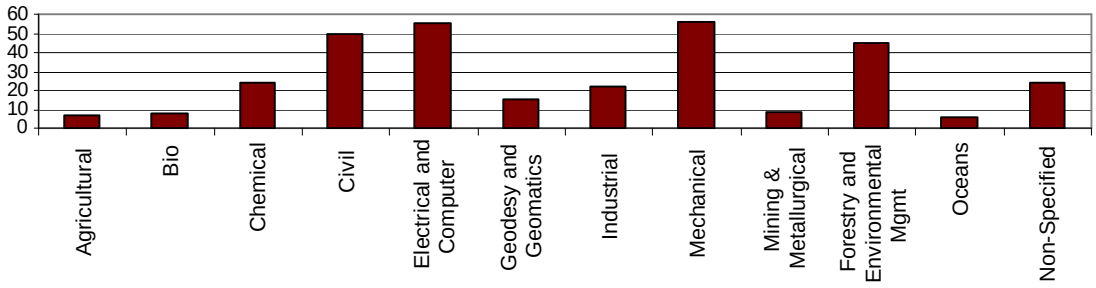


Figure 7
Engineering Faculty Members by Discipline in Atlantic Universities, 1999-00



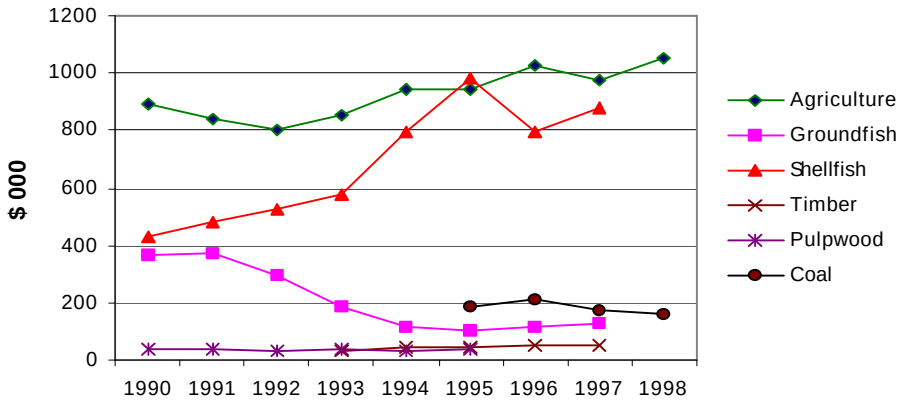
Source: Individual University Calendars and Websites

2.4 Participation in "Knowledge Economy" Research

> *Our knowledge-based economy is more than high-tech companies. It is an economy in which all sectors strive to use leading-edge technologies and processes.....Indeed, it is an economy where technology can lead to greater economic stability for the primarily rural regions in which cyclical resource industries –agriculture, fisheries, forestry, mining and tourism -- are the dominant sources of wealth.* (1999 federal Speech from the Throne).

As illustrated in the separate document on *Post-Secondary Research in Atlantic Canada: Institutional Profiles*, the region's universities are highly involved in research relating to the resource sector - in the development of knowledge and applications needed to better manage its primarily resource based economy. This is not surprising given the fact that the resource sector continues to be a mainstay of the Atlantic economy. While there have been declines in sectors such as groundfish and coal mining, the agricultural, shellfish and forest sectors remain healthy and prosperous (Figure 8). Oil and gas developments in the Hibernia and Scotia Shelf fields are additional bright spots on the Atlantic resources horizon.

Figure 8
Atlantic Resource Sector Revenues, 1990 to 1998



Source: Agriculture and Agri-Food Canada, Fisheries and Oceans, Natural Resources Canada

Atlantic Canada is actively encouraging the development of a knowledge based economy that goes beyond but also includes value-added aspects of natural resource areas. Benefits include higher value-added returns for manufacturers, increased opportunities for skilled employment and the potential to operate such industries in smaller jurisdictions.

Atlantic Canada is making strong strides in the development of the "high knowledge industries" as defined by Industry Canada.[2] Further room for growth is illustrated by the fact that Atlantic Canada's involvement in these industries in 1997 stood at 3.7 percent of the national total. The rate of growth (Figure 10) at 3.2 percent also argues for heightened strategic investments in this area.

[2]High knowledge industries include pharmaceutical, electrical power, machinery, communications products, aerospace manufacturing, engineering, computer and management services.

Figure 9
Share of Knowledge Activity by Region, 1997

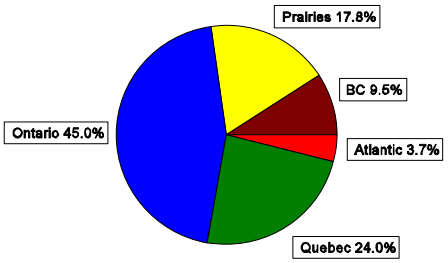
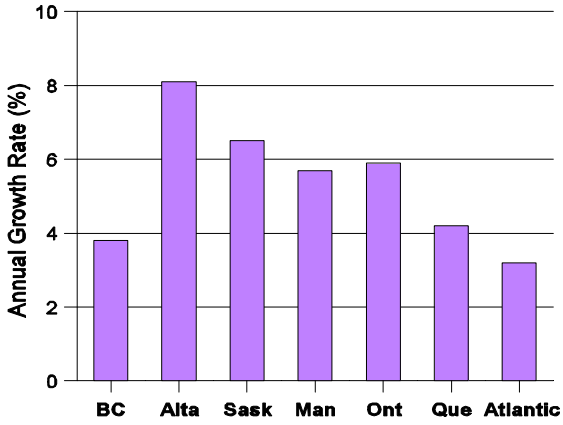


Figure 10
Average Annual Growth Rate of Knowledge-Based Economy, 1992 to 1997



Source: Industry Canada's Micro-Economic Monitoring, 1999

Current university strengths in the knowledge area can provide a strong base for further development. Some of these are outlined in a study funded by the Atlantic Canada Opportunities Agency (ACOA, 1997). The study highlighted six industrial domains, three on an Atlantic Region-wide base, and three on a sub-regional basis:

? Computer Science - Atlantic Canada-wide
? Geomatics - Atlantic Canada-wide
? Aquaculture - Atlantic Canada-wide
? Ocean Technology - Newfoundland and Labrador
? Medical Devices/Services - Nova Scotia
? Food Processing - New Brunswick and Prince Edward Island

Other authors have suggested that there are additional potentially strong industrial sectors in the region, including the possibility of building a biotechnology cluster in Atlantic Canada. The estimated potential of these sectors was in part based on existing research capacities in the Atlantic university sector with its highly developed centres of natural and applied science.

2.5 A Strong Base from which to Strengthen Research Investments and Outcomes

The post-secondary education research sector in the Atlantic provinces has built up over the years a strong base of research capacity and strengths that can serve as the foundation for a concerted strategy to keep pace with accelerating research trends in Canada and internationally. The following chapters of this report look at three critical elements: investment, people and environment. It looks specifically at trends in Atlantic Canada vis-à-vis national and international counterparts as well as key challenges and opportunities for future. The focus is on strengthening Atlantic Canada's contribution to the nation as a whole with specific emphasis on those areas where Atlantic Canada is best placed to contribute.

3.0 R&D INVESTMENT TRENDS

This chapter examines research investment trends in Atlantic Canada as compared to the country as a whole. It begins by placing Canada's research activities within the international picture. Next, it examines R&D performers, funders and expenditure levels in Atlantic Canada relative to Canada.

3.1 Canadian R&D Activities Relative to the Other G7 Countries

Gross domestic expenditures on Research and Development (GERD)[3] is the most widely used indicator of R&D levels in a country. It represents the absolute amount invested in R&D in a country by the different national players. It is calculated by adding together "the intramural expenditures on R&D performed on the national territory during a given period. It includes R&D performance within a country and funded from abroad but excludes payments made abroad for R&D" (OECD, 1993).

Canada's commitment to R&D reflects progressive growth. Canada's expenditures on R&D activities as a percentage of the Gross Domestic Product (GERD/GDP) increased from 1.39 percent in 1988 to 1.64 percent in 1997. Despite this growth, however, the most recent data show Canada's place among the G7 countries as still just ahead of Italy, the lowest ranking G-7 country (Table 1).

Table 1
International Comparisons of Research Expenditures (1995)

Country	GERD/GDP (%)	GERD per capita ($)
Sweden	3.02	565
Japan*	2.78	607
United States*	2.58	681
France*	2.34	466
Finland	2.32	413
Germany*	2.28	467
United Kingdom*	2.05	365
The Netherlands	2.04	381
Denmark	1.82	393
Canada*	1.61	338
Italy*	1.14	222

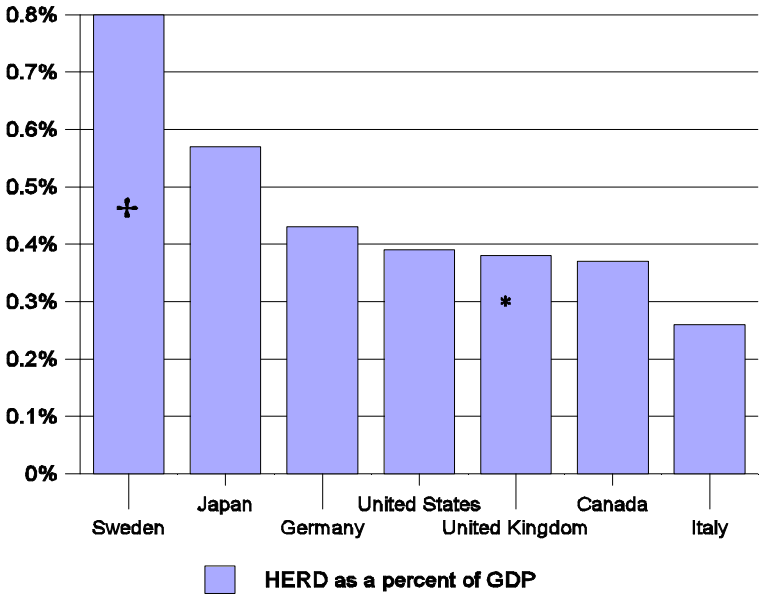
Source: Industry Canada/Science and Technology Data, Canada - 1997; Note: Canada GERD/GDP % (1997) = 1.57; *Part of G7 countries

In terms of expenditures on research and development in the higher education sector (HERD)[4], on the other hand, while still in sixth place, Canada stands closer to the average of other G-7 countries as shown in Figure 11. Current university R&D spending in Canada is at the level of $3 billion annually. Approximately 6 percent of this university research undertaking is centred in the 17 degree granting universities in Atlantic Canada.

[3]GERD serves as a general indicator of R&D activity and not as a detailed inventory of R&D projects within an organization, sector or province. It is an estimate and as such can show trends in R&D expenditures by sector and sub-sector, by province and country, from year-to-year. In this capacity, the GERD estimates are sufficiently reliable for their main use as an aggregate indicator for science policy. (Statistics Canada, 1998a)

[4]The estimation of the total R&D expenditures in the higher education sector is based on the "relevant" total costs of universities with R&D activities. The "relevant" costs are defined as the total expenditures of the universities as provided by the Canadian Association of University Business Officers survey but excluding costs of "ancillary" enterprises. (Statistics Canada, 1998b)

Figure 11
Higher Education Expenditures on R&D (HERD)
as a Percentage of GDP, 1995



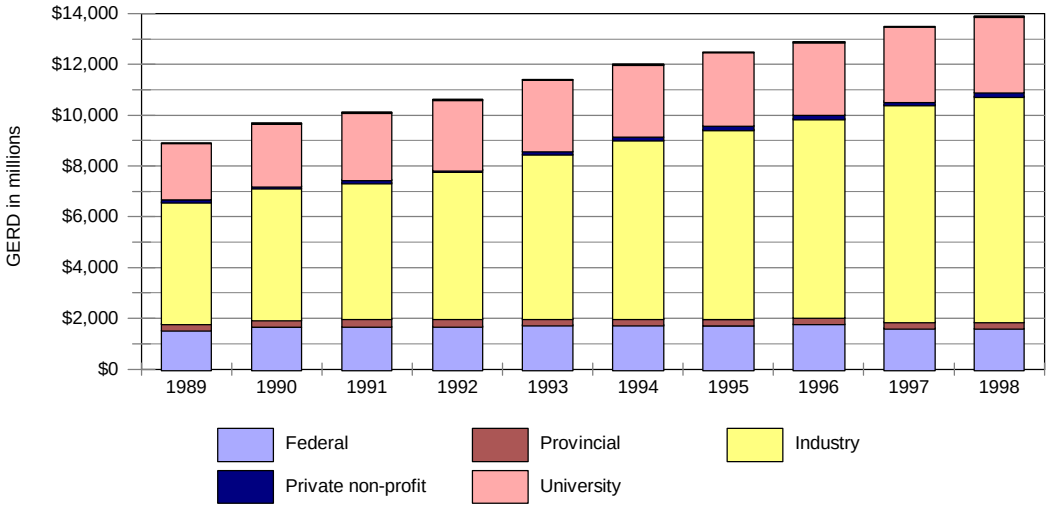
*data are for the year 1994; **?** data are for the year 1993
Source: OECD, Main Science and Technology Indicators, 1996 : 2

3.2 R&D Expenditures - Atlantic Canada vs Canada

3.2.1 Growth in national reinvestment

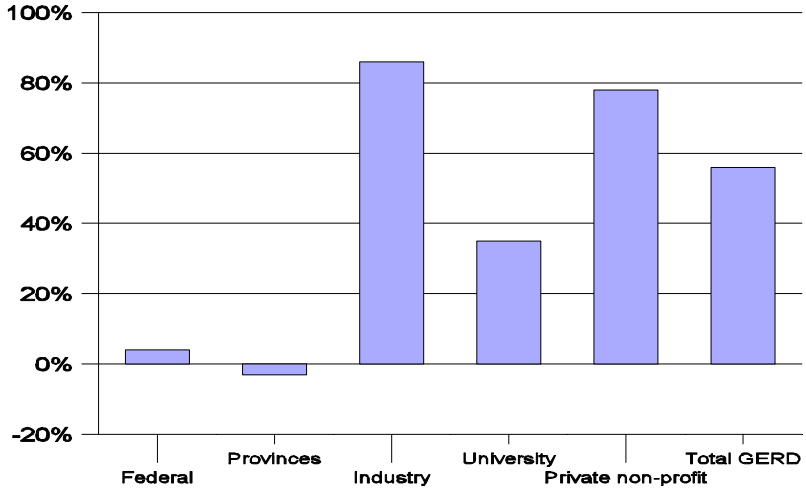
In 1998, Canada spent almost $14 billion on R&D activities. Between 1989 and 1998, expenditures on R&D increased by 56 percent (Figures 12 & 13).

Figure 12
R&D Expenditures by Performing Sector - Canada, 1989 to 1998



Source: Statistics Canada - GERD, Canada, 1987 to 1998 and by Province 1987 to 1996

Figure 13
Growth of R&D Expenditures by Performing Sector, Canada, 1989 to 1998



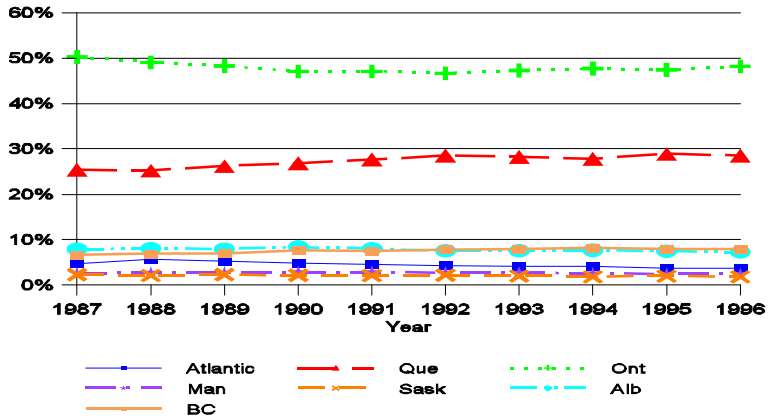
Source: Statistics Canada - GERD, Canada, 1987 to 1998 and by Province 1987 to 1996

Much of Canada's growth in R&D expenditures has resulted from increased activity by the industrial sector (+86% since 1989). This has been followed closely by increased activity in the private non-profit sector (+78%). Meanwhile, R&D spending by the university sector increased by 35 percent, whereas R&D activities by the federal government increased by only 4 percent and activity by the provincial governments actually decreased by 3 percent over this same time period. More recent data are not yet available; they are expected to show continuing growth up to and including 2000-2001.

3.2.2. National R&D expenditures by province/region

Nationally, Quebec and Ontario are the dominant players in R&D and account for just over 76 percent of total national expenditures (28.5 and 48% respectively) (Figure 14). British Columbia and Alberta make up 8 and 7 percent respectively, while research in Manitoba and Saskatchewan represents 2.4 and 1.9 percent respectively of national funding. Between 1988 and 1996, only Quebec and British Columbia have increased their share of national expenditures on R&D.
Atlantic Canada's percentage of the national expenditures on R&D has been steadily declining from

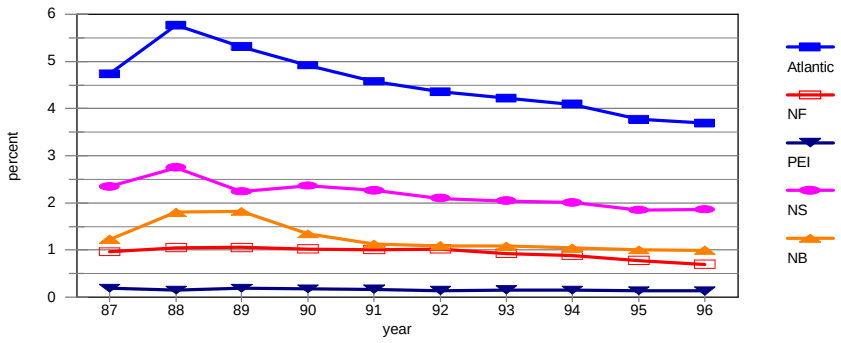
Figure 14
Provincial Share of National R&D Expenditures, 1987 to 1996



Source: Statistics Canada - GERD, Canada, 1987 to 1998 and by Province 1987 to 1996

1988-1996 (Figure 15). In 1996, Atlantic Canada accounted for just under 4 percent of national expenditures on R&D.

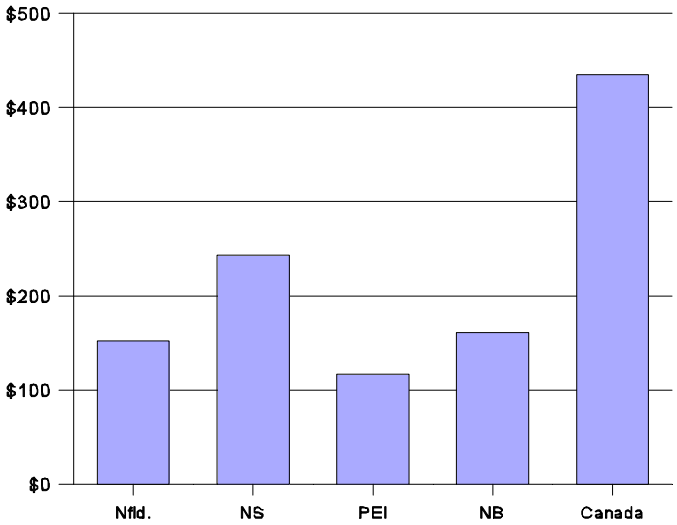
Figure 15
Atlantic Percentage by Province of National R&D Expenditures, 1987 to 1996



Source: Statistics Canada - GERD, Canada, 1987 to 1998 and by Province 1987 to 1996.

When per capita R&D expenditures are compared by province, it is clear that the Atlantic provinces' R&D performance has historically lagged behind the rest of Canada (Figure 16). Nova Scotia compares favourably with the western provinces whereas Newfoundland, New Brunswick and Prince Edward Island expenditures fall well below that of all other provinces. Québec and Ontario show the highest per capita R&D expenditures.

Figure 16
R&D Expenditures per Capita by Provinces, 1996



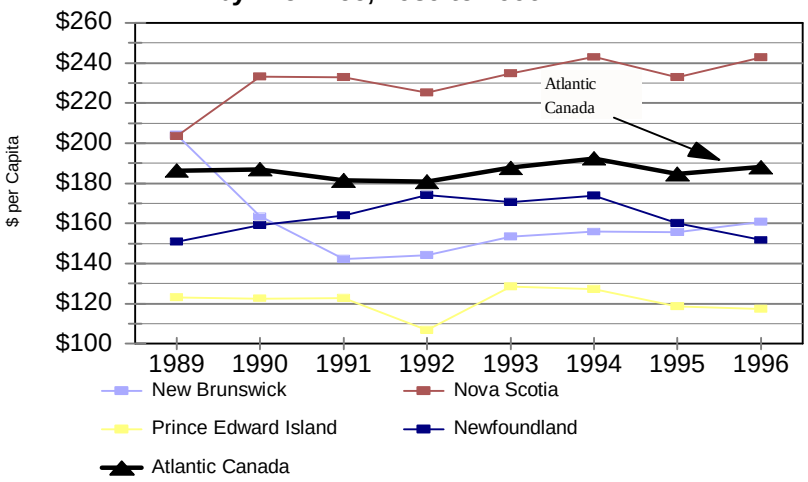
Source: Statistics Canada - GERD, Canada, 1987 to 1998 and by Province 1987 to 1996

While overall expenditures on R&D have increased over the past ten years in Canada, R&D expenditures across Atlantic Canada have remained stagnant from 1989-1996 at about $440 million. The bulk of research is being done in Nova Scotia - accounting for more than one-half of the aggregate research activity in Atlantic Canada. Newfoundland and New Brunswick show similar

intensities, whereas R&D activities in Prince Edward Island account for less than 4% of the regional whole.

Activities in Nova Scotia and New Brunswick showed modest growth from 1995 to 1996, while activities in Newfoundland and Prince Edward Island appeared to decrease during this same period (Figure 17). It remains to be seen whether these trends will continue. Relative to the rest of Canada, total R&D expenditures are lower in the Atlantic region due largely to the fact that it has a less developed industrial sector than the other provinces.

Figure 17
R&D Expenditures per Capita in Atlantic Canada by Province, 1989 to 1996



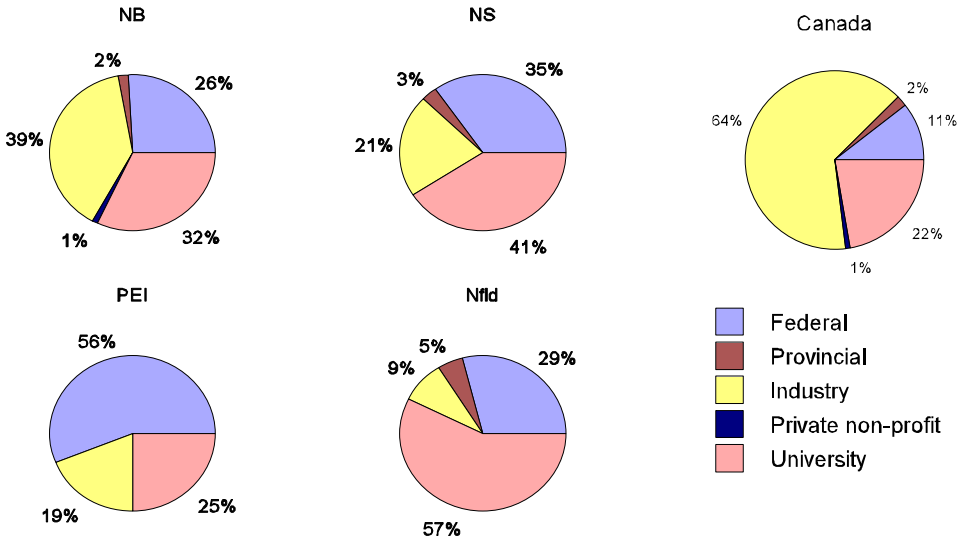
Source: Statistics Canada - GERD, Canada, 1987 to 1998 and by Province 1987 to 1996.

3.2.3 R&D expenditures by performing sector - Atlantic Canada versus Canada

In Atlantic Canada, the principal performer of R&D is the university sector at 39 percent, almost double the national level of R&D activity by universities (Figure 18). In contrast, Canada as a whole depends mostly on the industry sector for R&D performance at 64 percent, over twice the level of activity by the industry sector (29%) in Atlantic Canada. Atlantic Canada is also considerably more dependent on the federal government for R&D activities than Canada as a whole.

Within Atlantic Canada, there are significant variations among the four provinces as to who is performing R&D activities (Figure 18). In New Brunswick, the principal performer of R&D is the industry sector (39%) followed closely by universities (32%). Meanwhile in Nova Scotia, the principal performers of research are universities (41%) followed closely by the federal government (35%). In Newfoundland, on the other hand, universities are the dominant performers at 57 percent, followed by the federal government (29%); the industry sector accounts for only 9 percent. In Prince Edward Island, however, the principal performer has traditionally been the federal government which accounted for 56 percent, with the remaining 44 percent fairly evenly distributed between the industry and university sectors. It should be noted, however, that the Province of Prince Edward Island has recently introduced new measures to support post-secondary research.

Figure 18 - Who does research?
Distribution of R&D Expenditures, by PERFORMING SECTOR , in the Atlantic Provinces and Canada, 1996



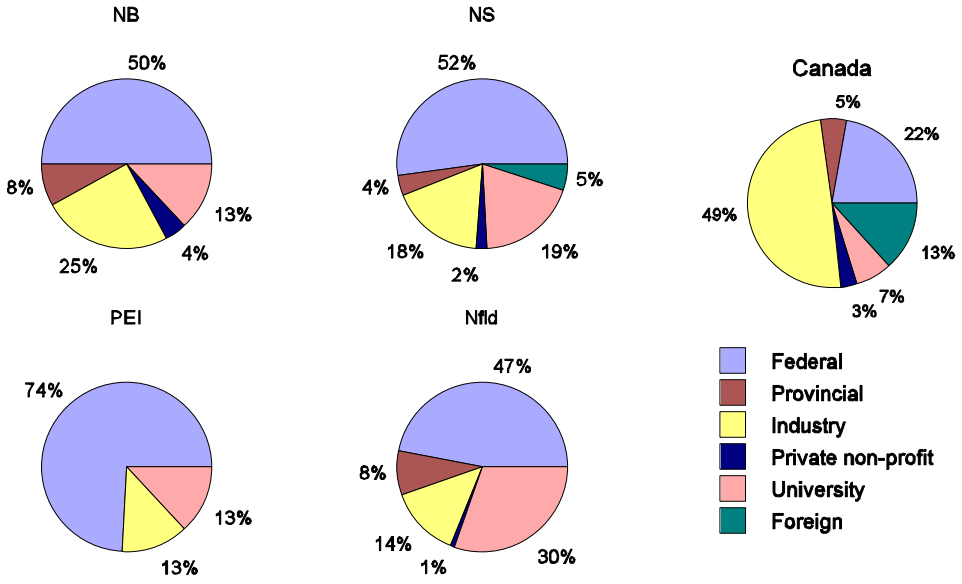
Source: Statistics Canada - Estimates of Canadian Research and Development Expenditures (GERD), Canada, 1987 to 1998 and by Province 1987 to 1996.

3.2.4 R&D expenditures by funding sector - Atlantic Canada versus Canada

In terms of the funding of R&D activities in Atlantic Canada, the federal government provides the lion's share - accounting for on average 50 percent of funding in Nova Scotia, New Brunswick, and Newfoundland and 74 percent in Prince Edward Island (Figure 19). In Canada as a whole, the industry sector is the primary source of funding at 49 percent with the federal government coming in at only 22 percent.

As with research performers, there are significant variations among the four Atlantic provinces as to who is funding R&D activities, notwithstanding the fact that the federal government is the primary funder in all four of the Atlantic provinces (Figure 19). In New Brunswick, the second largest contributor to R&D funding is the industry sector (25%) followed by universities (13%). In Nova Scotia, the university and the industry sectors account for 19 and 18 percent respectively of R&D funding. Similarly, in Prince Edward Island, the university and the industry sectors each account for 13 percent of R&D funding. In Newfoundland, on the other hand, the primary funder is the university sector at 30 percent, with the industry sector accounting for 14 percent of funding. It is noteworthy that Nova Scotia and Newfoundland were the only provinces in Atlantic Canada to secure foreign funding at 5 and 1 percent respectively of total R&D funding.

Figure 19 - Who funds research?
Distribution of R&D expenditures, by FUNDING SECTOR, in the Atlantic Provinces and Canada, 1995



Source: Statistics Canada - Estimates of Canadian Research and Development Expenditures (GERD), Canada, 1987 to 1998 and by Province 1987 to 1996. PEI subsequently instituted new initiatives to support PSE research in that province.

Table 2 compares R&D expenditures per capita in 1989 to expenditures in 1995 by Funding Sector in each of the Atlantic Provinces, Atlantic Canada as a whole, and in Canada and shows the percentage growth during this time period.

Table 2
R&D Expenditures - Growth by Funding Sector Between 1989 and 1995

Expenditures by Funding Sector - Atlantic Canada vs Canada	1989 ($ per capita)	1995 ($ per capita)	Growth (%)
INDUSTRY FUNDING			
New Brunswick	59.4*	38.6	-35
Nova Scotia	33.2	41.0	+23
Prince Edward Island	7.7	14.8	+92
Newfoundland	6.9	22.9	+232
Atlantic Total	33.6	34.4	+2
National Average	133.5	196.3	+47
UNIVERSITY FUNDING			
New Brunswick	17.7	20.0	+13
Nova Scotia	23.2	44.2	+91
Prince Edward Island	23.1	14.8	-44
Newfoundland	36.4	47.5	+30
Atlantic Total	24.7	35.6	+29
National Average	34.5	37.4	+8

Expenditures by Funding Sector - Atlantic Canada vs Canada	1989 ($ per capita)	1995 ($ per capita)	Growth (%)
PROVINCIAL FUNDING			
New Brunswick	8.2	12.0	+46
Nova Scotia	10.0	9.7	-3
Prince Edward Island**	0.0	0.0	0
Newfoundland	10.4	12.3	+18
Atlantic Total	8.9	10.4	+17
National Average	22.0	23.8	+8
PRIVATE NON-PROFIT FUNDING			
New Brunswick	1.4	6.7	+379
Nova Scotia	4.4	5.4	+23
Prince Edward Island	0.0	0.0	0
Newfoundland	5.2	1.8	-65
Atlantic Total	3.4	4.6	+35
National Average	7.7	11.3	+47
FOREIGN FUNDING			
New Brunswick	0.0	0.0	0
Nova Scotia	3.3	10.8	+227
Prince Edward Island	0.0	0.0	0
Newfoundland	1.7	0	-100
Atlantic Total	2.1	4.1	+95
National Average	31.0	54.4	75
FEDERAL FUNDING			
New Brunswick	73.4	78.5	+7
Nova Scotia	129.4	121.8	-6
Prince Edward Island	92.2	89.0	-3
Newfoundland	90.2	75.7	-16
Atlantic Total	100.1	9.2	-5
National Average	97.0	101.7	+5

* 1990 data used for New Brunswick Industry Sector

** The provincial government in PEI does fund research. However, this is a recent initiative that was not captured in the data available at the present time.

Source: Statistics Canada - GERD, Canada, 1987 to 1998 and by Province 1987 to 1996.

Industry Sector

While funding per capita from the industry sector increased from 1989 to 1995 by almost 47 percent nationally, the increase in Atlantic Canada was less dramatic at only 2 percent due in part to the fact that Atlantic Canada's industry sector is made up of mostly small and medium industry. Within Atlantic Canada, New Brunswick was the only province where there was a decrease in per capita funding from the industry sector, while Newfoundland experienced the most dramatic increase.

University Sector

Per capita funding contributions by Atlantic Canadian universities increased by 29 percent between 1989 and 1995; this is dramatically higher than the national average of 8 percent during this same time period. Per capita funding from Nova Scotia universities almost doubled while per capita funding from Prince Edward Island institutions decreased by 44 percent.

Provincial Sector

Per capita funding by provincial governments increased in Atlantic Canada by 17 percent**,** double the increase in Canada overall. Within Atlantic Canada, the bulk of the increase was in New Brunswick.

Federal Sector

Federal funding per capita in Atlantic Canada decreased by 5 percent between 1989 and 1995. In contrast, federal per capita funding in Canada as a whole increased by 5 percent over this same time period. Considering the fact that the federal government is the principal funding source in Atlantic Canada, this decrease would have had a more significant impact if not for the fact that funding from the other sectors increased somewhat over this same time period. Within Atlantic Canada, only New Brunswick witnessed an increase in federal funding; among the other three provinces Newfoundland experienced the sharpest decrease.

Foreign and Private Non-Profit Sector

Increased access to funding from foreign sources and the private non-profit sector is also needed. Historically, these two sources represent the smallest proportion of Atlantic R&D expenditures. Nonetheless, between 1989 and 1995, increases from these two sources of funding have been the most significant of the six funding sectors.

3.3 University Sector R&D Expenditures - Atlantic Canada versus Canada

A recent Association of University and Colleges of Canada publication (AUCC, 1999) notes a recent "awakening to the importance of research and the essential role played by university research in economic development" that "points to a renewed commitment to university research." Universities "are now seen as key to the country's competitiveness, taking centre stage in the policy debate" (AUCC, 1999, p. 80). This is even more true in Atlantic Canada because of the predominantly SME (small-to-medium-enterprise) structure of the economy. Subsequently, there is only one place where there is a large enough critical mass to serve as a catalyst for cross-sectoral generation and dissemination of knowledge and that is the universities.

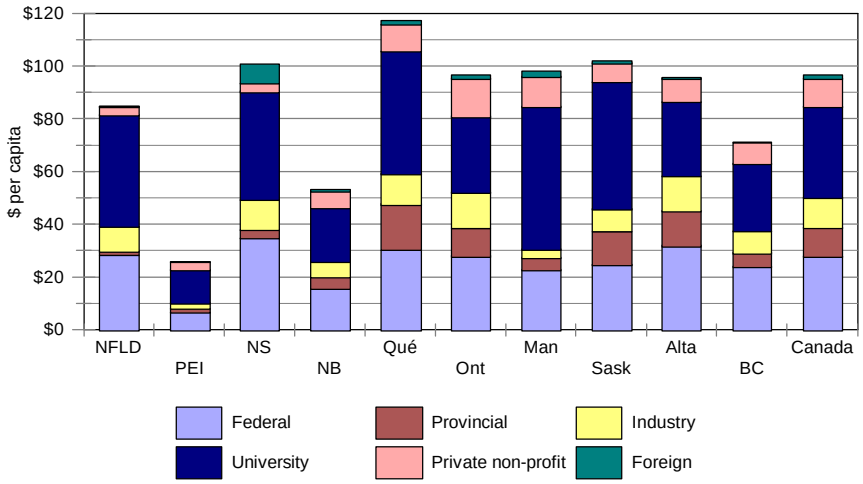
Performance and funding of research by industry and Non-Governmental Organizations (NGO's) in Atlantic Canada is negligible compared to other provinces. Federal performance of research has also been disproportionately cut back in the Atlantic compared to the national average. Between 1991 and 1997, Atlantic Canada absorbed 56 percent of the federal belt-tightening imposed on the country as a whole.

3.3.1 Provincial distribution of university R&D expenditures

In 1996-97, R&D expenditures by universities in Prince Edward Island, followed by New Brunswick, were the lowest in the country (Figure 20) even when expressed on a per capita basis. This may in part be due to the fact that these are the only two provinces without a medical school. Expenditures in Nova Scotia universities, on the other hand, are amongst the highest in the country, exceeded only by Quebec and Saskatchewan. Meanwhile, expenditures in the Newfoundland post-secondary education sector were the fourth lowest in Canada. The graph also reveals that it is universities

themselves followed by the federal government that are the primary funders of post-secondary education research. In Atlantic Canada, the private non-profit sector has been less involved than in the rest of Canada and provincial funding in the region is also among the lowest in the country.

Figure 20
R&D Expenditures per Capita in the Higher Education Sector
by Source of Funds and by Province, 1996-97



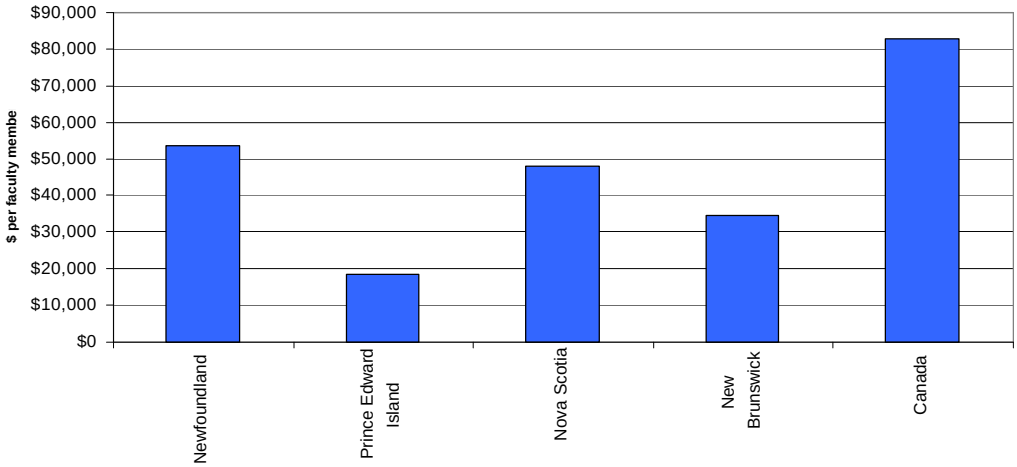
Source: Statistics Canada, GERD, 1996-1997

In spite of low levels of R&D investment in Atlantic universities, there has been steady growth in R&D expenditures per capita in the higher education sector since 1989 (Figure 21). However, this does not change the fact that per capita expenditures in New Brunswick fall below the national average - this gap is even more pronounced in Newfoundland and Prince Edward Island. In Nova Scotia, per capita expenditures were considerably higher than the national average between 1991 and 1994, although, since 1994, expenditures have stabilized at the national level.

3.3.2 University R&D in relation to faculty numbers

In 1996-97, Canadian universities employed 34,613 full-time faculty members. Of these, 4,183, or

Figure 21
Higher Education R&D Expenditures per Capita per Full-Time Faculty Member, 1997



Source: Statistics Canada, Estimation of R&D Expenditures in the Higher Education Sector, 1996-1997

12 percent of this national intellectual wealth, is located in the Atlantic provinces. It is well-known that Atlantic Canada is well-endowed with highly creditable institutions of higher learning; and it is evident from Figure 22 that university faculty as a whole in all four Atlantic provinces are significantly under-resourced relative to Canada as a whole.

3.3.3 Impact of differences in disciplinary focus - Natural Sciences and Engineering and Social Sciences and Humanities

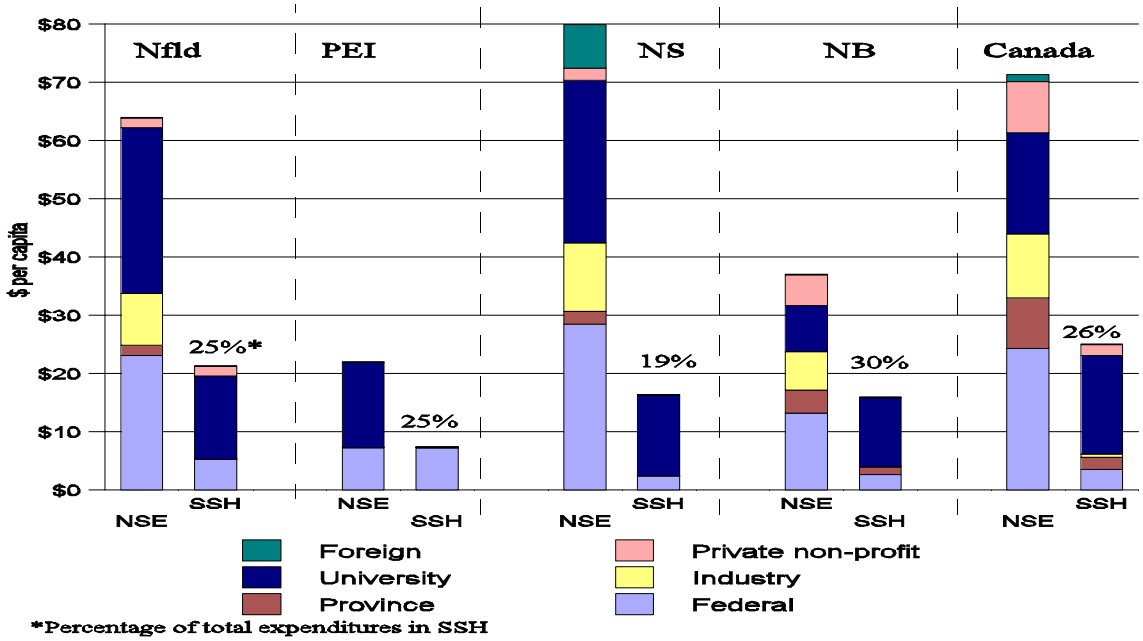
Figure 23 compares expenditures on R&D by the university sector in each of the Atlantic provinces to those by the university sector in Canada as a whole. These expenditures are then further broken down by source of funds and by type of science, i.e. research in the Natural Sciences and Engineering (NSE) disciplines versus research in Social Sciences and Humanities (SSH) disciplines. An interesting story emerges - which may explain in part why expenditures by the university sector in Prince Edward Island and New Brunswick fall significantly below the national average; why in Newfoundland the shortfall is less dramatic; and why the university sector in Nova Scotia is comparable or above the national average.

First, an examination of the distribution of R&D in the Social Sciences and Humanities disciplines versus the Natural Sciences and Engineering disciplines reveals that, in the university sector, New Brunswick spends a higher proportion (30%) on Social Sciences and Humanities than the rest of Atlantic Canada and Canada as a whole, while in Nova Scotia the proportion on Social Sciences and Humanities is the lowest at only 19 percent, compared to 26 percent nationally. Meanwhile, the university sectors in Newfoundland and Prince Edward Island meet New Brunswick and Nova Scotia in the middle at 25 percent each.

Second, Figure 23 also reveals that in Atlantic Canada funding for university research in the Social Sciences and Humanities disciplines is principally funded by the university sector, followed by the federal government, with a small portion coming from the province in New Brunswick and the private non-profit sector in Newfoundland. Therefore, funding from the industry sector is not present in the Social Sciences and Humanities disciplines. Nationally, however, industry has provided minimum funding to this area. In terms of research in the Natural Sciences and Engineering disciplines, on the other hand, the sources of funding are much more diverse and include funds from all the funding sectors to varying degrees.

Third, Figure 23 shows that per capita expenditures by the university sectors in New Brunswick and Prince Edward Island fall well below the national average; Newfoundland falls below slightly; and Nova Scotia exceeds the national average in the Natural Sciences and Engineering fields and falls below slightly in terms of the Social Sciences and Humanities fields.

Figure 23
University R&D Expenditures per Capita, by Funding Sector for Natural Sciences and Engineering and Social Sciences and Humanities, Atlantic Canada vs. Canada, 1996



Source: Statistics Canada, GERD, Canada, 1987 to 1998 and by Province 1987 to 1996

In summary, the three issues identified above lend themselves to the following observations:

? New Brunswick's lower investment level may be due in part to the fact that they do proportionately more research in the Social Sciences and Humanities disciplines - an area which typically must depend on funds from university and federal sources, namely the Social Sciences and Humanities Research Council. Moreover, industry in Atlantic Canada has been less supportive of the Social Sciences and Humanities disciplines than other areas. Rather, research in the Social Sciences and Humanities must rely on the private non-profit sector for funding outside of the public purse; unfortunately the private non-profit sector is made up for the most part of small social agencies with limited funds to begin with and has traditionally been a less important source of funding in Atlantic Canada than elsewhere in the country.

? In contrast, Nova Scotia's competitive edge, in terms of R&D expenditures, appears to be due, in part, to the fact that the province expends only 19 percent of its resources in the Social Sciences and Humanities disciplines - 11 percent less than in New Brunswick. Consequently, Nova Scotia has access to larger and more sources of funding, in particular from the industry sector.

? While Prince Edward Island is comparable to Canada in terms of expenditures in the Social Sciences and Humanities fields versus the Natural Sciences and Engineering fields, the Province has been considerably underresourced in terms of funding partners, i.e. the university sector only received funding from the federal government supplemented with in-house funding. The province has recently, however, put in place a number of new initiatives as referenced earlier.

? Finally, in Newfoundland, while the level of university R&D expenditures falls below the national average, the Province is doing well in relation to Prince Edward Island and New Brunswick.

All of the factors outlined above add up to a significantly lower than average post-secondary research investment level in the Atlantic region. This is due to a number of cumulative factors that are outlined in greater detail in subsequent chapters.

4.0 INVESTMENT TRENDS

4.1 Federal Investment

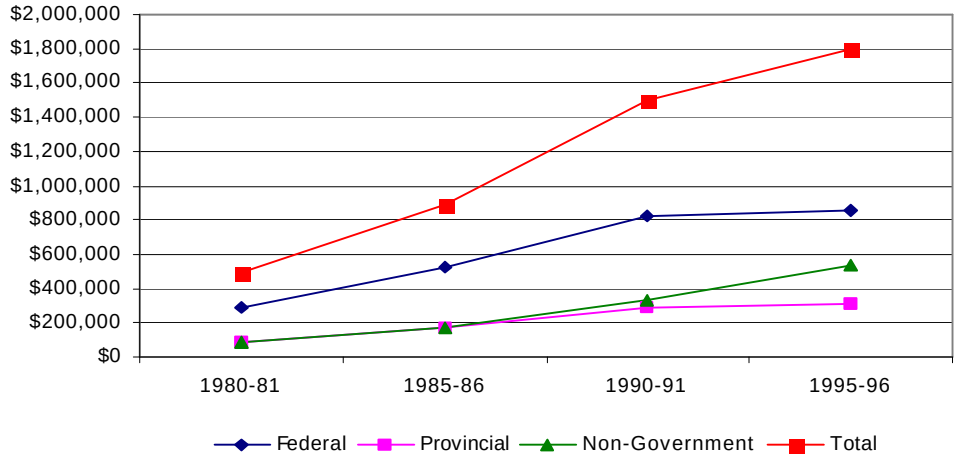
This chapter examines in detail R&D investment by the federal government, the provincial governments, and the private sector.

4.1.1 Federal research investment programmes

External funding for support of research in Canadian universities has more than tripled in the 15 years from 1980-81 to 1995-96 (Figure 24). The federal government is the single largest supporter (45 percent of total sponsored research funds in 1996-97). Non-government sources such as trusts and industrial contracts are the next largest sources (34%). Provincial government sources represent 16 percent of the total, with the balance derived largely from foreign sources.

Federal investment in Canada's post-secondary institutions can be broken down into three types of programmes: (1) granting councils; (2) line or regional departments; and (3) new initiatives. The granting councils are the single largest source of funding from the federal government. Of the total $827 million in funding made available in 1996-97 by the federal government for support of research, fully $635 million, or 77 percent was committed by the three granting councils.

Figure 24
Sources of Research Funding in Canadian Universities, 1980-81 to 1995-96



Source: AUCC

As illustrated below (Table 3), since 1980-81 funding to the three granting councils has grown dramatically. Then, between 1994 and 1997, the federal government, in an effort to control costs, markedly reduced the budgets of all three granting councils. Beginning in 1997-98, however, the budgets for these councils were substantially increased – opening up new opportunities for post-secondary research support. In 1999, the Federal Budget made available funding over three years of $75 million for the Natural Sciences and Engineering Research Council of Canada (NSERC) and $15 million for the Social Sciences and Humanities Research Council (SSHRC). Significant increases were also assigned to the federal granting councils over the next three years for health-related research as detailed below.

Table 3
Granting Council Support to Sponsored Research in Canadian Universities, 1980-81 and 1995-96 to 1999-00 ($000)

Source	1980-81	1995-96	1996-97	1997-98	1998-99	1999-00
SSHRC	14,459	58,817	55,248	87,152	84,201	97,956
NSERC	137,440	357,186	366,831	417,164	404,790	484,780
MRC	69,308	240,351	213,227	228,620	218,212	263,475
Total	221,207	656,354	635,306	732,936	707,203	846,211

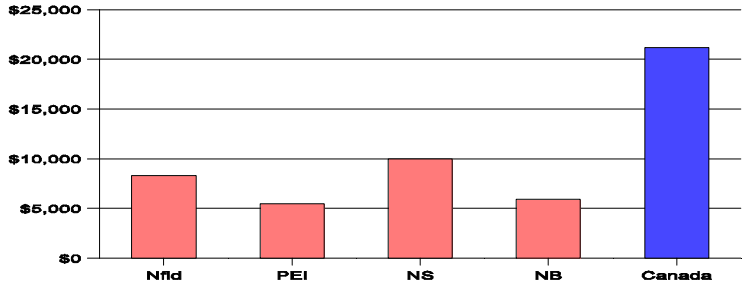
Source: Statistics Canada. ST-99-02. Provincial Distribution of Federal Expenditures on Science and Technology

The surge in federal investment in university R&D has led to the creation of a number of new and distinctive initiatives. These include (as discussed in greater detail below in terms of actual or potential impact on Atlantic Canada's universities): the Canada Foundation for Innovation, the Canadian Institutes of Health Research, the Nurse Fund, the Networks of Centres of Excellence as a permanent ongoing initiative, the Canada Research Chairs Initiative, and the recently-announced Atlantic Innovation Fund.

4.1.2 Federal investment in Atlantic Canada's post-secondary research

The surge in federal investment and initiatives provides significant opportunities to strengthen Canada's university research infrastructure and outcomes. It is clear from Figure 25, however, that "Atlantic Canadian universities and researchers get a much smaller proportion of federal funding than the regional population, student enrolments or faculty numbers would seem to warrant" (AAU, 1999, p. 10).

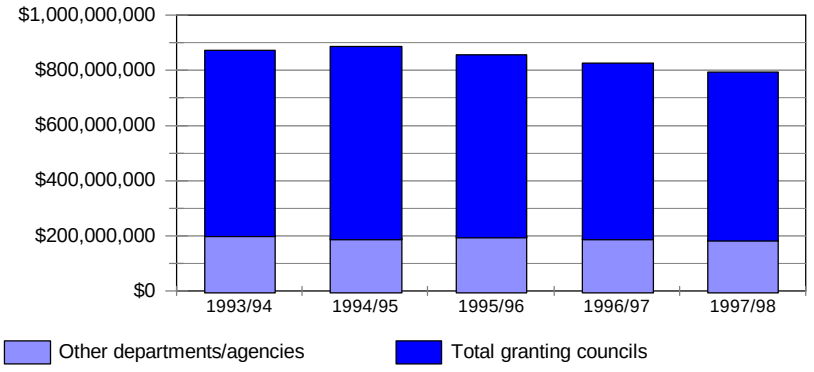
Figure 25
Federal R&D Funding to Universities per Full-Time Faculty Member, 1995-96



Source: AAU, Atlantic Canada - A Knowledge-Economy Drop-out? Presentation to the Federal Liberal Caucus, 1999, p. 10, based on MPHEC/Statistics Canada

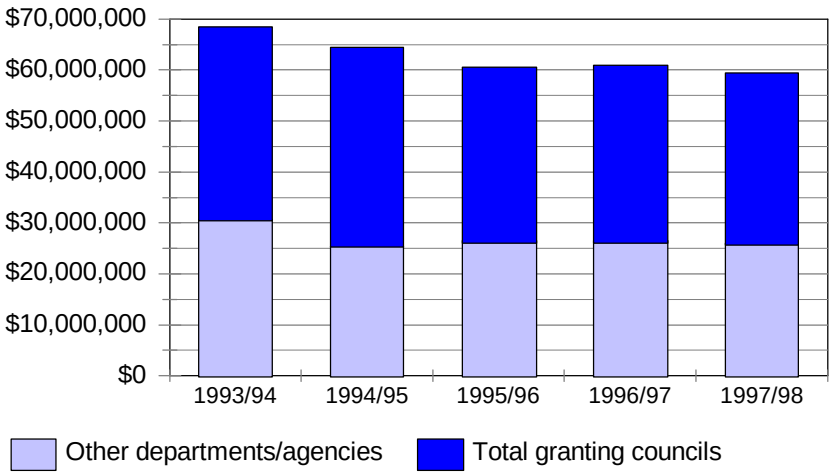
It is also important to note that there is a significant difference in programme distribution between Canada as a whole and Atlantic Canada. Nationally (Figure 26), granting councils are the most significant sources of revenues. In Atlantic Canada, however, federal departments represent the most significant source of funding (44 percent of total federal funds in Atlantic Canada versus 23 percent in Canada in 1997-98, Figure 27). This difference seems to indicate that Atlantic Canada is doing better in terms of line department programmes (generally institution to institution) than in researcher-generated proposals – a difference that warrants further exploration.

Figure 26
Federal Research Revenues Received by Canadian Universities 1993-94 to 1997-98



Source: CAUBO
Data by Canadian universities to the Canadian Association of University Business Officers (CAUBO) have not been consistent from year to year as a number of universities are now reporting sources of funding that were not previously reported. This may lead to "apparent increases" in reported funding. As a result it is important to keep in mind that trends may be affected by changes in institutional reporting.

Figure 27
Federal Research Revenues Received by Atlantic Universities 1993-94 to 1997-98



Source: CAUBO.

4.1.3 Federal Programmes

The following sub-sections deal in greater detail with each granting council as well as certain other major federal funding initiatives in order to gain a better understanding of funding patterns in Atlantic Canada.

Natural Sciences and Engineering Research Council of Canada (NSERC)

As Table 4 demonstrates, Atlantic universities received on average, between 1993-94 and 1997-98, 7.0 percent of total NSERC revenues received by universities across Canada. Fully half (50.5%) of the Atlantic revenues is received by Nova Scotia universities.

Table 4
Revenues Received from NSERC for University Sponsored Research by Province, 1993-94 to 1997-98 ($000)

	1993-94	1994-95	1995-96	1996-97	1997-98
New Brunswick	5,571	6,269	6,420	6,089	5,675
Nova Scotia	13,456	15,320	11,683	12,618	12,351
Prince Edward Island	485	410	272	443	469
Newfoundland	7,408	5,775	5,907	5,940	5,941
Québec	99,642	97,958	94,892	96,618	83,988
Ontario	145,120	148,493	129,308	138,894	122,582
Manitoba	9,796	11,315	9,754	8,500	9,274
Saskatchewan	13,921	14,681	12,172	14,919	10,061
Alberta	31,930	37,982	33,878	35,098	38,875
British Columbia	54,008	58,379	52,900	47,712	47,871
Atlantic Total	26,920	27,774	24,282	25,090	24,436
Canada Total	381,337	396,582	357,186	366,831	337,087
Atlantic as a % of national total	*7.06%*	*7.00%*	*6.80%*	*6.84%*	*7.25%*

Source: CAUBO

As Table 5 shows, Dalhousie University and Technical University of Nova Scotia (included within Dalhousie as of 1997-98) has received on average, over the same five years, 38.9 percent of total NSERC revenues by Atlantic universities. Memorial University and the University of New Brunswick were the other top receiving institutions, receiving on average 24.1 and 19.8 percent respectively of the Atlantic's share. These three universities thus receive over 80 percent of total NSERC revenues in the Atlantic. These figures must also be evaluated in the context of the diversity of institutional mandates and areas of specialization.

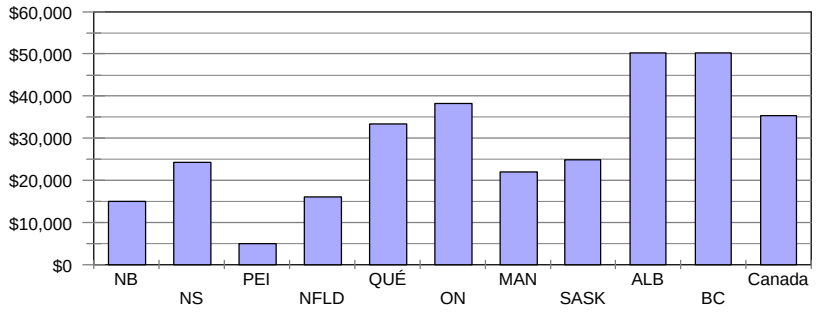
Table 5
Revenues Received from NSERC for Sponsored Research by Atlantic Universities, 1993-94 to 1997-98 ($000)

University	1993-94	1994-95	1995-96	1996-97	1997-98
Memorial University	7,408	5,775	5,907	5,940	5,941
University of Prince Edward Island	485	410	272	443	469
Acadia University	679	615	546	658	679
University College of Cape Breton	114	96	133	139	42
Dalhousie University*	8,701	8,598	7,735	7,592	9,461
Mount Saint Vincent University	192	228	114	79	63
NS Agricultural College	423	2,321	214	214	549
Saint Mary's University	546	696	541	830	614
St. Francis Xavier University	833	872	635	816	943
Technical University of NS*	1,968	1,894	1,765	2,290	-
St. Thomas University	0	0	0	2	0
Université de Moncton	492	427	423	478	595
Mount Allison University	529	465	384	407	444
University of New Brunswick	4,550	5,377	5,613	5,202	4,636
Total	**26,920**	**27,774**	**24,282**	**25,090**	**24,436**

***Technical University of Nova Scotia (TUNS) data included with Dalhousie data in 1997-98.
Source: CAUBO

The following graph (Figure 28) presents the distribution of NSERC funding on a per faculty basis by province.

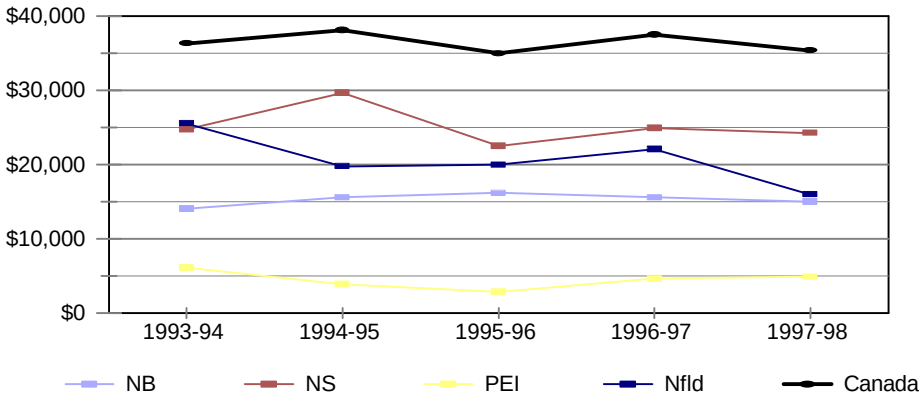
Figure 28
NSERC Funding Received by Universities for Sponsored Research per Faculty Member in Natural Sciences and Engineering Disciplines by Province, 1997-98



Source: CAUBO

The graph that follows (Figure 29) presents the same measure over time. Atlantic Canada was below the Canadian average in terms of the level of NSERC funding between 1993-94 and 1997-98.

Figure 29
NSERC Funding Received by Universities for Sponsored Research per Faculty Member in Natural Sciences and Engineering Disciplines, by Atlantic Province, 1993-94 to 1997-98



Source: CAUBO

It should also be noted that preliminary data indicate that the average NSERC grant received in Atlantic Canada is significantly lower than the Canadian average.

Social Sciences and Humanities Research Council (SSHRC)

As Table 6 shows, the Atlantic received on average, between 1993-94 and 1997-98, 5.4 percent of total SSHRC revenues received by universities across Canada. This is a lower share than that of NSERC revenues, as shown in the previous section. It should also be noted that the Atlantic's share of SSHRC funding has steadily decreased since 1994-95, and, in 1997-98, stood at a five-year low.

Table 6
Revenues Received by Universities from SSHRC for Sponsored Research by Province, 1993-94 to 1997-98 ($000)

	1993-94	1994-95	1995-96	1996-97	1997-98
New Brunswick	718	839	613	721	712
Nova Scotia	1,540	2,094	1,752	1,325	1,300
Prince Edward Island	103	98	119	96	86
Newfoundland	626	1,046	726	804	327
Québec	20,543	21,865	20,493	18,800	16,747
Ontario	21,967	21,162	20,656	18,362	18,532
Manitoba	1,320	1,373	1,273	1,270	1,352
Saskatchewan	439	1,312	1,121	1,116	469
Alberta	4,198	3,899	3,398	3,411	5,153
British Columbia	8,132	7,930	8,654	9,332	9,127
Atlantic Total	2,987	4,077	3,210	2,946	2,425
Canada Total	59,586	61,618	58,805	55,237	53,805
Atlantic as a % of national total	*5.01%*	*6.62%*	*5.46%*	*5.33%*	*4.51%*

Source: CAUBO

As the next table demonstrates (Table 7), the distribution of SSHRC revenues by universities is more even than NSERC's. Dalhousie University, on average, has received the most from SSHRC, followed

closely throughout the same period, except in 1997-98, by Memorial University. The other top recipients of SSHRC dollars were the University of New Brunswick, Acadia University, Université de Moncton, Saint Mary's University, Mount Saint Vincent University, St. Francis Xavier University and Mount Allison University.

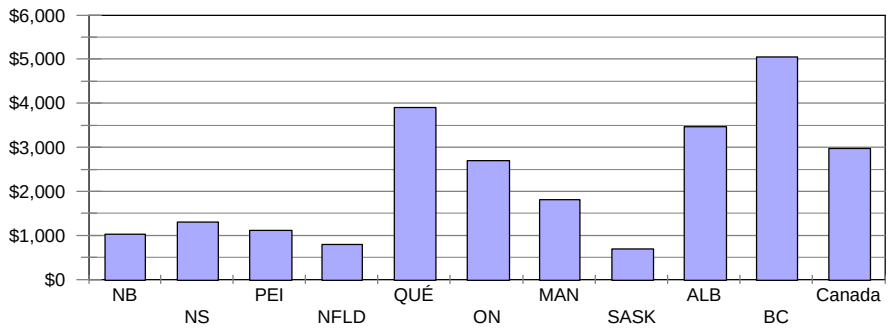
Table 7
Revenues Received from SSHRC for Sponsored Research by Atlantic Universities, 1993-94 to 1997-98 ($000)

University	1993-94	1994-95	1995-96	1996-97	1997-98
Memorial University	626	1,046	726	804	327
University of Prince Edward Island	103	98	119	96	86
Acadia University	380	392	238	207	225
University College of Cape Breton	13	27	86	180	78
Dalhousie University	747	789	907	532	605
Mount Saint Vincent University	232	203	124	100	113
NS Agricultural College	0	54	37	37	33
Saint Mary's University	0	429	213	133	132
St. Francis Xavier University	151	156	132	111	93
Technical University of NS*	17	44	13	13	0
University of King's College	0	0	2	2	2
Université Sainte-Anne	0	0	0	10	19
St. Thomas University	56	35	39	25	16
Université de Moncton	72	266	197	187	208
Mount Allison University	132	120	43	78	117
University of New Brunswick	458	418	334	431	371
Total	2,987	4,077	3,210	2,946	2,425

***** Technical University of Nova Scotia (TUNS) data included with Dalhousie data in 1997-98 and subsequent years.
Source: CAUBO

The graph that follows (Figure 30) presents the distribution of SSHRC funding on a per faculty member basis by province. Atlantic Canada lags behind the other Canadian provinces by this measure. Only Saskatchewan falls in the same category. The other provinces receive, on a per faculty member basis, nearly double or more what the Atlantic receives.

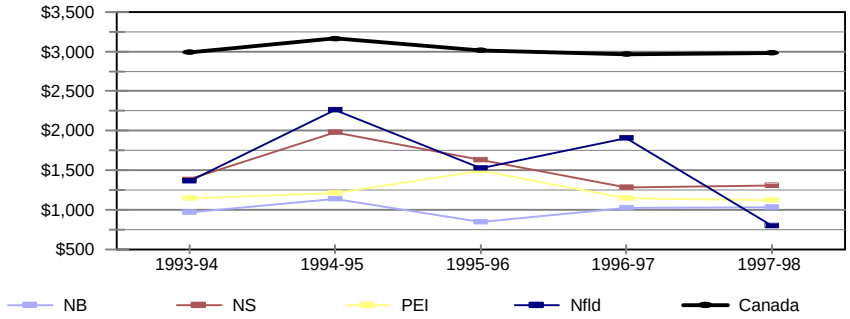
Figure 30
SSHRC Funding Received by Universities for Sponsored Research per Faculty Member in Social Sciences and Humanities Disciplines by Province,1997-98



Source: CAUBO

The following graph (Figure 31) presents the same measure over time. The differences between Atlantic Canada and the national average have remained relatively constant between 1993-94 and 1997-98. Universities have differing mandates. This should be kept in mind whenever quantitative comparisons are made. This note of caution holds for the use of quantitative comparisons throughout this report.

Figure 31
SSHRC Funding Received by Universities for Sponsored Research per Faculty Member in Social Sciences and Humanities Disciplines, by Atlantic Provinces, 1993-94 to 1997-98



Source: CAUBO

Furthermore, preliminary data indicate that the average SSHRC grant received in Atlantic Canada is significantly lower than the Canadian average grant.

Medical Research Council (MRC)

As Table 8 shows, the Atlantic received on average, between 1993-94 and 1997-98, 3.0 percent of total MRC revenues received by universities across Canada, which represents the lowest Atlantic percentage of revenues from all three granting councils.

Table 8
Revenues Received by Universities from MRC for Sponsored Research by Province, 1993-94 to 1997-98 ($000)

	1993-94	1994-95	1995-96	1996-97	1997-98
New Brunswick	38	22	72	97	10
Nova Scotia	6,150	5,685	4,878	4,666	5,278
Prince Edward Island	53	48	54	59	56
Newfoundland	1,803	1,507	1,508	1,598	1,189
Québec	70,202	76,212	74,024	68,450	65,256
Ontario	85,029	80,700	98,338	82,572	84,640
Manitoba	10,509	10,149	9,026	8,249	9,351
Saskatchewan	4,482	3,721	3,650	2,547	2,485
Alberta	26,390	26,960	26,201	25,894	28,688
British Columbia	26,420	30,246	22,600	19,095	19,226
Atlantic Total	8,044	7,262	6,512	6,420	6,533
Canada Total	231,076	235,250	246,791	213,227	216,179
Atlantic as a % of national total	*3.48%*	*3.09%*	*2.64%*	*3.01%*	*3.02%*

Source: CAUBO

As the following table shows (Table 9), Dalhousie University, followed by Memorial University, are the leaders in terms of revenues received from MRC by Atlantic universities. In this context, it should be remembered that these two universities have the only medical schools in Atlantic Canada.

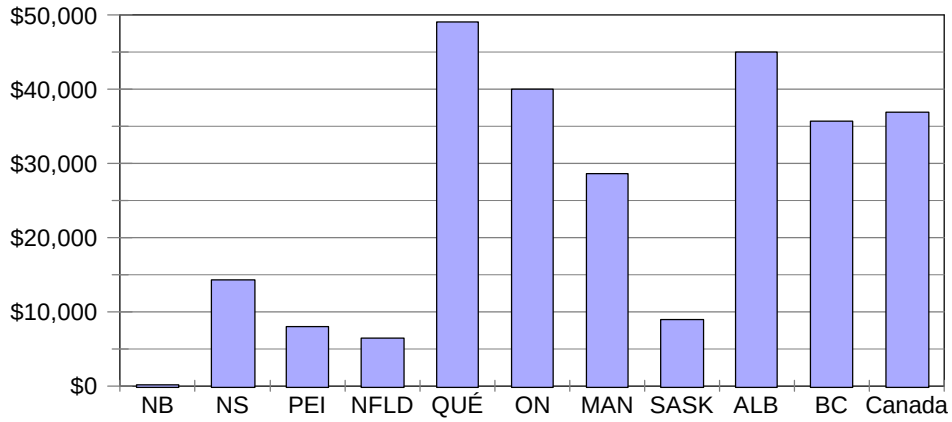
Table 9
Revenues Received from MRC for Sponsored Research
by Atlantic Universities, 1993-94 to 1997-98 ($000)

University	1993-94	1994-95	1995-96	1996-97	1997-98
Memorial University	1,803	1,507	1,508	1,598	1,189
University of Prince Edward Island	53	48	54	59	56
Dalhousie University	5,782	5,685	4,866	4,640	5,268
Mount Saint Vincent University	0	0	12	26	10
Saint Mary's University	368	0	0	0	0
University of New Brunswick	38	22	72	97	10
Total	8,044	7,262	6,512	6,420	6,533

Source: CAUBO

The graph that follows (Figure 32) presents the distribution of MRC funding on a per faculty basis by province. Atlantic Canada lags behind in terms of MRC funding. All other provinces, except Saskatchewan, receive nearly twice (Manitoba), or more (Quebec, Alberta and British Columbia).

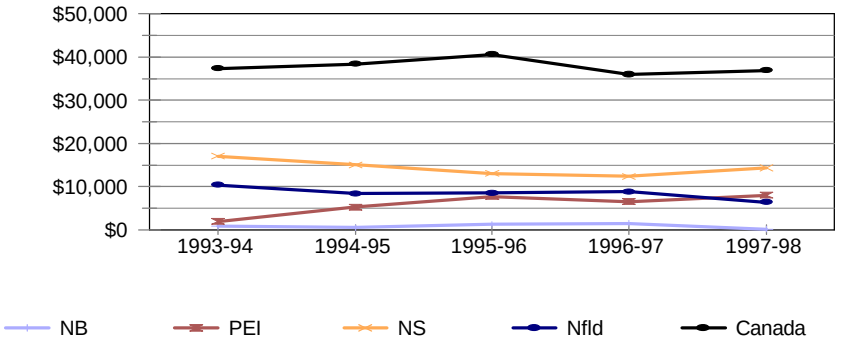
Figure 32
MRC Funding Received by Universities per Faculty Member in Health Disciplines by Province Sponsored Research, 1997-98



Source: CAUBO

The following graph (Figure 33) presents the same measure over time. Over the last five years, Atlantic Canada has systematically received less than one third the Canadian average of MRC funding received by universities.

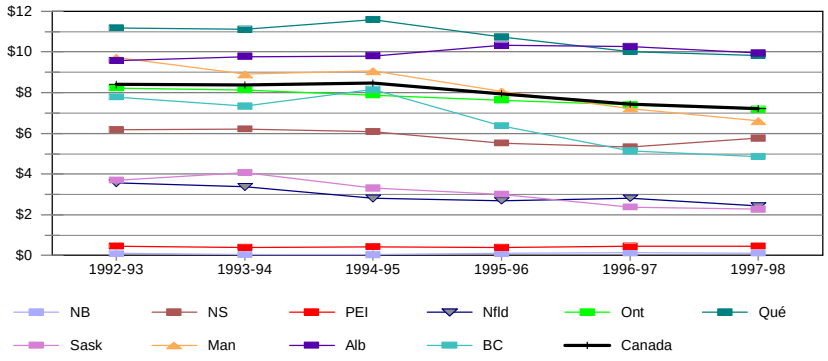
Figure 33
MRC Funding Received by Universities per Faculty Member in Health Disciplines, by Province, Sponsored Research, 1993-94 to 1997-98



Source: CAUBO

The next figure shows the distribution of Medical Research Council (MRC) expenditures, using dollars per capita, by province between 1992-93 and 1997-98 (Figure 34). The graph clearly shows that all four Atlantic provinces are below the national average. Within Atlantic Canada, per capita expenditures in 1997-98 were the lowest in New Brunswick at $0.12 per capita while the highest were in Nova Scotia at $5.76 per capita. Per capita expenditures in Prince Edward Island were four times higher than in New Brunswick at $0.45 per capita. Per capita expenditures in Newfoundland came in at $5.42. It should be noted again that only Nova Scotia and Newfoundland have medical schools. These are regional programmes that serve the needs of Atlantic provinces. Prince Edward Island outperformed New Brunswick due to the fact they are the home of the Atlantic Veterinary College (also designated as a regional programme).

Figure 34
Distribution of MRC Expenditures per Capita by Atlantic Province, 1992-93 to 1997-98



Source: MRC, Report of the President

In 1997-98, the national average was $7.23 per capita with Québec coming in at the highest level in the country, followed closely by Alberta. It is also important to note that, with the exception of Newfoundland, Atlantic Canada was the only region to experience an increase in per capita

expenditures between 1995-96 and 1997-98. As a result, the situation in Atlantic Canada appears to be improving. However, it has a long way to go just to come up to par with the national average.

A recent announcement by MRC to expand the Regional Partnerships Programme will likely help to improve the situation. In 1996, the MRC launched the Regional Partnerships Programme in response to a decline in MRC funding to health researchers in certain regions of Canada - Saskatchewan, Nova Scotia, Newfoundland and to a lesser extent Manitoba. This new programme is intended to support a local strategic planning process to establish research priorities and partnerships while emphasizing the recruitment of promising and/or recognized scientists in order to build and maintain a critical mass of health researchers. In the Fall of 1999, MRC announced that the programme had been extended to include researchers in New Brunswick and Prince Edward Island health research institutions. The inclusion of these two provinces shows that MRC recognizes the calibre of health research already being done in New Brunswick and Prince Edward Island. The expansion of the programme translates to a total of $2 million that is being made available to both New Brunswick and Prince Edward Island to fund new health research over the next five years. The programme was designed in part to ensure that a strong link exists between Canada and its researchers and to build on local strengths and priorities of area institutions. The support provided by this programme is a critical step in the development of a regionally-sensitive and locally-relevant research base.

All proposals under this programme are evaluated through the MRC's peer review process and are funded on a 1:1 basis, i.e. institutions must provide leverage of one dollar of research support from regional partners for every MRC dollar approved. Annual MRC funding of $200,000 has been allotted to the programme for both Prince Edward Island and New Brunswick for a period of five years. With matching partner funding, up to $400,000 in new health research can be undertaken in each of the two provinces annually over the next five years.

In MRC's June 1999 round of funding announcements, this programme created the potential for an additional 22 operating grants to health researchers: 13 at the University of Manitoba, six at the University of Saskatchewan, two at Memorial University, and one at Dalhousie University.

The criterion that the institutions must secure matching funding relative to MRC's Regional Partnership Programme is likely to present serious hurdles in the Atlantic provinces particularly for population health programmes where partners often tend to be cash-strapped non-profit groups. Experience with the Canada Foundation for Innovation (CFI), which also requires matching funds, has proven that, in Atlantic Canada. The need to secure matching funds represents a significant impediment to access.

Canada Foundation for Innovation (CFI)

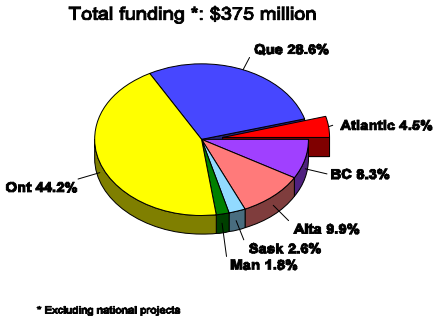
The announcement in the 1997 federal budget of the establishment of the Canada Foundation for Innovation was a key initiative in renewing the research infrastructure of Canadian universities. This was a major funding initiative set up as an independent entity with an endowment of $800 million. The 1999 federal budget added $200 million to the Foundation, with about half that amount expected to support health-related research infrastructure improvements. The Federal 2000 Budget provided a further $900 million to support continued awards to 2005. Designed to provide universities and teaching hospitals with leading edge research equipment and facilities, the CFI's mandate is to target areas of science, engineering, health and environment. As a matching fund scheme, with contributions from the Foundation limited to 40 percent of the total cost of infrastructure projects, the

total investment in research infrastructure leveraged by the CFI is expected to be around $5.0 billion, making it one of the most significant initiatives ever undertaken by the federal government to help ensure that the Canadian research establishment remains internationally competitive.

The CFI initiative triggered many provinces to introduce special funding envelopes or to modify existing funding programmes to help universities tap CFI programmes by providing some of the required matching funding. Significant capital proposals have been put forward by Atlantic universities and funding decisions are being taken as quickly as the review process will allow. To date, 13 institutions have received awards totalling over $17.5 million of the approximate $436 million committed to date for capital infrastructure projects ($388 million excluding national projects).

Again, however, the Atlantic Canadian total represents a very low proportion (around 4.5%) of the national allocation (Figure 35). While significant infusions of new capital are represented in these amounts, Atlantic universities are experiencing difficulties in accessing this programme. This is due largely to major difficulties in obtaining matching funds. The main reason, however, is that for the Research Development Fund (including all of Atlantic Canada's universities except Dalhousie) allocations were set according to a formula based on previous granting council funding. This meant that Atlantic Canada's universities that came under the Research Development Fund were limited in Round One by a historical cap. Those universities who have met their Round One quotas (eg. University of New Brunswick, Université de Moncton) will be competing in terms of competitive quality of proposals in Round Two but continue to have major problems securing matching funds. It is not yet clear whether the Atlantic Canada Opportunities Agency will provide the same level of matching funds as it did in Round One, though the recent announcement of the new federal Atlantic Innovation Fund may help to address the challenge in future.

Figure 35
Distribution of CFI Funding by Province, as of February 29, 2000



Source: AAU, based on CFI data

Canadian Institutes of Health Research (CIHR)

The new Canadian Institutes of Health Research concept was announced in the federal February 1999 Budget. The intent was to offer a modern framework to bring together all fields of health research in Canada. The proposal calls for the establishment of a network of virtual organizations that will link, coordinate and support the full spectrum of health research across Canada. The initiative will involve research hospitals, universities, private partners as well as experts drawn not only from the biomedical sciences but also from the natural sciences, engineering, the social sciences and the humanities.

The CIHR received significant support in 1999. The government established a transition team to further develop the proposal and provided financial support to health-related research in the meantime. Five groups share $50 million a year while the proposal is being developed ($27.5 million a year to the Medical Research Council; $7.5 million to SSHRC; $7.5 million to NSERC; $5 million to the National Research Council; and $2.5 million to Health Canada). To support the new CIHR, the government set aside an additional $65 million in 2000-01, the first year of operation. The Canadian Health Services Research Foundation received a $35 million endowment (in addition to the $65 million the Foundation received when it was established in 1996 to research the effectiveness of Canada's health care system). The new funds for the various agencies are to be used to support CIHR objectives. MRC is expected to become part of CIHR when it is established in the year 2000.

Experience with previous new federal opportunities indicates the need for continuing development of appropriate ways to maximize Atlantic Canadian participation.

Nurse Fund

The Federal Government also announced in its February 1999 Budget that it is providing an endowment in support of a ten year nursing research programme. This new research initiative will deal with the changing roles and needs of nursing. It will be administered by the Canadian Health Services Research Foundation, a partner in the CIHR enterprise. The expanded research capacity developed by the Nurse Fund would, in turn, strengthen the contribution of nursing research to the integrated research agenda anticipated by the CIHR. This new opportunity will be of significant interest to the Atlantic provinces' nursing programmes.

The Networks of Centres of Excellence (NCE)

The 1997 federal budget brought additional good news for inter-university collaboration with a permanent status conferred on the Networks of Centres of Excellence with a yearly envelope of $47.4 million. In 1999, the government added an additional $90 million over three years to the NCE programme. Supported and coordinated by the three granting councils and Industry Canada, this unique programme links researchers across the country.

The Networks of Centres of Excellence programme builds research networks that are also partnerships. Each NCE assembles researchers from many fields. Researchers remain in their own universities to teach students and provide advice locally. Each NCE involves a group of partners from industry and other sectors who work with the researchers to develop a research strategy to set their joint goals. The research is then supported by the federal government through the NCE programme, by industry, and by the universities all acting in partnership. It produces new knowledge and new solutions, and often leads to innovations in the market and greater productivity.

Today, Canada has 15 NCE's (5 located in Ontario, 4 in Quebec, 1 in Manitoba, 3 in Alberta and 2 in British Columbia) involving a majority of universities across Canada doing research on problems ranging from arthritis to sustainable forest management, from genetic diseases to robotics. Eight Atlantic universities are involved in 11 NCEs. In addition, there is a new Atlantic-led NCE in Aquaculture.

The Government of Canada issued a call for applications on January 12, 2000 to establish new Networks of Centres of Excellence in the following areas:

- The Automobile of the 21st Century;
- Genomics Technologies and Society;
- Meeting Environmental Challenges for Clean Water;
- Early Child Development and Its Impact on Society.

The Government has allocated $13 million for this year's targeted competition. The results from the 1999 competition, which was open to proposals for research in all areas were recently announced. As a result, three new NCE's were recommended for funding, one of which is a new Atlantic-led NCE in Aquaculture. It is expected that these two competitions will lead to the creation of up to eight new NCEs. Increased Atlantic Canadian leadership and participation in NCE's is critical.

Atlantic Investment Partnership

The new $300 million Atlantic Innovation Fund, will invest in the region's technology and research infrastructure, particular Atlantic universities and research institutions. It will also encourage the formation of new partnerships among the region's universities, as well as between government and industry. While the Fund will make investments in individual sites and institutions, it will place a strong emphasis on a pan-Atlantic collaboration and will favour those efforts that reach beyond a single locale or province. The Fund will foster excellent in innovation oriented to the world beyond Atlantic Canada, building on the existing comparative strengths of the region. It will also be an Atlantic "partner" in augmenting the impact of federal R&D programmes in the region.

4.2 Provincial Investment

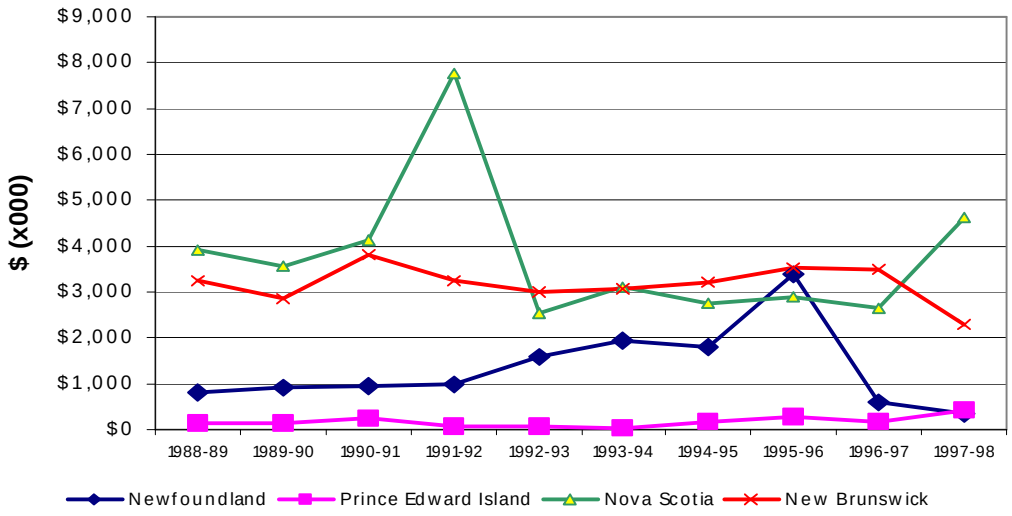
4.2.1 Overview

Between 1988-89 and 1997-98, total funding of university research by provincial governments in the Atlantic region ranged between $8 and $12 million or from $3 to $5 per capita. Figure 36 illustrates a ten-year trend in provincial funding of university research by province in Atlantic Canada.

In New Brunswick, provincial funding remained relatively stable over time and averaged around $3 million. In Nova Scotia, provincial funding averaged $3.8 million over 10 years; however, there was great fluctuation over this time period, with funding exceeding $7 million in 1991-92 which then dropped to an all time low in 1996-97 at $2.6 million. Provincial funding in Newfoundland increased steadily between 1988-89 and 1995-96, when funding peaked at approximately $3.4 million. This was followed by a sharp decrease in the subsequent years, reaching a low of $365,000 in 1997-98. Finally, provincial funding in Prince Edward Island fluctuated significantly between 1988-89 and 1997-98 and averaged $180,000 over this time period; in 1993-94 funding decreased to $37,000 and in 1997-98 it reached an all time high of $416,000.[5]

[5] In this context, it should be noted that the Province of Prince Edward Island has increased funding through several new programmes including the Provincial Health Research Programme (PHRP)), the Agriculture Research Investment Fund (ARIF), and the Aquaculture and Fisheries Research Institute (AFRI).

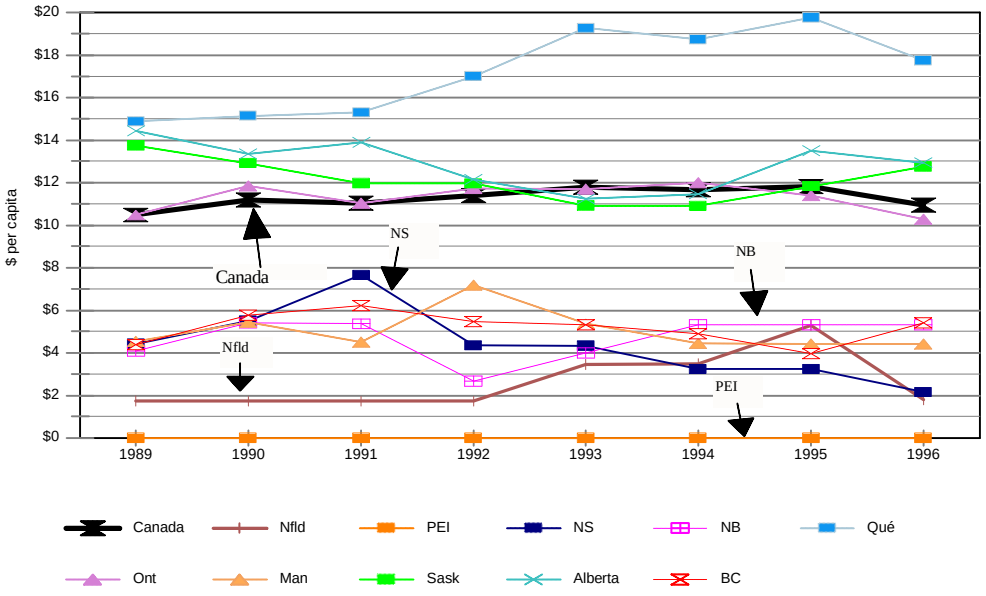
Figure 36
Provincial Government Funding of University Research Received by Atlantic Provinces, 1988-89 to 1997-98 ($000)



Source: CAUBO

Per capita contributions to university research by provincial governments are contrasted in Figure 37. The graph clearly demonstrates that provincial funding in the Atlantic region is seriously below the national average, with levels in Québec being the strongest in the country, followed by Alberta, Saskatchewan and Ontario.

Figure 37
Per Capita Funding of University Research in Canada by Provincial Governments, 1989 to 1996



Source: Statistics Canada, GERD-Canada, 1987-1998, GERD by province, 1987-1996

Provincial investment in post-secondary research in Atlantic Canada is clearly not keeping pace with investments by other provinces, particularly those that are moving ahead in terms of their share of national GERD.

4.2.2 Impact of decline in core funding

Any discussion of the role of the provinces in funding university research must take into account the issue of declining core funding. Indeed, approximately one half of all university research activity is funded by the universities themselves through salary and overhead contributions. Universities have suffered from an unprecedented decline in their core budgets over the past several years. One of the major factors contributing to this decline has been the federal cuts to transfers for post-secondary education. These cuts have hit the Atlantic provinces hard. If one assumes that 30% of the Canada Health and Social Transfer (CHST) is in support of post-secondary education, these reductions come to $62 million in Nova Scotia, $50 million in New Brunswick and $9 million in Prince Edward Island (Association of Atlantic Universities).[6] Provincial funding has also declined as a result of fiscal pressures and constraints.

As noted in a recent AAU-APEC study:

> *On a per-student basis, Atlantic Canadian universities receive comparatively less funding than other regions of the country. Provincial operating grants in Atlantic Canada in 1997/98 averaged $7,366 per full-time student, 13% below the Canadian average of $8,479. Regionally, these range from a low of $6,154 in Nova Scotia to a high of $11,312 in PEI* (APEC and AAU, 2000, p. 15).

There is also the size factor. Atlantic Canada's universities are smaller in size than Canada's largest research university. In this context, it is important to note that indirect research costs are higher for small universities (representing at least 50 percent of total research costs) than for large universities (where indirect research costs represent about 40 percent of total research costs).[7]

Such factors are affecting the capacity of Atlantic universities to provide infrastructure support for researchers (including support for release time, fund-raising, proposal preparation, partnership development, spin-off opportunities, commercialization etc.).

The disproportionately high reliance on government (as compared with industry) funding in the Atlantic provinces is exacerbating the impact of core funding reductions on the ability of post-secondary institutions to maintain, let alone strengthen, their research capacity. In Atlantic Canada, as noted in the previous section, there is only limited opportunity to capture increased investments available elsewhere from non-governmental or industrial sources.

[6] The 2000 Federal Budget contains provisions for increased CHST funding. However, the amount that will be allocated respectively by each province to health and post-secondary education has yet to be released.

[7] Unpublished material prepared for Statistics Canada Working Group on Higher Education, R&D Expenditures, February 2000.

4.2.3 Special provincial post-secondary research support initiatives

All Canadian provinces, with the exception of three in Atlantic Canada (New Brunswick, Prince Edward Island, and Newfoundland) have set up specific funding mechanisms to support post-secondary research. Examples include the Manitoba Innovations Fund, the BC Knowledge Development Fund and Alberta's Intellectual Infrastructure Partnership programme. The only Atlantic province that provides support specifically targeted towards research is Nova Scotia which has included an amount for post-secondary research in its funding formula. However, this amount has been capped so as to avoid a situation where any increase in awards would need to be covered from operating grants. New Brunswick has recently undertaken a review of post-secondary funding; the report notes that the MPHEC is undertaking a study in this area and recommends a closer look at post-secondary research funding in that Province when findings become available.

In this context, it should be noted that the Atlantic provinces have used their Federal-Provincial Regional Economic Development Agreement funds to match Canada Foundation for Innovation proposals that were successful under Round One of the Canada Foundation for Innovation competition. It is uncertain at the present time, however, to what extent this same opportunity will be available for Round Two. This presents a major challenge given that Atlantic universities do not generally have access to provincial CFI research support available in all other provinces. It is expected that the recently announced Federal Atlantic Innovation Fund will help alleviate this matching fund challenge in future.

There is also debate whether research should be included in the overall operating envelopes (thus giving universities wider discretion in terms of investment) or whether it should be specifically targeted. One advantage of specially designated funding is that these are more attractive to federal institutions and non-post-secondary education provincial departments. On the other hand, such programmes are usually short-term only, leading to longer term operational pressures:

> *....decreases in operating budgets...create a tension on campus between support for research and support for teaching. This tension is likely to be compounded by the additional demand generated by the injection of new money in the research infrastructure (through the CFI awards and matching funds) over the next five years. In fact, NSERC estimates it will need an additional $50 million a year starting in 2001-2002 to support the operating costs of the new CFI-funded installations and facilities. Granting council support is also stretched thinner by the inclusion of more indirect costs in grants. This shift has become increasingly frequent in recent years as the use of services and equipment from various sources has declined significantly and must now be bought with grant money* (AUCC, 1999, p. 90).

Regardless of this debate, it is clear that the combination of core budget constraints and the lack of availability of special research funding initiatives comparable to those in other provinces is impeding growth of post-secondary research in Atlantic Canada. The level of provincial investment (regardless of whether it is provided through basic operating grants or through the form of core budget increases or special envelopes) is significantly lower in the Atlantic provinces. The impact of this gap in funding is exacerbated as a result of the higher level of reliance in Atlantic Canada on government relative to industry and non-governmental organizations.

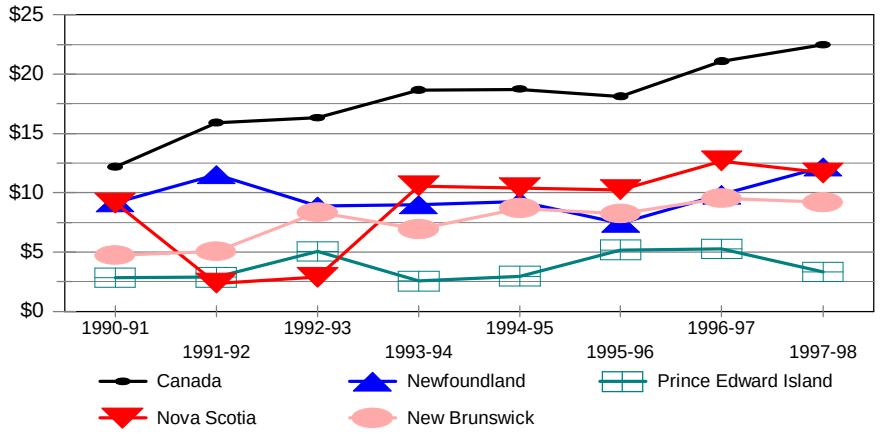
4.3 Private Sector Research Funding

Measures of private sector investments in university research activities are difficult to obtain through public information systems. Statistics Canada offers one such source but the most recent available data are for fiscal year 1996-97. Consequently, we have relied on summary data obtained from the Canadian Association of University Business Officers (CAUBO). The numbers, however, aggregate industrial research grants, contracts and contributions with other private sector allocations of funds, i.e. trusts.

In summary, private sector research funding in Canada has almost doubled in the last eight years. This trend is also occurring in Atlantic Canada, but at a reduced rate of growth (56 percent over eight years). Regionally, the level of private sector funding is 3.3 times that of the provincial governments and therefore second only to federal funding as a source of external funding for the universities, reaching the level of $25 million in 1997-98.

When private sector funding is expressed on a per capita basis, it is clear that the four Atlantic provinces lag behind Canada as a whole in terms of attracting funding from the private sector (Figure 38).

Figure 38
Private Sector Research Funding to Atlantic Universities, per capita, 1990-91 to 1997-98



Source: CAUBO

The presence of Non-Governmental Organizations (NGOs) in Atlantic Canada is largely through branch liaison offices. It is therefore somewhat more difficult for Atlantic post-secondary researchers to gain access to this support than those in closer geographic proximity to head offices in Central Canada. The proportion of non-government research taking place in Atlantic Canada is among the lowest in the country. In 1998, bequests, donations and non-government grants made up 23 percent of sponsored research revenues in Atlantic universities (APEC and AAU, 2000, p. 10).

In short, the Atlantic provinces have not in the past enjoyed the same partnerships and access to private sector funding as the larger provinces. The reality in Atlantic Canada is that small to medium sized companies make up the bulk of the potential partners in university research and they do not necessarily have the resources to provide the matching funds that are required for most federal

research funding programmes. This is particularly true for research in the social sciences and humanities where partners are often cash-strapped small, community, non-profit organizations.

5.0 RESEARCHERS

Chapter five examines current and projected availability of researchers and innovators in the Maritimes.

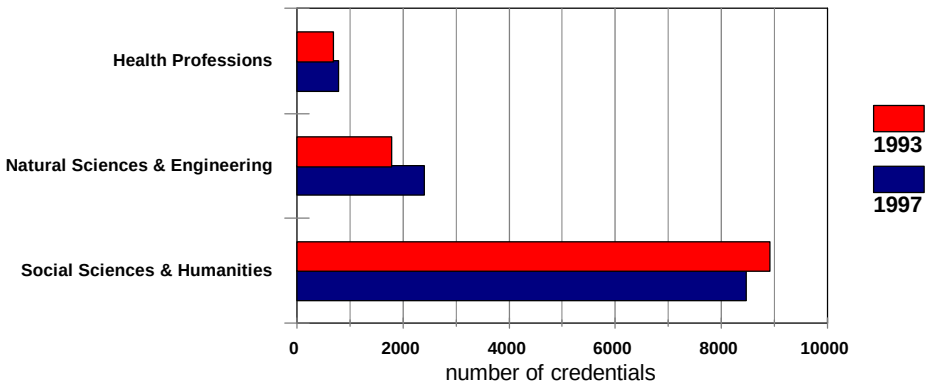
5.1 Undergraduate Students

It goes without saying that the pool of graduate students, and inevitably, faculty, is supplied solely by those who have an undergraduate credential. While not every undergraduate goes on to pursue studies at the graduate level, it is more likely that those who are exposed to research while undergraduates will go on to graduate school, given that students are often "turned off" or "hooked" on research in their undergraduate years.

It is important to recognize the critical role played by primarily undergraduate institutions. They provide excellent opportunities for undergraduates to participate in academic research. With no graduate programmes or a very limited number of graduate students, faculty at smaller institutions must rely on undergraduates to work as research assistants (Mandell, 1999). Such an enriching experience may inspire those students to enrol in a graduate programme. An opportunity to work closely with researchers at that level is essential to achieving a strong knowledge development capacity, regardless of whether these students go on to the graduate level. This raises the issue of the participation of undergraduates in academic research and, furthermore, their preparation by faculty for graduate research.

Figure 39 illustrates the supply of potential graduate students in the Atlantic provinces. Between 1993 and 1997, the number of undergraduate credentials in Natural Sciences and Engineering increased by 36 percent, while those in the health professions increased by 12 percent. Credentials earned in the Social Sciences and the Humanities decreased by 5 percent.

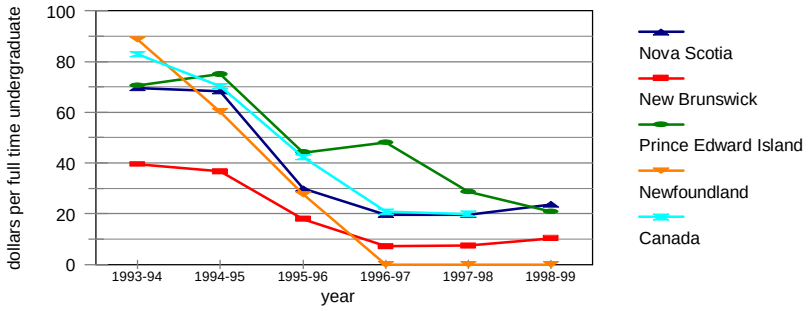
Figure 39
Number of Credentials (Bachelor's and First Professional) Granted at the Undergraduate Level by Atlantic Universities, by Major Area of Study, 1993 and 1997



Source: USIS (MPHEC subset); Memorial University of Newfoundland - Fact Book 1997

In the Natural Sciences and Engineering fields, funding is available at the undergraduate level from NSERC. While undergraduate research assistants may be funded from other sources, the Undergraduate Student Research Awards represent an important opportunity for these students to experience research first hand. Figure 40 shows the trend in this source of funding in the Atlantic provinces.

Figure 40
Dollars Awarded in NSERC Undergraduate Research Awards per Full-Time Undergraduate in Natural Sciences & Engineering by Province, 1993-94 to 1998-99



Source: NSERC administrative data; USIS (Statistics Canada)

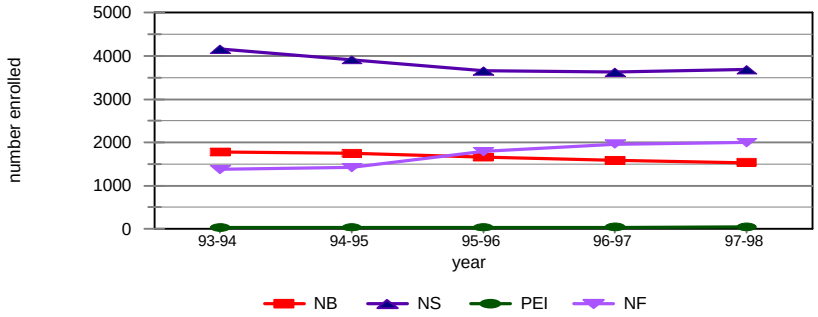
The trend in the four provinces is quite different, with New Brunswick and Newfoundland undergraduates obtaining the fewest NSERC dollars. Except for New Brunswick and Newfoundland, the remaining Atlantic provinces approached or exceeded the national average. The steep decline observed from 1994-95 (1,575 awards were available across Canada) to 1998-99 (only 110 awards were available across Canada) was a result of policy changes made by NSERC in response to budgetary cutbacks, which included the distribution of dwindling funds only to small universities, for which Memorial, University of New Brunswick and Dalhousie did not qualify.

Funding of Undergraduate Research Awards by NSERC has recently been given new life. For the academic year 1999-2000, 2,530 awards valued at $4000 each were available to all eligible Canadian universities. Nevertheless, the five-year decline likely had an adverse affect on opportunities for undergraduate involvement in research.

5.2 Graduate Students

The pool of future researchers and current research assistants may best be assessed by enrolment trends at the graduate level. Between 1980 and 1994, graduate programmes in the Maritimes saw a dramatic increase in enrolments (unpublished MPHEC research paper). The enrolment in 1994 had increased 63 percent since 1980. This mirrored events at the national level: national graduate enrolments increased by 57 percent from 1980 to 1994. New Brunswick and Nova Scotia experienced an overall decline in graduate enrolment between 1993-94 and 1997-98 while Newfoundland saw its graduate enrolment increase (Figure 41).

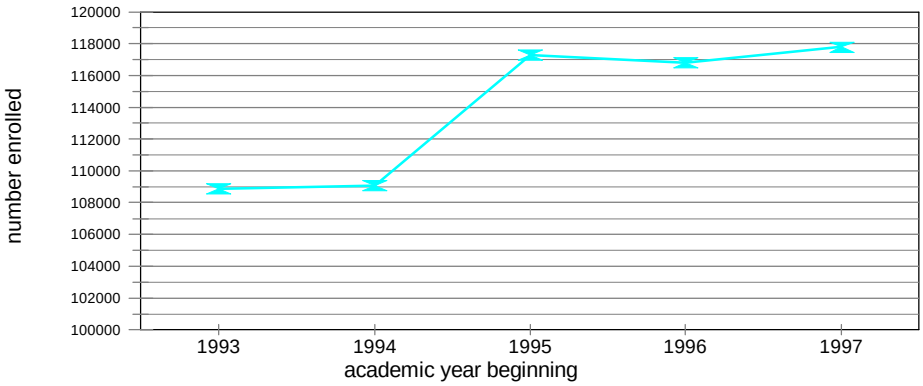
Figure 41
Number of Full- and Part-Time Students Enrolled in Graduate Programmes at Atlantic Canadian Universities by Province, 1993-94 to 1997-98



Source: USIS (Statistics Canada)

As is shown in Figure 42, there was an increase and levelling off of graduate enrolments at the national level over the same time interval.

Figure 42
Number of Full- and Part-Time Students Enrolled in Graduate Programmes at Canadian Universities, 1993-94 to 1997-98

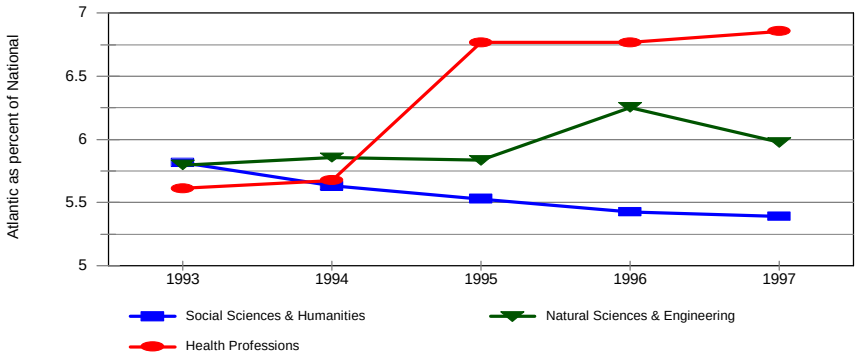


Source: USIS (Statistics Canada)

If we consider graduate enrolments within the three broad fields which mirror the three federal granting councils, between 1993 and 1997, the Atlantic region saw a decline in Social Sciences and Humanities, while enrolment in Natural Sciences and Engineering and the Health Professions remained relatively stable. These trends were similar to those observed at the national level.

Figure 43 illustrates the proportion of Atlantic Canadians enrolled in the three broad fields, relative to the national enrolment. Since 1994, Atlantic Canada has captured a greater proportion of graduate students in the Health Professions. At the same time, there have been minimal increases in Natural Sciences and Engineering. Atlantic Canada's proportion of graduate students in the Social Sciences and Humanities has been in steady decline since 1993.

Figure 43
Full- and Part-Time Enrolment of Students in Graduate Programmes in Atlantic Canadian Universities, as a Percent of the Total Canadian Enrolment, 1993 to 1995



Source: USIS (Statistics Canada)

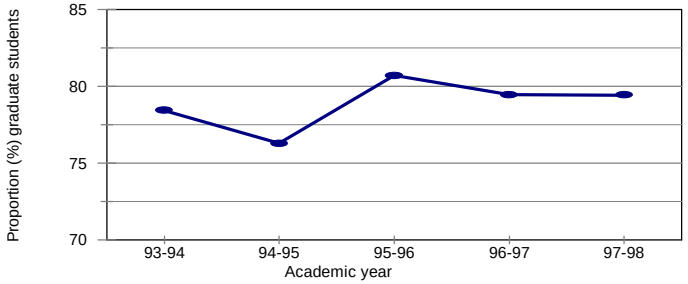
The Maritime (Newfoundland data unavailable at press time) decline in Social Sciences and Humanities and Natural Sciences and Engineering fields between 1993-94 and 1997-98 seemed to occur mainly among full-time males (unpublished MPHEC research paper), and thus may be related in part to the state of the economy.

Another perspective on the availability of graduate students is the status of graduate programmes delivered in the region. The programmes offered by universities in the Maritime region (Newfoundland data unavailable at press time) are currently in a state of vigorous growth: between 1993 and the present, 32 new Master's and seven new Doctoral degree programmes were approved by the MPHEC. While the number of doctoral programmes has increased in the region, it has been suggested that Atlantic Canada lacks the doctoral infrastructure needed to fully participate in the knowledge economy.

It is widely assumed that Atlantic residents have a strong affinity for the region and would prefer to stay there to work if at all possible. The results of the National Graduate Survey of 1995 graduates, carried out in 1997 (Statistics Canada, 1999), which captured a number of parameters relating to issues such as employment, student debt and programme satisfaction, tend to support this assumption. Furthermore, they suggest that graduate students who either resided in an Atlantic province or completed their graduate studies there, tended to remain in the region afterward (as measured two years after graduation). Analysis of the weighted data (Statistics Canada, 1999) showed that, of those graduates who resided in an Atlantic province before enrolment in their graduate programme, 70 percent studied in the Atlantic region and were living there two years after graduation. Of those who obtained their graduate degree from an Atlantic institution, regardless of their geographic origin, 77 percent were living there two years after graduation. The Follow-up to the 1990 National Graduate Survey (Statistics Canada, 1997) provides the most recent longitudinal study of Canadian graduates interviewed five years after graduation. Analysis of the weighted data showed that of those who were Atlantic Canadian residents 12 months before enrolling in their programme of study, 75 percent who obtained their graduate level credential from an Atlantic Canadian university were living in the region five years after graduation. The most recent data available from Statistics Canada show that the majority of Atlantic residents pursuing a graduate degree are doing so at

institutions in the Atlantic region, and that this proportion has increased slightly since 1994-95 (Figure 44).

Figure 44
Proportion of all Atlantic Canadian Residents Pursuing Full- or Part-Time Graduate Studies in Canada, Who Are Enrolled in Universities within Atlantic Canada, 1993-94 to 1997-98



Source: USIS (Statistics Canada)

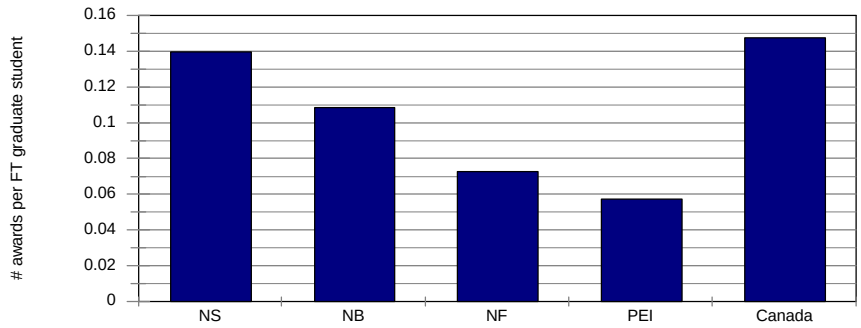
Thus it would seem that graduate programmes in the Atlantic region supply a strong pool of local research talent that can be drawn upon to staff faculty positions in Atlantic universities and other research institutions. However, this pool of talent may not be enough to replenish Atlantic Canadian faculty in the context of fierce competition across North America to recruit the best and brightest.

5.3 Graduate Funding

Most graduate students require financial assistance during their studies; federal agencies such as MRC, NSERC and SSHRC as well as provincial agencies are among the primary sources of scholarships and fellowships for these students (CAGS, 1992). This funding is critical to the support of graduate research.

An analysis of the data shows that there is considerable disparity within the region itself, with Nova Scotia generally faring much better than the other three provinces. A measure of Atlantic performance compares the number of NSERC postgraduate scholarships awarded per full-time graduate student in the general field of natural sciences and engineering in 1997-98 (Figure 45). All Atlantic provinces have fewer scholarship holders per full-time graduate student than the national rate; of the four provinces, Nova Scotia fared the best, approaching the national level. In 1997-98, NSERC awarded 4,644 scholarships; of these, Atlantic Canadian students enrolled full-time in Natural Sciences and Engineering graduate programmes received 219, or 4.7 percent. This percentage is less than the proportion of Canadian full-time Natural Sciences and Engineering graduate students enrolled in Atlantic Canadian universities (6.6%).

Figure 45
Number of Postgraduate Scholarships Awarded by NSERC per Full-Time Graduate Student in the General Field of Natural Sciences and Engineering, 1997-98



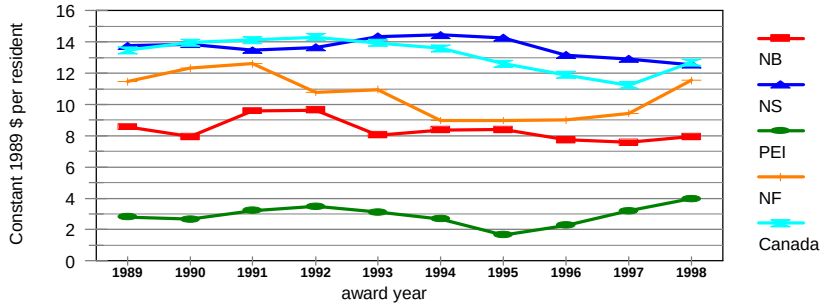
Source: NSERC administrative data; USIS (Statistics Canada)

The number of SSHRC doctoral fellowships awarded nationally in 1997-98 was 432. Only nine (2.1%) of these were received by doctoral students enrolled in Atlantic Canadian universities. At the provincial level, Newfoundland, Nova Scotia and New Brunswick each had three fellowship recipients (Prince Edward Island had no eligible applicants). In the same year, students enrolled in doctoral programmes at Ontario universities received 218, or 50.5 percent of the fellowships.

There is considerable evidence that the funding rate of graduate students in the Atlantic region has historically been lower than the national rate. This warrants further study.

Figure 46 shows NSERC research grant and scholarship expenditures by province, expressed in constant 1989 dollars per provincial resident. More grant and scholarship dollars were awarded in Nova Scotia than in either Newfoundland, New Brunswick or Prince Edward Island. Between 1993 and 1998, Nova Scotia exceeded the national average. The dollars awarded in Nova Scotia have, however, been declining (1994-98), along with the national average. After a decline in funding between 1991 and 1994, Newfoundland funding rates remained stable and have experienced very recent increases. Except for slight increases in 1991 and 1992, dollars awarded in New Brunswick have remained fairly stable over time. While NSERC expenditures in Prince Edward Island are by far the lowest in the three provinces, they are steadily increasing from the 1995 low. Again, this illustrates the disparity between the provinces. This data is pertinent to graduate research because those graduate students who do not obtain individual funding may need to be supported by grants to faculty.

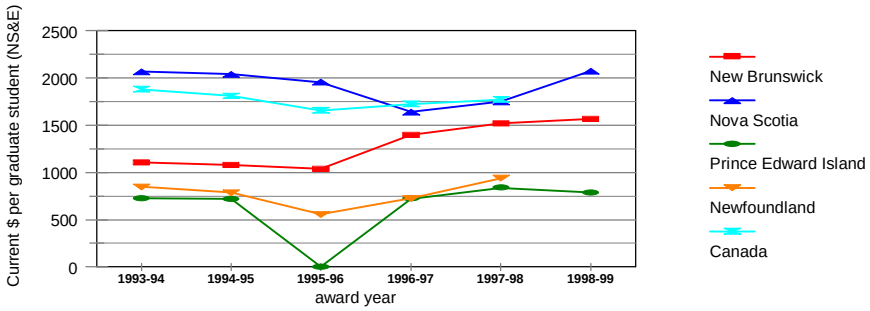
Figure 46
Total NSERC Grant and Scholarship Expenditures, $ per Resident, (constant 1989 dollars) by Province, 1989 to 1998.



Source: NSERC administrative data; Statistics Canada Census Data

If we look at NSERC postgraduate (Master's and PhD level) scholarships separately, we again see significant differences among the provinces (Figure 47). After 1990 and until 1994, Nova Scotia was consistently above the national average by at least 34 percent . In comparison with the national trend, the Atlantic provinces performed fairly well, with the amount of award per full-time graduate student in Nova Scotia reaching a low point in 1996, but increasing between 1997-98 (Figure 47). Newfoundland, New Brunswick and Prince Edward Island awards also increased after 1995-96.

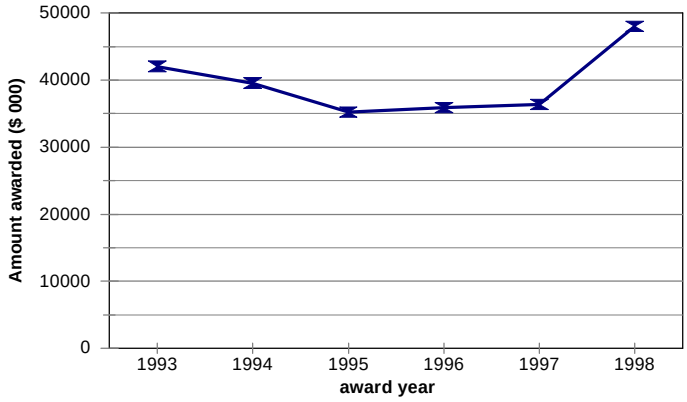
Figure 47
NSERC Postgraduate Scholarships Awarded (current dollars per full-time graduate student enrolled in Natural Sciences and Engineering fields), by Province, 1993-94 to 1998-99



Source: NSERC administrative data; USIS (Statistics Canada)

Figure 48 shows the national trend in NSERC postgraduate scholarship awards, highlighting recent increases in the total amount available for disbursement.

Figure 48
Amount Awarded in NSERC Postgraduate Scholarships across Canada, 1993 to 1998 ($000)



Source: NSERC administrative data

5.4 Faculty in Atlantic Universities

The faculty in Atlantic universities is aging. As in the rest of Canada, this is a direct result of hiring patterns over the last 40 years and the fact that universities were forced to limit their growth (due to financial constraints), beginning in the mid 1970s (AUCC, 1999). Specifically, the number of faculty in Canadian universities rose from 6,000 in 1955 to 25,000 in 1970; this parallelled a similar increase in enrolments over the same time period. Between 1976 and 1992, when the rate of growth had slowed considerably, the rate of intake of new faculty was not sufficient to offset the aging cohort that had been hired in the previous 15 years (AUCC, 1999).

The current situation in the Maritimes is that over 40 percent of the faculty are 50 years old or older. In Newfoundland, 65 percent of the Faculty are 50 years or older. According to the AUCC, the average age of a university professor in Canada is now 49 (AUCC, 1999).

Between 1985-86 and 1997-98, there was a significant shift in the age profile of Maritime full-time faculty in the three broad fields (Figures 49, 50 and 51). In the Social Sciences and Humanities and in the Natural Science and Engineering fields, the peak age group in 1985-86 was 40-44; by 1997-98, this had shifted to the 50-54 age group (Figures 49 and 50). Among faculty in the Health professions, the peak age in 1985-86 was 35-39; by 1997-98, this had shifted to 40-44, and many more faculty members were in the age groups 45-49 and 50-54 than 15 years earlier (Figure 51).

Figure 49
Demographics of Full-Time Faculty at Maritime Universities in the Social Sciences and Humanities

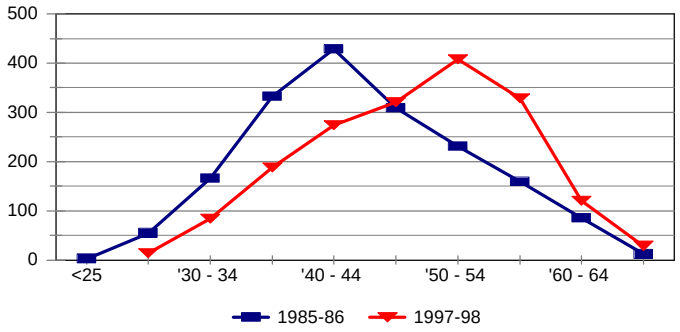


Figure 50
Demographics of Full-Time Faculty at Maritime Universities in the Natural Sciences and Engineering

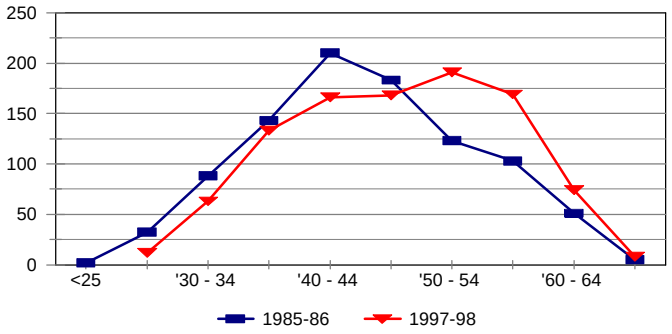
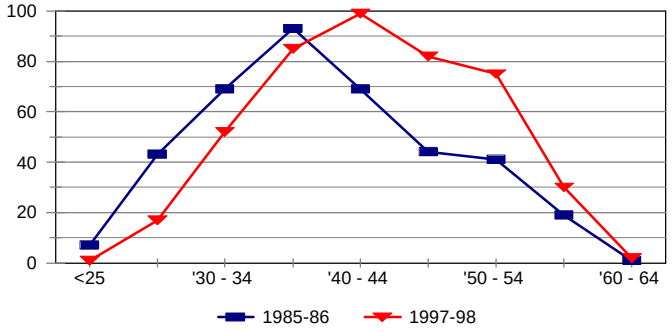


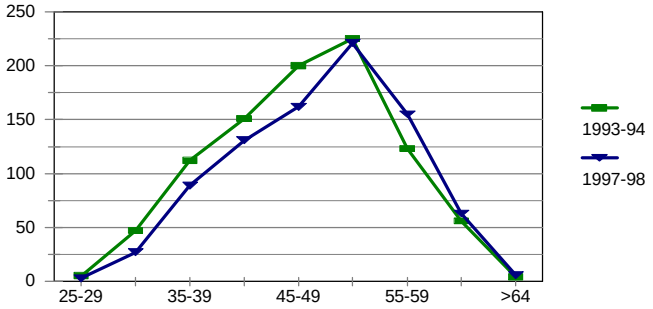
Figure 51
Demographics of Full-Time Faculty at Maritime Universities in the Health Professions



Source: UCASS (MPHEC subset)

Given that the age pyramid of full-time faculty in Newfoundland has shifted slightly to older age groups in only 5 years (Figure 52), and that 65 percent of faculty in that province are 50 years or older, it is clear that the aging faculty is a region-wide phenomenon.

Figure 52
Demographics of Full-Time Faculty at Memorial University of Newfoundland



Source: UCASS (Statistics Canada)

Between 1990-91 and 1997-98, the number of full-time faculty in Atlantic Canadian universities fell by more than 11 percent (APEC, 2000). This decline through attrition means that retiring tenured staff are either going unreplaced or their positions are being filled by part-time, temporary instructors. This has in many cases led to faculty student ratios that are higher than elsewhere in Canada.

The fact that almost half the faculty is over 50 years old represents both an important opportunity and a risk to the Atlantic research community. The future success of research in the Atlantic provinces depends on how the universities choose to deal with staffing policy and hiring practices. Specifically, if significant numbers of part-time teachers are hired in place of full-time professors, it is likely that the research enterprise will be directly and negatively affected. Part-time teachers or sessional lecturers generally do not have the time or the responsibility to do research and train graduate students.

As previously noted, the faculty shortage that the Atlantic region will face in the next few years will be exacerbated by the shortages faced across Canada and the United States. Therefore, in order for the Atlantic region to attract the best candidates for reasons not only of academic quality, but also in the interests of economic growth and viability (recall again the primary role of the universities in the region in research and development, and the link to economic growth in the new knowledge economy), we must be cognizant of the role of several factors which will influence our competitiveness. These factors include but are not limited to:

Faculty Salaries	Wage differential between the Atlantic region and the rest of the country
Infrastructure	The quality and availability of laboratory equipment and space, office space, library holdings, established collaborative links.
Teaching Load	Increases in teaching loads limiting the time available for research

Recruitment	Intensity and nature of recruitment efforts by individual institutions
Funding	Past success in securing research funding; support from institutions in preparing grant proposals and partnerships
Human Resources	Supply, and funding, of research assistants and graduate students and in some cases creative use of the capacity of retirees
Quality of Life	The perception of the quality of life in the Atlantic provinces

The federal government recently announced the Canada Research Chair initiative which will finance the creation of new research positions at Canadian universities. A portion of the fund will be earmarked for younger researchers identified by their peers as rising stars. The money will cover their salaries and free them from teaching duties. There have been concerns about the criteria for allocation of these Chairs on the basis of previous granting council success rates, An approval that would have significantly reduced Atlantic university participation. Representation by Atlantic universities and their partners have however led to a number of positive changes in this regard. Universities are now preparing strategies to make maximum use of this opportunity.

5.5 Conclusion

Our main human resource in the Atlantic research enterprise -- full-time faculty members -- are, and will continue, to decline in numbers as a result of demographic shifts. We will, in the very near future, face a shortage that will be made all the more severe because it will be faced by all universities across Canada and the United States. Therefore, institutions in the Atlantic Region will face intense competitive pressure to get the “best and brightest” to fill vacant positions. A number of factors have been outlined which must be considered in the issue of the attractiveness of Atlantic universities and that should be explored so as to ensure that Atlantic Canada can resist a “brain drain” from the region.

Data indicate that we have an ever growing number of graduate level programmes and a healthy supply of graduate students enrolled in the three broad fields which parallel those covered by the Federal Granting Councils. Enrolments, after a decrease between 1993 and 1997, now seem to be recovering. However, further exploration and monitoring will be needed to ascertain whether and to what extent graduate supply is adequate to meet regional needs (taking into account both graduate choice and the tendency of Atlantic graduates to want to stay in the region). In this context, graduate student support is critical and needs to be increased in Prince Edward Island, New Brunswick and Newfoundland in particular.

6.0 RESEARCH INFRASTRUCTURE SUPPORT

As outlined in the previous chapters of this report, Atlantic Canada has always had strong and nationally recognized researchers. Strength in “people,” however, is not sufficient. These researchers need outside investment to allow them to transform capacity into new knowledge and innovation. In addition, they need a sustaining and facilitative environment.

The quality of research infrastructure support is, in fact, the keystone for successful innovation. It makes productive effort possible and includes a broad range of factors, some of which are not as easily quantifiable as investment dollars. These include: access to advanced equipment equivalent to that available to researchers elsewhere; opportunities for appropriate participation in national programme design and peer review processes; and university support, including, for example, time allowances for research, mentoring, and commercialization and proposal development support. There is also a need for increased public and political awareness of the broad range of benefits arising from university-based research. This entails national awareness of the importance of strong geographic research nodes across the country as well as regional understanding that support for research is not just the responsibility of the ministries of education.

Some of these key factors are discussed in greater detail below. It is important to note, however, that sustaining a facilitative infrastructure will require continued revitalization of each of these factors as well as a number of other more subjective factors, including increasing the recognition of faculty as teacher-researchers.

This chapter looks at the following factors: (1) participation in programme design; (2) renewal of facilities and equipment; (3) participation in peer-review processes; and (4) institutional proposal development support.

6.1 Meaningful Participation in National Programme Design

In recent years, the surge in national investment in post-secondary research has taken the shape of specifically targeted programmes, including the Millennium Scholarships (providing support for students some of whom will become the next generation of researchers), the Canada Foundation for Innovation, the Canadian Institutes of Health Research, the Canada Research Chairs initiative and more recently the Atlantic Innovation Fund.

Though Atlantic Canadians have had some representation on design and implementation committees, this representation has been that of a minority with often only marginal influence on the final programme design. In some cases (e.g. Canada Research Chairs and the CFI), allocation of funds has been based on previous granting council success rates. This has tended to reduce access on the part of Atlantic universities (who receive as noted in Chapter 4 proportionately much less funding from the granting councils than the national average). The formula also gives less attention to emerging areas of research strength that do not have a council track record. Increased provision for strategic capacity building competition (as is done by the National Science Foundation in the United States) would help offset the trend towards “those that have, get.”

6.2 Access to Opportunities for Renewal of Physical Facilities, Equipment and Research Materials

Renewal of physical facilities and equipment and maintenance of library resources has generally fallen under the provincial PSE funding formulae. Over the past years of cost-cutting, the amount of deferred maintenance has grown significantly. In some cases, certain types of research have had to be curtailed for health and safety reasons until funding for new equipment is available.

The Nova Scotia Council on Higher Education/Council of Nova Scotia University Presidents survey (1999) revealed that Nova Scotia's 11 universities require more than $300 million to upgrade their older buildings, make the necessary repairs, and adapt their space to the 21st Century learner. The recent (1999) New Brunswick Multi-year Funding Plan report indicates that $64.8 million is needed plus an additional $20 million to update ancillary facilities. The Canadian Association of University Business Officers recently surveyed member institutions across Canada to gather data on the deferred maintenance/building renewal issue. An analysis of data has recently been released.

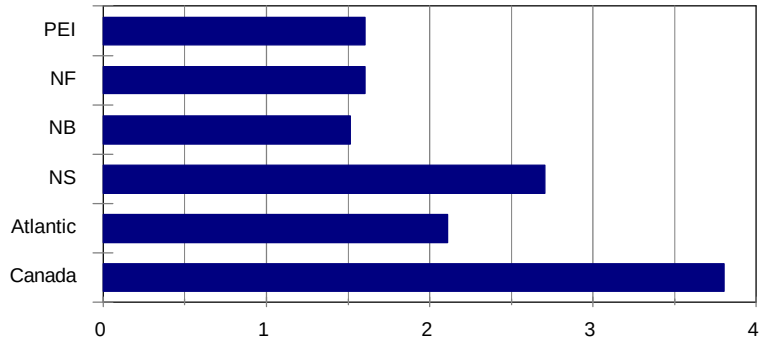
The Canada Foundation for Innovation provides significant support for infrastructure renewal across the country. As noted in Section 4.1.6, to date nine universities have received in total over $16 million of the approximate $436 million committed to date. Atlantic Canada's total in January 2000 represented less than 4 percent of the national allocation.

Round Two of the CFI is expected to provide a more significant challenge. To date, as noted above in Section 3, no source of matching funds has been found. Though matching funds for Round One were provided through the Atlantic Canada Opportunities Agency in each of the Atlantic provinces; funding has yet to be determined for Round Two. At the moment, Atlantic Canada could be the only region in Canada without sufficient matching funds to fully access this infrastructure renewal opportunity. All other provinces have special research initiative envelopes that allow them to provide 40 percent of the required matching funds. The recent creation of the federal Atlantic Innovation Fund is expected to alleviate matching fund challenges in future however.

6.3 Participation in National Peer-review Processes

Atlantic Canada is well represented on the governing Councils of NSERC, SSHRC and the CFI, and on the major policy selection committees. Atlantic representation on selection committees is, however, inadequate (Figure 53).

Figure 53
Proportion of Full-Time Faculty Members Serving on Federal Granting Councils' Selection Committees (NSERC, SSHRC, MRC), by Atlantic Province and Canada, 1999



Source: Respective Web sites

Natural Sciences and Engineering Research Council (NSERC)

The Atlantic region is well represented on the Council, occupying four chairs, and having representation from each of the provinces. There is also regional representation on each of the other principal policy committees, such as Research Grants. The Atlantic region is not, however, well represented on the 27 Selection Committees. Ten committees operate without Atlantic representatives. As of the end of 1999, of the 201 chairs in the remaining 17 committees, only 24 were occupied by representatives from the region (12%). These were distributed as follows: eight from Dalhousie, eight from University of New Brunswick, two from Saint. Mary's, and one each from Université de Moncton, Mount Allison University, St. Francis Xavier University, University of Prince Edward Island, federal government and industry.

Social Sciences and Humanities Research Council (SSHRC)

Again, the Atlantic Region is well represented on SSHRC's national Council. Of the 15 Selection Committees which review and recommend research grants, regional representation is lacking on four of these Committees. The remaining 78 chairs, 12 (15%) are occupied by Atlantic area specialists as follows: three from Dalhousie, two from Mount Allison University, two from Université de Moncton, two from University of New Brunswick, two from University of Prince Edward and one from St. Francis Xavier University.

The Medical Research Council (MRC)

Atlantic faculty are represented on 24 of the 46 Selection Committees. Memorial is represented on five Committees with University of New Brunswick and the University of Prince Edward Island each represented on one Committee only. The balance of the Atlantic representation is drawn from Dalhousie.

6.4 Institutional Proposal Development Support

The ability of faculty and graduate students to develop successful research proposals and partnerships and to complete their research projects is dependent on a number of factors: (1) availability of time devoted specifically to the research process, (2) knowledge of what must be included in a successful proposal and where to submit it, (3) access to potential industry and other partners, and (4) logistical support. Some researchers can do amazing things in the absence of this kind of support. Chances of success can be significantly increased, however, when appropriate support and encouragement is available, particularly for young faculty and graduate students. In this context, it should be recalled that, as a result of cumulative cutbacks, faculty - student ratios are now higher in the Atlantic than the Canadian average.

In addition, there is a need to further refine or prepare institutional strategic plans (a number started in the context of CFI competitions) to give clear guidance on these strategic opportunities and niche strengths that each university wants to exploit - without however discouraging the kind of independent curiosity that leads to significant benefits.

Many of the larger Canadian universities have offices specifically dedicated to supporting the preparation and submission of research proposals (professional proposal writers), including investigation of potential partnership/funding sources and assistance with commercialization and the creation of spin-off enterprises. This support structure does not exist to the same extent in the smaller Atlantic universities.

7.0 CONCLUSION

Atlantic Canada's research capacity depends on three ingredients needed for revitalization and to enable it to become a critical partner in the national knowledge effort: investment, people, and environment. Of these three, the research environment is critical, constituting a kind of "glue" that holds all the other pieces together.

Atlantic Canada's universities are determined to participate in the revitalization of Canada's knowledge society and in so doing to meet the specific needs of their own region. To do this, they propose to work closely with all potential regional and national partners, and in particular to derive maximum benefit from the Atlantic Innovation Fund and other related opportunities.. Emerging Atlantic strategies are described in a separate document entitled *Securing our Future: A Renewal Strategy for Post-Secondary Research in Atlantic Canada*. The stakes are high. In the end, one of the ties that bind Canadians together will be each region's ability to contribute to and to participate in the evaluation of Canada's knowledge society.

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