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SCIENCE AND TECHNOLOGY DATA — 2009

April 2011

National • Government • Industry • Higher Education • Canada and the World

Canada

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CONTENTS

ACRONYMS AND ABBREVIATIONS

AAFC — Agriculture and Agri-Food Canada
AECL — Atomic Energy of Canada Limited
BERD — Business enterprise expenditure on research and development
CFI — Canada Foundation for Innovation
CIHR — Canadian Institutes of Health Research
CSA — Canadian Space Agency
DND — Department of National Defence
EC — Environment Canada
GDP — Gross domestic product
GERD — Gross domestic expenditure on research and development
GOVERD — Government intramural expenditure on research and development
HC — Health Canada
HERD — Higher education expenditure on research and development
IC — Industry Canada
IP — Intellectual Property

M&E — Machinery and Equipment
NRC — National Research Council Canada
NRCan — Natural Resources Canada
NSERC — Natural Sciences and Engineering Research Council of Canada
OECD — Organisation for Economic Co-operation and Development
PPP — Purchasing Power Parity
R&D — Research and development
RSA — Related scientific activities
S&T — Science and technology
SSHRC — Social Sciences and Humanities Research Council of Canada
STC — Statistics Canada
TL2 — Territorial level 2

DEFINITIONS

R&D — Creative work undertaken on a systematic basis to increase the stock of knowledge, including knowledge of humankind, culture and society, and the use of this stock of knowledge to devise new applications.

RSA — Activities that complement and extend R&D by contributing to the generation, dissemination and application of scientific and technological knowledge.

S&T — "Science and Technology" includes both R&D and RSA and refers to the broad spectrum of activities required to generate, disseminate or apply new S&T knowledge.

Scientific Publications — Publications in the areas of health, pure and applied science.

Territorial level — Classification used by the OECD. Territorial level 2 (TL2) consists of 335 large regions across the OECD member countries. All the regions are defined within national borders and in most cases correspond to administrative regions. For Canada, TL2 regions represent the Canadian provinces.

INTRODUCTION

Science and Technology Data is published yearly by Industry Canada's Science and Innovation Sector. This publication presents a snapshot of the state of science and technology in Canada in an accessible and convenient format.

The booklet has five sections. The first section, "National," provides a summary view of Canada's R&D. This is followed by three sections, each covering a specific player in the national S&T system: "Government," "Industry" and "Higher Education." The booklet concludes with a section entitled "Canada and the World," which describes links between Canada's S&T activities and those in other countries around the world.

Due to the varied approaches to national collection and multilateral compilation of data, the figures used for international comparisons will often be for earlier periods than those used for domestic trends. All figures are based on the most recent, reliable data.

NATIONAL

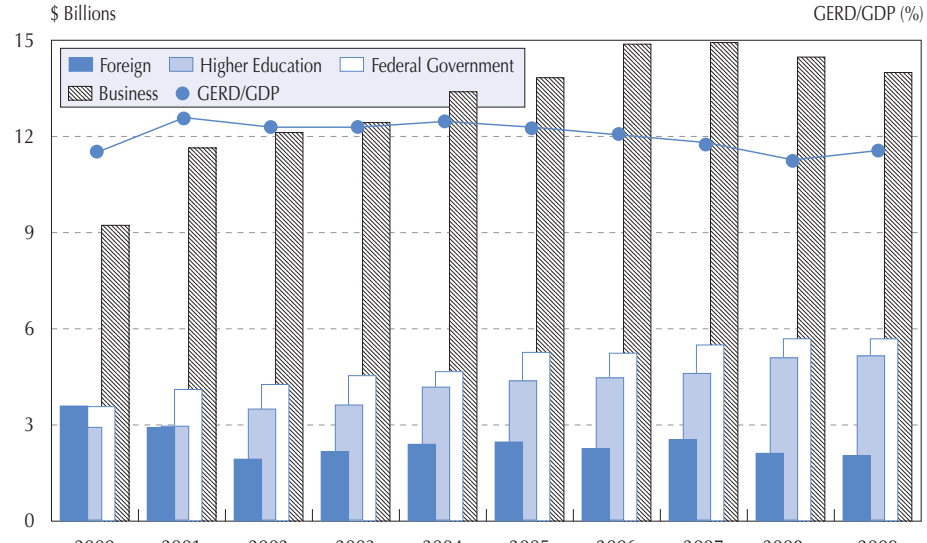
GERD represents the total R&D performed in a country. GERD figures can be broken down into either performers (those who spend the money) or funders (those who supply the money). In Canada, as in most other OECD countries, the business sector is the most important performer of R&D and its largest funder. In 2009, the business sector funded 48 percent of the R&D performed in Canada.

GERD intensity (i.e., GERD expressed as a percentage of GDP) is a standard indicator of the share of resources a country devotes to R&D. In 2008, Canada's GERD intensity stood at 1.8 percent and was ranked 15th among OECD countries.

Within countries, GERD intensity can vary significantly from one region to another. In Canada, Quebec and Ontario are the only two provinces whose GERD intensity is above that of the OECD.

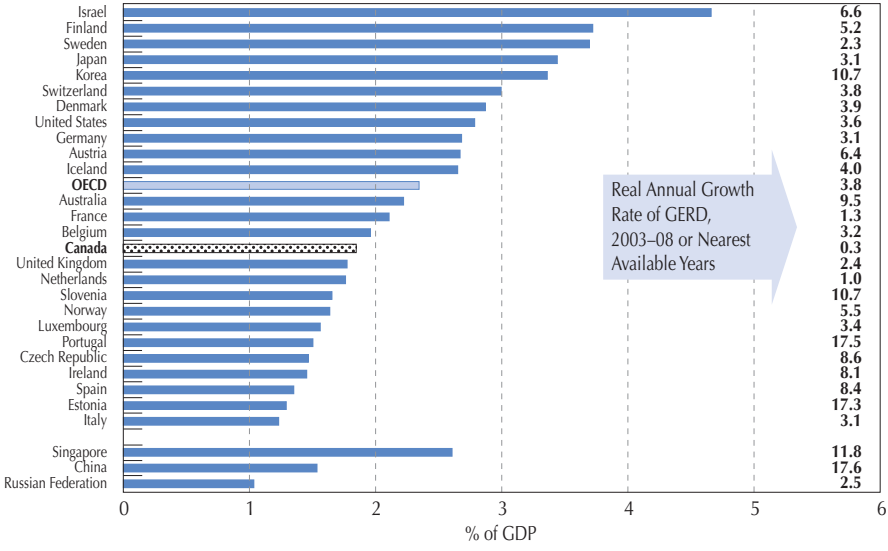
Co-patenting activities are an important indicator of the structure of collaboration networks. In Canada, co-patenting activities suggest collaboration occurs much more frequently within domestic regions than with co-inventors in other domestic regions or in foreign countries.

Canada's GERD by Major Source of Funds, 2000 to 2009



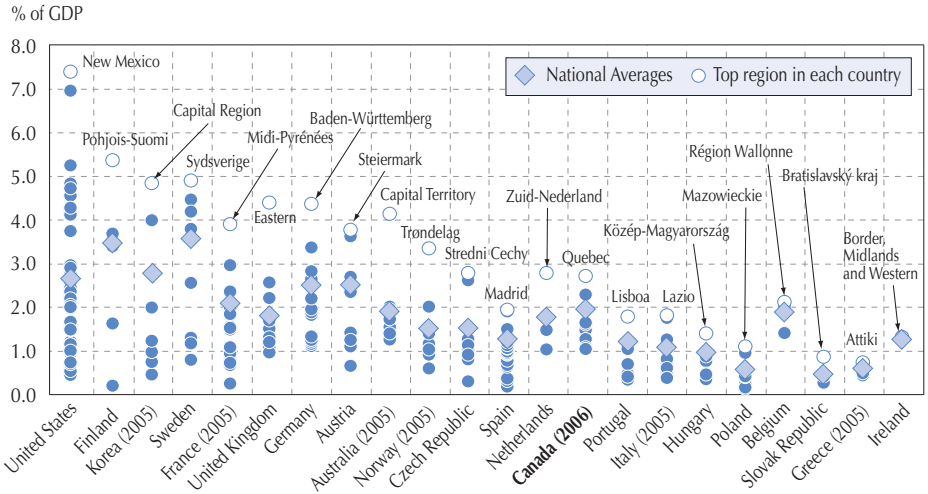
Source: Statistics Canada, *Gross Domestic Expenditures on Research and Development in Canada (GERD), and the Provinces,* Catalogue no. 88-221, December 2010.

GERD as a Percentage of GDP, Top OECD Countries and Selected Non-OECD Countries, 2008



Source: OECD, *Main Science and Technology Indicators*: 2010/2 edition, January 2011.

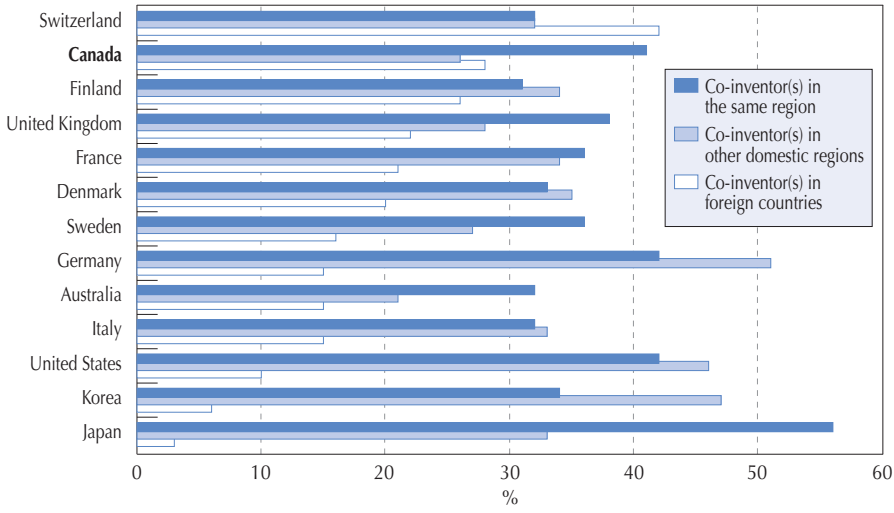
R&D Intensity by Region, Selected OECD Countries, 2007



Note: In this chart, the region (or province) identified is the most R&D-intensive one in its respective country. For example, in Canada, Quebec was the most R&D-intensive region in 2007. Regions are defined as the OECD's TL2 regions. Countries are sorted by their level of regional disparity.

Source: OECD, *Measuring Innovation: A New Perspective*, 2010.

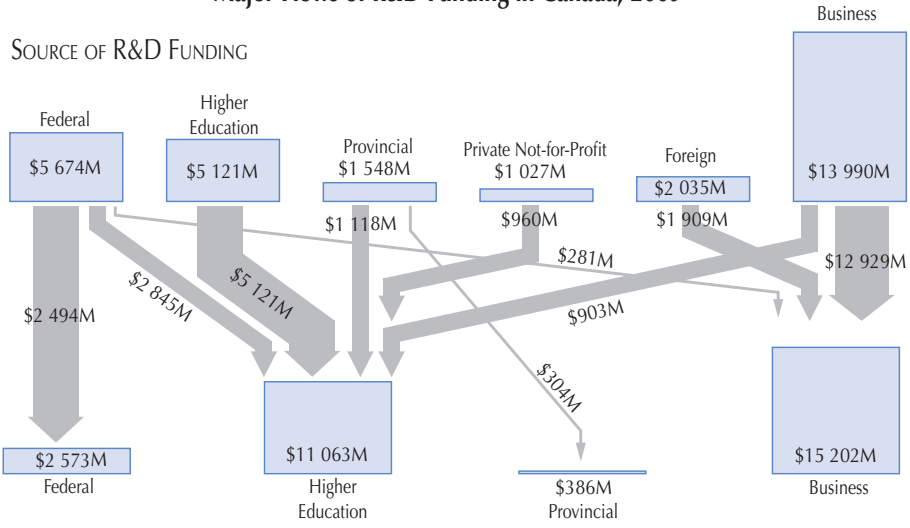
Patents with Co-inventor(s) by Region, Selected OECD Countries, 2005–07



Note: Patents refer to patent applications filed under the Patent Co-operation Treaty (PCT).
Regions are defined within national borders (TL2) and in most cases correspond to administrative regions.
For Canada, regions represent provinces.

Source: OECD, *Measuring Innovation: A New Perspective*, 2010.

Major Flows of R&D Funding in Canada, 2009*



*Only flows larger than $200M are shown in the figure.
Source: Statistics Canada, CANSIM Database, Matrix 358-0001.

GOVERNMENT

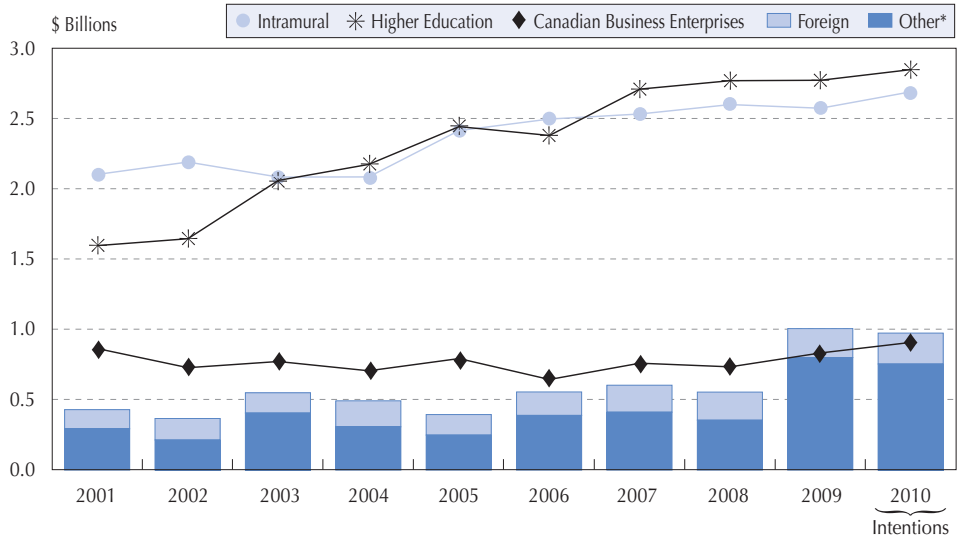
The federal government is the second most important funder of R&D in Canada behind the business sector. In recent years, federal funding for R&D was directed primarily to the higher education sector.

S&T spending by the federal government covers both R&D and RSA through a number of departments and agencies. Spending intention figures for 2010 suggest that the CIHR will be the largest funder of R&D while STC will be the largest funder of RSA.

Figures on federal R&D personnel can be an indicator of the R&D performed within the federal government (i.e., intramural). In 2010, the NRC accounted for 24 percent of all federal R&D personnel.

Federal R&D spending supports a variety of socio-economic objectives. Public health, industrial production and non-oriented research are the three objectives attracting the most funding and the bulk of these funds is for R&D performed outside of the federal government (i.e., extramural).

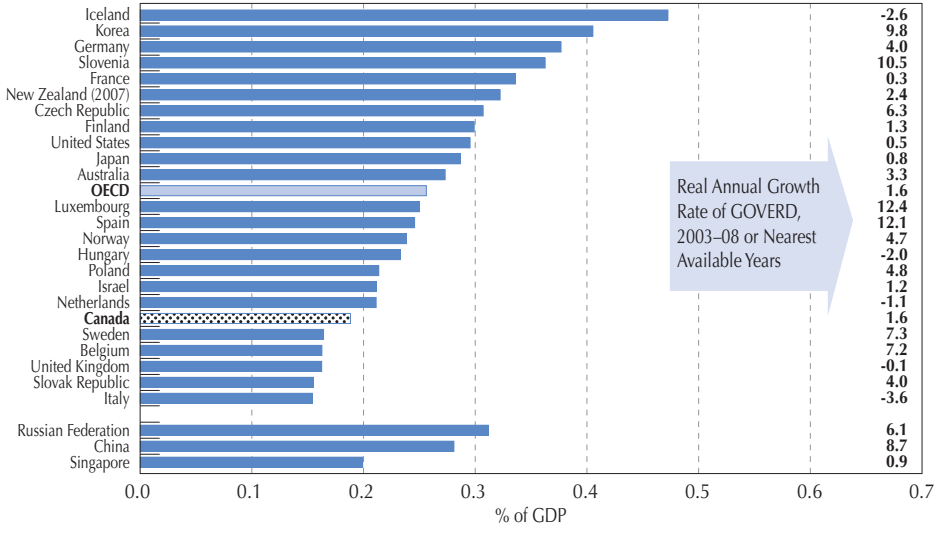
Federal R&D Spending by Performer Type, 2001 to 2010



*Other includes private not-for-profit organizations, provincial and municipal governments, and other Canadian performers.

Source: Statistics Canada, *Federal Scientific Activities 2010/2011*, Catalogue 88-204, October 2010.

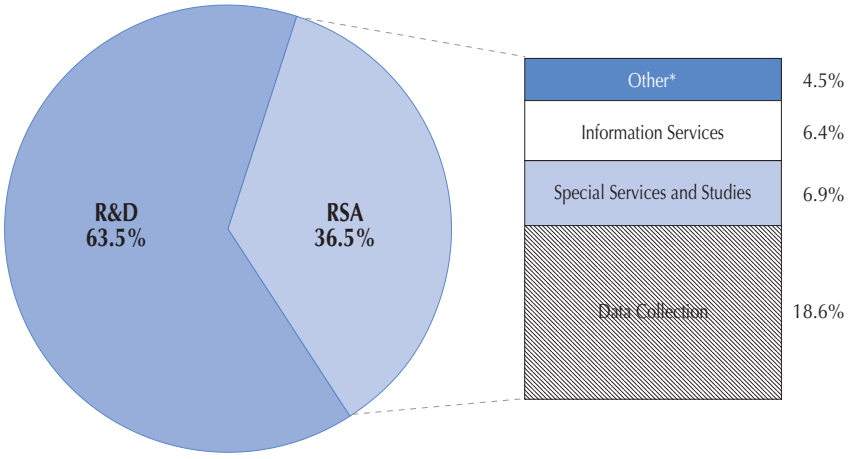
GOVERD as a Percentage of GDP, Top OECD Countries and Selected Non-OECD Countries, 2008



Note: Government expenditures include those by federal, provincial and local governments.

Source: OECD, *Main Science and Technology Indicators*: 2010/2 edition, January 2011.

Federal S&T Spending by Activity, 2010 Intentions

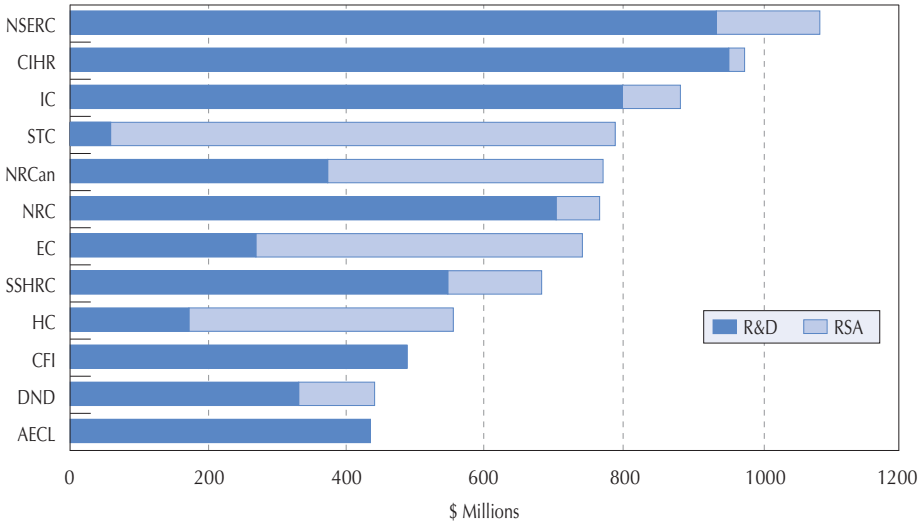


Total Intended Spending: $11.7B

*Other includes education support, administration of extramural programs and capital expenditures.
Note: The total may differ from the sum of components due to rounding.

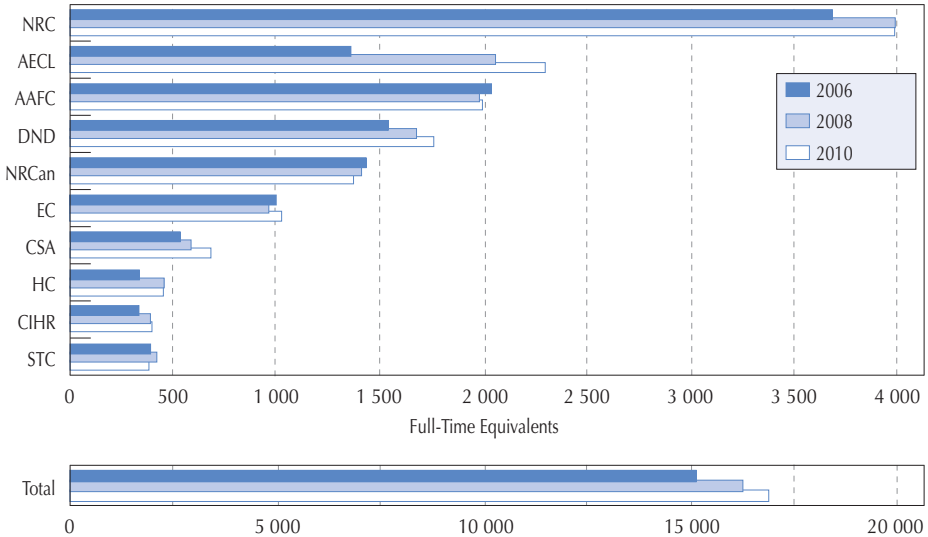
Source: Statistics Canada, *Federal Scientific Activities 2010/2011*, Catalogue 88-204, October 2010.

Major Federal S&T Departments and Agencies by Amount of Spending, 2010 Intentions



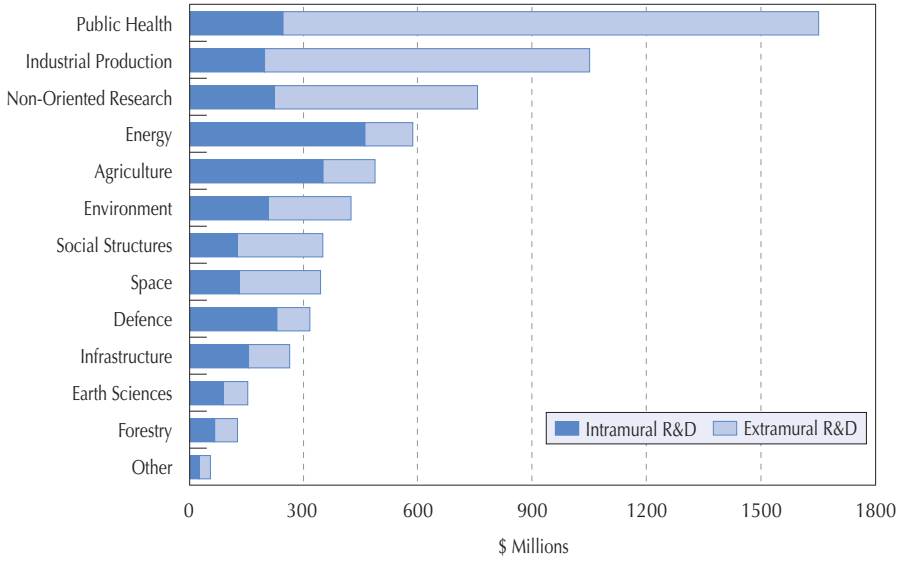
Source: Statistics Canada, *Federal Scientific Activities 2010/2011*, Catalogue 88-204, October 2010.

Federal Personnel Engaged in R&D, Major Departments or Agencies, 2006, 2008 and 2010



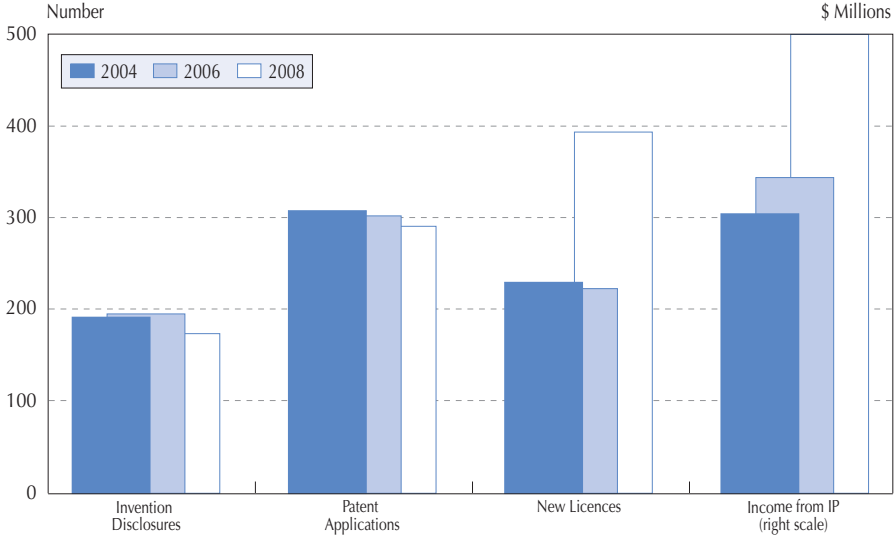
Source: Statistics Canada, *Federal Scientific Activities 2010/2011*, Catalogue 88-204, October 2010.

Federal R&D Spending by Socio-Economic Objective, 2008



Source: Statistics Canada, *Federal Scientific Activities 2010/2011*, Catalogue 88-204, October 2010.

Federal Government Licensing and IP Income, 2004, 2006 and 2008



Source: Statistics Canada, *Intellectual Property Management, by Federal Departments and Agencies Indicators*, CANSIM Table 358-0026.

INDUSTRY

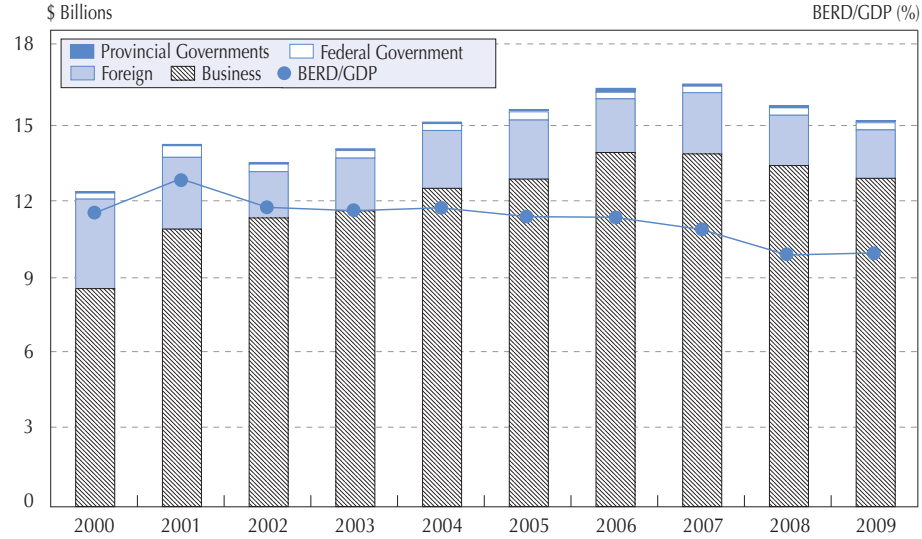
The business sector is the largest performer of R&D in the country. Following a 5-percent decline in 2002, BERD recovered to $16.6 billion in 2007 before receding to $15.2 billion in 2009, following the 2008 financial crisis.

In 2008, Canada's BERD-to-GDP ratio stood at 1.0 percent, below the OECD average (1.6 percent) and ranked 18th among OECD countries. Canada's two largest provinces, Ontario and Quebec, accounted for 77 percent of Canada's BERD and led all others in BERD intensity.

Capital investment, particularly M&E, is often viewed as an investment in embodied knowledge (as opposed to R&D, which could be viewed as knowledge creation). Experimental work on intangible assets suggests firms complement M&E investments with software, brand equity and other IP-related products and that the mix could vary significantly among countries.

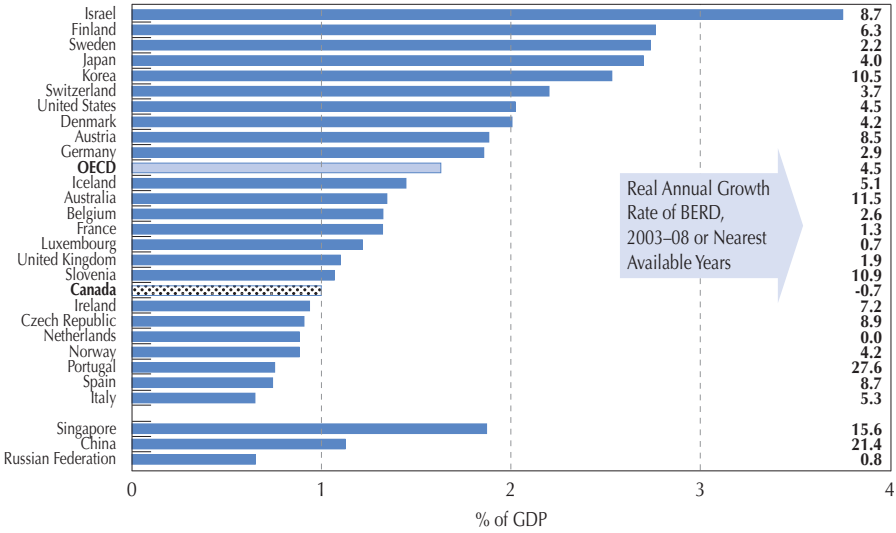
Recent results from Statistics Canada's *Survey of Innovation and Business Strategy* show that a significant proportion of product and process innovators in Canada also undertook changes to operational activities. The same survey also showed that about one out of five firms focus on introducing new or improved goods and services. Meanwhile, approximately one third of firms focused on the introduction of new or improved practices related to marketing, operational or organizational activities.

Canada's BERD by Major Source of Funds, 2000 to 2009



Source: Statistics Canada, *Gross Domestic Expenditures on Research and Development in Canada (GERD), and the Provinces*, Catalogue no. 88-221, December 2010.

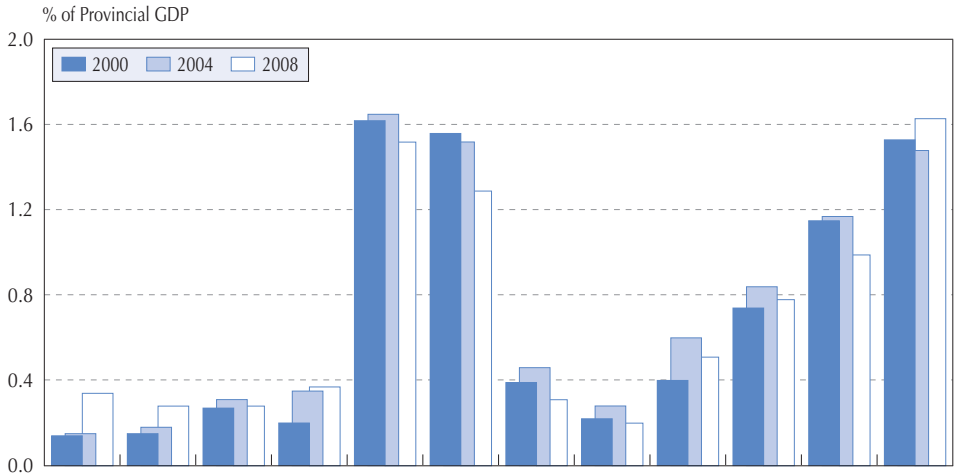
BERD as a Percentage of GDP, Top OECD Countries and Selected Non-OECD Countries, 2008



Note: Government expenditures include those by federal, provincial and local governments.

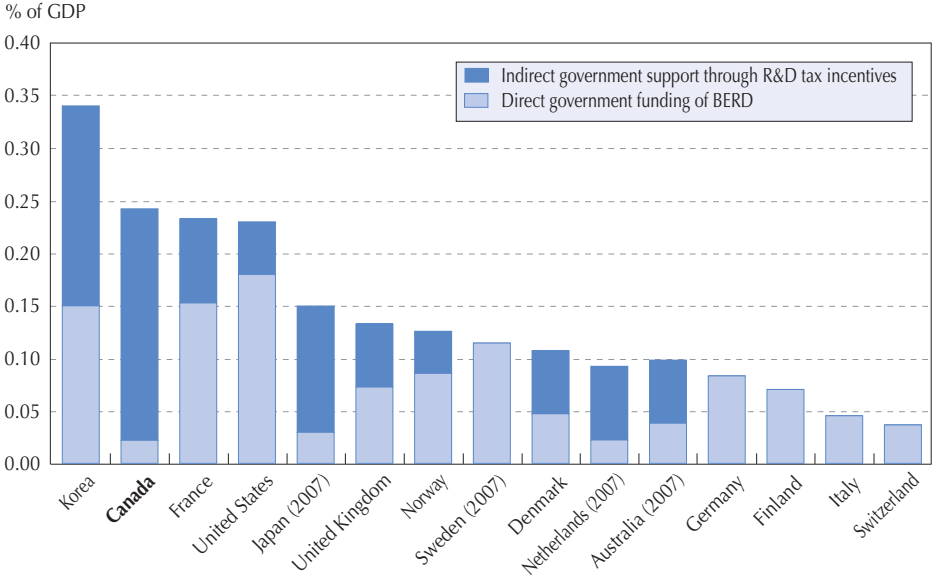
Source: OECD, *Main Science and Technology Indicators*: 2010/2 edition, January 2011.

BERD Intensity at the Provincial Level, 2000, 2004 and 2008



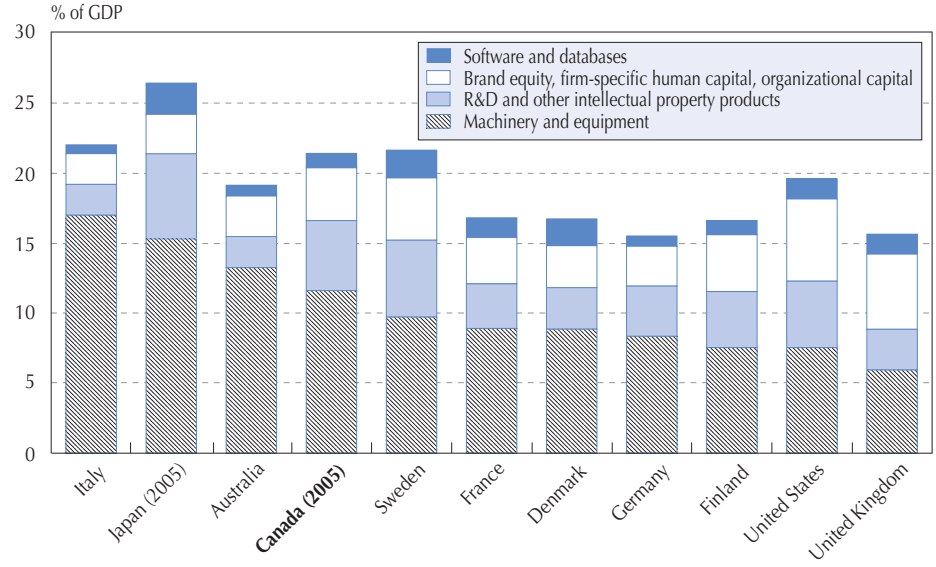
Sources: Statistics Canada, *Gross Domestic Expenditures on Research and Development in Canada (GERD), and the Provinces*, Catalogue no. 88-221, December 2010. OECD, *Main Science and Technology Indicators*: 2010/2 edition, January 2011.

Direct and Indirect Government Funding of Business R&D and Tax Incentives for R&D, Selected OECD Countries, 2008



Source: OECD, *Science, Technology and Industry Outlook*, 2010.

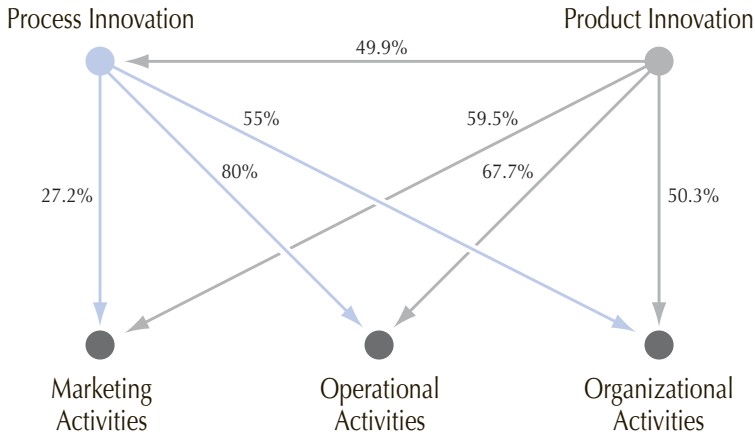
Investments in Fixed and Intangible Assets as a Percentage of GDP, 2006



Note: These estimates are based on national studies. They do not yet reflect standardised methods and definitions.

Source: OECD, *Measuring Innovation: A New Perspective*, 2010.

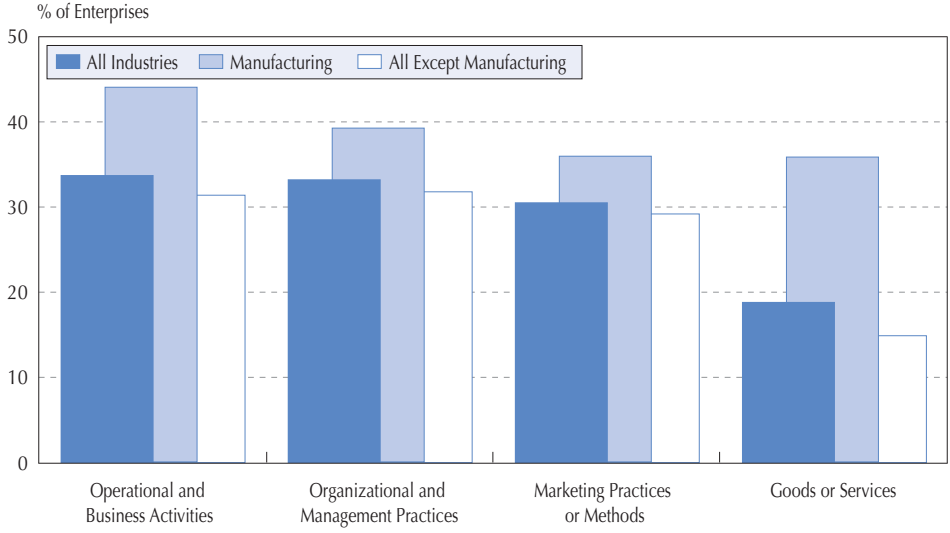
Percentage of Enterprises for which Process and Product Innovations Require Changes to Business Activities, All Process or Product Innovative Enterprises, Canada, 2007 to 2009



Note: This figure shows that 59.5 percent of product innovators reported implementing changes to their marketing activities.

Source: Statistics Canada, *Survey of Innovation and Business Strategy*, 2009.

Percentage of Enterprises with a Strategic Focus on New or Significantly Improved Products or Activities, All Enterprises, Canada, 2009



Source: Statistics Canada, *Survey of Innovation and Business Strategy*, 2009.

HIGHER EDUCATION

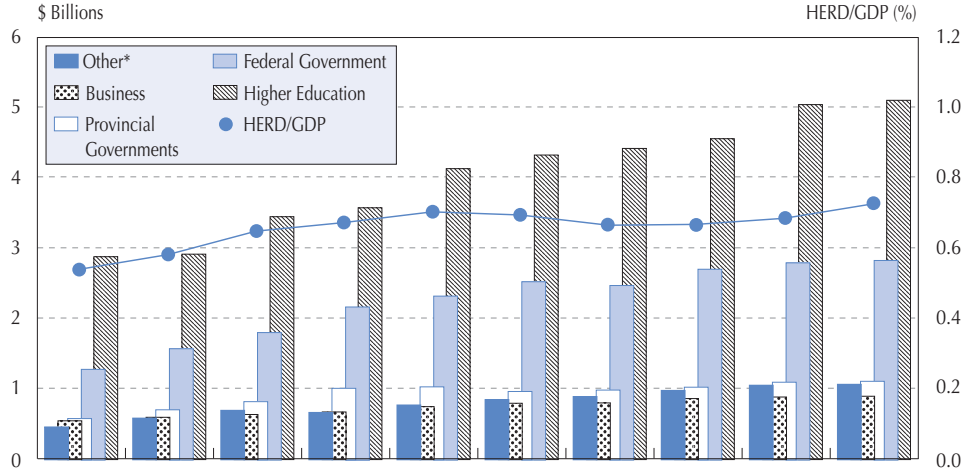
The higher education sector is Canada's second largest performer of R&D. Canada's higher education sector has been performing an increasing share of Canada's GERD. In 2009, HERD reached $11.1 billion and accounted for 38 percent of the R&D performed in Canada.

The higher education sector plays a dual role in the national innovation system. In addition to performing R&D, it also produces the highly skilled workers that Canada needs. A look at tuition fees and public subsidies shows large differences in how countries support university education. Compared to the United States, Canada's tuition fees are lower, as are public subsidies.

Scientific publications are one measure of scientific output. Canada ranks among the top-10 OECD countries for its number of scientific articles per million of population. However, on the skills front, Canada's graduation rates at the doctoral level remain below those of the OECD.

International scientific collaboration (measured by international co-authorship) greatly increases the chances that an article will be highly cited. Canada accounted for 6.8 percent of highly cited articles (over 2006–08) and ranked fifth in the world. Two thirds of these articles involved a foreign co-author.

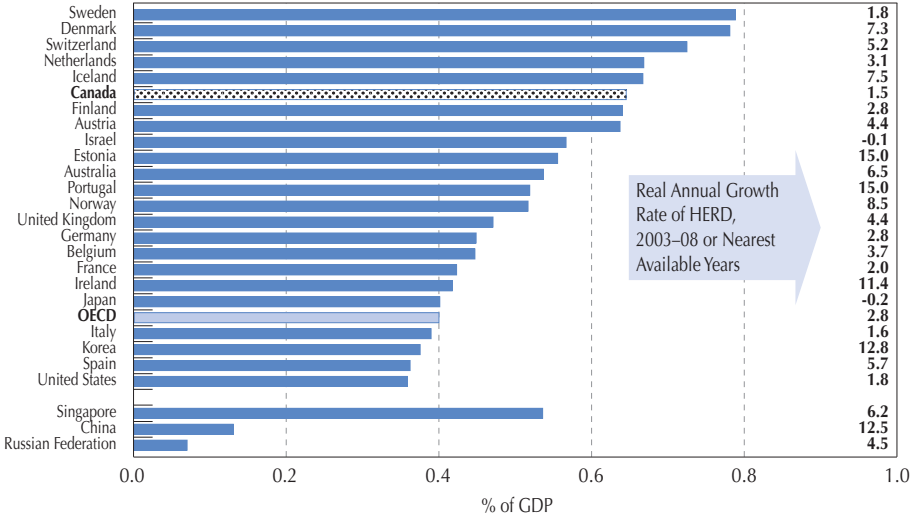
Canada's HERD by Major Source of Funds, 2000 to 2009



*Other includes foreign and private not-for-profit organizations.

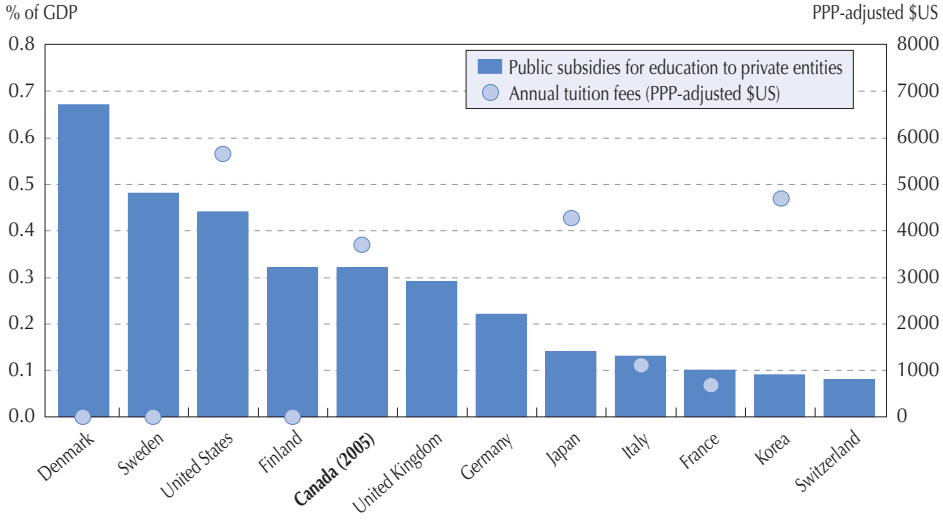
Source: Statistics Canada, *Gross Domestic Expenditures on Research and Development in Canada (GERD), and the Provinces*, Catalogue no. 88-221, December 2010.

HERD as a Percentage of GDP, Top OECD Countries and Selected Non-OECD Countries, 2008



Source: OECD, *Main Science and Technology Indicators*: 2010/2 edition, January 2011.

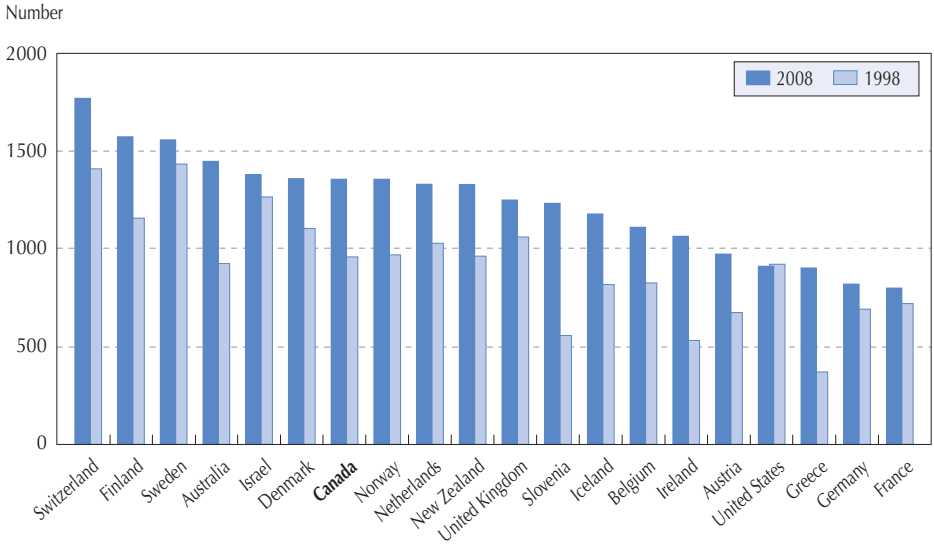
Annual Tuition Fees Charged by Public Universities and Public Subsidies to Private Entities, Selected OECD Countries, 2007



Note: The classification used for Japan differs slightly from that of other countries. Tuition fee data were unavailable for the United Kingdom, Germany and Switzerland.

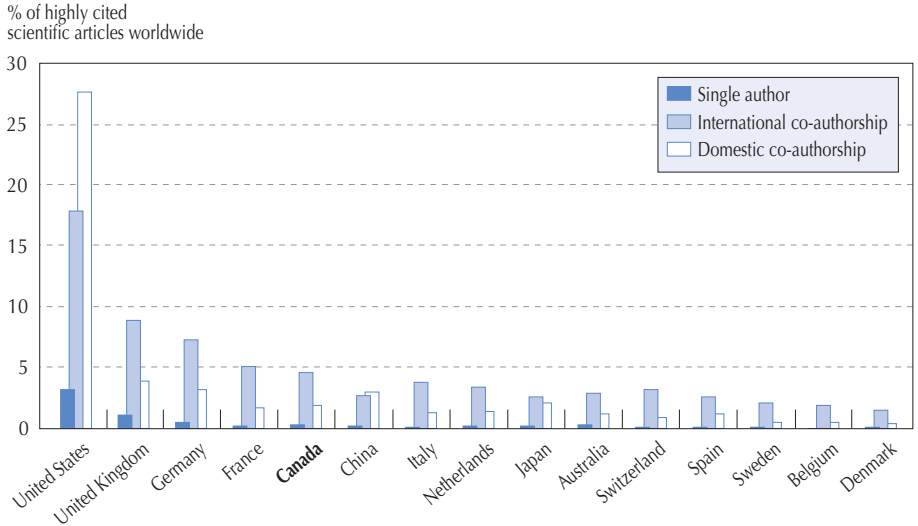
Source: OECD, *Measuring Innovation: A New Perspective*, 2010.

Scientific Articles per Capita, Top OECD Countries, 1998 and 2008



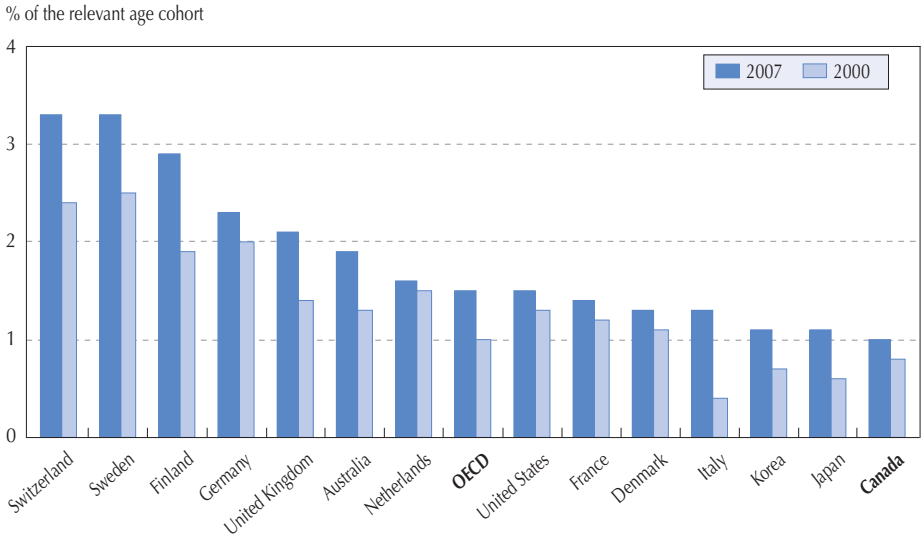
Source: OECD, *Science, Technology and Industry Outlook*, 2010.

Highly Cited (Top 1%) Scientific Articles by Type of Collaboration, Top Countries, 2006–08



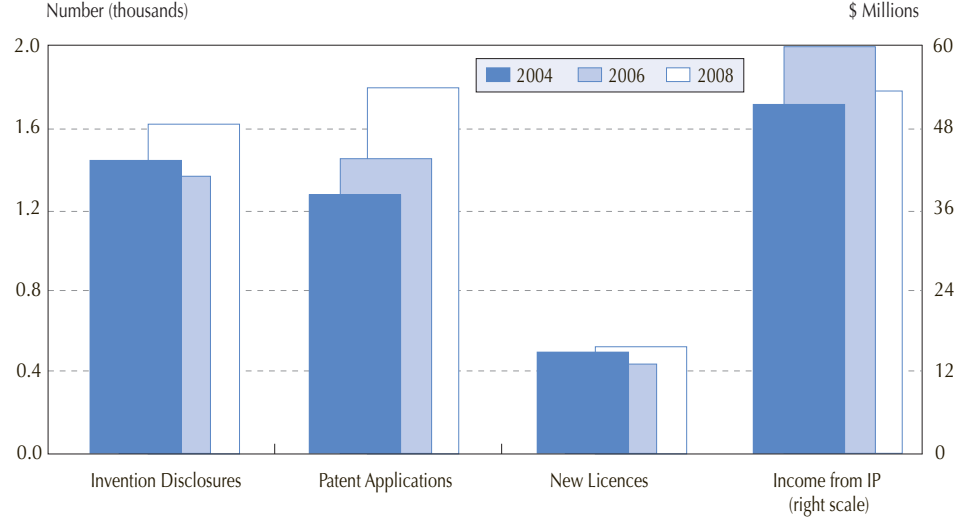
Source: OECD, *Measuring Innovation: A New Perspective*, 2010.

Graduation Rates at the Doctoral Level, Selected OECD Countries, 2000 and 2007



Source: OECD, *Measuring Innovation: A New Perspective*, 2010.

Selected Commercialization Output of University Research, 2004, 2006 and 2008



Source: Statistics Canada, *Survey of Intellectual Property Commercialization, by Higher Education Sector Indicators*, CANSIM Table 358-0025.

CANADA AND THE WORLD

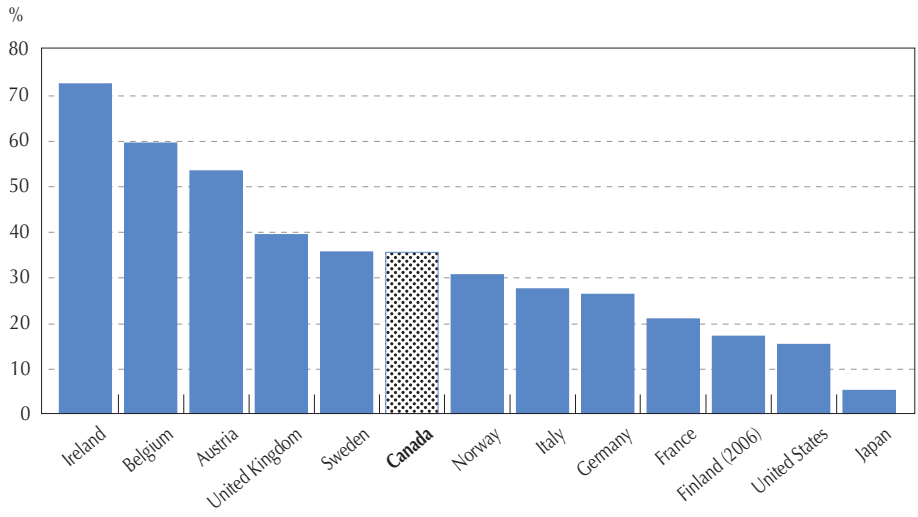
In 2007, foreign affiliates accounted for a relatively large share (35 percent) of Canada's BERD. This is second only to the United Kingdom among G7 countries.

Canada's patenting activities involve international cooperation. Over the 2005–07 period, 28 percent of Canada's patents filed under the Patent Cooperation Treaty involved a foreign co-inventor. Canada ranks first among G7 countries in that regard.

Over the 2007–09 period, 17 percent of Canadian firms (with activities outside the country) outsourced activities outside Canada. This share is much higher for manufacturing firms than non-manufacturing firms.

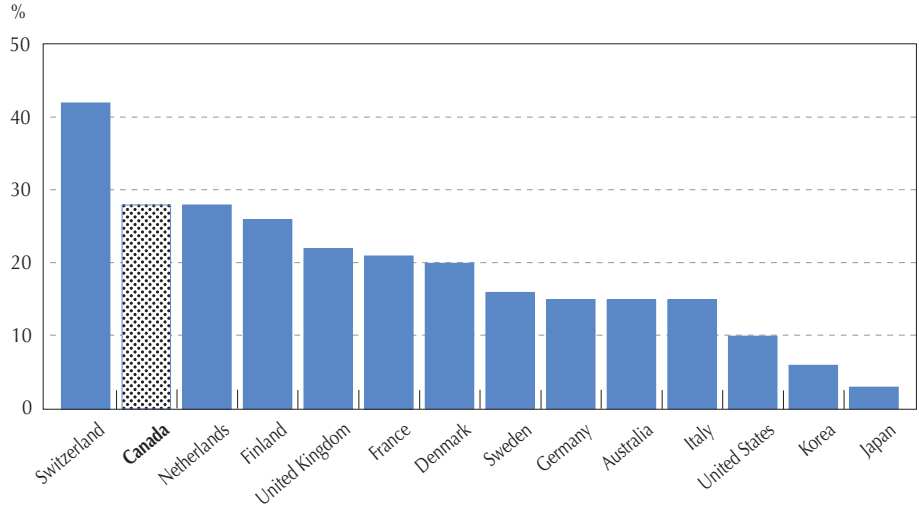
Business R&D expenditures within Canada are highly concentrated. Over the past five years, approximately one third of BERD in Canada was performed by only 25 firms. In 2009, the worldwide R&D budget of each of the eight largest multinational groups was almost of the same magnitude as Canada's total BERD.

R&D Expenditure of Foreign Affiliates as a Percentage of Business R&D Performed in the Country, Selected OECD Countries, 2007



Source: OECD, *Main Science and Technology Indicators*: 2010/2 edition, January 2011.

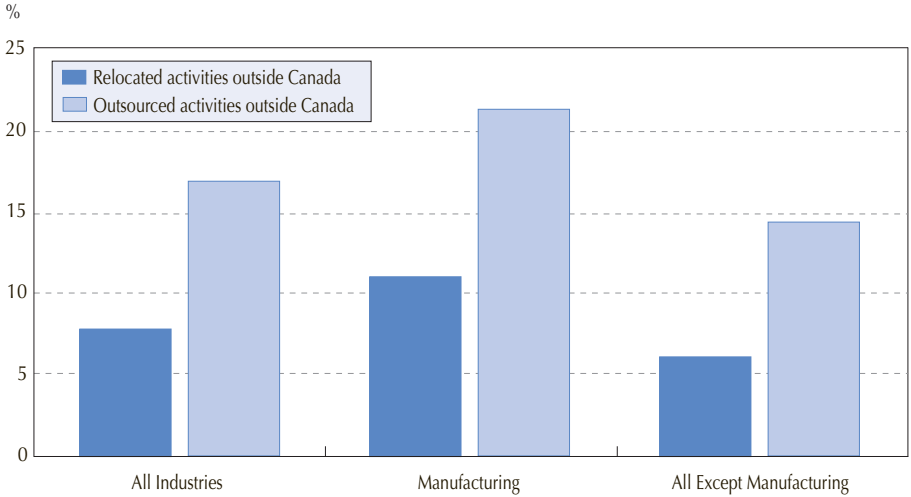
Percentage of Patents with Foreign Co-inventor(s), Selected OECD Countries, 2005–07



Note: Patents refer to patent filed under the Patent Cooperation Treaty (PCT). The country values reflect the average of the values observed for their respective regions (TL2).

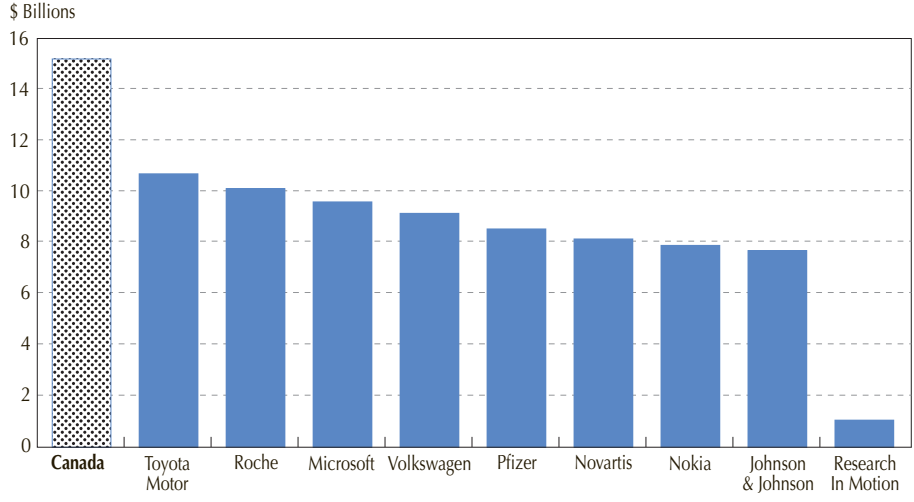
Source: OECD, *Measuring Innovation: A New Perspective*, 2010.

Percentage of Enterprises with Activities Outside Canada, having Relocated or Outsourced Activities Outside Canada, 2007–09



Source: Statistics Canada, *Survey of Innovation and Business Strategy*, 2009.

Industrial R&D Expenditures, Canada and the Top Large Multinational Groups, 2009



Note: The R&D expenditures of multinational groups are consolidated at the global level and may include a share of R&D performed in Canada. The graph includes the top eight multinational groups by level of R&D spending. Research In Motion (RIM) is Canada's largest R&D performer and is included for illustrative purposes. RIM's total may include spending on R&D performed outside of Canada.

Source: Statistics Canada, *Science Statistics*, Vol. 34, No. 6, December 2010. Department for Business Innovation and Skills (U.K.), *The 2010 R&D Scoreboard*, 2010.

NOTES

NOTES