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# SCIENCE AND TECHNOLOGY DATA — 2006

March 2008

Canada

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# ACRONYMS AND ABBREVIATIONS



**AAFC —** Agriculture and Agri-Food Canada
**BERD —** Business enterprise expenditure on research and development
**CFI —** Canada Foundation for Innovation
**CIDA —** Canadian International Development Agency
**CIHR —** Canadian Institutes of Health Research
**CRC —** Communications Research Centre Canada
**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
**HERD —** Higher education expenditure on research and development
**IC —** Industry Canada
**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
**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

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

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

**Triadic Patent Family —** An invention for which a patent application has been filed at the European Patent Office, Japanese Patent Office and United States Patent Office.

# 4 NATIONAL

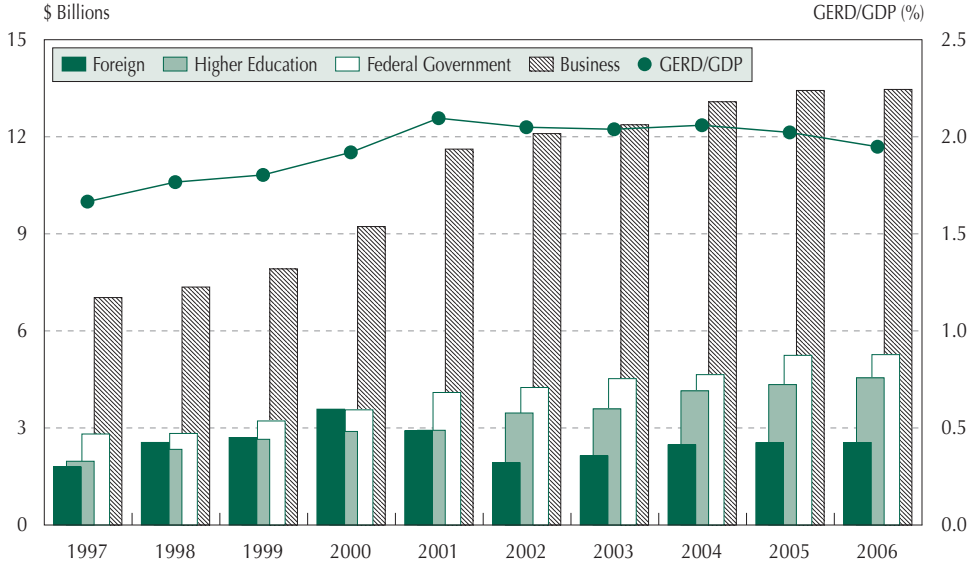
GERD represents total R&D performed in a country. In Canada, as in most other OECD countries, the business sector is the most important performer of R&D and its largest funder. In 2006, $28.1 billion worth of R&D was performed in Canada, of which $13.5 billion was funded by business.

GERD expressed as a percentage of GDP is a standard indicator of the share of resources a country devotes to R&D (i.e. its R&D intensity). In 2005, Canada devoted almost 2 percent of its GDP to R&D expenditures. This figure, which continued to be below the peak recorded in 2001, placed Canada 12th among OECD countries in R&D intensity.

Canada's aggregate spending on R&D can hide significant provincial disparities: the two Canadian provinces with the largest economies, Ontario and Quebec, lead all others in both the volume and intensity of R&D spending.

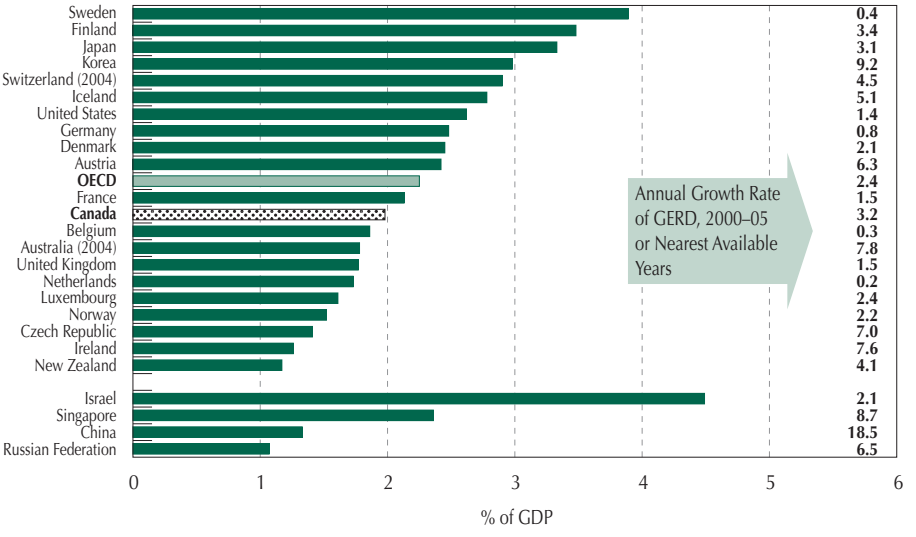
Although investment in R&D is often used to estimate the effort applied to the production of new goods or processes, investment in machinery and equipment can represent the adoption of new technologies. Canada's real spending on M&E has increased rapidly in recent years, reaching 8.8 percent of GDP in 2006.

# Canada's GERD by Major Source of Funds, 1997 to 2006



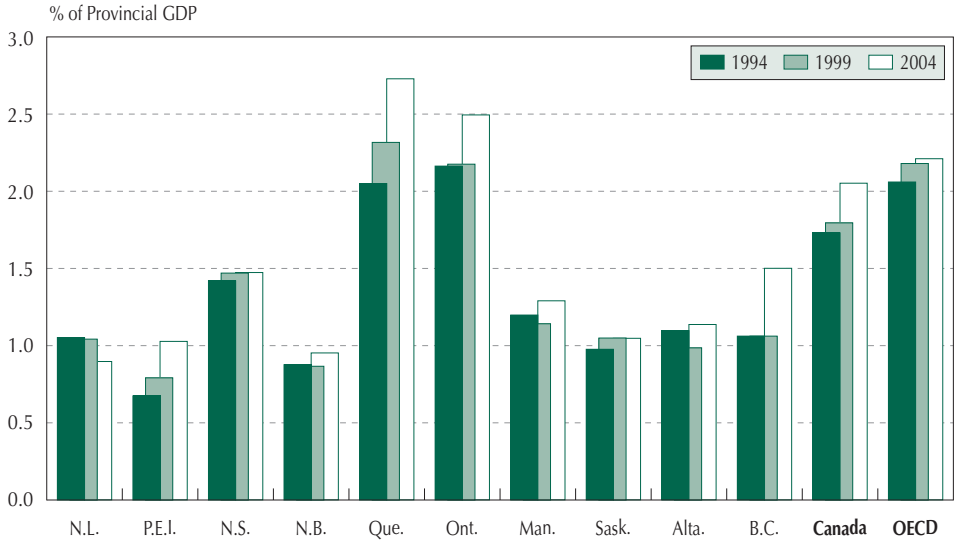

Source: Statistics Canada, *Science Statistics*, Vol. 31, No. 8, December 2007.

# GERD as a Percentage of GDP, Top OECD and Selected Non-OECD Countries, 2005



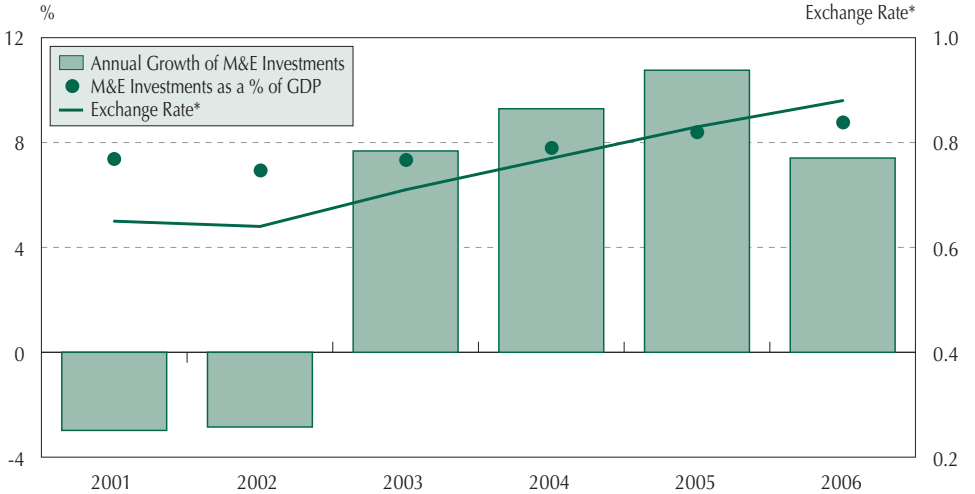

Source: OECD, *Main Science and Technology Indicators 2007/2*, November 2007.

# R&D Intensity at the Provincial Level, 1994, 1999 and 2004




Sources: Statistics Canada, *Science Statistics*, Vol. 31, No. 8, December 2007 and CANSIM tables 358-0001 and 384-0002.
OECD, *Main Science and Technology Indicators 2007/2*, November 2007.

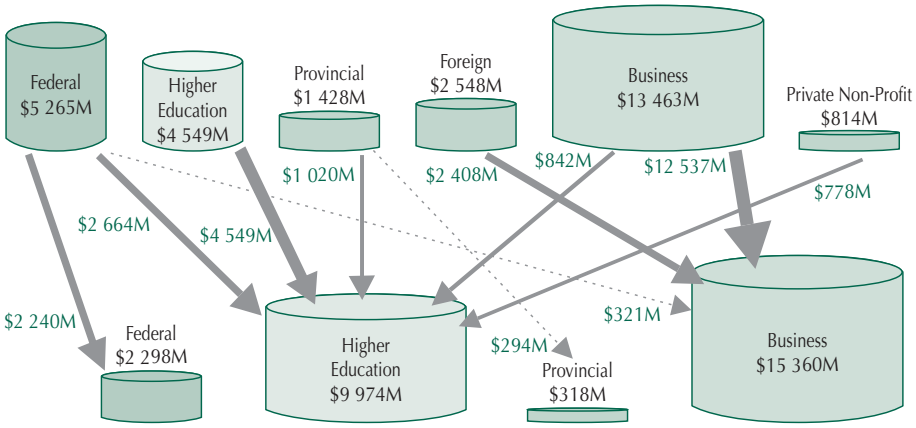
# Real Investment in M&E, 2001 to 2006




*Exchange rate expressed as United States dollars per Canadian dollar.

Sources: Statistics Canada, *National Income and Expenditure Accounts*, Second quarter 2007, Cat. No. 13-001-X, September 2007. Exchange rates were obtained from the Bank of Canada website.

## Major Flows of R&D Funding in Canada, 2006*




*Only flows higher than $150M are shown in the chart.

Source: Statistics Canada, *Science Statistics*, Vol. 31, No. 8, December 2007 and CANSIM Table 358-0001.

# 10 GOVERNMENT

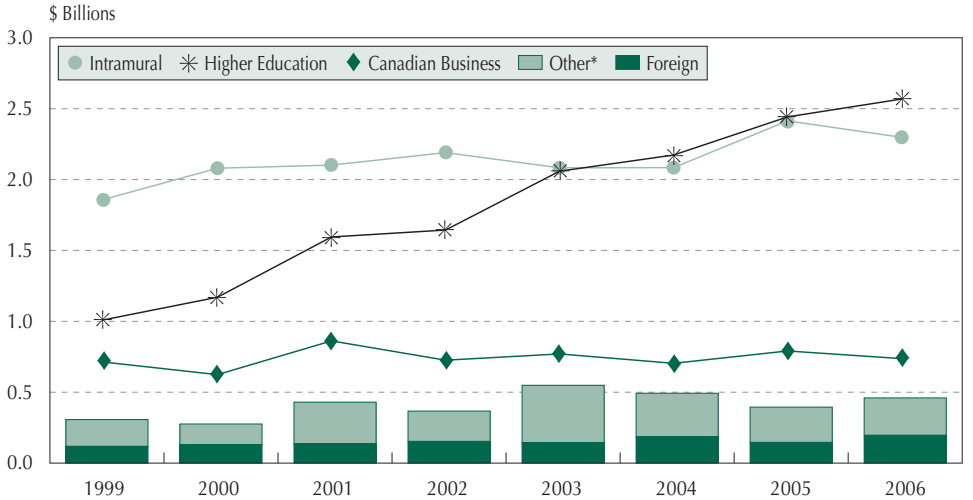
The federal government is a major funder of R&D in Canada, second only to the business sector. In the past, federal funding for R&D was directed primarily to in-house activities (intramural R&D). However, federal funding for R&D in the higher education sector now exceeds that for R&D in the government sector.

Federal government spending on S&T includes far more than spending on R&D: over a third of federal spending is dedicated to related scientific activities. RSA consist mainly of data collection, information services and special studies. These activities complement and extend R&D by contributing to the generation, dissemination and application of knowledge.

Federal support for S&T is channelled through various departments and agencies. Canada's three granting councils (CIHR, NSERC and SSHRC) are among the top five funding bodies. While the councils primarily support R&D, Statistics Canada (the third largest funder) focuses almost exclusively on RSA.

Federal R&D expenditures support a number of socio-economic objectives. The three objectives attracting the most funding are public health, industrial production and non-oriented research. These are supported mostly by extramural funding. Agriculture, defence and energy are the top three recipients of intramural funding.

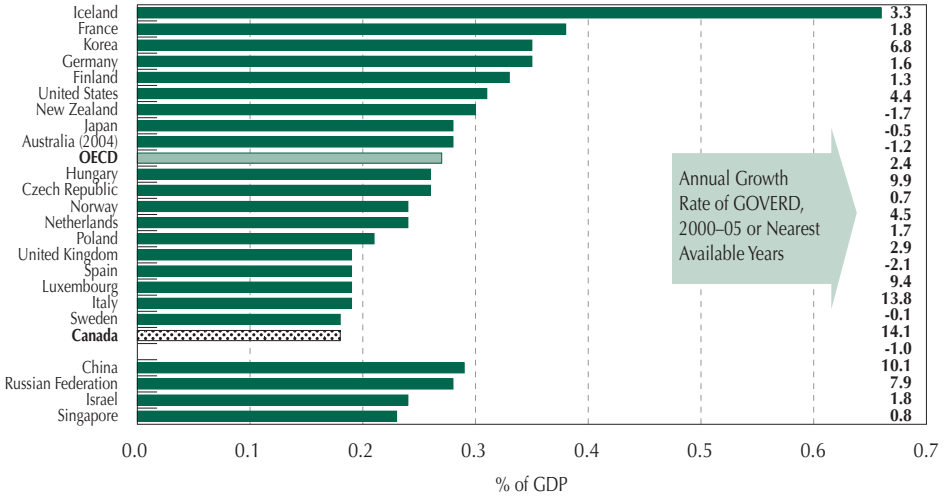
# Federal R&D Spending by Performer Type, 1999 to 2006




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

Source: Statistics Canada, *Science Statistics*, Vol. 31, No. 7, December 2007.

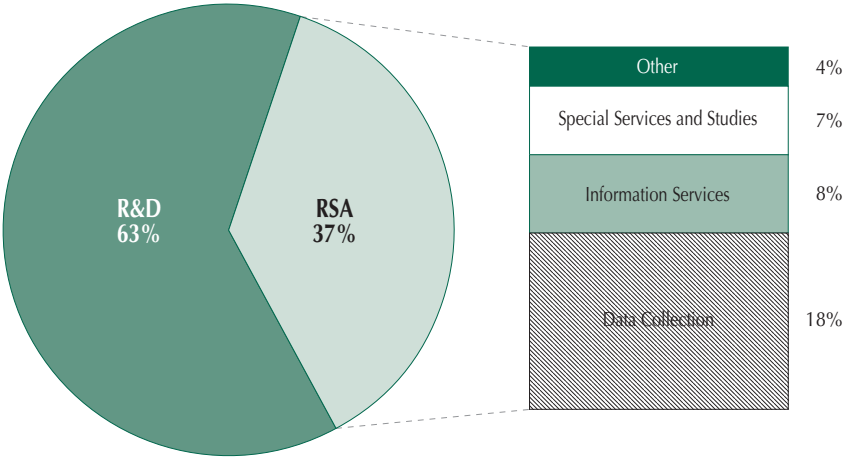
# GOVERD as a Percentage of GDP, Top OECD Countries and Selected Non-OECD Countries, 2005




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

Source: OECD, *Main Science and Technology Indicators 2007/2*, November 2007.

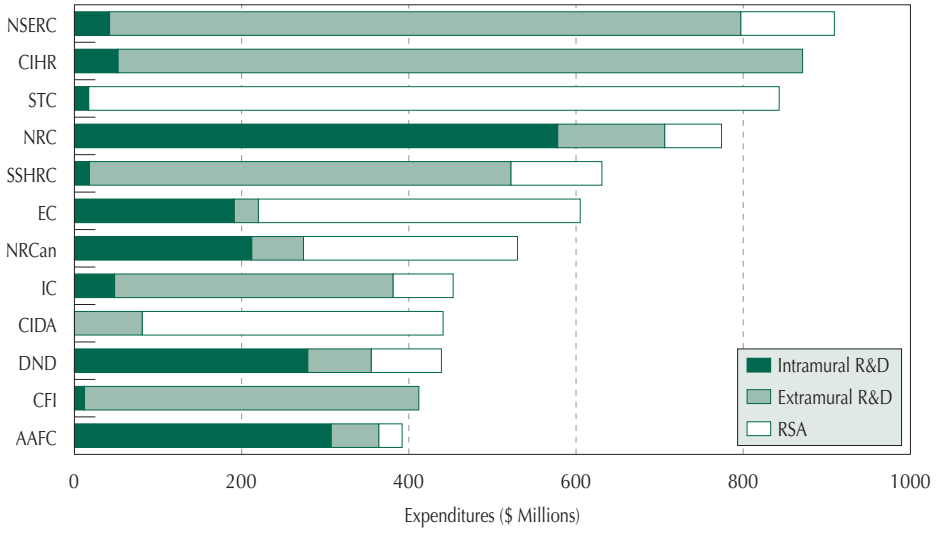
# Federal S&T Spending by Activity, 2006




Total spending: $9.7B

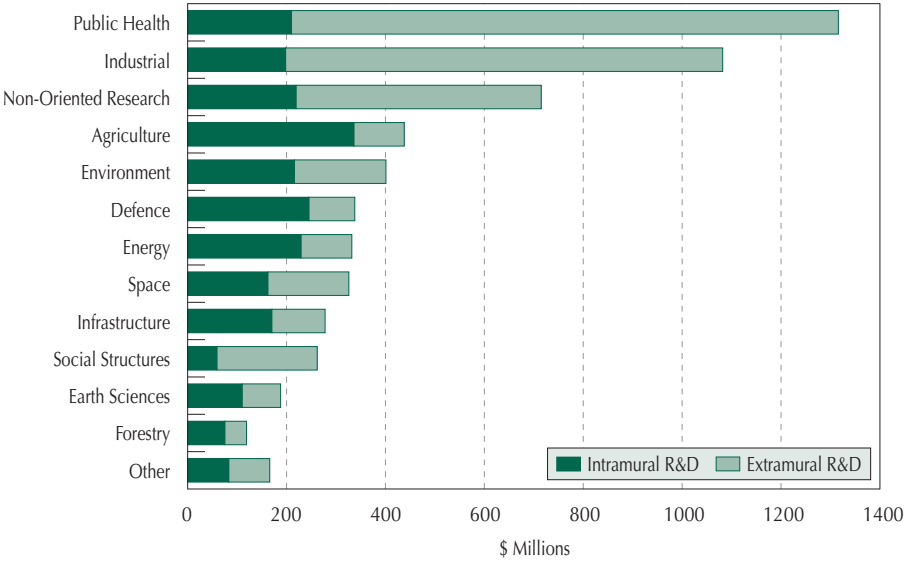
Source: Statistics Canada, *Science Statistics*, Vol. 31, No. 7, December 2007.

# Major Federal S&T Departments and Agencies by Amount of Spending, 2006




Source: Statistics Canada, *Science Statistics*, Vol. 31, No. 7, December 2007.

# Federal R&D Spending by Socio-Economic Objective, 2005




Source: Statistics Canada, *Science Statistics*, Vol. 31, No. 7, December 2007.

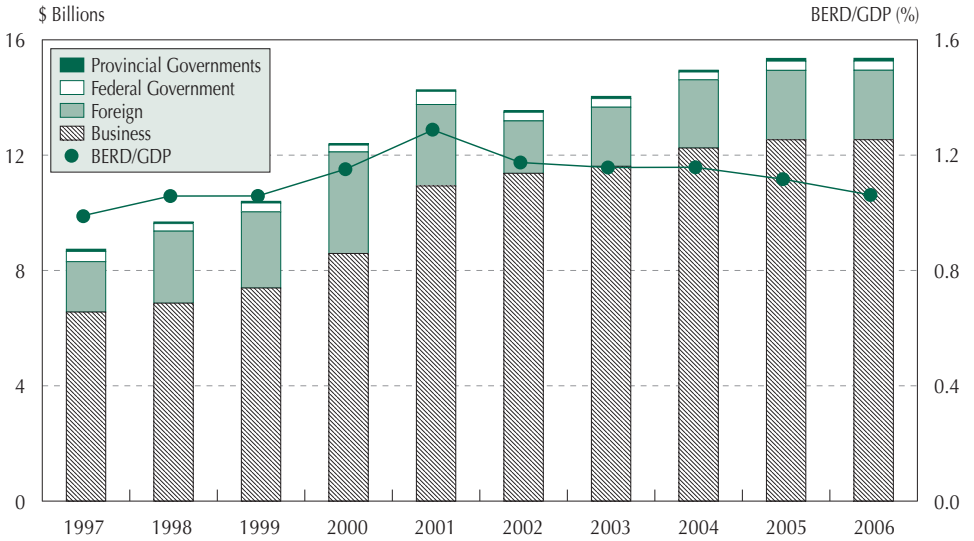
# 16 INDUSTRY

More than half of the R&D performed in Canada is performed by the business sector. In 2006, business expenditures on R&D accounted for almost 55 percent ($15.4 billion) of all R&D in Canada. Over the past 10 years, BERD has generally followed an upward trend. However, this growth seems to have levelled off since 2005. Compared with other OECD countries, Canada's BERD-to-GDP ratio is low, ranking 15th among OECD countries and below the OECD average.

In 2004, over 80 percent of Canada's business R&D was performed in Ontario and Quebec. These two provinces, which together account for 60 percent of Canada's GDP, are the only two whose BERD-to-GDP ratios match or exceed both the Canadian and OECD averages.

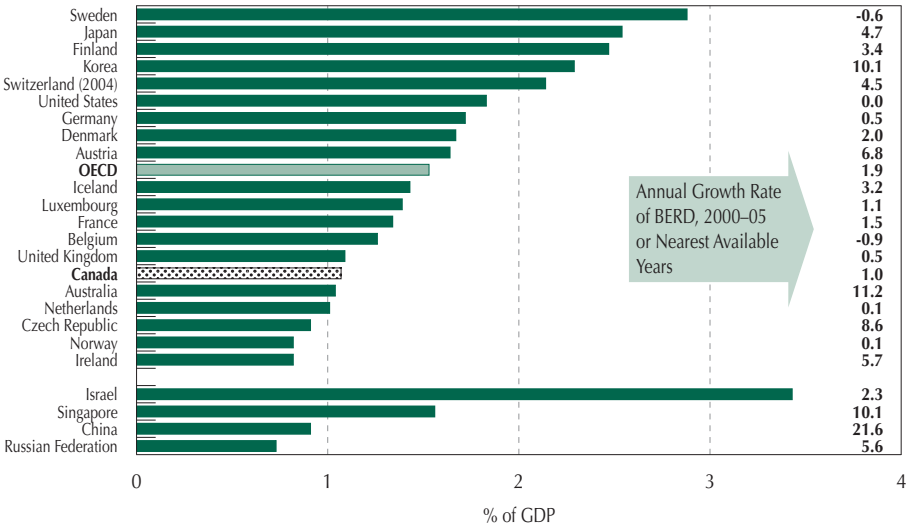
In most OECD countries, business R&D performance has become less reliant on direct government funding. Canada is no exception. Its share of government-financed business R&D declined from 6.2 percent in 1995 to 2.2 percent in 2005.

# Canada's BERD by Major Source of Funds, 1997 to 2006



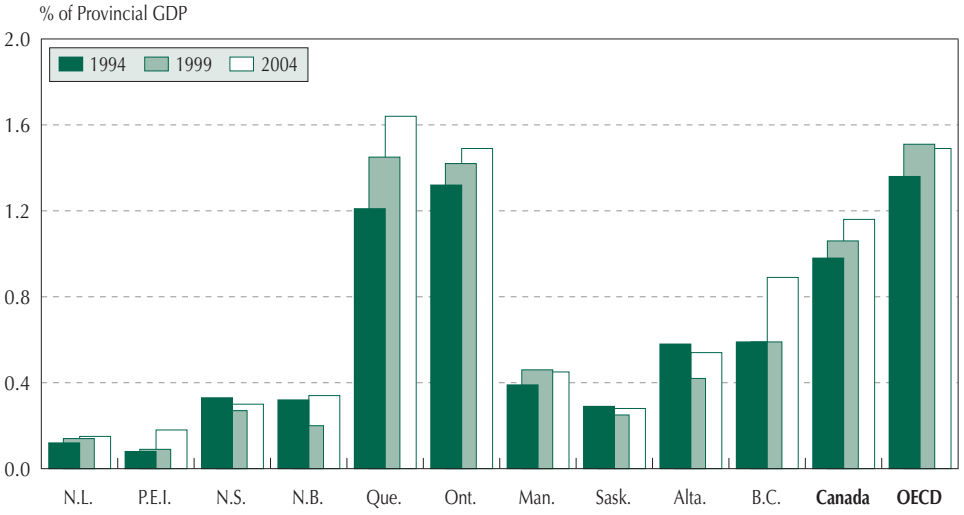

Source: Statistics Canada, *Science Statistics*, Vol. 31, No. 8, December 2007 and CANSIM tables 358-0001 and 384-0002.

# BERD as a Percentage of GDP, Top OECD Countries and Selected Non-OECD Countries, 2005



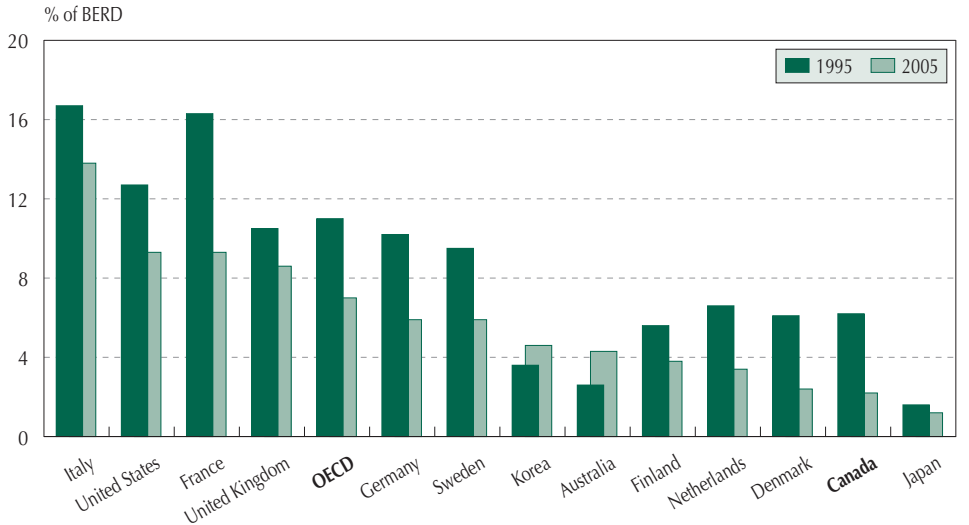

Source: OECD, *Main Science and Technology Indicators 2007/2*, November 2007.

# BERD Intensity at the Provincial Level, 1994, 1999 and 2004



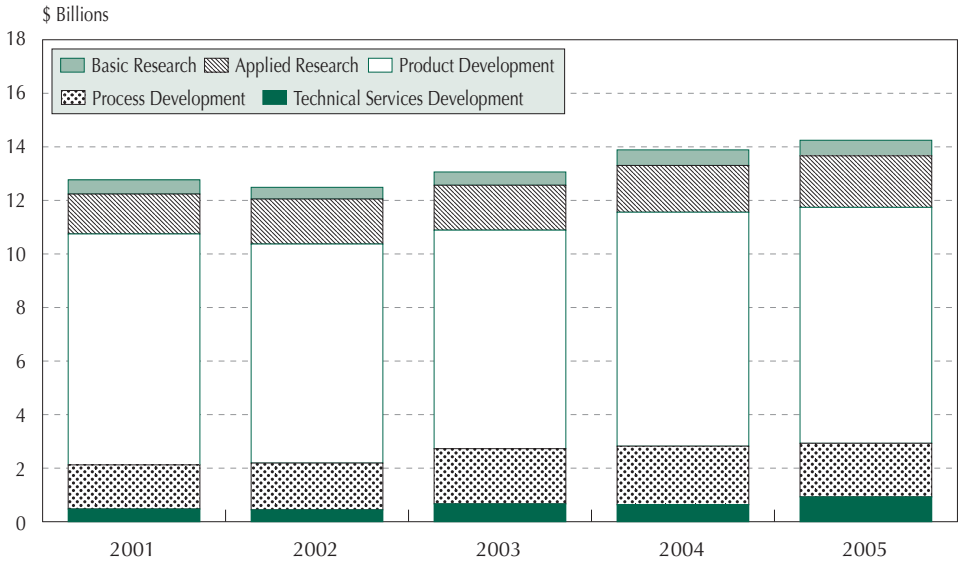

Sources: Statistics Canada, *Science Statistics*, Vol. 31, No. 8, December 2007 and CANSIM tables 358-0001 and 384-0002.
OECD, *Main Science and Technology Indicators 2007/2*, November 2007.

## Percentage of Business R&D Financed by Governments, 1995 and 2005 or Nearest Available Years




Source: OECD, *Science, Technology and Industry Scoreboard 2007*, October 2007.

# Business Intramural R&D by Type of Activity, 2001 to 2005




Source: Statistics Canada, *Science Statistics*, Vol. 31, No. 6, November 2007.

# 22 HIGHER EDUCATION

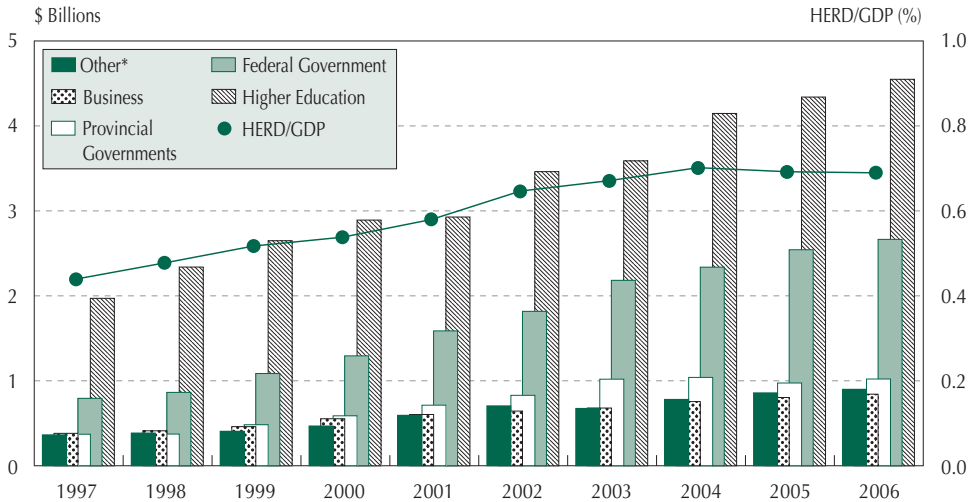
The higher education sector has performed an increasing share of Canada's R&D over the past decade. While expenditures appear to have stabilized in the past two years, they nevertheless reached $10 billion in 2006. The share of HERD funded by the federal government increased at a much faster pace than the share funded by business and provincial governments between 1997 and 2006.

Among OECD countries, Canada is second only to Sweden in HERD intensity. As well, growth in Canada's HERD has remained strong in recent years.

In addition to carrying out R&D, higher education institutions are also tasked with training the next generation of Canadians. Between 1998 and 2005, the share of university degrees awarded in business administration increased significantly. Among the science and engineering fields, computer science and engineering registered the highest percentage increases.

Compared with other OECD countries, Canada grants a high proportion of science and technology degrees. However, when compared with other G7 countries, Canada ranks sixth for natural science and engineering degrees and first for social science degrees. As well, regardless of the field, a smaller proportion of young people earn doctoral degrees in Canada than in most other OECD countries.

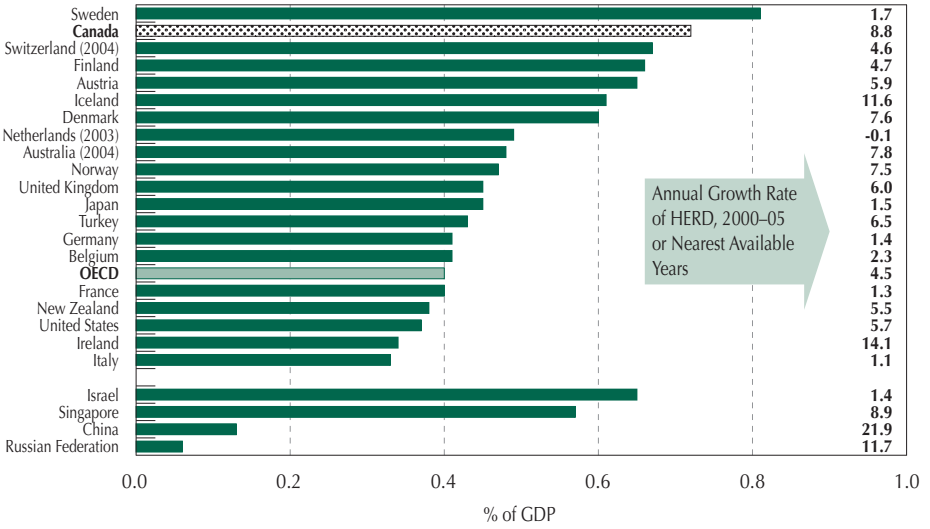
# Canada's HERD by Major Source of Funds, 1997 to 2006




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

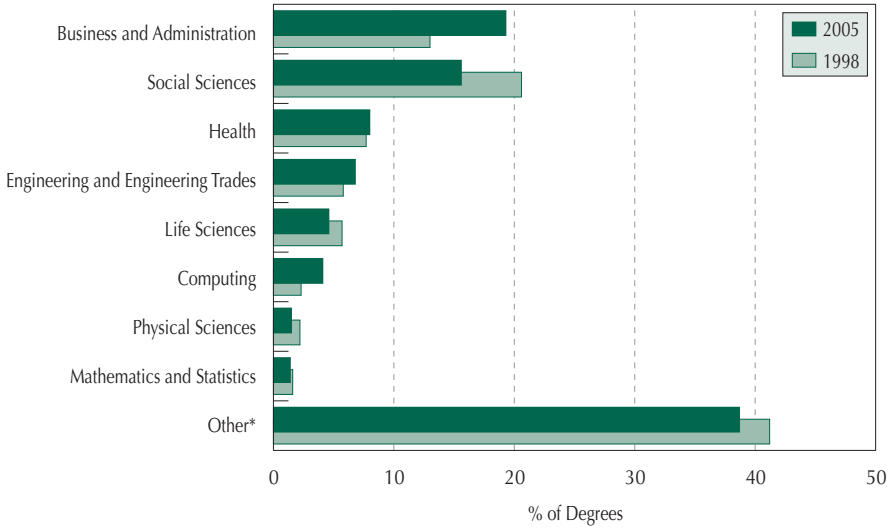
Source: Statistics Canada, *Science Statistics*, Vol. 31, No. 8, December 2007 and CANSIM tables 358-0001 and 384-0002.

# HERD as a Percentage of GDP, Top OECD and Selected Non-OECD Countries, 2005




Source: OECD, *Main Science and Technology Indicators 2007/2*, November 2007.

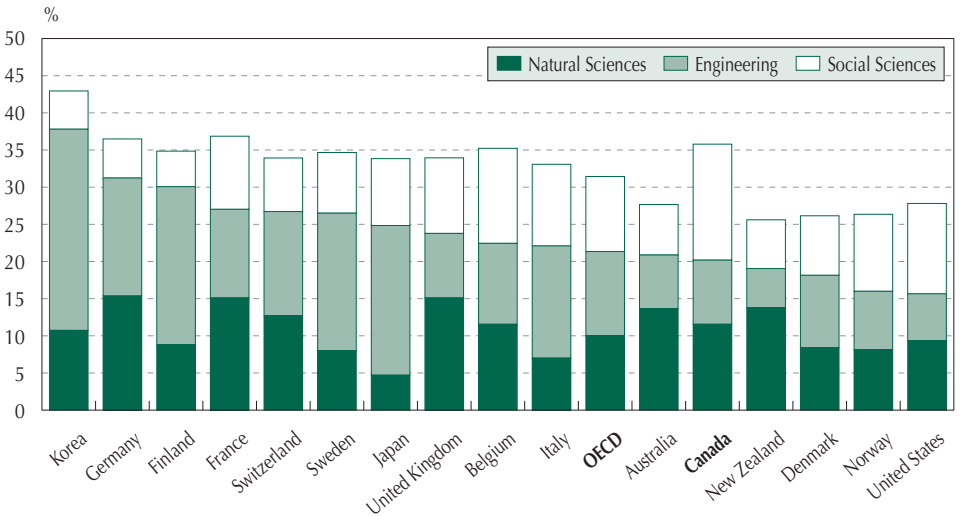
# University Degrees Granted by Selected Discipline, 1998 and 2005




*Other includes mainly *Humanities and Arts* and *Education*.

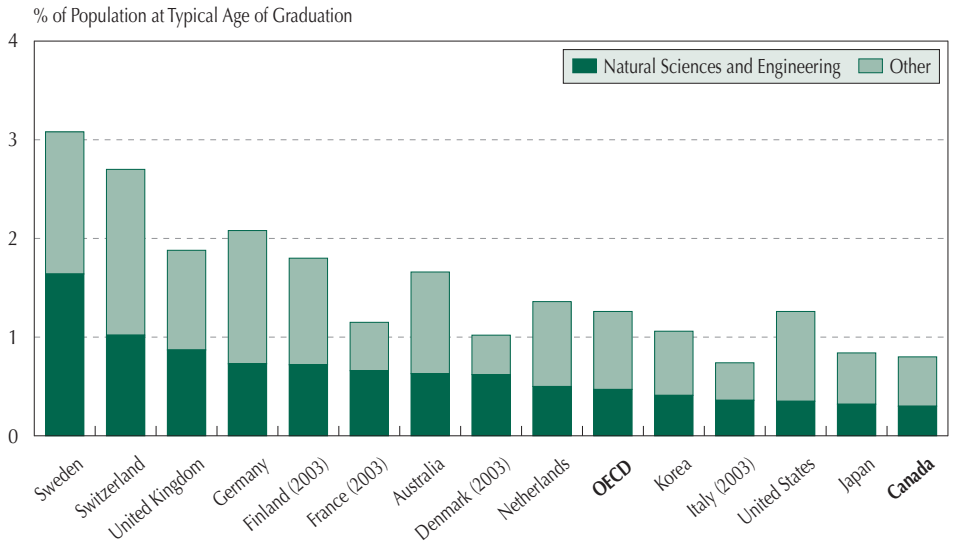
Source: OECD, OECD.Stat Extracts database, "Graduates by Field of Study," January 2008.

# Science and Engineering Degrees as a Percentage of New Degrees, Selected OECD Countries, 2005




Source: OECD, OECD.Stat Extracts database, "Graduates by Field of Study," January 2008.

# PhD Graduation Rates, Selected OECD Countries, 2004




Source: OECD, *Science, Technology and Industry Scoreboard 2007*, October 2007.

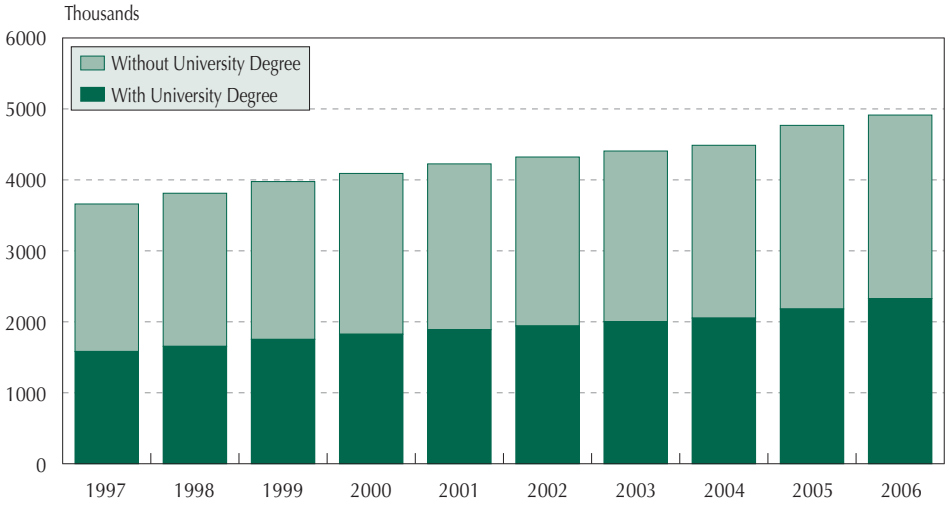
# 28 HUMAN RESOURCES

The number of people working in S&T occupations in Canada has increased over the past 10 years, with most of the growth accounted for by university graduates. Among these workers in S&T occupations, professionals outnumber technicians by almost 50 percent.

In Canada, as in other OECD countries, university graduates usually earn higher wages than non-graduates. However, in recent years, this wage premium has declined in Canada while it has remained stable in the United States.

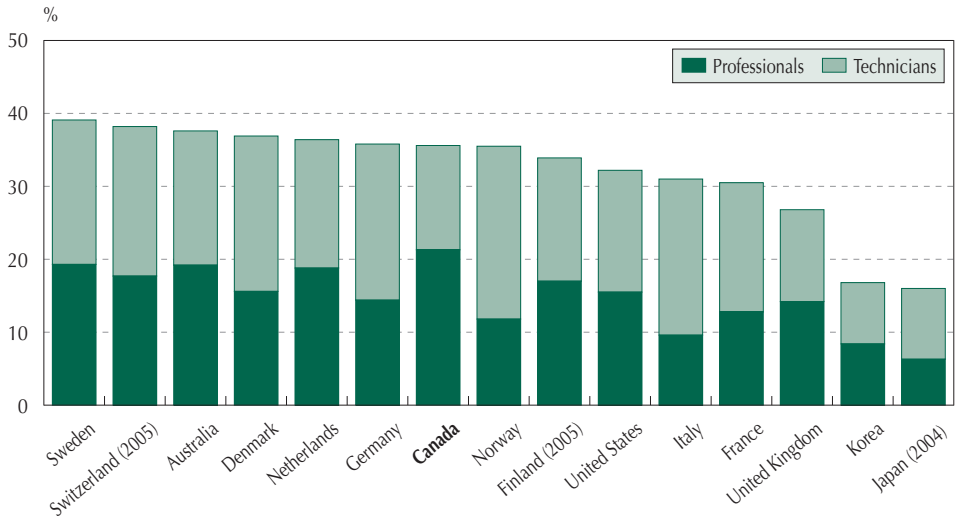
Canada employs fewer R&D personnel (per thousand employment) than a number of competitor economies. In contrast, its numbers of business researchers (per thousand employment) is close to the OECD average.

## Human Resources in S&T in Canada by Level of Education, 1997 to 2006



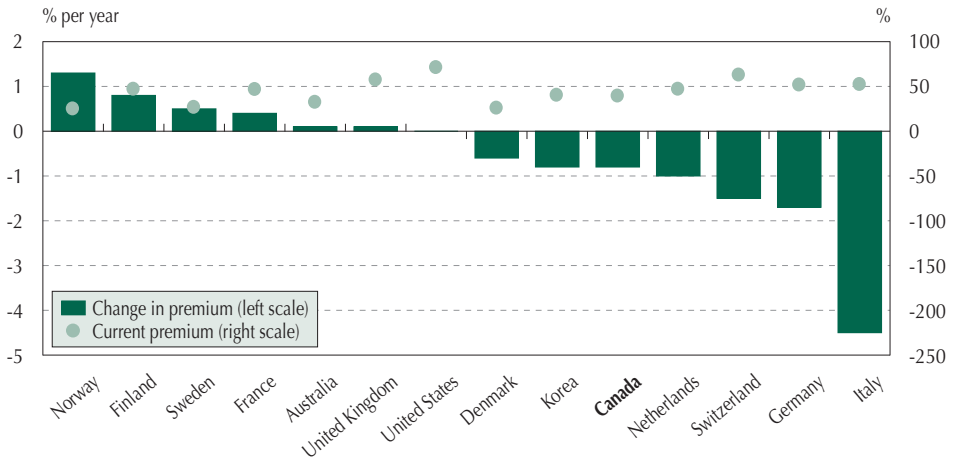

Source: Institut de la statistique du Québec, *Compendium d'indicateurs de l'activité scientifique et technologique au Québec*, 2007.

# Human Resources in S&T as a Percentage of Total Employment, Selected OECD Countries, 2006




Source: OECD, *Science, Technology and Industry Scoreboard 2007*, October 2007.

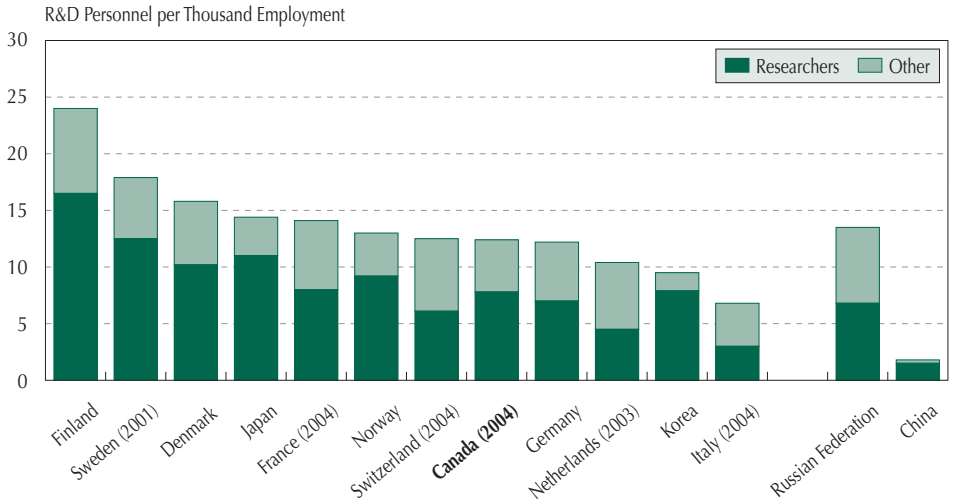
## Recent Change in Wage Premiums* for Holders of Tertiary Degrees, Selected OECD Countries, 1999 to 2003 or Nearest Available Years




*Relative to the earnings of individuals possessing upper-secondary and post-secondary non-tertiary education.

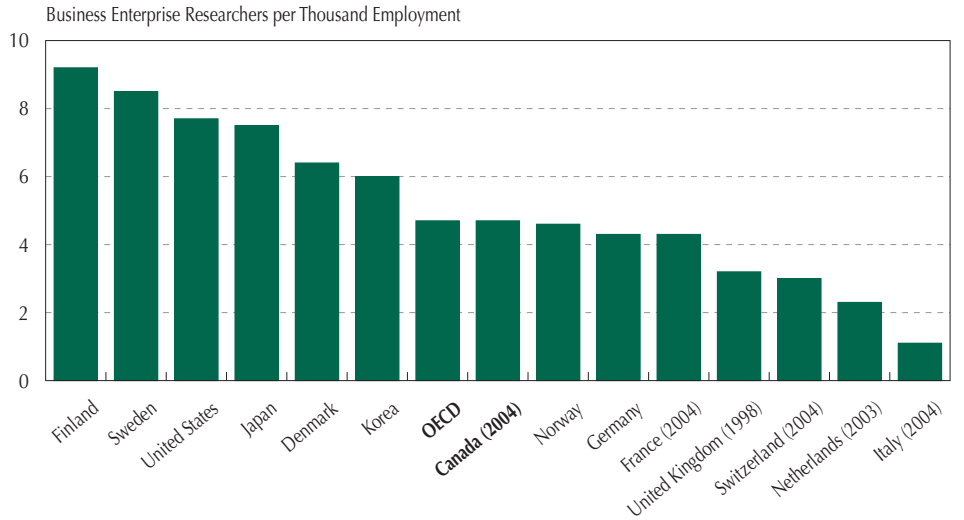
Source: OECD, *Science, Technology and Industry Scoreboard 2007*, October 2007.

# R&D Personnel per Thousand Employment, Selected OECD and Non-OECD Countries, 2005




Source: OECD, *Science, Technology and Industry Scoreboard 2007*, October 2007.

## Business Enterprise Researchers per Thousand Employment, Selected OECD Countries, 2005




Source: OECD, *Science, Technology and Industry Scoreboard 2007*, October 2007.

# 34 COMMERCIALIZATION AND OUTPUT

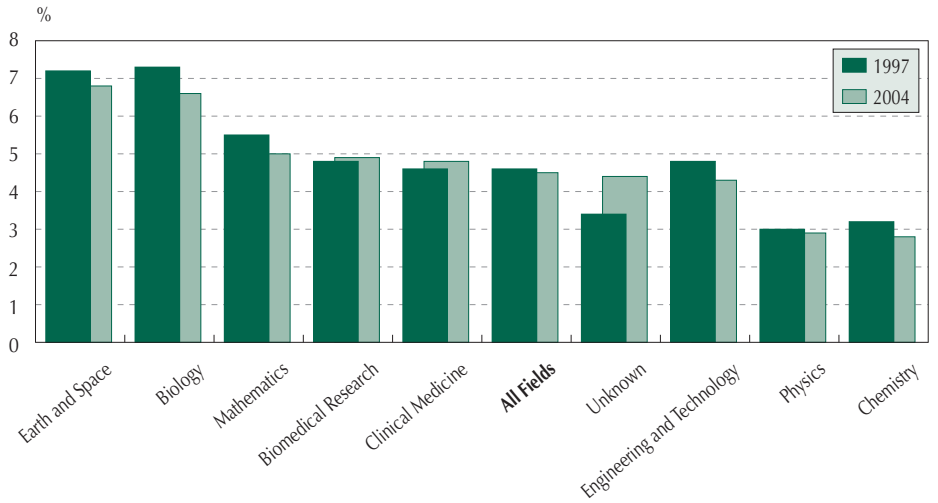
Canada accounted for 4.5 percent of the world's published scientific papers in 2004. In addition, it accounted for 6.8 percent and 6.6 percent, respectively, of papers published in the earth and space and the biology fields.

Between 1997 and 2005, all G7 countries (except Japan) increased their expenditures on higher education R&D. However, among them, only Canada and Italy recorded (slight) increases in their share of the world's scientific publications. Highlighting the more competitive environment, the share of Canadian papers in the natural sciences and engineering, published in the top 10 percent high-impact journals, has declined over the past 10 years.

Triadic patents are a standard indicator of scientific output. Compared with key competitors, Canada generates fewer triadic patents per unit of industry-financed GERD.

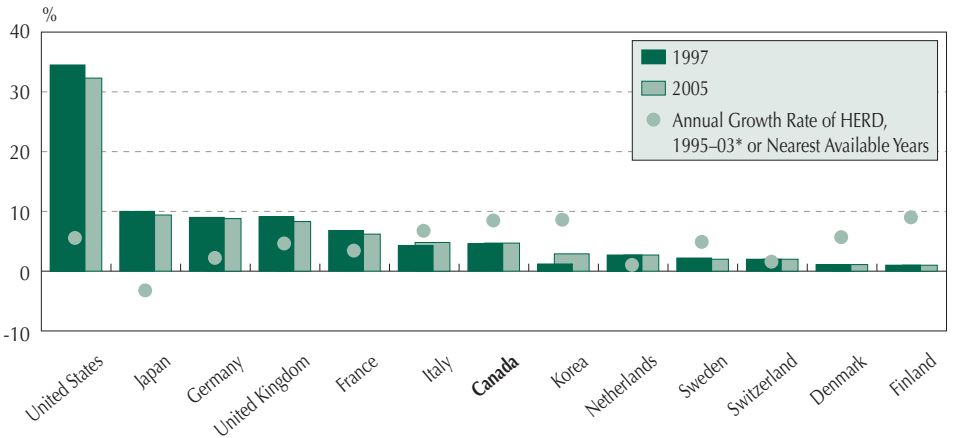
A number of commercialization and output measures are collected from Canadian universities. These suggest that Canada's largest universities account for the vast majority of disclosures, patent applications and income from intellectual property.

## Canada's Share of the World's Scientific Publications by Field, 1997 and 2004




Source: Observatoire des sciences et des technologies, 2006.

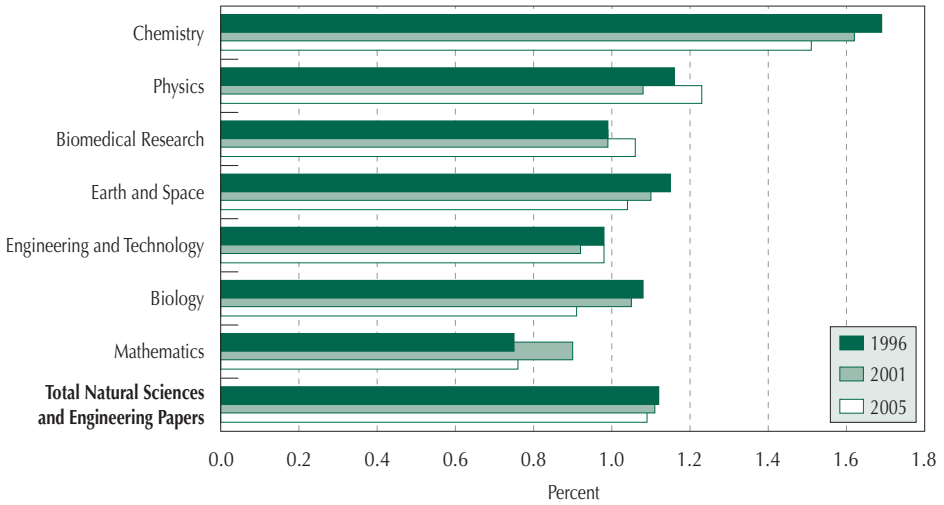
# Share of the World's Scientific Publications and Higher Education Investments in R&D, Selected OECD Countries, 1997 and 2005




*Real HERD growth is calculated from 1995 to 2003, to allow a two-year lag between investment and publication.

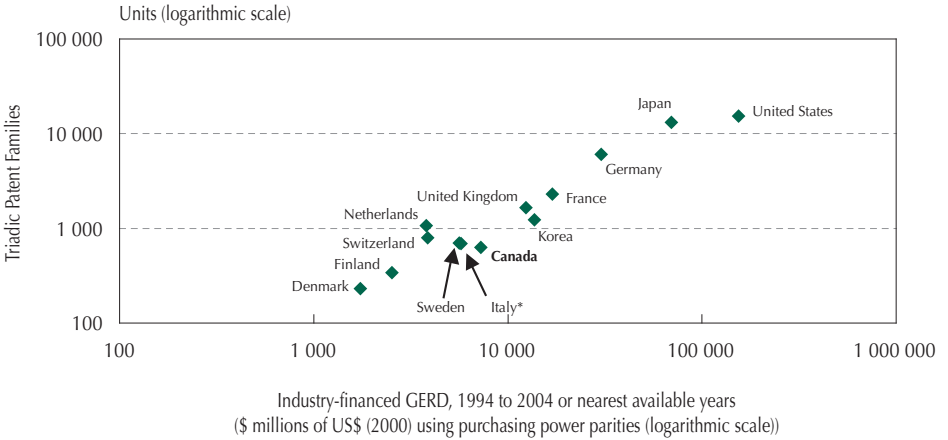
Sources: Observatoire des sciences et des technologies, 2007.
OECD, *Main Science and Technology Indicators 2007/2*, November 2007.

## Percentage of Canadian Natural Science and Engineering Papers Published in the Top 10 Percent High-Impact Journals, 1996, 2001 and 2005




Source: NSERC, *A Review of Canadian Publications and Impact in the Natural Sciences and Engineering, 1996 to 2005*, 2007.

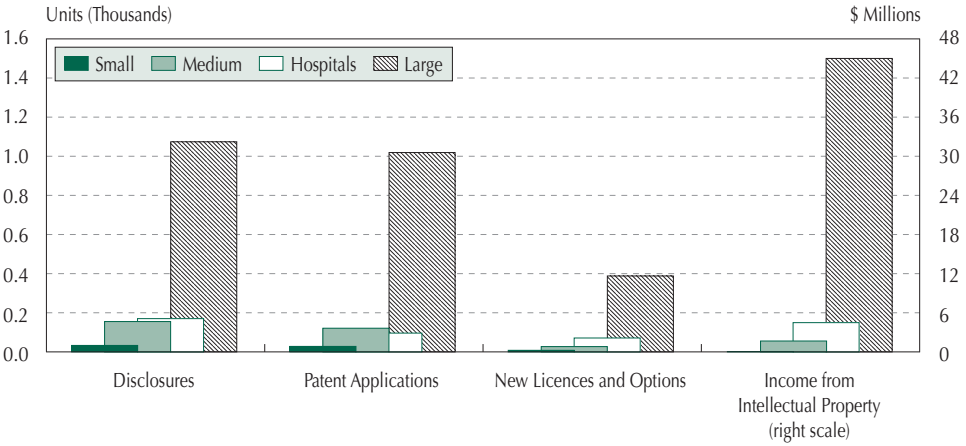
# Triadic Patent Families and Industry-Financed GERD, Selected OECD Countries, 1995 to 2005 Average




*BERD financed by industry instead of GERD financed by industry.

Source: OECD, *Science, Technology and Industry Scoreboard 2007*, October 2007.

# Selected Commercialization Outputs of University Research by Scale of Income Generated,* 2005




*Income is from sponsored research. Small is less than $25 million, medium is $25 million to $79 million, and large is $80 million or more. Hospitals associated with universities were included to ensure consistency with the aggregate figures.

Source: Statistics Canada, *Innovation Analysis Bulletin*, Vol. 9, No. 1, Cat. No. 88-003-XIE.

# NOTES