



Council of Canadian Academies
Conseil des académies canadiennes

REPORT IN FOCUS

April 2009

Innovation and Business Strategy: Why Canada Falls Short

PREFACE

The Expert Panel on Business Innovation first met in November 2007, a time when the Toronto Stock Exchange index was nudging 14,000, oil was close to \$100 a barrel, the Canadian dollar was above par with the U.S. dollar, economic growth was solid and the unemployment rate was at a multi-decade low.

But beneath the bullish daily headline data were worrisome longer-term trends, particularly the poor performance of productivity growth in Canada. Growth of the hourly output of Canada's business sector had been falling behind that of the United States for more than two decades, and the trend had deteriorated significantly since 2000. Investment in leading-edge technology – particularly related to computers and communications – was lagging significantly behind not only that of the United States, but also many of the advanced countries with which Canada compares itself. Business spending on research and development as a share of the economy was down 20% from its 2001 peak at the end of the technology boom.

It was in this context of mixed signals – rosy on the surface but less so underneath – that the Government of Canada asked the Council of Canadian Academies to appoint a broad-based panel of experts to assess the innovation performance of Canadian business. This document is an abridged version of the panel's findings.

The panel focused its analysis primarily on long-run phenomena, stretching over decades and across several ups and downs of the economic cycle. Its findings therefore remain relevant despite the severe shock to the global economy.

While the panel was completing its work in late 2008 and early 2009, the world changed dramatically. Because the extent of the global economic crisis – its depth, duration and ultimate impact on Canada's economy and society – is unknown, its full implications for the panel's analysis will only become clear with the passage of time. The panel has therefore not attempted to factor the crisis prominently into its diagnosis of business innovation in Canada – a longer-term perspective is needed in any event. The symptoms of lagging innovation by the business sector in Canada are of very long standing. The panel therefore focused primarily on long-run phenomena, stretching over decades and across several ups and downs of the economic cycle. The panel's findings remain relevant despite the severe contemporary shock to the global economy. As governments in Canada continue to take measures in the near term to mitigate the downturn, a sound diagnosis of the underlying causes of Canada's generally weak business innovation performance can help to target those measures so that they also strengthen the nation's economy for the long term.

The Expert Panel on Business Innovation: Robert Brown, Chair, President and Chief Executive Officer, CAE Inc. (Montréal, QC); **Savvas Chamberlain, FCAE**, Chairman and Founder, DALSA Corporation (Waterloo, ON); **Marcel Côté**, Founding Partner, SECOR Inc (Montréal, QC); **Natalie Dakers**, Chief Executive Officer, Centre for Drug Research and Development, University of British Columbia (Vancouver, BC); **Meric Gertler, FRSC**, Dean, Faculty of Arts and Science; Co-Director, Program on Globalization and Regional Innovation Systems, University of Toronto (Toronto, ON); **Bronwyn Hall**, Professor of Economics of Technology and Innovation, University of Maastricht (Maastricht, The Netherlands); Professor of the Graduate School, University of California at Berkeley (Berkeley, CA); **André Marcheterre**, Company Director, Former President and Chief Executive Officer, Merck-Frosst Canada (Lorraine, QC); **Arthur May**, President Emeritus, Memorial University; Chairman of the Advisory Board, Atlantic Innovation Fund (St. John's, NL); **Brian McFadden**, President and Chief Operating Officer, Prestige Telecom Inc. (Baie d'Urfé, QC); **Walter Mlynaryk**, Executive Vice-President, Kruger Inc. (Montréal, QC); **David Pecaut**, Senior Partner and Managing Director, Boston Consulting Group (Toronto, ON); **Jim Roche**, Company Director, and Former President and Chief Executive Officer, CMC Microsystems (Ottawa, ON); **Charles Ruigrok**, Former Chief Executive Officer, Syncrude Canada Ltd. (Calgary, AB); **Andrew Sharpe**, Executive Director, Centre for the Study of Living Standards (Ottawa, ON); **Jim Stanford**, Economist, Canadian Auto Workers (Toronto, ON); **Guthrie Stewart**, Former Partner, Equity Fund, Edgestone Capital Partners (Montréal, QC); **Alexandre Taillefer**, Co-Founder – Stingray Digital Group Inc (Montréal, QC); **John Thompson**, Chairman, TD Bank Financial Group (Toronto, ON).

The Full Report will be released in June 2009. Please visit www.scienceadvice.ca for more information.

EXECUTIVE SUMMARY

1. In assessing the fundamental factors that influence business innovation behaviour in Canada, the panel has regarded innovation as an *economic* process rather than as a primarily science and engineering activity. The report's focus is on the long run, across several turns of the economic cycle, and thus remains relevant despite the severe current shock to the global economy. As requested by the government, the panel's report is diagnostic rather than policy prescriptive.
2. Innovation is new or better ways of doing valued things. An "invention" is not an innovation until it has been implemented to a meaningful extent. Innovation is not limited to products but includes improved processes and new forms of business organization. Innovation is of great economic importance because it is, directly or indirectly, the key driver of labour productivity growth (increased output per hour worked) and thus the main source of national prosperity.
3. Canada has a serious productivity growth problem. Since 1984, relative labour productivity in Canada's business sector has fallen from more than 90% of the U.S. level, to about 76% in 2007. Over the 1985-2006 period, Canada's average labour productivity growth ranked 15th out of 18 comparator countries in the OECD group.
4. Canada's relatively poor productivity growth is due mainly to weak growth of multifactor productivity (MFP), which measures broadly the effectiveness with which labour and capital are used in the economy. The problem is not caused by shortcomings in Canada's workforce or inadequate capital investment (with the exception of significantly lagging investment in information and communications technology (ICT)).
5. The rate of MFP growth over suitably long periods primarily reflects the contribution to labour productivity growth of business innovation — including better organization of work, improved business models, the efficient incorporation of new technology, the payoff from R&D, and the insights of entrepreneurs. Canada's weak MFP growth indicates that the country's lagging productivity growth is largely due to weak business innovation.
6. Canada's innovation weakness is also signalled by conventional indicators. For example, business R&D in Canada, as a percentage of GDP, declined by 20% between the collapse of the technology boom in 2001 and 2007, and has consistently fallen below the OECD average. Canada's failure to develop many innovative Canadian-based multinationals has been a key contributor to the country's overall R&D weakness. A lack of global export leaders in advanced equipment for the resource sector is also an indicator of the country's innovation shortcomings.
7. Investment at the leading edge of technology (which represents the indirect acquisition of innovation) has also lagged. Empirical evidence suggests a correlation between investment in machinery and equipment and MFP growth. The most significant and puzzling area of lagging investment has been in ICT where average investment per worker in Canada was only about 60% of the U.S. level in 2007. Investment in ICT is an important driver of productivity growth, particularly in many service-producing industries that are the main source of job growth in advanced economies. The ICT investment picture is consistent with the view that Canadian businesses on the whole — but always with notable exceptions — are technology followers, not leaders.
8. *Business strategy drives innovative behaviour.* The starting point of any exercise that aims to improve Canada's innovation and productivity performance should therefore be to understand why relatively few Canadian businesses choose strategies that emphasize innovation. A focus on the determinants of business strategy, rather than on innovation activities themselves, is the most significant new contribution of this study.
9. The principal factors that influence the business innovation decision can be categorized broadly as (i) particular characteristics of the firm's sector; (ii) the state of competition; (iii) the climate for new ventures; (iv) public policies that encourage or inhibit innovation; and (v) business ambition (e.g., entrepreneurial aggressiveness and growth orientation). The relative importance of these factors will vary from sector to sector and over the lifecycle of individual firms. (These factors are analyzed fully in the panel's report.)
10. The foregoing factors are themselves influenced by certain long-standing features of Canada's economy — in particular:
 - *Canada is "upstream" in many North American industries.* This positioning is related to the traditional resource dependence of Canada's economy and the extent of foreign control. Upstream positioning limits contact with ultimate end-customers who are a strong source of motivation and direction for innovation.
 - *Canada's domestic market is relatively small and geographically fragmented.* Small markets offer lower potential reward for undertaking the risk of innovation and tend to attract fewer competitors, and thus provide less incentive for a business to innovate in order to survive. On the other hand, the innovation success of countries like Finland and Sweden shows that the disadvantage of a small domestic market can be offset by a strong orientation toward innovation-intensive exports.
11. There is no single cause of the innovation problem in Canada, nor is there any one-size-fits-all remedy. Public policy in respect of innovation therefore needs to be informed by a deep understanding of the factors that influence business decision makers, sector by sector. This requires consultation with business people themselves as well as the further development of innovation surveys and other forms of micro-analysis of the innovation process.
12. Overarching the sector-specific factors that influence innovation strategies, there are certain issues identified in the panel's analysis that suggest the need for proactive public policies to:
 - encourage investment in advanced machinery and equipment (M&E) in general, and in ICT in particular (such incentives should be designed only in light of a more thorough understanding of the reasons for the relatively slow adoption of ICT in Canada to date);
 - sharpen the incentive for innovation-oriented business strategies by increasing exposure to competition and by promoting a stronger export orientation on the part of Canadian firms, particularly in goods and services that are downstream in the value chain and thus close to end-users;
 - improve the climate for new ventures so as to better translate opportunities arising from Canada's university research excellence into viable Canadian-based growth businesses, bearing in mind that better early-stage financing and experienced mentorship hold the key; and
 - support areas of particular Canadian strength and opportunity through focused, sector-oriented strategies as was done in the past in, for example, the automotive, aerospace and ICT industries.
13. The many successes of Canadian businesses in the hyper-competitive global marketplace show that there is nothing innate or inevitable in the national character that prevents Canada's businesses from being just as innovative and productive as those of other nations.
14. As governments in Canada continue to take measures in the near term to mitigate the current global economic downturn, the panel's diagnosis of the nature and underlying causes of Canada's business innovation performance can help to target those measures so that they also strengthen the nation's economy for the long term.

1. INTRODUCTION

Innovation — new or better ways of doing valued things — is the manifestation of creativity, the uniquely human capacity to transform the imagined into the real. Innovation matters enormously for society because it is the means by which problems are solved and new opportunities are created. Innovation is what gave us insulin, the telephone, movies, the microchip and the shopping mall, for better or worse.

Innovation matters for *businesses* because novel products and more efficient processes are the principal means of making businesses more competitive. It is through innovation that businesses find ways to generate more value from existing resources. As will be argued in what follows, innovation is thus the main driver of productivity growth — the increased output of goods and services per hour worked. Productivity growth is, in turn, associated with the international competitiveness and commercial dynamism on which high employment and good jobs ultimately depend.

Looking forward, we see a convergence of trends that make innovation more necessary than ever:

- Intensified global competition, particularly the exceptionally rapid emergence of China, India, Brazil and Russia as economic powers, is creating both growing challenges and opportunities for Canada.
- Less resource-intensive and environmentally damaging methods of production need to be developed through innovation to permit the continuation of economic growth and the realization of its benefits in the still-developing world.
- An aging population in Canada is making productivity growth imperative as the proportion of population that is of working age plateaus and then declines.
- Continuing revolutionary developments in the transformative technologies of information and communications, life sciences and advanced materials provide extraordinary opportunities to benefit from their innovative application.

We must therefore be concerned in the face of evidence suggesting that Canadian business on the whole, though with notable exceptions, is lagging in innovation relative not only to the United States, but also to many of our peer group of economically advanced countries in the OECD.

The Charge to the Panel

The question is “why”. If innovation is good for business, why is Canadian business on the whole apparently less committed to innovation than analysts and policy makers believe it should be? The question is all the more puzzling since it has been asked for decades, yet things have not changed much in relative terms. The causes of Canada’s innovation deficiency must therefore run deep in the nature of the economy, and perhaps in Canadian society as well.

To the extent that some of the causes might be mitigated by more appropriate public policies, it is important that governments have a sound diagnosis of what ails business innovation propensity in

Canada. To this end, the federal Minister of Industry asked the Council of Canadian Academies to appoint a panel of business, labour and academic experts to answer the following questions:

- How should the innovation performance of Canadian firms be assessed?
- How innovative are Canadian firms, and what do we know about their innovation performance at a national, regional and sector level?
- Why is business demand for innovation inputs (for example, research and development, machinery and equipment, and skilled workers) weaker in Canada than in many other OECD countries?
- What are the contributing factors, and what is the relative importance of these contributing factors?

Outline

Despite an outpouring of research and commentary over the years on the innovation behaviour of Canadian business, the understanding of it remains incomplete. The aim of this report is to contribute to a greater understanding through analysis and diagnosis based on existing literature and the experience of panel members. No new studies were undertaken. The panel was not asked to provide policy recommendations, though much of its diagnosis of business innovation performance is of policy relevance. Where findings have direct implications for policy, the panel has usually taken the opportunity to make the implications explicit.*

The report is organized as follows:

- Section 2 defines the concept of innovation employed in the report and presents evidence of the impact of innovation on productivity growth in Canada.
- Section 3 provides a quantitative description of the innovation activities of Canadian business relative to Canada’s peer group of economically advanced countries.
- Section 4 establishes a framework for the panel’s analysis by identifying the key factors that influence a firm’s decision regarding the emphasis to be placed on innovation in its business strategy. The most important factors in this regard are (i) the structural characteristics of the Canadian economy; (ii) the state of competition; (iii) the conditions that favour, or inhibit, the creation and growth of new innovative businesses; (iv) public policies that have significant impact on innovation; and (v) business ambition.
- Sections 5 through 9 address each of the foregoing factors, assessing their impact on business decisions regarding innovation.
- Section 10 presents several short case studies on sectors of the Canadian economy — automotive, life sciences, banking, and information and communications technologies. The case studies contribute concreteness to the overall story and illustrate the great diversity and complexity of the innovation *problematique* in Canada.
- Section 11 summarizes the key conclusions of the report.

* While this abridged version of the full report fully reflects an extensive review of relevant data and literature, only those references are provided (as endnotes to this document) where data or publications are directly quoted in this digest version. A comprehensive list of references appears in the full report, available on the Council’s website at www.scienceadvice.ca, in June 2009.

2. THE NATURE AND IMPORTANCE OF INNOVATION

Innovation occurs in the economy in two distinct but complementary ways – “radical” innovation and “incremental” innovation. Radical innovations like the steam engine, canned food, the automobile, television and the transistor are often science or engineering based, and create entirely *new markets* where innovation initially evolves rapidly and competitive races sort out the fit from the unfit. This invention-driven form of innovation is what most people have in mind when they think of “innovation”. The ultimate economic benefits (jobs and income growth) of a blockbuster innovation usually diffuse broadly and rapidly beyond the firm and location where the innovation originates. For instance, while the microchip and the personal computer may have been pioneered by a small number of companies in the United States (e.g., Apple, IBM and Intel), many of the resulting production jobs migrated elsewhere and, more important by far, the productivity benefits of the resulting information and communication technologies (ICT) revolution continue to accrue to users worldwide. This is a spectacular example of the “spillover” benefit of innovation generally, and of research and development (R&D) investment in particular.

Much more pervasive is incremental innovation in which goods and services, and their means of production, marketing and distribution, are being continuously improved. Incremental innovation – in which developments are typically “new to the firm”, or perhaps to a sector, but not “new to the world” – is what drives productivity growth and firm competitiveness in *established markets*. Since established markets constitute the great bulk of economic activity, incremental innovation is directly responsible for the vast majority of labour productivity growth.

For analytical and statistical purposes, the OECD defines business innovation as “...the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations”.¹ This definition implies that:

- *an innovation is not simply an invention, or even a practical prototype.* There must be implementation to a meaningful extent.
- *innovation is not limited to products and services, nor to the direct application of science and technology.* Indeed, many of the most far-reaching business innovations – e.g., the factory assembly line, television advertising, just-in-time inventory management, web-based commerce and artistic commercializations like rock music – have little to do with the traditional image of breakthrough products coming out of the lab, much less simply to the application of R&D or the grant of a patent.

The concept of innovation used in this report is intentionally broad and encompasses not only the direct innovative activities initiated *within* a business but also the capital investment and knowledge acquisition by which the business captures and employs innovation that is generated elsewhere. That is because most of the innovation that is ultimately used in a particular business originates outside the

business itself and is acquired through investment in machinery and equipment, and by adaptation of leading-edge knowledge that is circulating in business and academic environments.

The focus of this report is on innovation in the business sector, which accounts for about 85% of Canada’s output. Of course, innovation also occurs in the public and not-for-profit sectors. Public-sector investments in infrastructure, education, R&D, health and social services are essential complements to private-sector innovation, but this report does not analyze these complementarities in depth.

Why Innovation Matters

Innovation drives an economy’s ability to create more economic value from an hour of work. The resulting productivity growth creates the potential for rising wages and incomes, and thus for a higher standard of living. Canada’s experience shows that natural resources can also make a region wealthy so long as supply lasts, prices are strong and the environmental costs are acceptable. But these favourable conditions may be unsustainable or out of a nation’s control. Moreover, resource production itself requires continuous innovation to increase efficiency, extend supply and mitigate environmental impacts.

The ultimate economic benefits (jobs and income growth) of a blockbuster innovation usually diffuse broadly and rapidly beyond the firm and location where the innovation originates.

While resource price booms may be welcomed, they lead to appreciation of the exchange value of the Canadian dollar and thus undermine the cost competitiveness of Canada’s non-resource sectors that are exposed to international competition. These sectors, which constitute a much larger share of Canada’s workforce and total output than the primary resource industries, will survive only by becoming much more productive and, to that end, more innovative.

A Long-Term Perspective on Canada’s Economic Performance

If Canadian business has lagged seriously in terms of innovation, the consequences should show up in macroeconomic comparisons with peer countries, and in fact they do.

Canada’s average living standard, measured as GDP per capita, has closely tracked behind that of the United States for as long as comparative estimates have been made. Output per person in the United States has always exceeded that of Canada, usually by about 20%, though with substantial fluctuations. When Canada has fallen too far behind, implicit forces – economic, attitudinal and political – have always eventually come into play to restore the balance. But history is not destiny. Indeed, the restorative forces that keep the relative gap from widening indefinitely are brought to bear only through the conscious actions of business and political leaders, and of Canadians themselves.

Per capita output (GDP divided by total population) is, by definition, output per hour worked (labour productivity) multiplied by hours worked per capita (a measure of overall labour utilization in the economy). Hours worked per capita have trended up in recent years in Canada and in 2007 exceeded the comparable measure in the United States by about 4%. Thus the roughly 20% gap between the United States and Canada in respect of per capita output today is due entirely to a lower level of labour productivity in Canada. Moreover, since the demographics of Canada's aging population will constrain the future increase of hours worked per capita, the growth of output per person in Canada will depend increasingly, if not entirely, on productivity growth.

Innovation encompasses not only the direct innovative activities initiated within a business but also the capital investment and knowledge acquisition by which the business captures and employs innovation that is generated elsewhere.

Canada was rapidly closing the labour productivity gap with the United States until the early 1980s (Figure 1). Since 1984, relative productivity in Canada's business sector has fallen from more than 90% of the U.S. level to about 76% in 2007. This near quarter-century of *relative* decline in Canada's productivity is ominous in view of the nation's dependency on strong productivity growth to sustain prosperity.

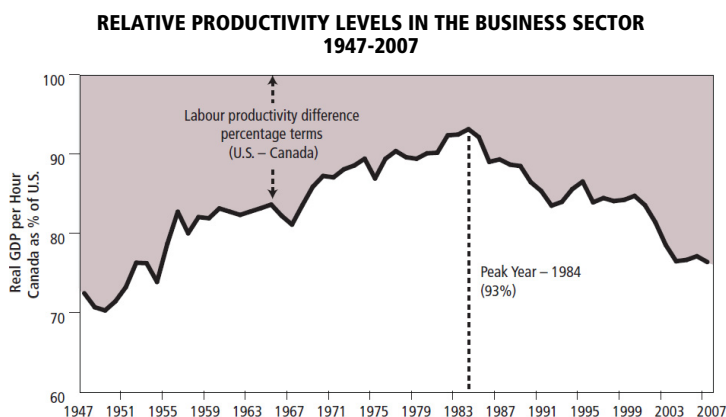


Figure 1*: Relative Productivity Levels in the Business Sector

Canada was rapidly closing the productivity gap with the U.S. until the early 1980s. The strength of U.S. productivity growth since the mid 1990s is primarily associated with the production and use of information and communication technologies.

Statistics Canada has analyzed the differences in labour productivity growth between the business sectors of Canada and the United States over the 45-year period, 1961-2006, and identified the relative contributions due to (i) upgrading of the labour force, (ii) "deepening" of the capital stock, and (iii) increases in multifactor productivity.² Multifactor productivity (MFP) reflects, among other things, the contribution to productivity from aspects of innovation not already embodied in the capital stock. The results of the productivity growth comparison are summarized in Figure 2 where the time period covers the entire span of years from 1961 to 2006 (left side of Figure 2) and the two sub periods (1961-80 and 1980-2006) that capture roughly the times when Canada was narrowing the productivity gap and when it was falling further behind.

The conclusions of the analysis, in summary, are as follows:

- As the top panel in Figure 2 shows, between 1961 and 1980 (middle set of bars) average annual labour productivity growth in Canada (2.9%) outstripped that of the United States (2.5%). Over that period, improvement in the skills composition of the workforce – measured by changes in average educational attainment and years of work experience – advanced more rapidly in Canada. There was also greater capital deepening in Canada – i.e., more rapid growth of productivity-enhancing capital per hour worked. These factors favouring labour productivity growth in Canada were partly offset by significantly lower MFP growth in Canada (0.7% per year) compared to the United States (1.5%) – the bottom panel in the figure.
- In the period since 1980 (the right side of Figure 2), average productivity growth in the U.S. (2.2%) has significantly outpaced that of Canada (1.5%), particularly since 2000. The rate of growth of capital intensity and improvement in workforce skills has been roughly similar, on average, in both countries, but the rate of MFP growth in the U.S. has averaged about five times that of Canada. In the most recent 10-year period, 1996-2006 (not shown in Figure 2), productivity growth increased in Canada (averaging 1.8% per year), but not nearly to the extent seen in the United States (2.8%). Again the Canada-U.S. difference reflects, almost entirely, much slower MFP growth in Canada.

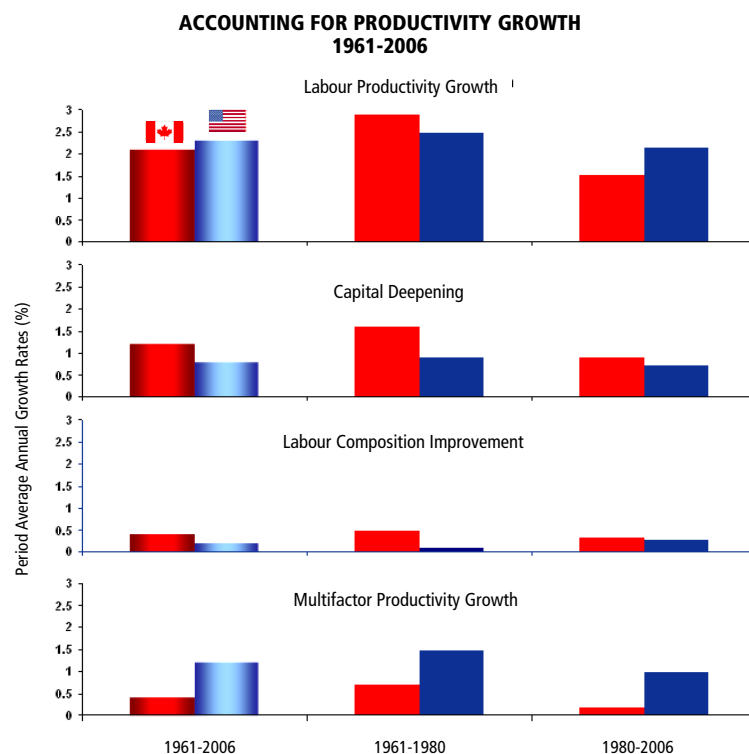
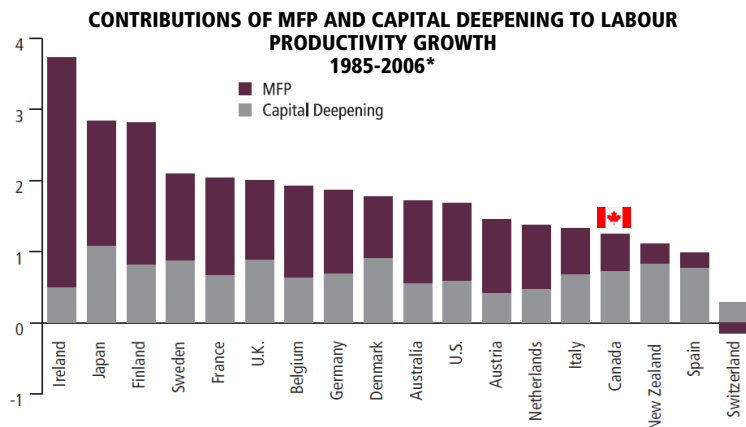


Figure 2: Accounting for Productivity Growth

Labour productivity growth can be accounted for by increasing capital intensity, improvement in workforce skills and a residual called multifactor productivity (MFP) — which broadly reflects the effectiveness with which labour and capital are used. Growth rates in the top panel are the sum of growth rates of the factors in the bottom three panels. The time periods cover the total 45-year interval (leftmost bars) and two sub periods when Canada was closing the productivity gap (roughly 1961-1980) and falling behind (roughly 1980-2006).

* Data sources for figures are listed at the end of this document.

For a time — between 1961 and the mid-1980s — Canada’s strong growth in capital intensity and more rapid improvement in the skill level of the workforce were able to offset persistently weak MFP growth. But that has long since ceased to be the case. Over the 1985-2006 period, Canada’s average labour productivity growth ranked 15th out of 18 comparator countries in the OECD and weak MFP growth was the principal cause (Figure 3). To reverse that dismal trend is the core economic challenge facing Canada.



* Data for some countries are for shorter periods — refer to original source for details.

Figure 3: Contributions of MFP and Capital Deepening to Labour Productivity Growth

The OECD’s decomposition of productivity growth into components reflecting MFP and capital intensity employs a less sophisticated methodology than the Canada-U.S. comparison in Figure 2 owing to less complete and consistent data across OECD countries.

The Significance and Meaning of Multifactor Productivity

Intuitively, changes in MFP measure that portion of labour productivity growth that can *not* be accounted for by measured growth of both capital intensity and the quality of the workforce. MFP is what is left over. Most significant for this discussion is that MFP growth contains the macroeconomic signature of aggregate business innovation — the extraction of increasing value from inputs of capital and labour through inventive activity. Two examples will illustrate:

- Consider the addition of a drive-through window in a fast food outlet. A small amount of construction and one or two extra servers could substantially increase sales volume by expanding the effective “seating capacity” of the restaurant, and, more importantly, by increasing service convenience and thereby attracting more customers. After accounting for the modest capital cost of installing the drive-through window and some extra labour, the remainder of the increased output is chalked up to MFP growth.
- Consider a sales force in the field before the advent of the cellphone or, better yet, the BlackBerry. Today’s relatively inexpensive wireless capital equipment has amplified greatly the value of each field employee, not only through more efficient allocation of time but also through more timely and co-ordinated service for customers. While some of the added value comes from new investment in equipment, most is measured as an increase in MFP.

Micro-examples like these can be multiplied endlessly. In each case, we see an innovation that may be based on science and technology

(e.g., the BlackBerry) or on some very simple engineering combined with entrepreneurial insight (e.g., the drive-through window). The economic impact of thousands upon thousands of such innovations, large and small, is huge.

There is an important interaction between new capital investment (which embodies prior innovation) and MFP since successive generations of capital induce complementary, and often highly innovative, changes in the organization of work and the training of employees — e.g., as the adoption of computer and communications technologies has done. Thus the distinction between the component of productivity growth ascribed to more and better capital, and the component ascribed to MFP, can be somewhat artificial. The impact of technological innovation on productivity growth enters jointly through both channels.

Since MFP is the residual after improvements in labour quality and capital intensity have been accounted for, it reflects all other factors that affect labour productivity. So the innovation signal in MFP growth comes mixed with a lot of “noise”. These other confounding factors include, prominently, changes in capacity utilization caused by booms and recessions, and changes in economies of scale that might be due to opening up of large new markets.

- When the economy slows, capital and workers may be underutilized yet much of their cost continues to be registered; thus some of the decline in output shows up as a temporary decrease in MFP. This business cycle effect can distort short-term comparisons, but the 45 years of data in Figure 2 are more than sufficient to average out such cyclical distortions.
- The effect on productivity due to efficiencies derived through economies of scale shows up as MFP. Such effects may arise from growing markets, as would typically occur after trade liberalization (e.g., NAFTA), which has facilitated Canada’s access to much larger markets. Canadian MFP should have benefited from this increased scale to a greater extent than the United States has since the late 1980s. Thus changes in scale economies can not explain the *slower* MFP growth in Canada — in fact, the effect of scale economies since the 1980s would be expected to be the opposite.

The analysis of growth rates summarized in Figure 2 applies the same procedures to both Canadian and U.S. data, minimizing the effect of methodological differences or errors. For these reasons, the long-term comparisons of MFP growth rates presented in Figures 2 and 3 primarily reflect differences in business innovation, understood in the broad sense used in this report.

Innovation, MFP Growth and Productivity Growth

The long-term analyses by Statistics Canada and the OECD show that Canada’s relatively poor productivity growth is due almost entirely to weak MFP growth. The panel believes that the rate of MFP growth over suitably long periods is primarily due to business innovation — including better organization of work, improved business models, the efficient incorporation of new technology, and the payoff from R&D and from the insights of entrepreneurs. The panel therefore concludes that Canada’s weak productivity growth over the past two decades is largely due to weak business innovation performance.

3. THE INNOVATION PERFORMANCE OF CANADIAN BUSINESS

The purpose of this section is to answer the first two questions in the charge to the panel: (i) How should the innovation performance of Canadian firms be assessed? (ii) How innovative are Canadian firms, and what do we know about their innovation performance at a national, regional and sector level?

How Should Innovation Performance be Assessed?

Only certain aspects of innovation are directly observable – for example:

- **Inputs** like R&D, investment in advanced equipment or venture capital financing for new businesses.
- **Outputs** like the fraction of sales contributed by products introduced within, say, the past three years.
- **Outcomes** like market share in sectors that are considered to be technologically dynamic. At the level of the entire economy, or for major sectors, the outcome of innovation is best indicated by the long-term growth of MFP.

Each of the foregoing groups of metrics has limitations and captures only a portion of the total innovation process. Individual firm performance can be correlated with measures of innovation through formal innovation surveys conducted by national statistical agencies. These, together with surveys of advanced technology use, have been carried out for many years by Statistics Canada and produce valuable micro-level data on firm behaviour in respect of innovation. In view of the need to gain a much deeper understanding of innovation, it is essential that Statistics Canada continues to build on its leading capabilities to conduct deeper and more extensive innovation surveys and analysis.

Over the 1985-2006 period, Canada's average labour productivity growth ranked 15th out of 18 comparator countries in the OECD and weak MFP growth was the principal cause. To reverse that dismal trend is the core economic challenge facing Canada.

How Innovative is Canadian Business?

The panel addressed this question by examining the principal input, output and outcome measures of innovation, drawing on international comparisons with a peer group of about 20 of the larger and most economically advanced OECD countries and, more specifically, with the United States. Although Canada is not strictly comparable to the United States in view of the vast difference in size and industrial structure, the close proximity and economic links between the two countries make comparison both inevitable and instructive. While no single indicator provides an adequate measure of the innovation performance of Canadian business, the following constellation of indicators yields a consistent and reliable picture.

Measures of Innovation Inputs

The following sections describe the principal statistical facts regarding Canada's performance in respect of R&D, employment of highly skilled people, and investment in machinery and equipment. Other key inputs, which include technology partnerships, outsourcing contracts, consulting relationships, and venture and angel investors, are increasingly important parts of an innovation

ecosystem, but are not readily captured in aggregate statistical measures, though Statistics Canada has done valuable initial work to develop a framework for such measures.³

Research & Development

Business expenditure on research and development (BERD) is a particularly relevant indicator because it has been found to correlate closely with other indicators of innovation activity, including micro-data collected through innovation surveys. Most sectors of the economy do little or no R&D. (About 80% of business R&D in Canada takes place in sectors that account for about 25% of GDP.) Innovation is not absent in sectors that perform little R&D, but is likely to be manifested as improved management practices and organization of work, and through employment of capital equipment. Machinery and equipment is the embodiment of R&D, and is a critical link in the chain of economic value creation, whether it is performed directly by a business firm or acquired indirectly.

R&D spending by business is of interest to policy-makers in view of strong evidence that R&D has large spillover benefits with "social" returns usually exceeding the private returns to the businesses that undertake the R&D. Business R&D spending in Canada was \$15.8 billion in 2007. In the 1980s and 1990s, BERD grew more rapidly than the total economy, particularly during the technology boom from 1996 to 2001 when BERD almost doubled, driven by the surge in the ICT sector, led by Nortel. Since the collapse of the technology boom in 2001, BERD has remained roughly flat after taking account of inflation. Canada's BERD intensity (BERD as a percentage of GDP) actually declined by 20% between 2001 and 2007 and has consistently remained below the OECD average (Figure 4). Finland, meanwhile, achieved an exceptionally rapid increase in BERD intensity during the 1990s, reflecting that country's concerted effort to become one of the world's technological leaders (Box A).

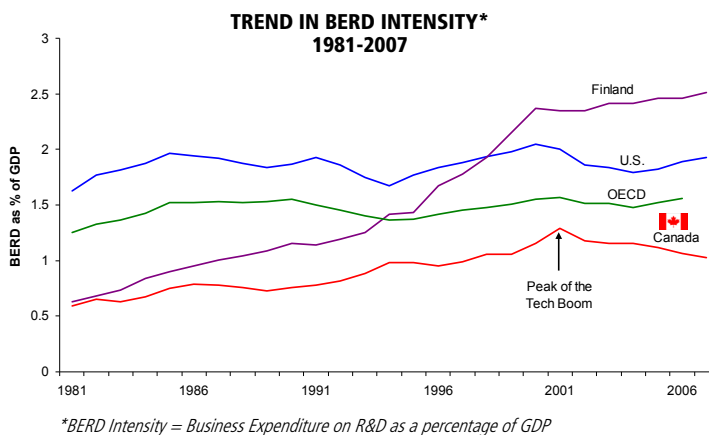


Figure 4: Trend in BERD Intensity

BERD intensity in Canada declined by 20% between 2001 and 2007 reflecting the pull back in Canada's large telecom equipment sector. The commitment of Finland to innovation-led growth accelerated sharply in the wake of a severe banking crisis in 1991, exacerbated by weakness in Finland's traditional exports following the collapse of the USSR.

Within Canada there is considerable provincial variation of BERD intensity. Only Québec and Ontario have levels at or near the OECD average, reflecting the relatively heavy weight of manufacturing and certain R&D-intensive industries, such as pharmaceuticals and ICT, in those provincial economies.

BOX A: FINLAND'S INNOVATION STRATEGY

The stimulus for Finland's commitment to an innovation-led economic strategy appears to have come in large part from the severe economic crisis of 1991 when the Finnish economy was devastated by the simultaneous impact of a near collapse of the domestic banking system and a massive export market disruption due to the disintegration of the USSR. Through the concerted effort of the government and the business sector, Finland committed to transform its economy into one of the most technologically advanced in the world. While the ICT sector has been responsible for a great deal of Finland's remarkable R&D growth, the country also stepped up its innovation performance in traditional resource sectors like forestry. Finland's success was also due to the fact that it was much less affected than Canada by the communications sector pullback after 2001. This is because the Finnish ICT industry, and notably Nokia, was more heavily oriented to mobile communications products and to the global consumer segment.

Finland's experience shows that a concerted strategy to focus resources on innovative activity and investments, and to nurture globally oriented national companies and sectors, can transform a national economy from laggard to leader in a remarkably short period of time. It must be acknowledged, however, that Finland's relatively small size (population of 5.3 million) and cohesive culture make for a significant difference compared with a much larger and highly diverse and regionalized country like Canada.

Canada's *total* R&D intensity — including business, higher education and governments — was 1.9% in 2006, placing Canada 11th in its peer group of 20 OECD countries. Weakness in BERD intensity has been partly offset by a sharp increase in higher education R&D (HERD) since the late 1990s (Figure 5), which reflects a significant allocation of federal government funds over the past decade or so to support university- and hospital-based research via major new initiatives including the Canada Foundation for Innovation, Genome Canada, the Canada Research Chairs and the research granting councils. GOVERD intensity — R&D performed within government departments and agencies — has meanwhile declined more or less steadily since the early 1980s.

There are potentially significant complementarities among R&D performed by businesses (more “D” than “R”), in universities (more

“R” than “D”) and in government laboratories (R&D applied in support of policy objectives, including intermediation between basic and applied knowledge). In view of its large public investment in university research, Canada could further benefit from improved R&D co-operation between universities, businesses and, in many cases, government scientific establishments. While Canadian academic science has received international recognition, the direct payoff from this investment in terms of new businesses created has been meagre. The relative weakness of business R&D and the disappointing level of university research commercialization appear to be two symptoms of the same underlying condition — a lack of orientation by Canadian business to the commercial exploitation of opportunities at the leading edge of science and technology.

Highly Qualified People

The productivity gap that has opened up between Canada and the United States since the mid-1980s has not been due to any measured relative deterioration in Canada's workforce. Indeed, among OECD countries, Canada has the highest proportion of workers who have completed post-secondary education — 46% in 2005. Although only about 39% of U.S. workers have post-secondary credentials, among these there is a higher proportion with university degrees than in Canada, where community college diplomas are much more prevalent. There is also a higher proportion of U.S. workers with advanced graduate degrees, indicating greater demand for the most technically sophisticated skills. The demand by businesses for research-level skills is in fact closely correlated with BERD intensity across OECD countries.

A higher proportion of managerial employees in the United States, relative to Canada, has university degrees, and the proportion of those with business degrees appears to be more than double. There is a great deal of anecdotal evidence that technology-based startups in Canada suffer from deficient business management skills, particularly when compared with the United States where the pool of experienced technology executives is exceptionally deep. Business school programs focused on technology entrepreneurship can complement practical experience and mentorship in solving the new venture management problem.

Investment in Machinery and Equipment

Investment in advanced machinery and equipment (M&E) is a principal source of productivity growth, both through its direct labour-augmenting effect and through its induced impact on innovation, including innovations in the business reorganization required to fully exploit new M&E. (Most of this induced impact is captured statistically as part of MFP growth.)

Canadian industries have largely relied on leading-edge capital equipment provided from other countries. Canadian innovation was therefore more likely to be manifested as *adaptation* of technical equipment than as the development of sector-leading capital goods industries. This has been particularly notable and puzzling in forest products, mining and fisheries where, despite a comparative advantage in resource endowment, Canada did not develop leading global firms in machinery for these industries. Canada's failure to develop global export leaders in advanced M&E for the resource sector is one particularly telling indicator of the country's innovation shortcomings.

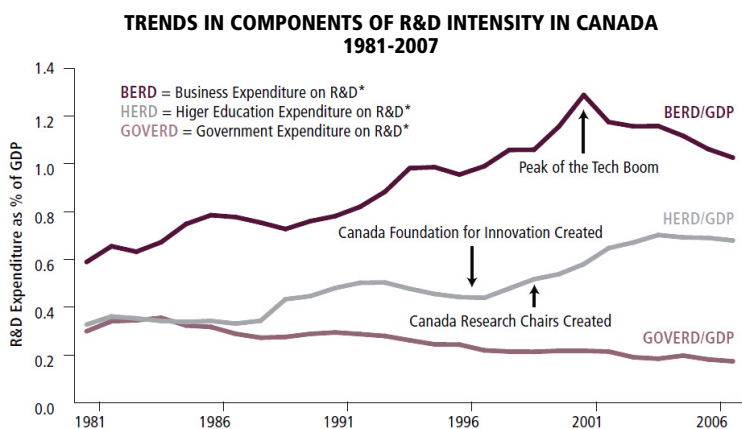


Figure 5: Trends in Components of R&D Intensity in Canada

Heavy investment in university R&D (HERD) — led by the federal government once budgets swung into surplus in the late 1990s — boosted Canada's HERD intensity to second place in the OECD (behind Sweden) in 2007. In recent years, all three major categories of R&D intensity have been flat or declining.

Investment in M&E by Canadian business has not always lagged the United States as has been the case with R&D, though a gap has opened up since the early 1990s (Figure 6). The gap has been almost entirely due to Canada's persistently weaker investment in ICT. This gap is particularly significant since the near consensus among economists is that the ICT-producing sector drove the productivity revival in the United States during the 1990s. Since then, the influence of ICT has been primarily to drive productivity growth in sectors that use ICT intensively. Studies of the introduction of ICT show that the technology by itself will not boost aggregate productivity growth unless accompanied by training and significant changes (i.e., innovation) in business organization and work practices.

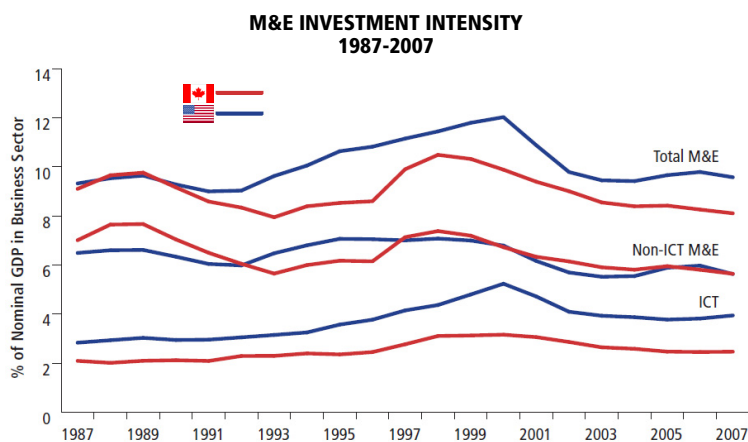


Figure 6: M&E Investment Intensity

This chart traces annual investment in nominal terms (i.e., using current prices) as a percentage of nominal GDP. Since ICT prices, per unit of performance, have fallen substantially (especially for microelectronics and optical communications), the performance-adjusted “volume” of ICT investment would be much greater than the chart suggests. Note that Canada's non-ICT investment ratio increased from 1993 to 1998, despite Canadian dollar weakness (which increased the cost of imported capital goods) and has been flat to declining since 2002 even as the dollar strengthened.

Why has the ICT investment gap between Canada and the United States remained so large? One study found that about 20% of the Canada-U.S. gap was due to industry structure differences – e.g., Canada has a smaller share of output in ICT-intensive industries and a slightly higher proportion of small firms, which tend to invest less in ICT. The study was not able to account definitively for the majority of the ICT investment gap but noted anecdotal evidence that differences between the United States and Canada in terms of business “culture” and intensity of competition are contributors, although the hard evidence is still inconclusive.⁴

The panel believes that the ICT investment picture is consistent with the view that Canadian businesses on the whole – but always with notable exceptions – are technology followers, not leaders, and are reluctant to adopt new practices until they have been well proven south of the border. In today's fast-paced world, that strategy is unlikely to work as well as it once did.

Measures of Innovation Outputs

The results of innovation surveys indicate generally that Canada ranks ahead of most European countries in terms of the proportion of manufacturing firms that self-report to be innovative. But the proportion of sales derived from innovative products has consistently been reported to be lower for Canadian businesses than for their European counterparts. Survey data of this type promise eventually

to yield much deeper insight into innovation behaviour than can be conveyed by aggregates like national R&D spending. But the coverage and methodology have not yet reached the point where firm conclusions can be drawn. The continuation of innovation surveys and the further development of their methodology may be the best way to improve both the understanding of business innovation and the design of policies to foster innovation.

Measures of Innovation Outcomes

Reliable and internationally comparable measures of innovation outcomes are even more elusive than measures of innovation output. For reasons explained in Section 2, the growth rate of MFP is the best overall indicator of innovation outcome at the aggregate level. Sustained weakness in MFP growth is the most compelling indicator that Canada has a business innovation problem, and that this problem is the primary source of Canada's lagging labour productivity growth.

Composite Indicators of Innovation

The business media publicize various global competitiveness and innovation rankings primarily based on surveys of executives and other stakeholders. The World Economic Forum, which has tracked and refined its criteria over many years, appears to provide the most reliable of such rankings. The overall message is consistent with the objective statistics – i.e., Canada is a mid-to-low performer among peer group countries in terms of business innovation. The quality of Canada's research institutions is considered to be world class, and there appears to be an ample supply of scientists and engineers – in fact, slightly more ample than U.S. business people believe their own supply to be. On the other hand, university-industry collaboration is seen as quite weak in Canada as is the perception of Canada's “capacity for innovation” – i.e., the extent to which companies conduct formal research and pioneer their own new products and processes.⁵

The ICT investment picture is consistent with the view that Canadian businesses on the whole – but always with notable exceptions – are technology followers, not leaders.

Canada's Subpar Innovation Performance

Given the unimpressive long-term trend in the level and growth of business sector productivity in Canada, there is no reason to believe that Canada excels in the areas of innovation that are not captured by conventional metrics such as R&D and M&E investment. Weaknesses in the less easily quantified dimensions of innovation would be expected to show up in subpar growth of Canada's MFP, and this has emphatically been the case. Canada's relative lack of export aggressiveness outside the North American market, despite the burgeoning opportunities in Asia, also implies a degree of complacency incompatible with attitudes needed to excel in the *non-technological* aspects of business innovation.

Despite many examples of successful innovation by Canadian firms, the weight of evidence from the benchmark indicators reviewed in this section establishes that the innovation performance of Canadian business, taken as a whole, is significantly weaker than the innovation performance of the U.S. business sector, and in fact weaker than that of many of Canada's peers among OECD countries.

4. INNOVATION AS A BUSINESS STRATEGY

This section addresses the third question in the charge to the panel: Why is business demand for innovation inputs (for example, research and development and skilled workers) weaker in Canada than in many other OECD countries?

Business strategy drives innovative behaviour – some companies have strategies based heavily on innovation and some do not. *Explaining business innovation performance in Canada therefore comes down to explaining the business strategy choices of Canadian firms.* In other words, to understand why Canadian firms have not invested more in innovation, one must shift the perspective of analysis from innovation activities themselves – e.g., inputs such as R&D and M&E investment – and focus instead on the factors that influence the choice of business strategy. Such a reframing of the innovation puzzle is the most important contribution of the panel’s analysis.

Factors Influencing the Choice of Innovation as a Business Strategy

What are the factors that principally influence firms in Canada to choose, or not to choose, business strategies based around innovation? The five factors that are, in the panel’s view, of greatest importance are depicted in Figure 7. The logic flow in this diagram serves as the conceptual framework for the panel’s analysis.

The decision as to the emphasis to be placed on innovation in a firm’s strategy will be primarily influenced – to varying degrees depending on the circumstances of the individual firm – by the following:

- **Structural characteristics** – For example, is the firm in a sector of the economy that typically does little in-house innovation, relying instead on technology embodied in capital equipment and/or on production of relatively standard goods or services? Or is the firm foreign controlled with most innovation originating in the home country?
- **Competitive intensity** – For example, is the pressure from competitors so intense that innovation is needed to maintain profitability and/or market share? This would be the case in many export markets, and particularly in those where technology or customer requirements or tastes are changing.
- **Climate for new ventures** – For example, is sophisticated early-stage venture financing available? Are there research universities nearby to provide potential innovation partners and highly trained graduates? Is there an ecosystem of supplier firms to help carry an innovation from concept to success in the market?
- **Public policies** – For example, are government policies in respect of tax, regulations, targeted assistance programs or public procurement favourable to innovation, or not?

- **Business ambition** – For example, is the business dedicated to market expansion and prepared to take the required risks? Business ambition, in this context, reflects the extent of entrepreneurship and drive.

Once a firm has decided on an innovation strategy, it assembles the enabling inputs. These include the appropriate mix of highly qualified employees; investment in the necessary capital equipment and training; an R&D program if needed; and retention of consultants and various external suppliers, including licensing arrangements and partnerships with other firms. While these inputs, and R&D spending in particular, can be regarded as indicators of innovation, they are actually the *consequences* of a commitment to innovation as a business strategy.

To the extent that Canadian businesses lag in respect of innovation, the reasons lie primarily in some combination of the primary influencing factors outlined above. Business ambition will be a key factor in almost every case. For would-be radical innovators in new markets, the other significant influencing factors will be the climate for new ventures and perhaps some supportive public policies. For firms in established markets, on the other hand, the innovation strategy choice is likely to be most influenced by the state of competition, by specific features of public policy or by some industry characteristic such as the firm’s sector or its domicile of control. The specific context can have a major influence on innovation strategy – e.g., whether the firm is a stand-alone innovator or part of a network where it must operate within the constraint of an alliance.*

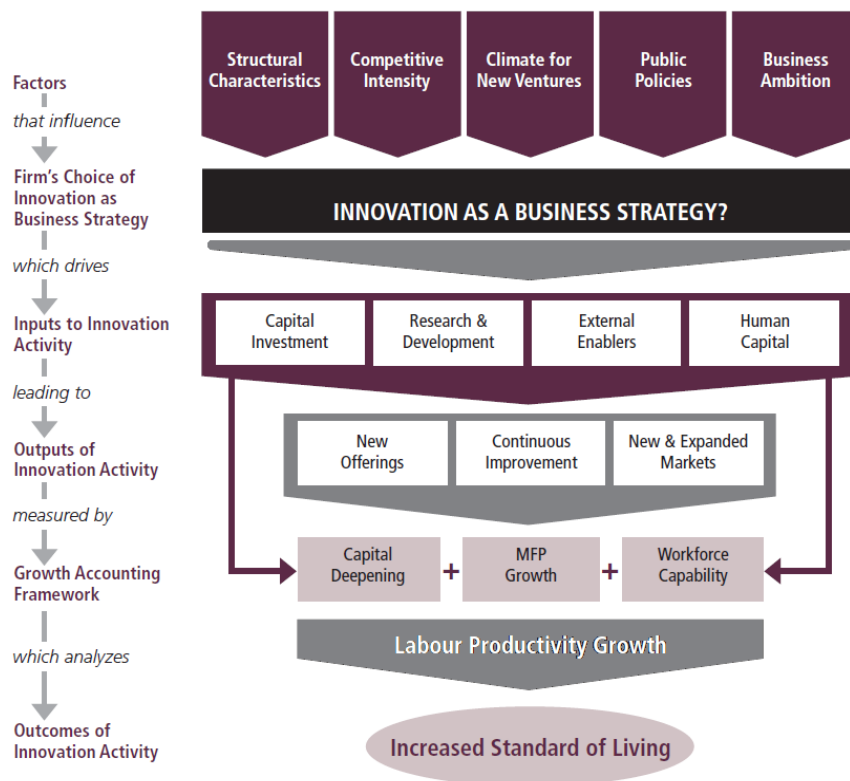


Figure 7: Logic Map of the Business Innovation Process

* A global survey of 1,000 firms identified six different innovation “games” that innovators can play, depending on the competitive dynamics that prevail in their industry. Each innovation game is associated with a dominant strategy and a set of best practices.⁶

For policy makers, the concern is the extent to which the factors that influence the innovation strategies of businesses can be affected by public policy. Clearly some can be — taxes, regulations, procurement, assistance programs, foreign investment rules and certain aspects of competition. Policy has much less impact, at least in the near- to mid-term, on factors such as industry structure and the ambition of business leaders, though business attitude can certainly be affected by competitive intensity, which is amenable to policy influence.

The final question in the charge to the panel asks: What are the contributing factors [responsible for the weak business demand in Canada for innovation inputs], and what is the relative importance of these factors? In the panel's view, the key factors are the five identified in Figure 7 as having the greatest influence on the innovation strategy decision. The next five sections address each of these factors, the relative importance of which will vary from sector to sector (as illustrated by the examples in Section 10), and across the life cycle of individual businesses.

5. STRUCTURAL CHARACTERISTICS

Structural issues related to sector mix, foreign control and firm size are most readily analyzed in the limited context of R&D spending because a long series of internationally comparable data is available from the OECD. The influence of sector mix and of foreign control is most pronounced in the subsets of the economy that perform at least some R&D. The analysis of the effect of sector mix and foreign control through the lens of R&D intensity is therefore appropriate, provided we accept that observed R&D investment is a reasonable proxy for the degree of commitment to an innovation strategy in the studied sectors.

The Effect of Sector Mix on R&D Expenditure

To what extent do differences in industry sector mix — e.g., the relatively heavy weight of resource-based industries in Canada — account for the large gap between Canada and the United States in business expenditure on R&D as a percentage of GDP (BERD intensity)?* OECD data show that in 2002 (the latest year for which a full set of comparable data was available) the BERD intensity gap was about 1.03 percentage points — the difference between a U.S. intensity of 2.90% and a Canadian intensity of 1.87%. The manufacturing sector contributed 0.63 percentage points to the gap; business services added 0.46 percentage points; whereas mining, utilities and construction all *diminished* the gap by a total of 0.06 percentage points (Table 1).

Manufacturing

Within manufacturing, the auto industry was the largest contributor to the gap. In 2002 the BERD intensity of the U.S. auto industry was more than seven times the Canadian intensity. (This reflects the overwhelming concentration of R&D activity in parent companies based primarily in the United States and Japan.) A rough pattern, apparent in Table 1, is that Canada tends to have a relatively low R&D intensity in those manufacturing sectors where it has a relatively large presence (e.g., autos, machinery, and “other” manufacturing)

and, conversely, a relatively small presence in sectors where it has a high R&D intensity (e.g., pharmaceuticals, computing machinery, electrical machinery and communications equipment). The 11 sectors in Table 1 that *reduce* the overall gap tend to be those that are either resource based or highly mature. These sectors may nevertheless employ sophisticated technology acquired by investment in M&E.

Services

Many of the most dynamic subsectors in today's economy are in business services, which in 2002 constituted a much heavier weight in U.S. business GDP (66%) than in Canada (53%). This, combined with a higher BERD intensity in services in the United States (1.71%) than in Canada (1.26%), added 0.46 percentage points to the overall U.S.-Canada gap in 2002. The major sectoral contributor was “wholesale and retail trade”, which, due to firms like Wal-Mart, has used process innovation and ICT investment to revolutionize productivity.

Evolution of the R&D Gap

Figure 8 traces the evolution, by sector, of the U.S.-Canada BERD intensity gap over 16 years from 1987 through 2002. The total gap diminished from about 1.7 percentage points in the 1988-91 period to about 1 percentage point in 2001-02, though it has increased somewhat since then.† The most significant drivers of the trend have been (i) the sharp reduction in the manufacturing sector's contribution to the gap, and (ii) the increasing share of the gap accounted for by business services since the mid-1990s. The strong U.S. investment trend in ICT described in Section 3 is consistent with such a shift to services.

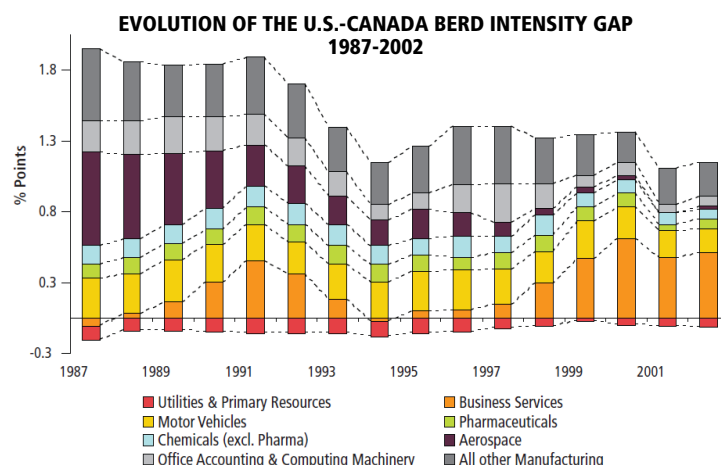


Figure 8: Evolution of the U.S.-Canada BERD Intensity Gap

This chart traces the evolution of the most important sectoral components of the R&D intensity gap. The narrowing of the manufacturing gap (at least through 2002) has been due entirely to the disappearance of the gap in the aerospace sector as the U.S. industry downsized after the Cold War and due to commercial competition from Airbus. The business services gap has meanwhile widened since the mid 1990s. Much more work is needed to improve data on sub-sectors of business services.

* A similar analysis could be undertaken to compare Canada with other high-intensity R&D spenders like Sweden, Finland, Switzerland and Japan, but comparison with the United States is most relevant in view of its close integration with the Canadian economy.

† A detailed sectoral breakdown for the Canada-U.S. comparison was not available for more recent years.

TABLE 1: U.S.-CANADA BERD INTENSITY GAP BY SECTOR

| 2002 | SECTOR SHARE OF BUSINESS GDP (%) | | BERD INTENSITY (BI) | | CONTRIBUTION TO BI GAP (U.S.-CAN) |
|--|----------------------------------|--------------|---------------------|-------------|-----------------------------------|
| | CAN | U.S. | CAN | U.S. | GAP ⁽²⁾ |
| BUSINESS SECTOR ⁽¹⁾ | 100.0 | 100.0 | 1.87 | 2.90 | 1.034 |
| MANUFACTURING | 27.0 | 21.9 | 4.16 | 8.03 | 0.634 |
| Motor vehicles and parts | 3.4 | 1.7 | 1.88 | 13.41 | 0.166 |
| Pharmaceuticals | 0.5 | 1.0 | 27.17 | 21.16 | 0.066 |
| Chemicals (excl. pharmaceuticals) | 1.5 | 1.5 | 2.01 | 6.45 | 0.066 |
| Office accounting and computing machinery | 0.1 | 0.4 | 65.01 | 32.80 | 0.053 |
| Machinery and equipment n.e.c. ⁽³⁾ | 1.8 | 1.5 | 2.70 | 6.59 | 0.048 |
| Food, beverages and tobacco | 3.3 | 2.6 | 0.45 | 1.28 | 0.018 |
| Aircraft and spacecraft | 0.8 | 0.8 | 15.41 | 18.49 | 0.018 |
| Rubber and plastics products | 1.4 | 1.0 | 0.73 | 2.32 | 0.013 |
| Other non-metallic mineral products | 0.7 | 0.6 | 0.29 | 0.98 | 0.004 |
| Electrical machinery & apparatus n.e.c. | 0.4 | 0.6 | 7.20 | 5.46 | (0.001) |
| Pulp & paper, paper products printing and publishing | 4.1 | 3.2 | 1.29 | 1.52 | (0.004) |
| Textiles, leather and footwear | 0.9 | 0.7 | 1.44 | 0.53 | (0.010) |
| Fabricated metal products | 2.0 | 1.6 | 1.61 | 1.24 | (0.011) |
| Basic metals | 1.6 | 0.6 | 2.04 | 1.14 | (0.025) |
| Radio, TV & communication equipment | 0.7 | 1.1 | 53.67 | 29.52 | (0.054) |
| Other manufacturing ⁽⁴⁾ | 3.8 | 3.0 | 1.88 | 11.80 | 0.288 |
| BUSINESS SERVICES | 53.4 | 66.2 | 1.26 | 1.71 | 0.457 |
| Wholesale and retail trade | 17.1 | 20.5 | 0.53 | 1.83 | 0.285 |
| Other business services | 19.0 | 28.9 | 2.85 | 2.49 | 0.181 |
| Transport and storage | 6.2 | 4.6 | 0.10 | 0.11 | (0.001) |
| Financial intermediation | 11.0 | 12.3 | 0.33 | 0.23 | (0.007) |
| MINING & QUARRYING | 7.5 | 1.6 | 0.64 | 0.68 | (0.037) |
| UTILITIES | 4.0 | 3.2 | 0.46 | 0.06 | (0.016) |
| CONSTRUCTION | 8.1 | 7.2 | 0.08 | 0.03 | (0.004) |

¹⁾ Excludes agriculture, primary forestry and fishing and real estate services (largely the imputed value of owner-occupied housing). The OECD definition of Business GDP (\$715 billion in 2002) differs from the Statistics Canada breakout for that sector (\$873 billion in 2002) which the panel believes to be largely due to real estate services.

²⁾ The contribution to the gap is calculated as: "Sector share of BERD intensity times sector share of GDP" for the United States, minus the analogous product for Canada. For example, for manufacturing the contribution is: (8.03 x .219)-(4.16 x .27)=0.634. Negative contributions to the BI gap — i.e., those numbers in parentheses in the final column of the table — are associated with sectors where the ratio of Canada's BERD to total GDP exceeds that of the United States — i.e., sectors that reduce the gap.

³⁾ n.e.c. = not elsewhere classified.

⁴⁾ An omnibus group of subsectors (including precision instruments among others) that is not further broken down in the OECD database.

Data Source: Panel calculations based on OECD STAN Database.

Mix versus Intensity

In accounting for the overall U.S.-Canada BERD intensity gap, further analysis of the data in Table 1 and Figure 8 shows that low R&D intensity within Canadian sectors is more important than an adverse sector mix. Since the precise quantitative results are sensitive to the granularity of the sectoral breakdown, it is not particularly meaningful to ascribe a *specific* percentage of the BERD intensity gap to either sector mix or to intensity. Moreover, any such allocation would vary from year to year.

The Effect of Foreign Control on R&D Expenditure

The foreign control of Canadian industry is often cited as an explanation for Canada's low R&D spending in view of the fact that Canada has a disproportionate share, relative to most OECD countries, of facilities that are subsidiaries of foreign companies. (Canadian facilities nevertheless benefit from parent company R&D embodied in advanced equipment and business processes.)

While foreign control is part of the explanation for low R&D intensity in Canada, it is not necessarily the *cause* in the sense that were the foreign-controlled facilities not here, there is no guarantee that Canada would have had a "replacement set" of domestically owned R&D performers. In the motor vehicle industry, for example, it is far more likely that the alternative to the *status quo* would not have been a domestically owned assembly industry, but rather a situation where both assembly and R&D took place outside Canada and all vehicles were simply imported. By contrast with the auto industry, there are other sectors — e.g., pharmaceuticals, computers, machinery — where, despite extensive foreign control, R&D intensity in Canada actually exceeds that in the United States. The pattern in Table 1 depends on the history and specific circumstances of the individual sectors (Box B).

Analyses of individual firms, based on R&D spending data and innovation surveys, reveal a common pattern and produce a three-tiered structure (relative to ownership) of R&D and innovation behaviour in Canada:⁷

- Canadian-owned multinationals are the most likely to engage in product innovation and R&D spending.
- Canadian subsidiaries of foreign multinationals are second, with generally lower R&D intensity than Canadian-owned multinationals, but higher than purely domestic Canadian firms.
- Canadian firms with only domestic operations have both the lowest incidence of R&D spending and the lowest BERD intensity.

This underlines the fact that Canada's failure to develop a greater number of innovative Canadian-based multinationals has been a key contributor to the country's overall R&D weakness.

BOX B: R&D AND PRODUCTION INCENTIVES

A comparison of the automotive and pharmaceutical sectors provides a revealing contrast in the domestic economic impact of government policies on R&D spending by foreign firms. The negotiation of the Canada-U.S. Auto Pact in 1965 focused on offering tariff-free access to the Canadian market in exchange for guarantees of manufacturing jobs and Canadian content. While concerns about R&D spending had been identified, the agreement did not address the issue. With pharmaceuticals, the trade-off was quite different. In recognition of changes in Canada's patent legislation, the industry committed to spend 10% of its Canadian sales on R&D in Canada.

In both cases, the Canadian government traded market access concessions for a specific commitment from a foreign-owned industry, and in both cases the industry delivered what was promised. However, the impact on R&D intensity, and on jobs in Canada, has been entirely different in the two situations. In the case of pharmaceuticals, the R&D ratios have been impressive but the scale of the industry in Canada in terms of jobs and income has been much less so. The opposite has been the case for the auto industry.

The Effect of Firm Size on R&D Expenditure

The conclusion of recent analysis is that Canada's greater proportion of small firms does *not* explain a meaningful proportion of the BERD intensity gap between Canada and the United States. (The fraction of total R&D performed by small firms — those with fewer than 20 employees — is very small and thus the U.S.-Canada difference in the proportion of such firms necessarily accounts for a very small part of the R&D gap.) To the extent there is a size effect, it is within the largest category of firms — those with 500 or more employees — which account for a large proportion of total R&D and where Canada's share of such firms is relatively low.

The Position of Canadian Firms in North American Value Chains

Canadian firms, reflecting the nation's traditional areas of specialization, have often chosen, or been relegated to, an *upstream* position as providers of commodities or other intermediate goods in many North American value chains, with most product innovation taking place elsewhere.

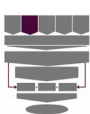
Successful innovation, especially in respect of goods and services, is most likely to come from businesses that have direct contact with end-users, and thereby develop a deep understanding of what those ultimate customers need or want. It is also the case that firms at the upstream end of the value chain are removed from the leading edge of business decision making regarding innovation, especially in respect of product development, marketing and new business models.

It has been noted that Canadian businesses on the whole, but always with many exceptions, appear to be less customer focused than those in the United States. This difference in attitude would be expected if the reference is to the end-user customer and the Canadian business is an intermediate supplier, and particularly if it is a supplier of commodities or a foreign-controlled branch producer for export, often to the United States. Since Canada's economy is relatively heavily weighted toward such upstream industries, the (end-user) customer focus would be relatively less pronounced in Canada than

is typical in the United States. The motivation to adopt innovation-oriented business strategies would, as a result, also be relatively less pronounced in Canada.

The implications for Canada looking forward are challenging. The U.S. market has excelled in supporting vibrant innovation because of the “venturesome” nature of its consumers. (In some sectors, particularly consumer electronics, such customers are now increasingly to be found in Asia.) As a small market, Canada does not naturally attract early deployments of new technologies or new products. However, as innovation is increasingly being driven by the interaction between global leaders — that is, between firms leading technology development and customers leading technology adoption — any country whose businesses and citizens do not participate at the leading edge risks falling farther behind.

6. THE ROLE OF COMPETITION



Competition is among the most potent incentives for innovation, both because of the benefits innovation can provide in terms of greater market success and the threats that can be averted if innovation can keep a firm running ahead of its competitors. The state of competition in a firm's market will thus often be the deciding influence on the choice as to whether or not to employ innovation as a core strategy.

In the 1940s Joseph Schumpeter argued that large firms with market power were more likely to innovate than small firms. Almost all of the recent empirical analysis contradicts Schumpeter and shows that too much concentration inhibits innovation by removing the incentive created by competitive rivalry, and also that small firms with specialized expertise can be the most innovative.

Canada's failure to develop a greater number of innovative Canadian-based multinationals has been a key contributor to the country's overall R&D weakness.

Interplay Between Competition and Innovation in Canada

Is the state of competition in Canada a significant cause of the country's weak productivity and innovation performance? The evidence does not permit a definitive answer in view of (i) the difficulty in measuring the intensity of competition; and (ii) the great variety of market situations throughout the economy, some of which are intensely competitive and others not. The following general observations are germane.

Export-Oriented Sectors

For some sectors, particularly technology-intensive industries and many parts of manufacturing, the market for the product is North American or global. In these cases, the competitive intensity faced by Canadian firms is essentially identical to that faced by competitors in other countries, and most indicators suggest that Canadian firms achieve comparable levels of innovation and competitiveness. For example, the Canadian ICT sector consistently demonstrates R&D intensity levels similar to those elsewhere. Assessments of innovation activity at the firm level demonstrate that exporting firms are more likely to invest in R&D and to manifest innovative behaviour.

Sectors Where Competition is Curtailed

There are some important sectors in Canada — e.g., telecommunications services, broadcasting, air transport and certain agri-foods — where regulations curtail foreign entrants, thus limiting competition. Innovation tends to be more muted in those situations than might otherwise be the case because there is very little incentive for the well-established incumbents to compete for domestic market share via innovation.

Market Regulation

According to work by the OECD, Canada has among the fewest policy-related restraints on product market competition overall. On the other hand, in 2003 Canada was ranked worst out of its 20-country peer group in respect of foreign ownership barriers. Many Canadian authorities consider this to be too harsh a judgment since in practice, and apart from sectors where there are formal restrictions on foreign ownership, Canada's treatment of foreign investment does not appear to be more restrictive than that of most industrialized countries.⁸

Internal Barriers

The impact of Canada's internal trade barriers that limit competition is most evident in a few high-profile industries like beer and wine. Governments sometimes also impose conditions on their suppliers in the form of preferences in favour of local firms in several industries. While such procurement policies support certain public objectives, they nevertheless reduce competition and may thus diminish the incentive to innovate.

Indirect Evidence of Competitive Intensity

There is a great deal of anecdotal evidence that the intensity of competition in the U.S. domestic market is far greater than in comparable sectors in Canada. For example, the generally lower level of business profit (relative to the size of the economy) in the United States as compared with Canada (Figure 9) is indirect evidence of stiffer competition in the U.S. market because, other things being roughly equal, more intense competition would be expected to lead to the observed lower relative level of business profitability in the United States.

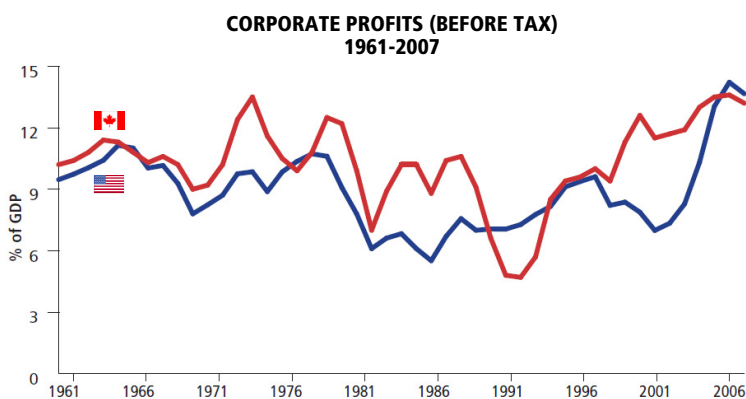


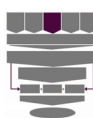
Figure 9: Corporate Profits — Canada-U.S. Comparison

Aggregate corporate profit (before tax) as a percentage of GDP has generally been higher in Canada than in the U.S., with the Canadian ratio higher in 39 of the 47 years (83%) from 1961 to 2007. The only time when the profit ratio in Canada was significantly below that of the U.S. was in the 1990-93 period reflecting the deeper recession in Canada.

The Effect of Canada's Market Size on Competition and Innovation

A fundamental characteristic of the Canadian economy is its relatively small size and geographic fragmentation, particularly when compared with the enormous scale of the United States. As a general rule, larger markets promote innovation via two principal channels. First, larger markets attract and support more competitors and the resulting competitive intensity stimulates innovation; and second, larger markets increase the size of the potential reward for innovation and thus improve the likelihood that the upfront cost and risk of innovation will be recouped. Since Canada starts with the limitation of a relatively small domestic market — which in some sectors is made even smaller by interprovincial and regulatory barriers — to stimulate innovation it would be particularly important to increase the “effective size” of the market by reducing internal barriers and increasing access to markets abroad.

7. THE CLIMATE FOR NEW VENTURES



New ventures are the “green shoots” of the innovation system, bringing new ideas to market and creating new competition. It is important to understand what features of Canada's business environment affect the quality of the breeding ground for such enterprises. The key enabling conditions can be grouped into three broad categories:

- *Venture financing and acquisition of commercial skills* — the sources and availability of risk capital and mentorship to support the development of new companies from concept to sustainable business.
- *Technology transfer* — the mechanisms to take research and intellectual property developed within universities and government laboratories to commercial realization.
- *Clusters* — the development of a local innovation ecosystem that supports and sustains the creation and growth of new ventures.

Venture Financing and Acquisition of Commercial Skills

Successful venture investing demands much more than financial capital: operational and business experience is a key ingredient needed to monitor and manage these investments. That is a key reason why traditional capital markets for public equity or commercial debt do not play a significant role at the early stage of new technology ventures. Venture funding is critical for new business creation, but its precise nature changes as companies evolve from seed or early-stage investment, through commercial validation, to later-stage growth and expansion (Table 2). The focus here is on the initial funding stages that are needed to bridge the new venture across the so-called “valley of death” that separates a promising business idea from a sustainable commercial operation.

Getting Started

Support from family and friends (“love money”) is often needed for new firms to get started, but is usually limited. Angels — investors that are independent of the firm but usually knowledgeable in its business sector — are typically needed to enable a startup to proceed to the next level. The limited available data on these “informal” investment sources in Canada suggest that they are much less extensive, in relative terms, than the comparable sources in the United States.

This relative weakness is of concern because the angel and venture capital communities are linked and complementary. Successful entrepreneurs are valuable as angel investors not only for the funds they bring (a byproduct of their own past success), but particularly for the valuable experience and mentorship they can offer to new entrepreneurs, often providing business contacts as well as specialized market knowledge.

| TABLE 2 — EVOLUTION OF NEW BUSINESS FINANCING | | | |
|---|---|--|--|
| | STAGE | USE OF FUNDS | SOURCE OF FUNDING |
| INITIAL FUNDING | GETTING STARTED <i>Pre-seed, Seed & Early-stage Funding</i> | <ul style="list-style-type: none"> Prove a specific concept for a potentially profitable business opportunity Complete product development and conduct initial marketing Use initial capital to initiate commercial-scale business activities | <ul style="list-style-type: none"> Family and friends Angels |
| | COMMERCIAL VALIDATION | <ul style="list-style-type: none"> Expand production and support growing accounts receivable and inventories (Although potential is there, company may or may not be profitable at this stage.) | <ul style="list-style-type: none"> Venture capital |
| GROWTH & EXPANSION | LATER STAGE <i>Expansion Stage</i> | <ul style="list-style-type: none"> Increase sales and profitability Significantly expand capacity, marketing and working capital Develop new product and technology | <ul style="list-style-type: none"> Equity and debt funding |

Canadian governments have sought to address the early-stage gap in financing through various initiatives. For example, the Business Development Bank of Canada has been directing a growing share of its resources to seed-stage and startup companies. While such programs improve the availability of capital, they do not address the other critically important aspects of the role of angel investors — experience, contacts and mentorship. To address that gap, a number of incubation centres have been created to assist small companies in their earliest stages of growth — e.g., the Regional Economic Intervention Fund established by the Québec government, the Centre for Drug Research and Development in British Columbia and the Accelerator Centre in Waterloo.

Commercial Validation (Venture Capital)

Venture capital is provided primarily by professionally managed funds that pool assets from multiple investors. While venture capital (VC) investment is substantially smaller than the total pool of informal investment — in Canada it has ranged from \$1.5 to \$2 billion per year over the last five years — it is concentrated in those firms with the greatest potential to eventually become public, or to grow into large companies.

There are reasons to be concerned about the state of venture capital in Canada. Fundraising for Canadian VC firms — i.e., the capital raised or committed from investors for subsequent VC investments — has been falling with 2007 marking the fifth decline in the previous six years. By contrast, there were five consecutive years of growth in the United States. In 2007 the fundraising level in Canada dropped to \$1.2 billion, or around 3% of the \$37 billion raised in the United States (Figure 10).

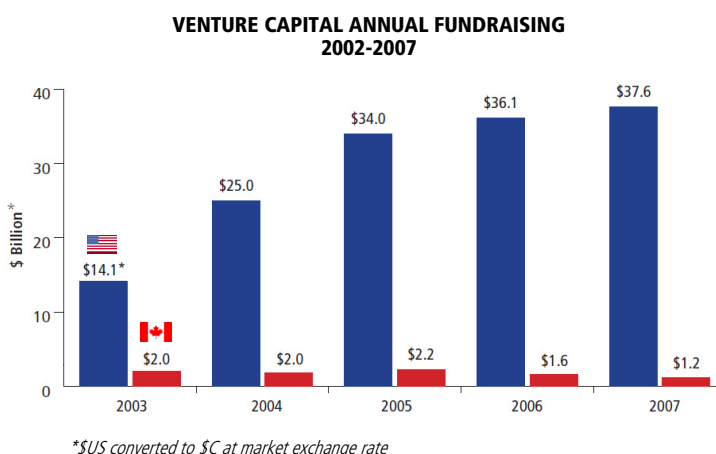


Figure 10: Venture Capital Annual Fundraising

Shown are the annual funds obtained by VC firms for subsequent investment in companies. (U.S. amounts are shown converted to \$C at market exchange rates.) Amounts committed to U.S. VC firms have been increasing while Canadian commitments have fallen. New funds obtained by VCs in Canada have been only 3 to 6 % of the U.S. level since 2005.

The fundamental questions regarding the weak state of the Canadian VC industry are the following:

- Are there too few attractive opportunities for investment relative to the amount of venture capital potentially available in Canada?
- Alternatively, is there too little venture capital available in Canada to support the development of the skills base needed for a healthy VC industry — i.e., a supply-side problem?
- Are there deficiencies in the structure and skills base of the Canadian VC industry itself that have depressed investment performance?

It might be argued that if there were, in fact, a sufficient number of good quality companies in Canada that were attractive for VC funding, the money would be forthcoming, whether from Canadian investors or from those in other countries. There is a perception that there are too few Canadian entrepreneurs with the experience needed to successfully develop startup firms in science and technology-based sectors. However, there are no pertinent data to effectively measure demand for venture capital, as categorized by quality of opportunity, which would be the relevant correlate.

To the extent that there is a supply constraint on VC funding, it is believed to be due to the low level of institutional VC investment in Canada. More than a third of the funds raised by the U.S. VC industry in 2004 derived from pension funds and foundation endowments, while Canada generated only 15% from those sources.

Canadian institutions would presumably be more inclined to invest in Canadian venture capital if the sector produced better investment performance. It is significant that “buyout funds” (those that target more mature businesses than venture capital) have generally performed well in Canada and have not experienced the fundraising issues that have afflicted venture capital.

Problems concerning the sustainable supply of capital to the VC industry in Canada appear to be rooted primarily within the industry itself and its poor performance (Figure 11). There are two main contributors: (i) Canada’s VC industry is still relatively young, and therefore has not fully developed the necessary skills for success; and (ii) there are structural issues related to the historical predominance of tax-advantaged Labour Sponsored Investment Funds.

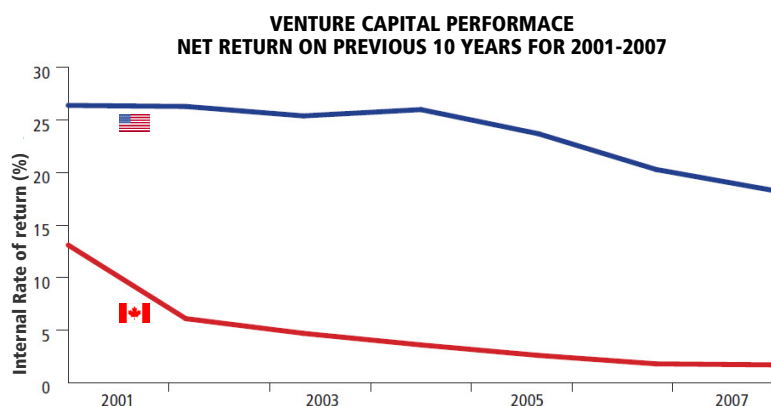


Figure 11: Venture Capital Performance

The financial underperformance of aggregate VC investment in Canada is clear. (Some individual funds may of course perform well.) There has been a decline in the 10-year rate of return for VC funds in both the U.S. and Canada following the end of the tech boom, but the fall-off was steeper in Canada and started from a much lower level.

Compared with the United States, the Canadian VC industry is very young, with the great majority of firms dating only from the mid-1990s. More than 80% of existing Canadian firms were created during the expansion of the technology bubble between 1995 and 2001. Fund managers in Canada thus have less operational experience than their U.S. counterparts, which has led them to take a more passive role in investments; whereas it is through active management that the investee firms are made more valuable. Canadian VC firms invest a larger share of their funds in early-stage companies, do too many deals and tend to underinvest in each one. The big maturity gap between the U.S. and Canadian VC industries is important because it takes time for a VC sector to learn the lessons of successful investing, and to winnow out weak firms and reallocate resources to the strong ones.

A significant component of the Canadian VC industry – Labour Sponsored Investment Funds (LSIFs) – have used the availability of personal tax credits as an incentive to draw significant amounts of capital into the industry. The evidence is strong that LSIFs across Canada have contributed to weaker performance of the VC industry, essentially by accumulating significant capital in a vehicle that is poorly designed for new venture investments. This led the *Fonds de solidarité* – the first and still the largest LSIF in Canada – to exit

direct early-stage VC investments in 2006 and channel its technological VC investments through the private VC firms in which it invested.

The message of the foregoing discussion is that there is no quick or easy fix for the Canadian VC industry. Attracting sufficient capital to become self-sustaining will require VC firms to demonstrate they have the skills and experience to generate acceptable returns. The dilemma is that the industry requires access to sustainable pools of investment capital to develop a critical mass of investing skills. It is encouraging that recent government policy initiatives at both the provincial and federal levels have been designed to support the growth of market-based venture firms that will be judged, and will succeed or not, based solely on their performance.

Technology Transfer

Research that takes place in universities and government labs is a potentially important source of ideas and new technologies, particularly for startup businesses. Given Canada’s heavy investment in university-led R&D the effective transfer of technology from university research labs to commercial practice is an opportunity to be seized.

Research Support Philosophy and Incentives

Research funding for university faculty is allocated primarily by peer review committees whose criteria are focused on the research significance of the proposed effort and not on commercial potential. The priority usually given to the quick publication of university-based research militates against commercialization of discoveries and, by extension, implementation of a patent strategy to protect commercially promising intellectual property (IP). There is a thriving debate internationally about the relative merits of “open science” regimes versus those in which IP rights are strongly asserted. Recently, the balance has shifted in favour of the view that an open science model leads to more rapid technological advances overall than the alternative approach.

There is no quick or easy fix for the Canadian VC industry. Attracting sufficient capital to become self-sustaining will require VC firms to demonstrate they have the skills and experience to generate acceptable returns.

Although the effect of university practices and incentives on research commercialization will continue to be debated, the panel believes there is an unambiguous case for improving the critical infrastructure for identifying and mobilizing potentially commercializable knowledge as it emerges from university-based research. In many cases this will involve well-designed partnerships between universities and private-sector businesses or government labs.

Institutional Support for Technology Transfer and IP Ownership

Even when researchers identify discoveries with commercial potential, the technology transfer challenge remains. Most Canadian universities support this process through a technology transfer office (TTO). The overall performance of university technology transfer in Canada has not been strong. Almost no TTO in Canada is self-sustaining and licensing revenue is insufficient to pay the full costs of an office. Funding limitations may leave a TTO without sufficient

scale and expertise to effectively manage the technology transfer segment of the commercialization process. A challenge facing the Canadian technology transfer system is to generate sufficiently specialized expertise in appraising the commercial potential of university-generated IP and then facilitating the commercialization process. (A recent organizational innovation in this regard is the new MaRS Innovation initiative in Toronto, funded through the federal government's Centres of Excellence for Commercialization and Research program.)

Canadian universities exhibit a wide range of policies as to the ownership and commercialization of IP. For example, the University of Waterloo places no restrictions on faculty seeking to commercialize the products of their research, but no one model appears to be best in all circumstances. In life sciences, for example, where patents and the ability to assemble complementary IP from various institutional sources may be a critical component of the technology's value, a centralized model through a TTO could be the most effective.

Business Receptors for Research

The university is only one side of the technology transfer equation. There must be a business — either an established firm or a startup — that can receive the technology and commercialize it. Research originating in universities is most readily commercialized by businesses that are oriented strategically toward the development and marketing of opportunities at the leading edge of science and engineering. Almost inevitably, these are businesses that do a lot of R&D. The low BERD intensity of the Canadian business sector, as documented earlier, would therefore tend to correlate with subpar commercialization of university research. The implication is that commercialization is more likely to occur if the surrounding business environment is rich in firms that are committed to science and technology-based innovation as a major business objective — i.e., more “market pull” is needed to complement the “research push”.

Clusters

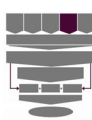
The Waterloo region stands out in the Canadian innovation system as an area that has developed a cluster of successful startup firms with a particular focus on information technologies (Box C). There are several others across the country. For example, Ottawa has a leading cluster in communications technologies; Montréal has developed a digital media and computer graphics cluster; and Saskatoon has an agricultural biotechnology cluster. In every case, a local community has developed a sufficient critical mass of resources — from people to new ventures to financing and support services — to enable a self-sustaining ecosystem that nurtures and amplifies innovation and growth.

While it is easy, after the fact, to identify successful clusters, public policies designed to create a cluster from whole cloth have yet to demonstrate much success, though continued learning from initiatives like MaRS will aid the design of supportive policies. Experience has shown that highly individualized, and often essentially random factors can influence the development of a local cluster or region,* but a strong local catalyst and some pre-existing advantages appear to be critical success factors.

BOX C: THE WATERLOO CLUSTER

The industrial, small-firm background of the Kitchener-Waterloo area, combined with the strong community focus of the local population, led to the University of Waterloo's emphasis on technology and its practical application in local industry. The immensely successful vehicle for this has been the co-operative educational model. The combination of qualities that has made the Waterloo region such a successful cluster is difficult to replicate. Other regions that have developed technology clusters have often done so very differently. One key lesson of the Waterloo experience is that development of a sustainable, vibrant cluster takes time. While the university was founded in 1957, it took almost 25 years before the first wave of startups emerged. It has since taken almost another 25 years to reach the point that a sustainable ecosystem has emerged.

8. THE INFLUENCE OF PUBLIC POLICY



This section addresses the influence of several areas of public policy on the decisions of businesses in Canada to adopt innovation-based strategies. It is complementary to the foregoing treatment of structural characteristics, competitive intensity and the climate for new ventures, each of which is also amenable, in varying degrees, to policy influence.

International Trade

The general liberalizing trend of trade policy, until very recently at least, has favoured innovation strategies both to counter import competition and to take advantage of new markets. Still, Canada maintains substantial barriers, notably to the import of some agri-food goods and to foreign presence in some services — for example, in sensitive sectors such as culture, health care, transportation and telecommunications. But the restrictions have not worsened over time and now represent an opportunity for improvement. The concern looking forward — particularly in view of the severe economic stress in most countries — is the risk of increased protectionism. This would reduce the size of the addressable market for many Canadian businesses and thus the potential return from an investment in innovation.

As a relatively small open economy, Canada is particularly exposed to the vicissitudes of global markets and especially to conditions in the United States. While Canada's prudent macroeconomic policy over the past 15 years has provided some capacity to absorb shocks, further insulation depends on building a base of export industries at the leading edge of innovation in order to be among the last to lose market share if customers retrench.

Education

Education and the quality of human capital is one of Canada's most significant strengths and therefore offers little by way of explanation for the long-term relative weakness in productivity growth or business innovation. The federal government's commitment to the support of university research has been strong since the mid-to-late 1990s. This has increased the supply of leading-edge skills and, other things being equal, made Canada a more attractive location for innovative business. The competition from China and India, among others, for knowledge-intensive activity has meanwhile increased sharply as those countries have also succeeded in rapidly expanding their

* For example, the consent decree between the U.S. Justice Department and AT&T that separated Western Electric from Northern Electric (later to become Nortel), forced Northern to develop its own technology, and was thus indirectly a key catalyst for the evolution of the Ottawa ICT cluster.

production of skilled people. The accumulation of human capabilities is a race without a finish line.

Of particular significance for innovation performance is the fact that Canadian business managers are, on average, not as well trained as those in the United States. This education gap may leave many Canadian managers less aware than their U.S. counterparts of developments at the leading edge of technology and business practice, and thus less likely to choose business strategies that emphasize innovation.

Education and the quality of human capital is one of Canada's most significant strengths but the accumulation of human capabilities is a race without a finish line.

Regulation

The impact of regulatory policies is usually sector-specific, thus few generalizations can be made. Moreover, the effect of regulation on business innovation may either be stultifying or encouraging. Regulations often inspire innovation either to meet the rules (e.g., auto emission limits and fuel efficiency standards) or to design around them (e.g., refrigerant substitutes for CFCs to avoid ozone depletion). The intensifying pressure on virtually all aspects of the natural environment due to population and economic growth in general, and energy use in particular, requires an unprecedented innovative response, elements of which will need to be encouraged by well-designed regulation in all countries. This is both an enormous challenge and opportunity for government and business, and will be one of the world's main arenas of innovation for decades to come. While Canada has some companies that have been successful innovators in various fields of environmental technology (e.g., fuel cells and wastewater treatment), it has not generally been an area of comparative global strength for Canada despite this country's outstanding research competence in many fields of environmental science.⁹

The OECD product market regulation index ranked Canada as the seventh least restrictive country overall among its 20-country peer group in 2003. More specifically, Canada was judged, together with the United Kingdom, to be the least restrictive in respect of barriers to entrepreneurship. A less favourable OECD study presented evidence that Canada's relatively restrictive regulations in several ICT-intensive sectors – particularly electricity, retail distribution, air transport and professional services – have contributed to Canada's weak ICT investment numbers.¹⁰ There appears to be considerable potential for targeted regulatory reform to increase the incentives for innovation in many service sector industries in Canada, and particularly the incentive for ICT adoption and use.

Intellectual property rights (IPRs) – e.g., patents, copyrights, trademarks, trade secrets – play an important role in innovation strategies in certain industries. The design of IPRs must seek to balance the incentive to innovate as against the spillover benefits to society of relatively unencumbered access to knowledge and innovative ideas. While Canada's IPR regime is generally considered to comply with global best practice, there is concern that Canada's efforts to thwart various forms of IP theft have been inadequate.

Moreover, the new challenges facing IPR protection, in light of the Internet and other manifestations of information technology, call for innovation and vigilance to keep Canada's IPR regulation on the leading edge.

Taxation

Many studies over the years have pointed to a relatively high rate of business taxation in Canada, particularly as it affects the after-tax cost of M&E investment. This would reduce the incentive for firms to accumulate M&E and, because of the strong linkages among M&E, R&D and innovation generally, would explain some part of Canada's weak productivity performance. According to estimates by the C.D. Howe Institute, Canada's marginal effective tax rate (METR) for medium and large companies was the highest in the OECD in 2005 and 2006, though the comparable rate in the United States was only slightly lower.¹¹ The federal government has meanwhile been steadily reducing corporate tax rates of various kinds, and in Budget 2009 committed to continue with measures that would give Canada the G7's lowest overall tax rate on new investment by 2010.

The Scientific Research and Experimental Development Tax Incentive

The SR&ED incentive, with an estimated annual tax expenditure (i.e., foregone revenue) of \$4 billion in 2007, is by far the most significant government-provided support for business R&D in Canada. A rigorous cost-benefit analysis of the SR&ED estimated a net economic benefit of 11 cents per dollar of tax expenditure, or a benefit of about \$400 million annually for the economy.¹² Although the SR&ED program is generally popular with business, there has also been persistent criticism of its design because the incentive is of much less benefit for large firms when tough economic conditions reduce or eliminate taxable income and there is pressure to delay R&D spending. A *refundable* SR&ED credit (which is available for very small R&D performers) would strengthen the incentive for larger firms to sustain the pace and continuity of R&D through downturns.

Direct Government Support for Innovation

Governments can provide incentives to business directly through grants, co-investments, government laboratories (via mandates that are important to business) and, less transparently, by various forms of favoured public-sector procurement. To the extent that such support mechanisms can be shown to subsidize export activity, they have been increasingly limited by international trade rules.

Direct forms of support are, almost by definition, targeted to specific sectors, and their benefits and costs reflect many specific circumstances. The panel has therefore limited its discussion to some general principles based on empirical evidence from cross-country studies. The case for public support of business innovation (whether direct or tax-based) should be judged in terms of:

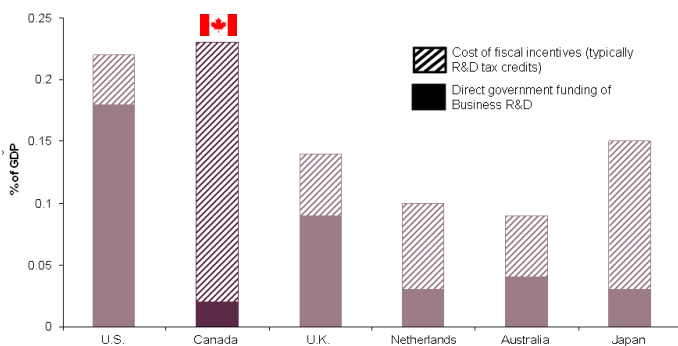
- *incrementality* – does the public subsidy simply substitute for work the recipient would have done anyway (“crowding out”) or does it induce extra investment by the business (“crowding in”)?
- *spillovers* – to what extent does the “social return” arising from the innovation activity induced by the public expenditure exceed the full economic cost of public funds?

This framework can, in principle, also be used to determine the most effective way to deliver a given amount of public support — i.e., whether via the tax system or directly. Canada's total government support for business R&D (tax and direct spending combined) is somewhat larger, relative to GDP, than that of the United States and the United Kingdom. It is noteworthy that Canada's heavy reliance on the tax assistance channel makes it virtually an outlier (Figure 12). This invites close analysis as to why Canada has chosen such an extreme mix of assistance delivery mechanisms and whether such a tax-heavy emphasis is appropriate.

Canada has provided a progressively more encouraging environment for business innovation — e.g., prudent fiscal and monetary policies, a trend of lower tax rates and support for university research — but Canada's innovation performance is still far from where it needs to be so there is still a great deal of work to do.

A recent study by Finance Canada reviewed the extensive literature seeking to estimate the impact of different mixes of direct and tax-based support for business research and concluded that "...there is presently *no evidence-based reason* to choose between tax credits, grants and publicly performed R&D as alternative ways to deliver support for R&D".¹³ This is a good starting point but is probably not the last word. Subsidies are likely to be more effective in motivating firms to take bigger risks and are attractive to companies that are constrained for funds. Tax credits — unless they are refundable — benefit only profitable firms. Thus a policy based largely on (non-refundable) tax credits would tend to bias the innovation process toward established companies conducting less risky projects. Of course the SR&ED credit is refundable for small Canadian R&D performers, so riskier projects, for these companies at least, should not be discouraged by the nature of the tax incentive.

GOVERNMENT FUNDING OF BUSINESS R&D*



*2005 data or last year available

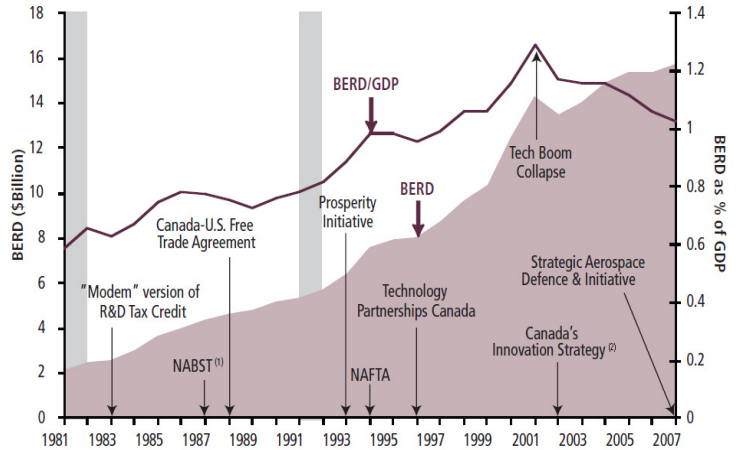
Figure 12: Government Funding of Business R&D

Government funding of business R&D, whether through direct grants or tax credits, is a relatively small proportion of BERD in most OECD countries (e.g., about 20% in Canada). The use of tax-based incentives has been increasing in the OECD group, but Canada is unusual in its almost exclusive reliance on the SR&ED incentive.

Influences on Business R&D Trends

It is instructive to revisit the long-term trend of business R&D spending in Canada (1981-2007), superimposing on it a number of key policy initiatives and other factors (e.g., North American recessions and trade agreements) that might have been expected to influence the expenditure pattern (Figure 13). Nothing appears to have had a material impact on the gradual upward-sloping trend other than the Internet/telecom boom between the mid-1990s and 2001, and the aftermath of the bubble's collapse. While the *aggregate* impact of targeted support for business innovation is hard to discern in Figure 13, such support can nevertheless be decisively important at the scale of individual firms and sectors.

THE MACRO CONTEXT FOR BUSINESS EXPENDITURE ON R&D 1981-2007



¹ NABST = Prime Minister's National Advisory Board on S&T.

² Included a target for Canada to be among the OECD's top 5 in R&D intensity by 2010. Shaded areas indicate recessions in North America.

Figure 13: The Macro Context for Business Expenditure on R&D

Shown is the growth of BERD since 1981 (in current dollars and as a per cent of GDP) with a number of relevant economic and policy developments superimposed. The inflation and collapse of the tech bubble has had by far the largest impact on the aggregate trend.

Policy to Encourage Innovation

Canada has provided a progressively more encouraging environment for business innovation, at least in respect of those factors over which public policy has *direct* influence — e.g., prudent fiscal and monetary policies, a trend of lower tax rates and support for university research. In the meantime, Canada's other benchmark competitors are not standing still and globalization and ICT are changing the way in which a great deal of business innovation is conducted. Most important, Canada's innovation performance is still far from where it needs to be so there is still a great deal of work to do — for example to:

- enhance competition
- foster the supply of finance for new ventures
- encourage the transformation of university and government research into innovation
- reform regulations that may be inhibiting ICT investment in certain service sectors
- continue to improve the design of tax incentives, and
- design ways to encourage innovation-based business strategies in sectors where Canada has demonstrated strengths or significant opportunities.

Box D summarizes several highlights of OECD research on policies to foster innovation.¹⁴

BOX D: STIMULATING INNOVATION — INSIGHTS FROM A DECADE OF OECD RESEARCH

In 2007, the OECD launched a concerted work on innovation strategy for presentation to its Ministerial Council in 2010. A paper released in February, 2009 and entitled: *OECD Work on Innovation – A Stocktaking of Existing Work*, provides a broad overview of OECD research over the past decade as to good policy practices for innovation. Summarized below is a selection of findings from the paper that are of particular relevance for issues addressed in this report.

Policy conditions that generally create a favourable environment for innovation include:

- macroeconomic stability, openness to trade and investment, deep financial systems, competitive markets, and regulation that is proportionate and appropriate;
- flatter, lower and more predictable taxes; and
- labour markets that allow mobility and adjustment, assist workers to retrain, and allow firms to undertake organizational change.

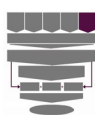
OECD research supports the following general propositions of relevance for policies to foster innovation.

- Access to secondary “high risk” capital markets, in addition to generally deep financial markets, is useful for young innovative firms.
- Intellectual property rights require a balance between rewarding risk-takers and diffusing new knowledge.
- Supporting management training appears to be beneficial.
- For clusters, the role of government is mainly as a catalyst and broker for strengthening cluster formation.

With regard to areas particularly in need of further investigation, the following were noted.

- More research is needed to appropriately measure human capital as an input to innovation. Especially important would be a better understanding of “soft skills” such as teamwork.
- Tax subsidies are increasingly used (relative to direct grants) to support firms. More evaluation is needed to determine the efficiency and effectiveness of this support since it is unclear whether the social benefits outweigh the costs.
- Since innovation is closely linked to demand from users, government as a large-scale purchaser can promote innovation by being a demanding buyer. More work is needed to better understand the linkages and policy responses to support innovation through procurement.
- Evaluation is sparse in many areas of innovation policy and much more work is needed to assess the return on government investment in the innovation activities of firms.
- Further work on the measurement of innovation is likely to yield benefits, particularly in understanding innovation in the service sector and better capturing the increasingly international nature of innovation activity.
- Indicator and related econometric research must move forward from innovation inputs and activities to include the outputs and impacts. A marked improvement in the policy relevance of innovation research is required in order to create a “science of science policy.”

9. BUSINESS AMBITION



The intangibles that make up Canada’s business culture are believed by many to reduce the supply of entrepreneurial talent, the appetite for risk, the urge to grow and the propensity to innovate. The relevance of “business ambition” to an explanation of Canada’s lagging innovation performance is a matter for debate based on evidence that is largely anecdotal. But it is almost by definition the residual explanation once all the other more tangible factors have been assessed.

The Influence of History

Canada’s particular colonial history, its specialization in natural resources and its proximity to the U.S. colossus have had a powerful shaping influence on Canada’s path of economic development, and on the nation’s values and the attitudes of its business people (Box E). This history should be less a barrier to business innovation tomorrow. Members of Canada’s immigrant communities are increasingly moving into positions of business leadership that will allow them to exploit advantages of language, contact networks and deep cultural understanding to succeed in new export markets. Moreover, with each new generation, Canadian business people – whether born in Canada or abroad – will have an increasingly global mindset and be further removed psychologically from the more limiting conceptions that shaped the nation’s past.

Empirical Evidence

The question of business culture is frequently the subject of surveys and commentaries in which there are two contradictory threads. One is pessimistic and reflects a widespread view among Canadian business people that too many of their number simply do not measure up to the standards needed for global success. The contrary view, based on surveys of the broader population – e.g., the World Values Survey conducted periodically in a large number of countries – contends that Canadians are not that much different from Americans when it comes to attitudes regarding risk and entrepreneurship, and therefore any explanation of innovation shortcomings based on public attitude and “business culture” is a red herring.

There is nevertheless a widespread conviction in the Canadian business community, usually based on direct experience, that there is an inbred propensity among U.S. business people to maximize the economic heft of their enterprise – to always go for growth. In Canada and Europe, “good enough” appears more often to be reached at a lower level. In other words, there appears to be a deficiency of business ambition in Canada. Too many successful Canadian businesses would rather behave like an “income trust” than like a “venture capitalist”. On the other hand, Canadians have been bold and entrepreneurial in domains where the country has had long experience and deep knowledge flowing from the particular opportunities and challenges the country has faced – mineral exploration and project engineering being good examples. Canadian business, on the whole, has acquired much less experience at the frontiers of science and technology, and has thus been less able to gauge the risks and opportunities in many of these domains. Fewer Canadian companies have therefore been prepared to adopt strategies based on technological innovation.

BOX E: A PERSPECTIVE FROM AN INNOVATION PIONEER

V.O. Marquez, when CEO of Northern Electric (later to become Nortel), drew on his extensive experience to conclude in a 1972 article that foreign ownership and an abnormal degree of dependence on imported innovation and technology were key characteristics of the Canadian manufacturing economy. As a result, "...the lack of need to make risk decisions in Canada and the consequent stunting of experience in making such decisions have conditioned the managers of manufacturing enterprises in Canada into becoming inexperienced, diffident and reluctant risk-takers".

In Marquez's view, "we lack, above all, the entrepreneurial initiative achieved by others, not because their people have greater potential than Canadians, but because their corporations and their countries have been forced to develop more vigorous responses by exposure to severe conditions from which we have been insulated... Technology is not a prime mover; entrepreneurship is. Seeking by incentive to lure our present industries into generating more of their own technology, or to seek foreign markets with vigor, will continue to meet with indifference and spotty success until and unless these activities are preceded by a greater proliferation of native entrepreneurial talent." ¹⁵

Innovation and Global Growth Strategies

Innovation is needed to move from a domestic to a global growth strategy. Reciprocally, a heavy investment in innovation usually requires Canadian businesses to go for the scale of global markets. Canadian businesses, on the whole, have so far failed to aggressively grasp the opportunities created by globalization. Canada has never had a single global brand in consumer products, though the BlackBerry has become a contender. Canada has no "super-major" energy multinationals and, notwithstanding Canada's vast forest tracts, no domestically owned forest company to rival those of Scandinavia. Despite a strong tradition in mining, only very few major international players – e.g., Barrick Gold, Teck Cominco, Sherritt International – have Canadian head offices.

There appears to be a deficiency of business ambition in Canada. Too many successful Canadian businesses would rather behave like an "income trust" than like a "venture capitalist".

More positively, Canada has produced companies like Research in Motion, Cirque du soleil, SNC-Lavalin, Bombardier and CAE, all of which are still controlled by Canadians. High-profile foreign takeovers like Alcan, the Hudson's Bay Company and Molson tend to attract much more media play than acquisitions of foreign firms by Canadian companies – e.g., Manulife's purchase of John Hancock Financial Services, TD Bank's acquisition of Commerce Bancorp (as a result of which TD now has more branches in the United States than in Canada) or Thomson's takeover of Reuters, a global company with deep historical roots.

Comprehensive research suggests that recurring fears of the hollowing out of Canadian industry through foreign takeover are probably exaggerated. Between 1994 and 2007, Canadian merger and acquisition (M&A) activity abroad exceeded foreign M&A in Canada, and the number of billion-dollar-plus deals was about the same on both sides of the ledger. At the same time, there has been persistent concern that too many innovative startups fail to mature in Canada with the most promising often acquired and eventually

relocated to the United States. The greater supply and sophistication of venture capital investors in the United States and immediate proximity to a larger market can be irresistible attractions for young, technology-based firms. Because these businesses are small they attract far less media attention than major takeovers but their disappearance saps the long-run innovation capacity of the Canadian economy. This underlines the importance of improving the climate for new ventures as discussed in Section 7.

A Lack of Business Ambition?

Are Canadian businesses good enough to compete in global markets, aggressive enough, willing to take risks, and sufficiently outward-looking beyond the huge and accessible U.S. market? Clearly, the many Canadians who have built successful global businesses have the necessary attributes. But the issue is whether there are enough of them to ensure the long-term prosperity of the entire economy. The panel's view is that today, there are not. This is not due to any lack of innate capacities of Canadian business people – it is not in the "DNA", so to speak. Rather, the traditional attitudes of business people have been shaped over a very long time by the particular circumstances of Canada's economy. For many exporters, easy access to the world's largest market next door has blunted the incentive to venture farther afield. With relatively subdued domestic competition, there are fewer market incentives to push toward the kind of competitiveness that can survive in larger world markets. As a small country, Canada offers a limited field on which business people can test themselves (though examples of innovation leaders like Finland and Sweden show that small size need not be a definitive constraint). Finally, Canada is rich and business has been profitable – so why change?

The truth is that the behaviour of Canadian business will not change unless its circumstances change. Those circumstances are, in fact, changing radically due not only to the current turmoil in the world economy but, more fundamentally in the long run, to a massive reallocation of the share of global economic activity as China and others become full participants in world commerce. The demographics of the Canadian business community are also changing as immigrants and a younger generation of entrepreneurs, unencumbered by traditional attitudes, expand their presence. So whether by necessity or inclination, there is reason to expect that Canadian business will become more ambitious.

10. CASE STUDIES: SECTORAL PERSPECTIVES ON INNOVATION

No one industry is "average" and there is no one-size-fits-all explanation for Canada's innovation shortcomings. The four sectors addressed in this section – automotive, life sciences, banking and ICT – were chosen as examples because innovation of different varieties tends to be an important business strategy in each and, taken together, they illustrate most of the innovation issues that arise in the economy.

Innovation also occurs in Canada's resource-based sectors. Much of the innovation in these industries involves process improvements, the adaptation of foreign-sourced M&E and techniques to Canadian circumstances, mineral exploration, and the financing and engineering of resource projects at all scales. But with very few

exceptions, Canadian firms have not been at the forefront of innovation in capital equipment for resource industries or in the development of the most sophisticated materials and products derived from the nation's resources — further evidence of Canada's characteristic upstream, commodity-oriented position in global value chains.

THE AUTOMOTIVE INDUSTRY — WEAK R&D BUT STRONG PRODUCTIVITY

The Canadian automotive sector presents an innovation paradox. Canada's R&D intensity in the sector is about one-seventh that of the United States, yet average labour productivity in the Canadian industry has exceeded U.S. levels in recent years, making automotive one of the few manufacturing industries where Canada enjoys a productivity advantage. The unprecedented decline in customer demand for motor vehicles since mid-2008 has now overshadowed considerations related to Canada-U.S. cost and productivity differences and left the industry in crisis in both countries. A recommitment to innovation by the major U.S.-based firms will be necessary for the industry eventually to return to a sustainable state.

Canada's Performance and Challenges in Automotive Innovation

The Canadian segment of the industry has focused on process innovation, as a result of which Canada has some of the most productive assembly plants in the industry. This kind of innovation is not captured in R&D statistics but has evidently contributed to the performance of Canadian automotive plants and, by doing so, encouraged additional investment in Canada.

Canada's contribution to automotive product development has been mixed. Despite pockets of product innovation strength (e.g., in global players like Magna and Linamar), Canada has primarily been an adapter, rather than a creator, of automotive innovation.

The global success of automotive parts makers such as Magna and Linamar shows that ambitious Canadian firms can expand from their base in a Canada-U.S. supply chain to serve the world market.

Canada has some areas of strength in relevant basic research — including lightweight materials, fuel cells and biofuel technologies — but better integration of this research with industry-sponsored initiatives would be desirable. Where there are automotive design centres in Canada, these facilities attract both talent and the R&D efforts of their suppliers. To the extent that such centres remain in the United States, or are established elsewhere, they can serve to pull R&D activity, even for Canadian firms, out of Canada.

General Motors, Ford and Chrysler represent more than two-thirds of Canadian vehicle production and purchase an even larger share of Canadian-made auto parts. There has been an increase in Canadian R&D and innovation activity by these companies in recent years (especially by GM and Chrysler), partly leveraged through targeted government support for new investment in Canada. But the declining North American market share of these firms — which reflects a long-standing innovation problem but not specifically a "Canadian" innovation problem — has put further pressure on the industry in this country.

Some Lessons for Business Innovation Strategy

- The innovation strategies adopted by firms in the Canadian auto sector have been influenced heavily by structural characteristics — specifically the integration of the North American market and the role of foreign-controlled assemblers. But the global success of parts makers such as Magna and Linamar shows that ambitious Canadian firms can expand from their base in a Canada-U.S. supply chain to serve the world market.
- The experience of Canada's auto industry shows that it is possible to build a competitive industry without a strong base of domestic R&D. The structure of the sector in Canada has instead led to innovation strategies that focus on process efficiency and workplace practices. This raises the question as to whether public policies could be designed to foster more such gains in productivity, including in resource industries where process innovation is also the prominent strategy. While questions of policy design are beyond the mandate of the panel, the message is that innovation policies in Canada should not be too heavily focused on the more typical measures of innovation, such as R&D spending. These do not adequately take into account the Canadian context with its unusually high reliance on sectors that are components of global supply chains and that do not necessarily rely on significant R&D spending to achieve greater productivity.
- The recent decline of the automotive sector in the face of an extraordinary convergence of adverse factors — some demand-related and some exchange-rate-related — shows that Canada's automotive policy will need to become more flexible and proactive. Fostering Canadian-based innovation by both vehicle assemblers and parts makers should be a goal of a new Canadian auto strategy that emerges from the industry's crisis.

LIFE SCIENCES: GREAT PROMISE BUT MIXED RESULTS

Life sciences comprise the most R&D-intensive sector of the economy and generally exhibit a strong strategic commitment to innovation. Companies in health-related life sciences are of three main types, each of which faces different issues:

- Large, brand name pharmaceutical companies are foreign owned and dominate the industry with more than 80% of total sales.
- Small R&D-oriented companies — biotech or medical devices — account for relatively insignificant sales but are important generators of innovation and future growth.
- Generic pharmaceutical manufacturers represent more than 15% of industry sales and 40% of volume, but do relatively little R&D. Canadian generic firms are nevertheless quite competitive and export a significant proportion of their sales.

In total, Canada spends slightly more than \$6 billion annually on R&D in health-related life sciences. More than half supports basic and pre-commercialization research done in universities and teaching hospitals and is funded primarily by governments and private non-profits. Businesses in Canada and foreign sources account for about 40% of total R&D funding in the sector.

Canada's Performance and Challenges in Life Sciences Innovation

Beginning in the 1980s, Canadian governments adopted a variety of policies specifically to encourage growth in life sciences R&D. As part of this initiative, the multinational pharmaceutical companies committed to spend 10% of their sales on R&D in return for favourable patent legislation. Private-sector R&D spending has been complemented by significant public-sector investments. This concerted investment nevertheless failed to produce the economic results desired or expected. For example, the share of the pharmaceutical industry in Canada's business GDP has fluctuated around 0.5% (Figure 14(a)), despite the large increase in R&D intensity (Figure 14(b)).

While there has been some modest success in growing mid-sized health biotech firms in Canada, most have been absorbed by larger global enterprises. The one area where Canada has had increased commercial success is in generics, which benefited from the government's previous policy of compulsory licensing.

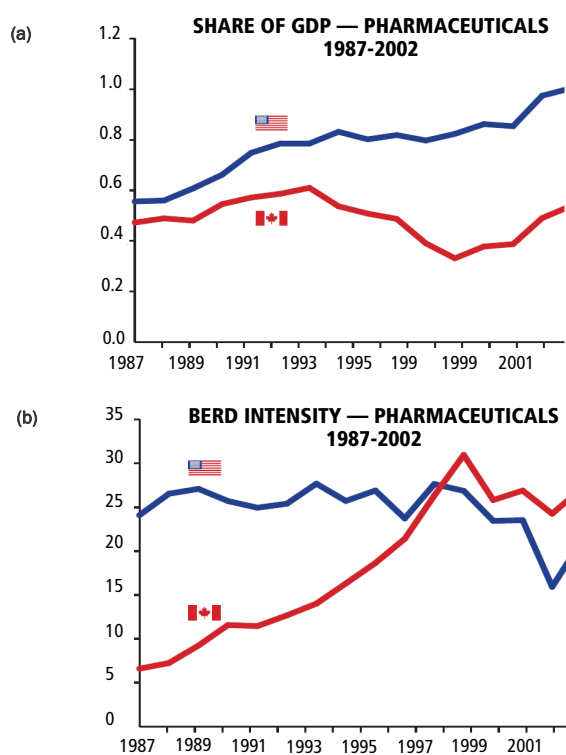


Figure 14: Pharmaceutical Industry — Canada and U.S.

The R&D intensity of the pharma industry in Canada actually exceeded that of the U.S. after the late 1990s — the result of industry undertakings in the context of Canadian patent law tightening. But the size of the sector in Canada did not grow and in 2002 was much smaller relative to the U.S. than it had been in 1987.

Segmenting the Product Development Value Chain

The past decade has seen a significant shift in the R&D spending of the global pharmaceutical companies. During the 1990s, while their worldwide R&D expenditures tripled, the number of new drugs approved is estimated to have fallen by about half. This has forced the major pharmas worldwide to look beyond their own doors for new opportunities. The shift in strategy has fit with the need for smaller biotech firms to seek out partners to take promising compounds through high-cost later-stage trials and to market. For

small Canadian biotech companies, the most appropriate ties to the large pharmas are typically not through their Canadian subsidiaries, but directly with R&D or product development groups abroad. Since the symbiosis between biotech and pharma is increasingly important, the countries that will become leaders in the health-related life sciences are those that create conditions where the mutual interdependence can flourish.

Competition for R&D Mandates

The competition for global R&D mandates has intensified and Canada is increasingly competing against low-cost locations like China and India and several highly developed countries as well. Although the research environment in Canada is strong, the country is seen by the global industry as increasingly uncompetitive in terms of market access to provincial formularies, drug pricing and patent rules, which, in combination, undermine new business opportunities.

Climate for New Ventures

Small biotech companies, which are dependent on external financing to fund research and product development, face the same issues that confront other innovative new ventures, as outlined in Section 7. However, the exceptionally long development cycles in health biotech — often taking 10 to 15 years from initial discovery to final regulatory approval — present a challenge that other technology-based sectors do not face to the same extent. To get a health biotech startup to market therefore requires risk capital that is both large and patient.

Legacy of Poor Results

The 1990s saw a significant increase in funding for new biotech ventures in Canada. Unfortunately, too many startups were created with neither experienced management nor a viable business case. Inexperienced venture capitalists compounded the problem by failing to bring to bear the due diligence and operational expertise that is always needed to weed out unlikely prospects and install better management. The poor results of the venture investments in the 1990s have produced a predictable pullback, with the entire sector now finding it difficult to obtain additional funding.

Some Lessons for Business Innovation Strategy

- The strategies of life sciences companies are strongly science based and thus are heavily influenced by public policies that support R&D as well as research and training in universities. Public policies in respect of health procurement and regulation are also of great importance, particularly for multinational pharmaceutical firms where there is strong and increasing competition among national affiliates for innovation and product mandates. The strategies of the smaller, biotechnology-based companies are very heavily influenced by (i) the availability of patient early-stage finance and mentorship, and (ii) their ability to strike collaborative arrangements with global pharmas.
- The experience of life sciences demonstrates what can and cannot be accomplished through a targeted government policy. The federal government set out to generate increased R&D spending in the life sciences in Canada and it worked, but it has not yet produced the expected follow-on benefits, neither of a growing pharmaceutical sector nor a vibrant, sustainable biotech industry.

- Additional IP protection could strengthen Canada’s position as an R&D location and help domestic affiliates in winning global mandates, but new IP policies are not likely to be sufficient. More important is the fact that, with the exception of Québec, governments do not view life sciences as a genuinely high economic priority and do not take a holistic approach to the sector by insuring that procurement practices are harmonized with industry development objectives.
- Given Canada’s single-payer health care system, Canadian governments could seek to establish a leading role in using health innovation to improve the productivity and quality of the health care system. An exceptionally promising initiative is the partnership among the federal and provincial/territorial governments through Canada Health Infoway (a federally funded, not-for-profit organization) to accelerate development of an electronic health record for all Canadians.
- Public policies should seek to increase links among industry participants: global pharmas with their sophisticated product management and marketing competencies; biotech and medical devices companies with creative new products but facing significant regulatory and marketing challenges; and universities and research centres with great ideas but few links to the marketplace.

BANKING SERVICES: TRADE-OFF BETWEEN STABILITY AND RADICAL INNOVATION

The banking sector, which comprises about 60% of the Canadian financial services industry, has a long history of innovation and technology adoption including some of the earliest deployments of automated teller machines, multi-branch banking and electronic bill payments. The areas where Canada has been an innovation leader have depended on attaining a critical mass of customer and merchant adoption in order to generate benefits. The small number of large banks in Canada provided the necessary scale of adoption of these technology-based innovations, an advantage that the highly fragmented banking system in the United States had formerly lacked. Banking has thus been one of the very few industries where scale has traditionally played to Canada’s advantage.

Competition and Innovation in Canadian Banking

The major players in the Canadian banking industry compete primarily through mild product differentiation aimed at creating brand recognition and loyalty. The particular structure of the industry – a small number of well-established national players – reduces the incentive for “visible” innovation (in products, services and marketing) since such innovation can be quickly copied by the other banks, thus nullifying the benefits being sought by the first innovator. Innovation in the Canadian setting instead typically takes the form of *internal* process and organizational improvements, which are less visible and therefore less readily copied. (This is supported by heavy investment in ICT physical capital and software, which embody a great deal of innovation indirectly.) Product and service innovations from elsewhere eventually diffuse across the Canadian banking industry after an innovation has proven successful, and the costs and risks have become well understood. This “early follower” strategy has kept the industry in Canada from slipping behind.

Balancing Innovation and Stability

More than in virtually any other sector, innovation in financial services is a doubled-edged sword. Both the benefits of getting it right and the costs of getting it wrong are enormous and not easily managed. In particular, banking is an industry that requires exceptionally vigilant regulatory oversight in order to ensure that risk is kept within appropriate bounds, that bank’s obligations are transparently disclosed and that a high level of funder/depositor confidence is maintained.

Given Canada’s single-payer health care system, Canadian governments could seek to establish a leading role in using health innovation to improve the productivity and quality of the health care system. An exceptionally promising initiative is Canada Health Infoway to accelerate development of an electronic health record for all Canadians.

The events that rocked the world’s financial system in 2008, and subsequently, are proof that innovation and specialization do not always create beneficial results. The banking crisis is a case where several financial innovations combined in unforeseen ways to generate a drastically negative outcome. The catastrophic consequences for many banks in the United States and elsewhere have not been felt to nearly the same extent in Canada where high standards of bank supervision and more cautious business strategies (e.g., relatively few “subprime” mortgages were created) have insulated Canadian banks from the worst of the global financial sector turmoil.

Some Lessons for Business Innovation Strategy

- The innovation strategies of the major Canadian-owned banks strongly reflect the market structure of the sector. The state of domestic competition has militated against a strong focus on product innovation leadership (being content with early adoption).
- The generally more conservative banking and regulatory practices prevailing in Canada – relative particularly to those in the United States and Europe – have kept Canadian banks off the “bleeding edge” of innovation in the design and distribution of the most sophisticated financial instruments. The analysts at the IMF consider that the performance and stability of Canada’s major banks are among the best in the world.
- The success of Canadian banks over many years may have dulled their business ambition. With limited exceptions, Canadian banks were, until fairly recently, content to focus on the domestic market and to restrict their international activity primarily to commodity-type wholesale banking as parties to international lending consortia. Now Canada’s banks have become more aggressively and creatively outward-looking with many examples of large investments to establish a substantive presence abroad.
- The recent turmoil in the banking industry globally has created a window of opportunity for Toronto to become one of the major North American, if not worldwide, innovation centres for the financial services industry. Canadian banks have economic

and strategic decisions to make as to where to locate their product and service development, software programming, data centres and other innovative activities going forward. With the right business climate, Toronto has the potential to emerge as a centre not only for these activities, but also to attract specialists from around the world to create financial industry products and services.

ICT: A CATALYTIC ROLE FOR GOVERNMENT

Information and communications technologies are vitally important for innovation because (i) the producers of ICT are themselves key innovation-intensive sectors of the economy; and (ii) the use of ICT in other sectors contributes increasingly to productivity growth in the entire economy, and particularly in service sectors.

Canada's Challenges in ICT Innovation

As with other technology-intensive sectors in Canada, the Canadian ICT industry is significantly smaller (as a share of GDP) than its counterpart in the United States. For Canada to improve its position in ICT, the challenge is to grow more businesses that can expand the sector's role both in the domestic economy and in exports.

Slower Adoption of New Technology

The slow adoption of new ICT by Canadian small and medium-sized enterprises (SMEs), as compared with SMEs in the United States, was a significant source of the growing ICT investment gap during the 1990s. The reasons for this are still debated. Attitudinal issues may explain the technology-follower approach of Canadian firms. While the relative cost of capital and labour and the weak Canadian dollar have also had an impact on investment in ICT at least until the last few years, the perception of many industry participants is that too many Canadian SME managers lack formal training and thus lack the knowledge and confidence to take full advantage of the benefits of ICT. This adoption gap has an impact on the ICT-producing sectors. In addition to shrinking the effective size of the Canadian market, it leaves Canadian new entrants with too few local lead customers and has the further effect of limiting the development of a surrounding ecosystem of ICT service and support firms that can evolve into growing ventures themselves.

The role of government in ICT sectors has typically been catalytic, enabling an innovative line of activity to take root and to build scale to the point where commercial viability has emerged.

Globalization of Value Chains

Canadian firms cannot compete internationally on cost — instead, they must rely on superior skill and value creation. One response has been to create “fabless” semiconductor companies, where the design is conducted in Canada and the manufacturing is outsourced. Canada has also had success in software, but to maintain and grow capacity, the domestic workforce must remain competitive in the face of the improving skill levels in developing countries. Recent trends are cause for concern. During the 2005-06 academic year, for example, the share of enrolment at Canadian universities in mathematics, computer and information sciences was the lowest since 1992.

Some Lessons for Business Innovation Strategy

The ICT sector is a heterogeneous collection of industries encompassing many different innovation strategies as the following examples illustrate.

- The fact that several large players in the computer industry in Canada are foreign controlled has not stunted Canada-based product innovation activity as has been the case, for example, in the automotive and industrial chemicals industries. The prospect of government procurement contracts for ICT firms that established a substantial presence in Canada provided in some cases (notably IBM) an initial attraction that grew into major activities with global product mandates. This experience shows that government's role as lead customer can, under the right conditions, provide the impetus to kick-start a new industry. The case of ICT procurement, which catalyzed substantial economic development, stands in contrast to the very different philosophy of health sector procurement that has prevailed for pharmaceutical products.
- Canada became a leader early on in satellite and microwave communications technology in order to communicate across a vast geography, a mission that was initially supported by targeted government research and enterprise. For example, Telesat was founded in 1969 as a joint government-private-sector business.
- The climate for new ICT ventures (hardware, software, systems and services) in Canada has been quite favourable in view of (i) a strong base of research and training in universities and colleges, and in major players like Nortel, IBM and RIM; (ii) government supports such as the SR&ED tax credit and various laboratories and programs; and (iii) supportive clusters of ICT subsector activity in several centres across Canada. The many successes have produced numerous role models and angel investors, and bred confidence in young ICT entrepreneurs that they could succeed in Canada. Business ambition has not been in short supply although lack of a strong base of leading-edge ICT customers in Canada is a significant drawback. Unfortunately, the sharp decline in the telecommunications technology sector since 2001 (now exacerbated by the global recession) has hit Canada particularly hard in view of this country's specialization in several of the most heavily affected market segments. Canada's hard-won advantages are now at risk.

A theme running strongly through the foregoing examples is the key influence of government, at least at the outset. The initiating influence has taken many forms — early procurement, public-private commercial partnership in support of a national mission (satellite communication), and research support through targeted university funding and sector-oriented government facilities and programs. The role of government in ICT sectors has typically been catalytic, enabling an innovative line of activity to take root and to build scale to the point where commercial viability has emerged.

11. CONCLUSIONS

The panel has approached innovation as an *economic* process rather than as a primarily science and engineering activity. The panel's analysis of business innovation in Canada thus provides a perspective on the fundamental factors that connect business strategy, innovation activity and productivity growth. The analysis demonstrates that the persistent weakness of productivity growth in Canada is rooted in subpar business innovation. The main quantitative evidence is Canada's persistently slow growth in multifactor productivity. When measured over long periods of time, MFP growth provides the appropriate broad measure of business innovation – that is, the combination of human and capital resources in new or more efficient ways to create value. While this is not a new finding, this report describes Canada's innovation shortcomings in quantitative terms more precisely than most previous studies have.

The panel's principal conclusion is that Canada's poor performance in respect of innovation is due to the prevalence of business strategies that do not emphasize innovation as a key competitive tool. It follows that the starting point of any exercise that aims to improve Canada's productivity performance should be to understand why so many Canadian businesses and entrepreneurs choose business strategies that place little emphasis on innovation. A focus on the determinants of business strategy, rather than on innovation activities themselves, is the most significant new contribution of this study.

The many successes of Canadian businesses in the hyper-competitive global marketplace show that there is nothing innate or inevitable in the national character that prevents Canada's businesses from being just as innovative and productive as those of other nations.

The principal determinants that influence the business innovation decision can be categorized broadly as (i) particular structural characteristics, (ii) competitive intensity, (iii) the climate for new ventures, (iv) public policies that encourage or inhibit innovation, and (v) business ambition (e.g., entrepreneurial aggressiveness and growth orientation). These five factors are themselves influenced by certain deep and long-standing features of Canada's economy, of which the two most significant are the following:

- ***Canada is "upstream" in many North American industries.*** This positioning, which is related to important structural characteristics such as sector mix and foreign control, is the result of Canada's resource endowment and development history as a commodity supplier and technology adopter. Canada's upstream position in many continentally integrated value chains limits contact with ultimate end-customers (who are a strong source of motivation and direction for innovation), and shapes the nature of business ambition in many sectors.
- ***Canada's domestic market is relatively small and geographically fragmented.*** Small markets offer lower potential reward for undertaking the risk of innovation and tend to attract fewer competitors, and thus provide less incentive for a business to innovate in order to survive. Of course the innovation success of countries like Finland and Sweden shows that the disadvantage of a small domestic market can be offset by a strong orientation toward innovation-intensive exports.

Addressing Canada's Innovation Challenge

Canada has a serious productivity growth problem. The statistical evidence is unambiguous and of long standing. The panel believes that Canadians should be concerned about the productivity of our export-oriented economy as competition from China and other emerging economies intensifies. Strong productivity growth is the way to remain internationally competitive with a rising standard of living. The panel also believes that Canadians should be concerned about the long-run consequences of continued weak productivity performance in the domestic economy as the population ages and competition intensifies among the mature economies for the best human skills, and particularly for entrepreneurial talent.

Because *Canada's productivity problem is actually a business innovation problem*, the discussion about what needs to be done to improve productivity in Canada needs to focus on the factors that encourage, or discourage, the adoption of innovation-based business strategies. This is a complex challenge because the mix of relevant factors varies from sector to sector and requires a much broader conception of innovation than the conventional R&D-centred view, which, while important, is far too limiting.

The short case studies in this report illustrate the great variety in the circumstances facing individual sectors of the Canadian economy and the very different incentives and constraints that affect the choice of innovation strategy in each. There is no single cause of the innovation problem in Canada, nor is there any one-size-fits-all remedy. Public policy in respect of innovation therefore needs to be informed by a deep understanding of the factors that influence business decision makers, sector by sector, and this clearly requires extensive consultation with business people themselves as well as the further development of innovation surveys and other forms of micro-analysis of the innovation process.

Overarching the sector-specific factors that influence innovation strategies, there are certain issues of pervasive influence identified in the panel's analysis that suggest the need for proactive public policies to:

- encourage investment in advanced M&E in general, and in ICT in particular (such incentives should be designed only in light of a more thorough understanding of the reasons for the relatively slow adoption of ICT in Canada to date);
- sharpen the incentive for innovation-oriented business strategies by increasing exposure to competition and by promoting a stronger export-orientation on the part of Canadian firms, particularly in goods and services that are downstream in the value chain and thus closer to end-users;
- improve the climate for new ventures so as to better translate opportunities arising from Canada's university research excellence into viable Canadian-based growth businesses, bearing in mind that better early-stage financing and experienced mentorship hold the key; and
- support areas of Canadian strength and opportunity through focused, consistent sector-oriented strategies, such as was done in the past in, for example, the automotive, aerospace and ICT industries.

Fortunately, the many successes of Canadian businesses in the hyper-competitive global marketplace show that there is nothing innate or inevitable in the national character that prevents Canada's businesses from being just as innovative and productive as those of other nations.

The panel has completed its analysis of business innovation in the shadow of the most severe global economic downturn in decades. The panel has nevertheless remained focused on the long term because Canada's innovation conundrum is deeply rooted and has

little to do with the booms and busts of the economic cycle. As governments in Canada continue to take measures in the near term to mitigate the downturn, the panel's diagnosis of the nature and underlying causes of Canada's generally weak business innovation performance can help to target those measures so that they also strengthen the nation's economy for the long term.

DATA SOURCES FOR FIGURES

Figure 1: CSLS (2008). *Relative labour productivity trends in the business sector in Canada and U.S.* Ottawa: Centre for the Study of Living Standards.

Figure 2: Baldwin, J. & Gu, W. (2007). *Long-term productivity growth in Canada and the United States.* Ottawa: Statistics Canada.

Figure 3: OECD (2008). *OECD compendium of productivity indicators.* Paris: OECD.

Figure 4: OECD (2008). *Main science and technology indicators 2008.* Paris: OECD.

Figure 5: OECD (2008). *Main science and technology indicators 2008.* Paris: OECD.

Figure 6: CSLS (2008). *Database of ICT investment and capital stock trends: Canada vs. United States.* Ottawa: Centre for the Study of Living Standards.

Figure 8: Panel calculations based on OECD's STAN Database.

Figure 9: Statistics Canada (2007). CANSIM Database.

Figure 10: CVCA (2007). *Industry statistics.* Toronto: Canadian Venture Capital Association.

Figure 11: CVCA (2007). *Industry statistics.* Toronto: Canadian Venture Capital Association.

NVCA (2008). *Industry statistics.* Arlington, VA: National Venture Capital Association.

Figure 12: OECD (2008). *Science, technology and industry outlook 2008.* Paris: OECD.

Figure 13: OECD (2008). *Main science and technology indicators 2008.* Paris: OECD.

Figure 14: OECD's STructural ANalysis (STAN) Database.

ENDNOTES

- ¹ OECD (2005). *Oslo Manual: Guidelines for collecting and interpreting innovation data*. Paris: OECD Publishing.
- ² Baldwin, J., & Gu, W. (2007). *Long-term productivity growth in Canada and the United States*. Ottawa: Statistics Canada.
- ³ Baldwin, J., Beckstead, D., & Gellatly, G. (2005). *Canada's investments in science and innovation: Is the existing concept of research and development sufficient?* Ottawa: Statistics Canada.
- ⁴ Sharpe, A. (2005). *What explains the Canada-U.S. ICT investment intensity gap?* Ottawa: Centre for the Study of Living Standards.
- ⁵ World Economic Forum (2008). *The global competitiveness report 2008-2009*. Geneva: World Economic Forum.
- ⁶ Miller, R., & Côté, M. (2008). The games that innovators play. *Ivey Business Journal*, University of Western Ontario.
- ⁷ Baldwin, J., & Gu, W. (2005). *Global links: multinationals, foreign ownership and productivity growth in Canadian manufacturing*. Ottawa: Statistics Canada.
- ⁸ Competition Policy Review Panel (2008). *Compete to win— final report*. Ottawa: Industry Canada.
- ⁹ Committee on The State of Science & Technology in Canada (2006). *The state of science & technology in Canada*. Ottawa: Council of Canadian Academies.
- ¹⁰ Conway, P., & Nicoletti, G. (2007). Product market regulation and productivity convergence: OECD evidence and implications for Canada. *International Productivity Monitor*, 15 (Fall), 3-24.
- ¹¹ Chen, D., & Mintz, J. M. (2008). Limited horizons: The 2008 report on federal and provincial budgetary tax policies. *C.D. Howe Institute Commentary*, no. 270. Toronto: C.D. Howe Institute.
- ^{12&13} Parsons, M., & Phillips, N. (2007). An evaluation of the federal tax credit for scientific research and experimental development (Working paper No. 2007-08). Ottawa: Finance Canada.
- ¹⁴ Box, S. (2009). *OECD work on innovation — a stocktaking of existing work*. Paris: OECD Publishing.
- ¹⁵ Marquez, V. O. (1972). Building an innovative organization — wanted: small catastrophes. *Business Quarterly*, 37(4), 40.

This assessment was made possible with the support of the Government of Canada.

Canada



Council of Canadian Academies
Conseil des académies canadiennes

Science Advice in the Public Interest

The Council of Canadian Academies supports independent, expert assessments of the science that is relevant to important public issues. The Council is a not-for-profit private corporation, and is supported by a \$30 million grant provided in 2005 by the Government of Canada. This “Report in Focus” was prepared by the Council based on the report of the Expert Panel on Business Innovation.

© 2009 Council of Canadian Academies