

Business Sector Productivity in Canada: What Do We Know?

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ABSTRACT

Business sector productivity growth is central to Canadians' future prosperity. This article reviews the performance of the Canadian business sector in improving labour and multifactor productivity and examines possible factors underlying recent developments. The article links weak multifactor productivity growth in the Canadian business sector to the weak innovation performance of Canadian firms. The conclusion to this article describes a research program that Industry Canada, in conjunction with others, is carrying out. The research program seeks to identify the reasons for Canada's poor innovation and productivity performance, in order to shed light on actions that can be undertaken to improve productivity growth.

IN THE FUTURE, more than in the past, labour productivity growth will be the key determinant of the rate of improvement in the living standards of Canadians. Over past decades, increases in the employment/population ratio have contributed significantly to the growth in real incomes. In the more recent period, since 2002, Canadian prosperity has been boosted by stronger commodity prices and a major improvement in Canada's terms of trade — the price of exports relative to imports. Neither of these factors can be counted on to support the future growth in Canadian living standards. Over the last few decades, the trend in commodity prices has been relatively flat and, prior to the recent sharp upswing in price of the country's commodity exports, Canada's terms of trade were below where it had been in 1980. Demographic changes, which are occurring in all developed economies, are likely to be espe-

cially pronounced in Canada. Starting around 2010, it is expected that declines in the employment/population ratio and in average hours worked will both exert a negative influence on the growth in living standards.

In this context, Canada's weak productivity performance is especially troubling. If the country does not improve on its poor performance since 2000, Canadians are likely to see their economic well-being decline relative to other major industrial countries. There is also a risk that in future years when employment growth has slowed and the terms of trade have stabilized, the country will face considerable difficulty finding the resources to finance rising health, social and environmental costs.

With a view to the central role of productivity growth in Canadians' future prosperity, this article reviews what we know about business sector productivity. Business performance in

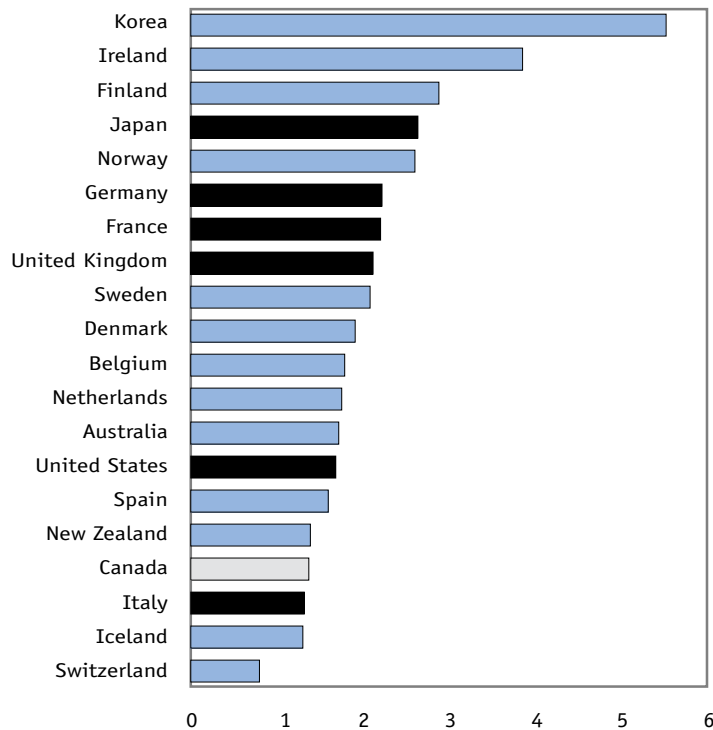
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Table 1
Sources of Income per Capita Growth
in Canada, 1981-2007
(per cent)

Labour Productivity	56.8
Multifactor Productivity	47.8
Capital Deepening	9.0
Working-Age/Total Population	11.5
Employment Rate	9.9
Hours Worked per Worker	-3.5
Net Foreign Income	3.7
Terms of Trade	21.5
Total	100

Source: Industry Canada computation based on data from Statistics Canada.

Chart 1
Labour Productivity* Growth in OECD Countries,
1981-2006
(per cent, average annual rate)



* Real GDP per hour worked.

Source: OECD Productivity Database, July 2007.

improving labour and multifactor productivity is examined and possible factors underlying recent developments are examined. The article concludes with an identification of research questions that Industry Canada in conjunction with others is attempting to answer and that will hopefully shed light on actions that can be taken to bolster Canada's productivity performance.

Labour Productivity Performance

The challenge identified in the introduction can be better understood from Table 1, which examines the sources of real income per capita growth in Canada. The table pertains to gross national income (GNI) per capita, which is a measure of the purchasing power of the income earned by Canadians that takes account of changes in the terms of trade and in investment income from foreign assets (net of the payments to foreigners who have assets in Canada). Over 1981-2007, the standard of living of Canadians, as measured by GNI per capita, increased at an average annual rate of 2.2 per cent. Growth in labour productivity accounted for 57 per cent of per capita income growth, but increases in the proportion of the population that is employed and improvements in the terms of trade were both major sources, each contributing over 20 per cent to the growth in per capita income.

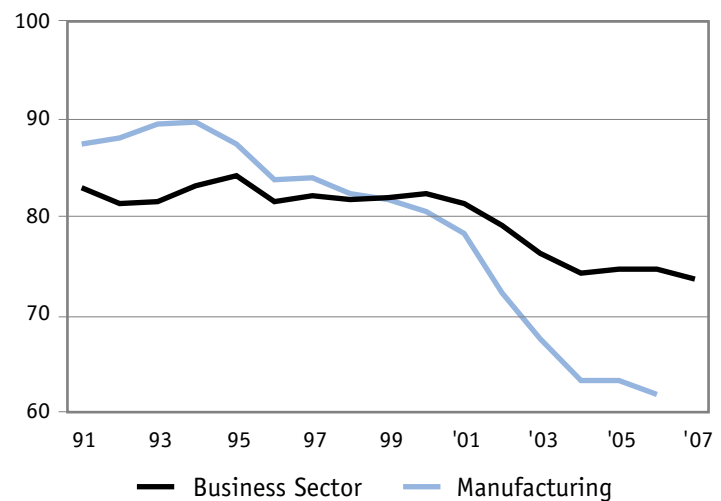
In the recent period, increases in the extent of employment and improvements in the terms of trade have not only contributed to absolute income gains, they have also helped Canada achieve significant increases in real per capita income relative to the United States. While the purchasing power of Canadians received a major boost from the post-2002 commodity boom, real incomes in the United States have been largely unaffected by trading gains. In addition, since 2000, the labour market has been much more buoyant in Canada than the United States and jobs per capita have increased more

strongly. As a result, real GNI per capita has grown much more rapidly in Canada than the United States.²

Looking to the future, it is relevant to ask how Canadians would have fared if these other sources were not available and per capita income growth depended solely on increases in labour productivity. The short answer is “not very well”. Over the entire 1981 to 2006 period, labour productivity in Canada, defined as GDP per hour worked, increased at an unimpressive 1.4 per cent per year. This growth rate places Canada 17th among the 20 OECD countries for which productivity data are available, and 6th among the G7 major industrial countries (see Chart 1). Over the 2000-2007 period, labour productivity in Canada has increased at an annual average rate slightly below 1.0 per cent. While productivity growth has fallen in Canada, the United States has strengthened its performance since 2000, raising the pace of productivity growth some 24 per cent above its trend rate (1981-2007) of 2.1 per cent.

Given the difficulties in measuring non-commercial outputs, it is most meaningful to focus on productivity developments for the 80 per cent of the economy involved in business activities. The general story, however, is the same. According to Industry Canada calculations, the level of business sector labour productivity in Canada was only about 75 per cent of the level in the United States in 2007 (Chart 2).³ The gap has widened markedly since 2000. The decline in Canada’s relative performance has been especially pronounced in manufacturing and, in 2006, the gap between Canadian and U.S. manufacturing productivity levels was close to 40 per cent.

Chart 2
Relative Labour Productivity in Canada, 1991-2007
(U.S.=100)



* Labour productivity is defined as GDP per hour worked, PPP-based. The series are extrapolated based on 1999 benchmarking estimates of the Canada-U.S. labour productivity gap, using labour productivity indexes from Statistics Canada and U.S. Bureau of Labor Statistics.
Source: Industry Canada calculation based on data from Statistics Canada and U.S. Bureau of Labor Statistics

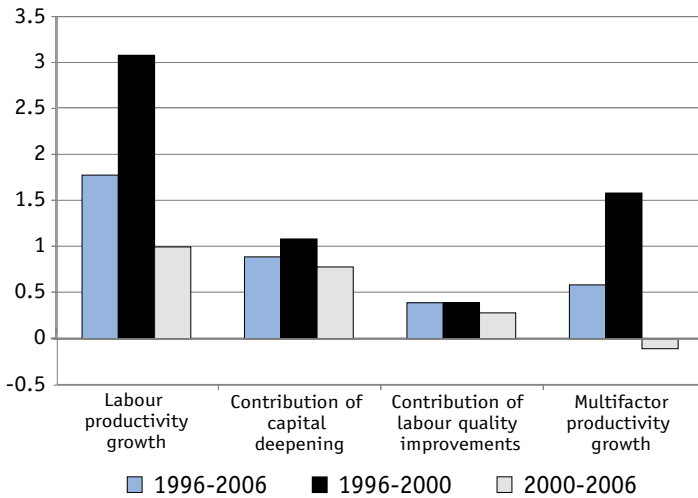
Multifactor Productivity Performance

Labour productivity growth can be decomposed into the parts coming from increases in capital intensity, improvements in labour quality, and multifactor productivity. Capital intensity is the capital services (based on the stock of machines, buildings and engineering structures) available per hour worked. The labour quality component measures improvements in worker skills as a result of education and on-the-job experience. Multifactor productivity (MFP) is a measure of the efficiency with which labour and capital are used in production. It is calculated as a residual and captures all other effects after

2 Over the 2002-2006 period, the growth rate of real gross national income per capita was 14.3 per cent in Canada and 8.1 per cent in the United States.

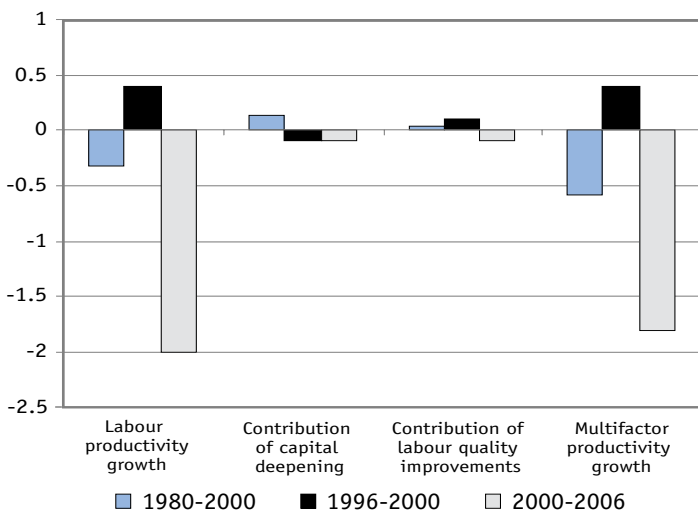
3 Estimates of the Canada-U.S. productivity level gap estimates vary among researchers because of differences in data sources and in the PPP exchange rates used in the calculation. Despite the variations in the point estimates, all researchers concur that the Canada-U.S. labour productivity gap is significant and has widened significantly since 2000.

Chart 3
Sources of Labour Productivity Growth in the Canadian Business Sector



Source: Statistics Canada.

Chart 4
Canada-U.S. Differences in Sources of Business Sector Productivity Growth



Source: KLEMS Database, Statistics Canada.

increases in capital intensity and improvements in labour quality have been taken into account. The possible contributors to MFP growth

include the creation of new products and processes, improvements in technology, economies of scale, organizational changes and new human resource practices.⁴

A decomposition of labour productivity growth in the Canadian business sector is shown in Chart 3. Over the 1996-2006 period, increased capital intensity was the most important factor underlying the growth in labour productivity. While MFP growth made a significant contribution to labour productivity growth between 1996 and 2006, the weakness in MFP was the major cause of the slowdown in labour productivity experienced over the 2000-2006 period.

Chart 4, which compares the sources of labour productivity growth in the Canadian and the U.S. business sectors, provides a more telling picture of Canada's weak MFP performance. Over 1980-2000, capital intensity, and to a lesser extent, labour quality, were increasing more strongly in Canada than in the United States, but these positive factors were more than offset by the weakness in Canadian multifactor productivity. Over the 2000-2006 period, Canada's poor MFP performance accounts for almost all of the 2 percentage point difference in labour productivity growth between the Canadian and U.S. business sectors. Chart 5 examines the gap in productivity levels in a particular year. The chart highlights the extent to which the weakness in multifactor productivity is a cause of Canada's low labour productivity level relative to the United States.

As discussed above, MFP captures a host of factors that affect the overall efficiency with which inputs are used. Poor MFP growth may reflect weak investment by firms in building their "knowledge capital", a failure to realize the opportunities from increased specialization, weak governance mechanisms or the use

⁴ MFP growth is often used as an indicator of long term technological progress. While technological change is the most important factor underlying MFP growth in the economy over the longer-term, it may not be the main influence on MFP productivity growth in particular periods and specific sectors.

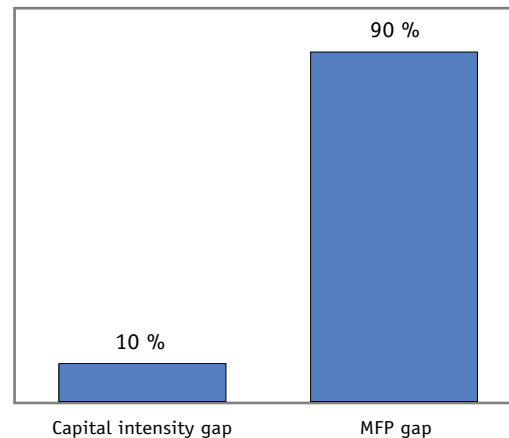
of outdated organizational practices. The decline in MFP growth in the Canadian business sector since 2000 is partly due to special factors associated with the pressures to meet strong demand for the extraction of minerals and oil and gas.⁵ A factor contributing to the MFP slowdown in manufacturing was the fall off in output growth, which reduced the intensity of use of existing labour and capital inputs.

One of the strongest candidates for explaining MFP performance by business, however, is innovation, broadly defined.⁶ Econometric studies show that business innovation, as indicated by various proxies such as R&D intensity, is a major source of technological improvement and productivity gain. Micro studies that focus on output relationships by analyzing cross-sectional data at the firm or industry level and analyses using a cost function approach both find that investments in R&D tend to pay big dividends.⁷ Macro studies using aggregate data similarly find that knowledge acquired from R&D as well as international knowledge spillovers has a significant influence on productivity growth.⁸

Innovation by Canadian Business

On a number of measures of innovation, Canada lags behind many other major industrial countries. The OECD (2004) has

Chart 5
Contribution to the Canada-U.S. Labour Productivity Gap in the Business Sector, 2004



Source: Industry Canada calculation based on data from Statistics Canada and U.S. Bureau of Economic Analysis.

attempted to benchmark innovation, using a broad indicator that recognizes that the impact of innovation on productivity comes not only from the introduction of new products and processes, but also the diffusion of new technologies throughout the economy. In this composite measure, which combines three measures of innovation activity and three measures of technology diffusion,⁹ Canada ranks 10th among 27 OECD countries. Our overall score is below that of many top performers that include Sweden, Switzerland, Japan, Finland, the United States, Germany

5 There was a dramatic decline in multifactor productivity in the mining and oil and gas extraction sector (about 5 per cent of GDP in 2006) over 2000-2006. As a consequence of strong markets and the pressure to increase output, labour markets tightened and less productive mines and oil wells became a more important source of production. Since mining and oil and gas extraction are highly capital intensive industries, however, their increased importance raised the average level of capital per worker, which resulted in a partially offsetting positive influence on business sector labour productivity.

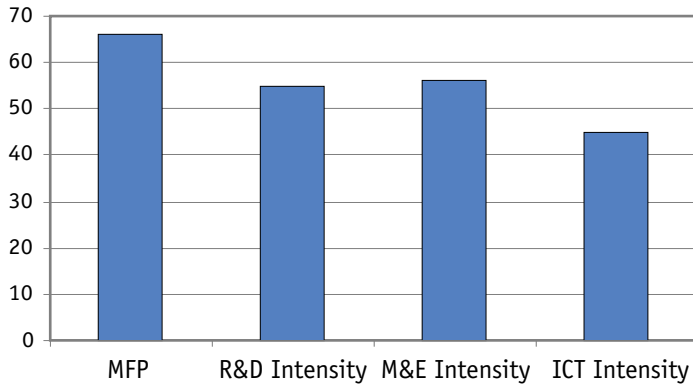
6 Innovation is defined, according to the OECD-Eurostat Oslo manual, as "the implementation of a new or significantly improved product, or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations".

7 See, for example, Griliches and Mairesse (1990), Wang and Tsai (2003), and Nadiri and Purcha (1990).

8 See, for example, Coe and Helpman (1995) and Keller (2004).

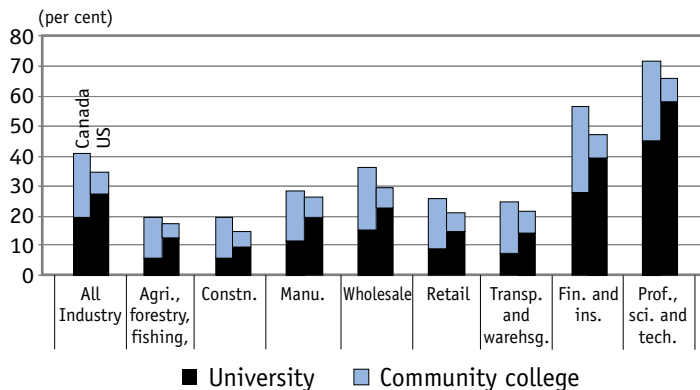
9 The indicators of innovation activity relate to: the proportion of firms introducing new or significantly improved products/processes; business assessments of innovation activity; and the number of patented innovations in the United States, EU and Japan. Technology diffusion is based on indicators of: import of foreign technology; business assessments of the application of new technology; and share of firms involved in technology collaboration.

Chart 6
MFP and R&D, M&E, and ICT Intensity in the Canadian Business Sector, 2004
 (US=100)



MFP: based on output per worker.
 R&D intensity (2002): R&D stock (assuming a depreciation rate of 0.15) per worker.
 M&E capital intensity: M&E capital stock per worker.
 ICT capital intensity (2003): ICT capital stock per worker.
 Sources: Industry Canada calculations based on data from Statistics Canada, U.S. Bureau of Economic Analysis and OECD.

Chart 7
Percentage of Post-Secondary Graduates in Selected Industries
 (per cent)



Source: Canadian Census of Population 2001, U.S. Census of Population 2000.

and the Netherlands. Canada's performance is especially poor on the innovation activity sub-index, where we rank 12th, falling behind the United States, Japan and most western European countries.

Canada's poor performance in relation to the United States, our main trading and investment partner and our major foreign competitor, is of particular concern. As shown in Chart 6, on a number of metrics, Canadian businesses are much less innovative than their U.S. counterparts. Canadian firms spend much less per worker on R&D, which is a key mechanism for the development of new products and processes. They also invest much less than U.S. firms in equipping their workers with machinery and equipment. Since M&E investment is the means of accessing the most advanced technology, Canada's lower M&E intensity reflects its slower pace of technology adoption. In addition, Canadian firms invest less per worker in ICT. Given the role of ICT in facilitating the application of sophisticated production, scheduling, modeling and testing systems, this suggests that Canadian firms have fallen behind in the application of various modern business processes.

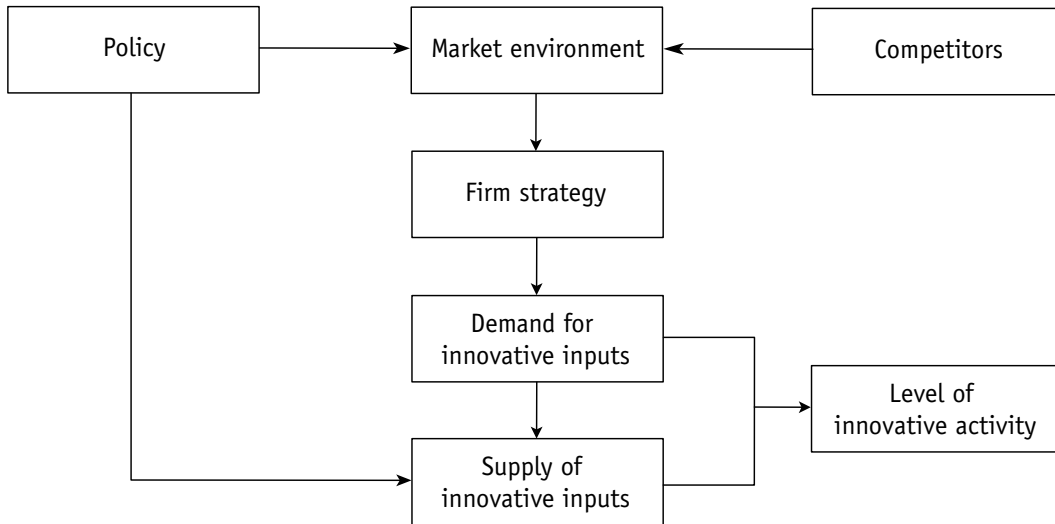
Possible Causes of Our Weak Innovation Performance

Exhibit 1 outlines a conceptual framework that is useful in understanding the factors influencing business innovation. This suggests that innovation is the result of:

- The strategies that firms develop based on an assessment of the market environment and their competitive situation;
- The available supply of inputs that are utilized in the innovative process; and
- The extent to which government policies create an environment that is conducive to innovation-based firm strategies and support the development of inputs that are important for business innovation.

Is Canada's poor record of innovation mainly a result of constraints on the supply side, weakness in the demand for innovative inputs or both? There is strong evidence that the problem is not the supply of innovative inputs. While, for

Exhibit 1
Framework for Analyzing Business Sector Innovation



example, Canadian firms make less use of university-educated workers than U.S. firms (Chart 7), the supply of new PhDs graduates has been growing faster in Canada than the United States. It is significant that, over the 1990s, when the real earnings of PhDs increased by 18 per cent in the United States, they rose by only 3 per cent in Canada. It does not appear that PhDs, who are a key input to innovation, are in short supply in Canada.

If we look at venture capital, another input to business innovation, the story is similar. Venture capital is important to smaller firms that need support for commercialization of new technologies. In response to concerns about the adequacy of the venture funds available in Canada, a number of programs have been put in place to promote the supply of venture capital.¹⁰ However, with the exception of the two year period prior to the bursting of the technology bubble in 2001, venture capital raised, measured as a percentage of business expenditures on R&D

Chart 8
Company Operations and Strategy Index
Ranking*
 (out of 121 countries)

Country	Ranking
United States	1
Germany	2
Japan	5
United Kingdom	9
France	11
Canada	18
Australia	23
Italy	32

* The company operations and strategy index measures the extent to which company strategies and operating practices are oriented toward innovation versus other modes of competing.

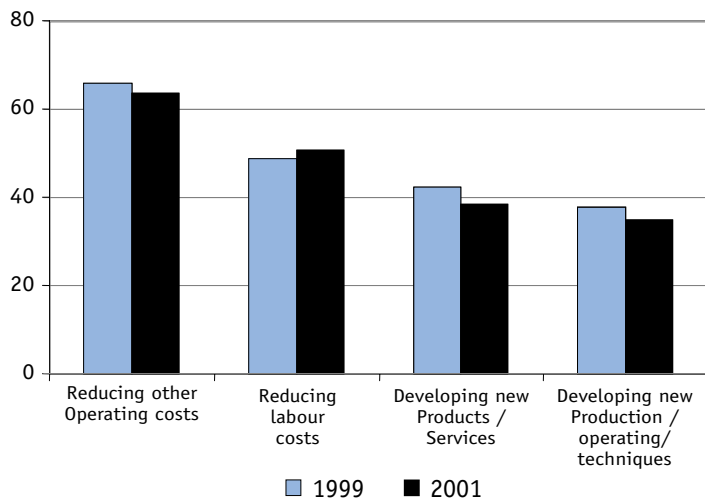
Source: World Economic Forum, Global Competitiveness Report, 2006-2007.

(BERD), has been higher in Canada than the United States.¹¹ Since 1996, the cumulative amount of venture capital raised in Canada is

¹⁰ These include the Technology Partnership Canada (TPC) program, Labour Sponsored Venture Capital Corporations (LSVCC) tax credits and the financing programs of corporations such as Business Development Corporation (BDC) and the Export Development Corporation (EDC).

¹¹ This is based on data from Thompson Financial.

Chart 9
General Business Strategy in Canada, 1999, 2001
(per cent of establishments)



Source: Employer portion of the Workplace and Employee Survey, Statistics Canada.

over twice the amount that has been invested, resulting in a substantial “overhang” of capital. Moreover, the data show that venture capital markets are becoming increasingly integrated and that Canadian entrepreneurs can also access foreign sources of venture capital and related expertise. So, here again, the evidence indicates that it is not limitations on the supply side that are responsible for Canada’s comparatively low level of innovative activity.

The appropriate focus, therefore, is on factors influencing firms’ demand for innovative inputs. In particular, there is a need to understand why Canadian companies are less likely than U.S. firms to adopt strategies that involve a significant commitment of resources to innovative activities? Available international data does not offer much guidance on this issue. The World Economic Forum (WEF) has developed a “company operations and strategy” index that measures the extent to which company strategies and operating practices are oriented towards innovation. In the 2006-2007 WEF report, Canada ranked 18th out of 121 countries on this index

(Chart 8). We placed next to last among the G-7 countries and well behind the United States, which ranked first. These results are broadly consistent with a Statistics Canada survey that suggests Canadian businesses attach greater importance to reducing costs than to developing new products or new production techniques (Chart 9). These findings are instructive, but they are partial and preliminary. They mainly serve to highlight the need for further research into why Canadian firms adopt strategies which lead them to engage in less innovative activity than firms in the United States, and many other advanced economies.

Suggestions for Future Research

There are a number of possible explanations for the relatively low investment of Canadian firms in innovative activities. The potentially influential factors include:

- Firm factors
 - Firm size/scale
 - Managerial skills and experience
- Market factors
 - Market size
 - Industrial structure/regulations
 - Competitive pressure/rivalry
 - Property rights protection
 - Tax/credit structures
 - Foreign ownership/foreign direct investment

Canadian companies differ significantly from firms in the United States and elsewhere with respect to a number of these firm and market characteristics. At present, however, there is only limited evidence on the significance of these factors in explaining differences in innovative activity.

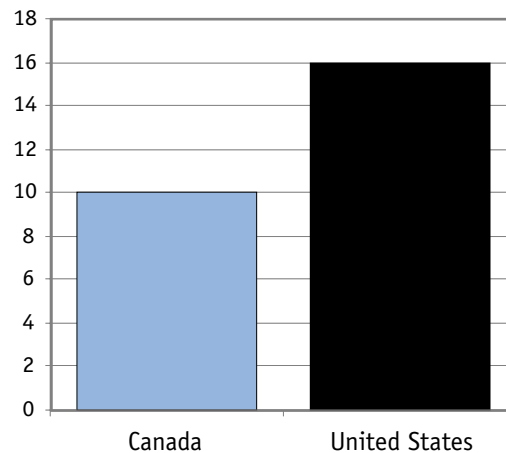
The small size of Canadian firms relative to firms in other countries is often cited as a reason for our comparatively low business expenditures on R&D. However, small firms are no more

prevalent in Canada than the United States. The main difference between the two countries is in the size of the very largest firms; the biggest public companies in Canada are about half the size of the biggest firms in the United States. Size matters when it comes to R&D, but is that the only explanation, or do Canadian firms lag behind in other types of innovative activity and do they also perform poorly relative to U.S. firms of comparable size? Is the different distribution of large Canadian and U.S. firms across sectors another significant factor underlying the disparity in innovative performance?

A potential causal factor that has received attention in a number of reports, including the Annual Reports of Ontario's Institute for Competitiveness & Prosperity, is the different skill level of Canadian and U.S. managers. It is argued that the lower capabilities of Canadian managers lead to less innovation-oriented firm strategies and poorer performance. Differences between Canada and the United States, however, may reflect the lower demand for the services of highly educated managers and business professionals in Canada rather than shortages in supply. This explanation is more consistent with the data showing that there is a net out-migration of highly qualified managers from Canada to the United States. The main focus, therefore, should perhaps be not on promoting increased education, but on increasing the demand for highly qualified managers. For researchers, the questions that need addressing are: how do managerial skills affect the adoption of innovation-based strategies? And, why do firms in Canada hire less-educated, and seemingly less capable, managers than firms in the United States?

Among the market factors in the above list, market size deserves attention, given evidence that there are economies of scale in R&D and that firms with greater output are better able to

Chart 10
Average Shipments per Manufacturing Establishment, 2002
(millions of Canadian dollars)



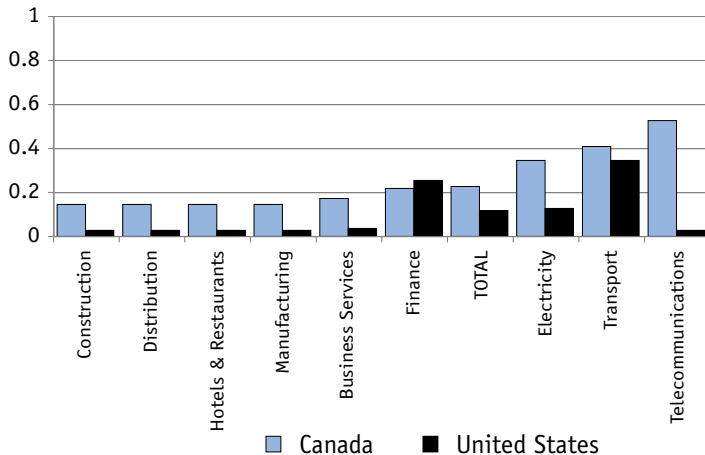
Source: Industry Canada calculation based on Statistics Canada and US census bureau.

cover the significant fixed costs associated with innovation. In 2001, the vast majority (84.7 per cent) of Canadian enterprises served the Canadian market rather than larger export markets. While Canadian manufacturers export a significant portion of their shipments, Canadian shipments per manufacturing plant are still about 40 per cent smaller than that in the United States. (Chart 10).¹² This suggests that North American markets are still not completely integrated and Canadian firms are facing difficulties penetrating the large U.S. market.

The excellent record of Swedish and Finnish firms as innovators suggests that it is not the size of the domestic market that is the crucial factor, at least for tradable goods and services, but access to large export markets. The appropriate research focus, therefore, is on the link between market access and innovative performance. More specifically, there is a need to investigate whether market access problems help explain the size difference between Canadian and U.S.

12 Baldwin, Jarmin and Tang (2004) found that Canada has fewer large manufacturing plants than the United States as a share of both manufacturing output and employment.

Chart 11
Foreign Direct Investment Restrictions by Industry,
Canada and the United States, 2005



Note: The scale of the indicator is 0-1 from no to complete restriction.
 Source: Koyama and Golub (2006).

manufacturing establishments. If Canadian firms do face significant barriers in export markets, we must attempt to understand the nature of these barriers and how can they be addressed.

Another issue that merits examination is the extent to which Canada realizes the potential gains from foreign direct investment. There is considerable evidence showing that multinational enterprises are important vehicles for the diffusion of knowledge and skills across national boundaries. Studies have documented the favourable innovative performance of MNE affiliates in Canada and the contribution foreign-controlled firms make to increasing innovation and improving productivity within Canada. At the same time, however, OECD data indicate that Canada has restrictions on inward foreign direct investment in many sectors that are high by international standards and well above those in the United States (Chart 11).

A related question pertains to the strength of competition within Canada. In markets that are highly competitive, firms are under pressure to adopt more efficient practices and technologies

and to develop new, higher quality products. Competition is also an important part of the dynamic process through which resources are transferred from poorly performing to more innovative and successful firms. In a recent study, Baldwin and Gu (2006), estimate that about 70 per cent of overall labour productivity growth in Canadian manufacturing is due to output reallocations across firms that result from the competitive process.

These findings point to some additional research questions. Are Canadian firms subject to less competitive pressure than firms in the United States and other advanced economies? Can weaknesses in competition account for the relatively limited innovative activity in some sectors of the economy? Is there a causal relation between the comparatively low level of innovation in a number of Canadian industries and the restrictions impeding the flow of foreign direct investment into these sectors?

Conclusion

Productivity growth holds the key to our future economic prosperity and innovation is crucial to productivity growth. Evidence also indicates that there is considerable scope for Canadian firms to upgrade their performance through the implementation of strategies that are more on par with the innovation-oriented approach of companies in the United States and other G-7 countries.

However, there remain important gaps in our understanding of the determinants of productivity growth. Further research is needed to identify the firm and environmental factors that have the most significant influence on business innovation and to determine what actions governments could take to encourage increased investment in innovative activities.

Industry Canada is attempting to address these knowledge gaps in its research program on the “demand for innovation in the business sec-

tor”. In collaboration with other research organizations inside and outside government, the department seeks to achieve a better understanding of how business innovation is conditioned by factors such as:

- The size of markets and the size of firms;
- The intensity of competition in specific industries;
- The regulations that affect the price of inputs and outputs (e.g. electricity prices);
- The way business ownership and industry structures are organized and the technical skills of management.

In coming years, as a result of this and other research initiatives, we will hopefully arrive at an improved understanding of the main factors underlying the poor performance of Canadian firms relative to their U.S. counterparts and of the policy actions that could be taken to help Canadian business become more innovative and productive.

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