Challenges Facing Canada in the Areas of Productivity, Innovation, and Investment[1]

I would like to begin by thanking Allan Gregg for his generous introduction and the Institute for Competitiveness and Prosperity for the invitation to speak today.

The title of this session is human capital, technology, and innovation. Given the great expertise of my co-panelists, the Presidents of McGill University and the University of Waterloo, in the area of human capital, I will focus on technology and innovation. The objective of the presentation is to highlight some of the key stylized facts and challenges in these areas. My presentation will be divided into three parts, focusing first on productivity trends, then on innovation trends, and finally on investment, particularly investment in information and communication technology (ICT).

Productivity

The importance of productivity for the future growth of living standards, defined as GDP per capita, is becoming increasingly recognized. With 1 per cent annual productivity growth, real income takes 72 years to double. With 2 per cent, real income doubles in 36 years and with 3 per cent 24 years. Productivity growth really is our economic destiny. But the Achilles heel of Canadian economic performance in recent years has been weak productivity growth, a disconcerting development.

Earlier today Statistics Canada released estimates of labour productivity for Canada for 2005. These numbers are found in Chart 1.The goods news is that business sector output per hour, the most widely used measure of aggregate labour productivity performance, advanced at 1.1 per cent in 2005, up from -0.4 per cent in 2004 and 0 in 2003. At least we have returned to a path of positive labour productivity growth.

The bad news is our labour productivity growth performance in 2005, and more generally since 2000, has been well below that recorded during the second half of the 1990s, and below that of the recent performance in the United States. From 1996 to 2000 business sector output per hour advanced at a 2.9 per cent average annual rate in this country, well above the 1.1 per cent increase in 2005 and the 0.7 per cent average annual rate between 2000 and 2005. Equally, the 2.7 per cent rise recorded for US business sector output per hour growth in 2005 was more than double that in Canada, while the 3.4 per cent average annual rate of increase over the 2000-05 period was nearly five times that in this country.

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[1] Presentation by Andrew Sharpe, Executive Director, Centre for the Study of Living Standards to the panel session "Human Capital, Technology, and Innovation" at the Conference on Canada's Competitiveness and Prosperity, organized by the Institute for Competitiveness and Prosperity, Ottawa, Ontario, March 10, 2006.

The same patterns are found for labour productivity growth at the total economy level (Chart 2), although our performance is slightly better since 2000 both in absolute terms and relative to the United States because of our superior productivity performance in the non-business sector. However, this may be a productivity measurement issue and not indicative of stronger productivity growth in Canada's health, education and public administration sectors.

The shortfall in labour productivity growth in Canada since 2000 relative to the United States has resulted in a precipitous decline in our relative productivity level (Chart 3). Based on an Industry Canada relative productivity benchmark of 82 per cent in 1999 (Rao, Tang, and Wang, 2004), output per hour in the business sector is estimated to have been only 72.3 per cent of its US counterpart in 2005, down from 82.4 per cent in 2000. In other words, the Canada-US business sector labour productivity gap rose 10 percentage points to 27.7 percentage points from 17.6 points in the space of only five years. While other productivity benchmarks may give different relative productivity levels, all show the same downward trend.

Why has Canada experienced such dismal labour productivity growth since 2000? Unfortunately, like many productivity developments, there is no definitive answer to this puzzle. But it appear that the post-2000 labour productivity slowdown is due in part to slower rates of capital investment and higher commodity prices.

A key driver of labour productivity growth is the capital intensity of production, as manifested by the capital-labour ratio. The rate of growth of the capital-labour ratio, particularly for ICT capital, was much weaker after 2000 than in the second half of the 1990s. The relative price of labour and capital influence trends in the capital-labour ratio. The relatively weak increase in the price of labour in Canada since 2000 (2.1 per cent per year for nominal hourly labour compensation in the business sector), relative to that experienced during the 1996-2000 period (4.0 per cent) in Canada and since 2000 in the United States (4.4 per cent), may in part account for this weakness in capital-labour growth.

High commodity prices can reduce labour productivity growth in the natural resource industry (and by consequent in the aggregate economy) by the providing firms with an economic incentive to expand production to less productive, high cost deposits. Because of the relative price increase in natural resources, the current dollar value added per hour in the natural resource sector increases, even though the productivity growth, defined in terms of constant dollar or physical output per hour worked, falls. Rao, Sharpe, and Smith (2005) find that more than one quarter (28.6 per cent) of the fall in labour productivity growth in Canada between 1997-2000 and 2000-2004 was accounted for by the mining and oil and gas sector.

It should be noted that in terms of the impact on the real income of Canadians, the negative productivity growth effect of higher commodity prices is offset by the improved terms of trade related to the higher commodity prices. In addition to productivity growth, improved terms of trade can make significant contributions to real income growth, at

least in the short run. Indeed, real GDP per capita growth in Canada, at 1.5 per cent per year since 2000, has exceeded labour productivity growth largely because of improved terms of trade. However, it is unlikely that improved terms of trade are sustainable in the long run.

It is also important to note that there may be a silver lining to the growing Canada-US productivity gap to the degree it is driven by the acceleration of productivity growth in the United States. This country is on the world frontier in most technologies and the very strong productivity growth implies that the technological frontier is rapidly moving out. With the appropriate economic environment, productivity levels in developed countries have the potential in the long run to converge toward that of the world leader. If the productivity level of the leader increases, there are greater potential gains from convergence.

Innovation

Innovation in Canadian industry can take the form of the creation of new production processes and products by the firm itself through research and development (R&D) or the adoption by the firm of new production processes and products developed by others in Canada or abroad.

Only a very small proportion of Canadian firms undertake R&D, around 2,000. Consequently, for the vast majority of firms, it is the adoption of best practice techniques that is the basis of their innovation effort, even though innovation policy in this country has largely focused on R&D performance.

Canada has greatly improved its R&D performance since the 1970s. Chart 4 shows that total R&D intensity, defined as R&D expenditures as a share of GDP, doubled in Canada from 1.04 per cent in 1976 to a peak of 2.09 per cent in 2001, before falling off somewhat to 1.92 per cent in 2005. This increase was largely driven by business sector R&D, which more than tripled from 0.38 per cent of GDP in 1976 to a peak of 1.29 per cent in 2001, before falling with the high tech crash to 1.01 per cent in 2005. In the last eight years, R&D intensity in the higher education sector has nearly doubled, rising from 0.44 per cent of GDP in 1977 to 0.72 per cent in 2005. This development reflects major federal government initiatives to fund university research. Indeed, Canada likely has the highest ratio of higher education R&D to business sector R&D in the world (0.71). In contrast to the upward trend in R&D performed by both the business sector and higher education sector, R&D performed by government has fallen in relative importance, from 0.44 per cent of GDP in 1971 to 0.18 per cent in 2005.

From an international perspective, Canada's R&D performance is slightly below average. In 2004, Canada ranked fifth in the G-8 in terms of R&D intensity, behind Japan, the United States, Germany, and France, but ahead of the United Kingdom, the Russian Federation, and Italy (Chart 5). Many small OECD countries (Sweden, Finland, Iceland, Korea, Denmark, Austria) and some small non-OECD countries (Israel, Taiwan, and Singapore) also have higher R&D intensity than Canada (Chart 6). Two factors that

have historically contributed to Canada's below average R&D intensity have been the high degree of foreign ownership and the relatively small size of R&D-intensive industries.

One lesser known stylized fact about R&D spending in this country is its strong concentration in central Canada. Indeed, in 2003 Ontario and Quebec, while responsible for 61 per cent of Canada's nominal GDP, accounted for 73 per cent of Canada's R&D spending (up from 55 per cent in 1971). Quebec had the highest R&D intensity of any province at 2.70 per cent of GDP (Chart 7), comparable to that of the United States and not far behind Sweden and Finland. Ontario was second at 2.16 per cent. The third ranking province, well behind the two frontrunners, was, perhaps surprisingly, Nova Scotia (1.42 per cent), followed by British Columbia and Manitoba. Alberta ranked a poor seventh at 1.07 per cent. A similar pattern emerges for business sector R&D intensity by province (Chart 8), with business sector R&D spending in Atlantic Canada particularly weak.

Quebec's strong R&D performance reflects two factors: an industrial structure characterized by a large concentration of the very R&D-intensive pharmaceuticals and aerospace industries, and very favourable provincial tax treatment of R&D expenditures. Quebec has shown that very generous R&D tax incentives can stimulate business sector R&D spending, although the cost effectiveness of such programs is not always evident.

At $25.3 billion Canadian dollars in 2005, Canada accounts for less than 3 per cent of the world expenditure on R&D. This share will undoubtedly fall in the future as developing countries such as China and India devote more resources to R&D. The federal government, through its Scientific Research and Experimental Development (SR&ED) tax incentive program, provides one of the most generous tax regimes in the world for R&D spending and this program has contributed to the growth of business sector R&D spending. But the issue is whether the federal government and the provincial governments have the appropriate balance between support for R&D and support for the adoption of best practices. Indeed, a case could be made that a rebalancing on the margin between government subsidies for business sector R&D and government programs (such as the Industrial Research Assistance Program (IRAP) run by the National Research Council) that promote the diffusion of best practices would foster a greater degree of innovation in this country.

ICT investment

Information and communication technology (ICT) investment is defined to include investment in computers, communications equipment, and software (in turn composed of pre-packaged, customized and own account software). It is now well recognized that ICT investment is a key driver of productivity growth. Indeed, the acceleration of labour productivity growth in both Canada and the United States in the second half of the 1990s is directly related to the very strong ICT investment of the period.

In discussion of ICT investment trends, it is very important to distinguish between growth expressed in current dollars and that expressed in constant dollars or real terms because of the falling prices of ICT investment goods. According to Statistics Canada estimates, real ICT business sector investment grew at a very impressive 13.4 per cent average annual growth rate between 1987 and 2005 (Chart 9). But much of this growth reflected a 6.0 per cent average annual fall in the prices of ICT investment goods, due largely to quality improvements in computers. Current dollar ICT investment advanced at a more modest 6.6 per cent average annual pace over the period.

The decline in the price of computers (-14.2 per cent per year) was much greater that that for the other two ICT components: communications equipment (-0.9 per cent) and software (-2.6 per cent). Consequently, the increase in real computer investment (22.0 per cent per year) greatly outstripped that of communications equipment (6.8 per cent) and software (12.0 per cent). But in nominal or current dollar terms, computer investment growth was weaker than that of both communications equipment (5.8 per cent) and software (9.2 per cent).

Perhaps surprisingly, the share of current dollar ICT investment in GDP has not greatly increased over time, rising only 0.55 percentage points from 2.10 per cent in 1987 to 2.65 per cent in 2005, and all this rise was due to the greater investment share for software (Chart 10). Of course, measured on a constant dollar basis, the ICT investment/GDP share has risen dramatically. But current dollar shares are a more appropriate metric to gauge the amount of resources that are devoted to ICT investment as they reflect the current relative price structure.

While ICT investment in Canada has certainly grown, it has not kept pace with that in the United States. This has resulted in a decline in the ICT investment share in Canada relative to that in the United States. Chart 11 shows that business sector ICT investment as a share of GDP in Canada as a proportion of the United States fell from 74.0 per cent in 1987 to 66.1 per cent in 2004.

The shortfall in ICT investment between Canada and the United Sates reflects all three ICT components (Chart 12). In 2004, ICT per investment per worker in Canada was 48.4 per cent of that of the United States. For computers it was 57.0 per cent, for communications equipment 55.4 per cent, and for software 40.9 per cent. It is interesting to note that Canada's business sector ICT investment as a share of GDP, as a proportion of the United States, is very similar to the for ICT investment as a share of total investment. This shows that Canada's ICT shortfall does not reflect a shortfall of overall business sector investment, but rather a smaller proportion of total investment devoted to ICT investment.

Canada's ICT shortfall with the United States manifests itself at the industry level (Chart 13). For 16 industries, 13 have lower ICT investment per worker in Canada than in the United States (Chart 13). It is interesting to note the very large differences in ICT use between industries. The low levels of ICT per worker in such industries as accommodation and food services; agriculture, forestry, fishing and hunting; health care

and social assistance; and retail trade suggest that significant productivity gains may obtain from the appropriate introduction of ICT.

The reasons for the lower ICT investment in the Canada than in the United States are still poorly understood. In a recent analysis of this situation, Sharpe (2005) identified the following factors as contributing to the gap.

- Under-measurement of ICT investment in Canada due to lack of information on ICT investment in certain industries such as mining (this problem appears to have been recently resolved).

- Canada's industrial structure where ICT-intensive industries such as finance and insurance are somewhat less important than in the United States.

- The greater importance of small and medium size firms in Canada, as these firms invest considerably less in ICT than large firms.

- The lower level of formal educational attainment of Canadian managers relative to their US counterparts, as ICT introduction is positively associated with the level of education of managers.

- The lower cost of labour in Canada, giving firms less economic incentive to substitute ICT capital for labour.

- the high marginal effective tax rate (METR) on ICT assets in Canada, which discourages ICT investment. Finance Canada estimates that the METR on ICT investment in 2005 was 47 per cent, compared to 32 per cent for non-ICT machinery and equipment (Chart 14). This wedge between tax rates on different assets reflects the imposition of the PST on investment goods in certain provinces (Ontario and British Columbia because of their size are the most important). This PST cost-augmenting effect is much greater for short-lived assets like ICT than long-lived assets.

Conclusion

I would like to conclude by reiterating three key points made in the presentation.

First, given its importance for future real income growth, Canada should make productivity growth a top national priority. We should focus on gaining a better understanding of productivity trends and determinants and the development of effective policy to increase productivity growth.

Jeffrey Simpson had it right in his column earlier this week when he recommended the formation of a Royal Commission to help "define the productivity challenge" (Simpson, 2006). The rate of return on such public policy research can be astounding. Nominal GDP in Canada is around $1.2 trillion. Assume that a Royal

Commission on Productivity Performance costing $12 million through its recommendations could increase labour productivity growth by a very conservative 0.1 percentage points per year over a ten year period. Nominal GDP would be $1.2 billion per year higher and over ten years, the economy would have generated an additional $12 billion in GDP. A GDP increase of $12 billion for an investment of $12 million!

Second, governments in Canada should rebalance their approach to innovation by putting more emphasis on the adoption of best practice technologies by all firms and less on the performance of R&D. Given the current high levels of government support for R&D in this country, the marginal program dollar will likely have a greater impact on innovation if allocated to programs that promote the diffusion of world class technologies and their adoption by all Canadian firms, particularly small and medium sized enterprises than to subsidize R&D spending.

Third, given the importance of ICT investment for productivity growth, governments in Canada should work towards reducing the marginal effective tax rate on ICT assets by dropping the provincial sales tax on the purchase on investment goods. This argument is particularly relevant in Ontario and British Columbia, the two largest provinces that continue to impose the PST on investment goods.

References

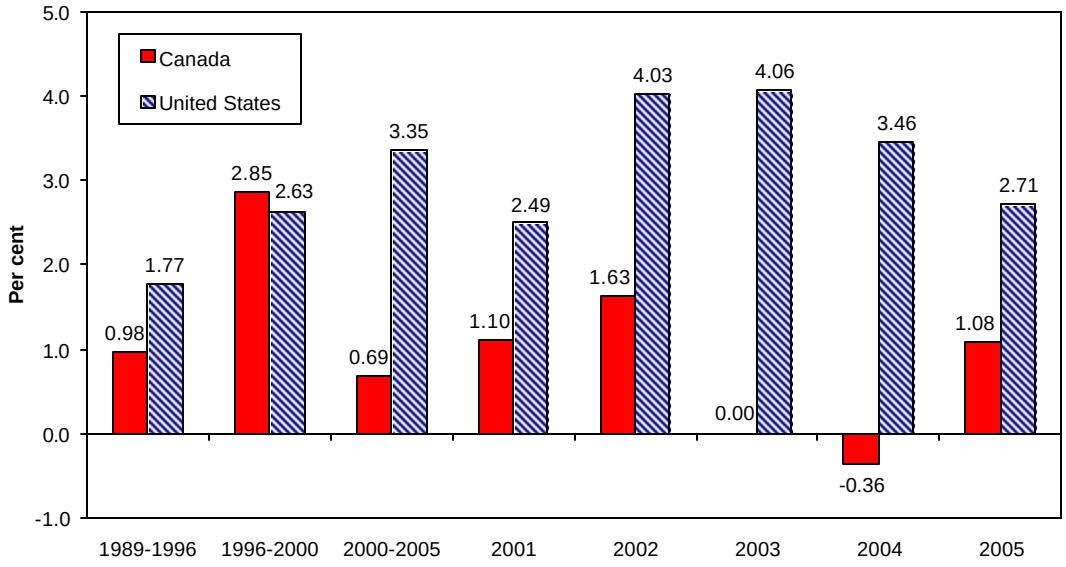
Rao, Someshwar, Jianmin Tang and Weimin Wang (2004) "Measuring thee Canada-US Productivity Gap: Industry Dimensions," *International Productivity Monitor*, Number Nine, Fall, pp. 3-14.

Rao, Someshwar, Andrew Sharpe and Jeremy Smith (2005) "An Analysis of the Labour Productivity Growth Slowdown in Canada Since 2000," *International Productivity Monitor*, Number Ten, Spring, pp. 3-23.

Sharpe, Andrew (2005) "What Explains the Canada-US ICT Investment Gap?" *International Productivity Monitor*, Number Eleven, Fall, pp. 21-38

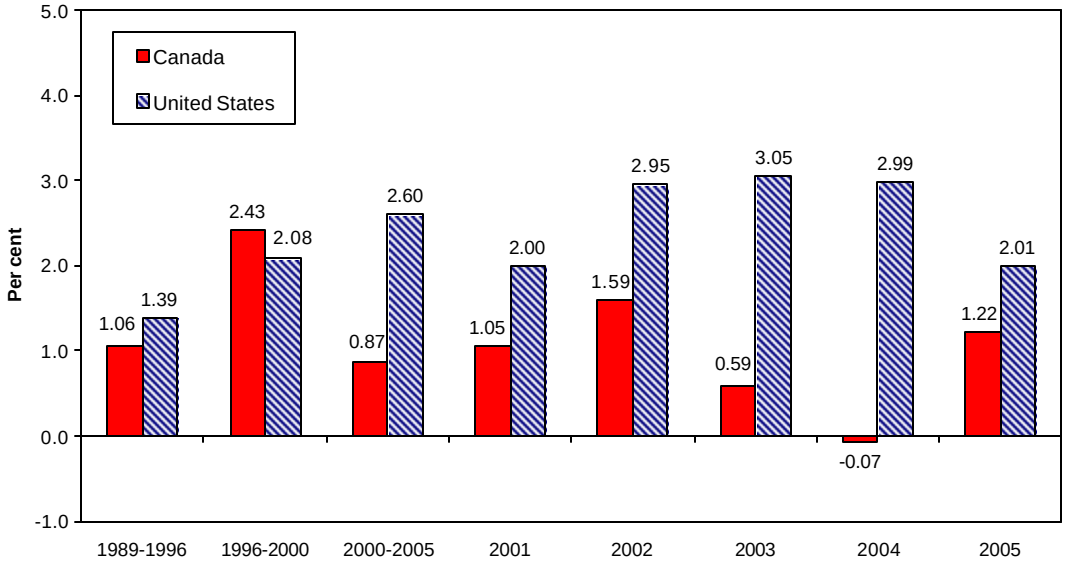
Simpson, Jeffrey (2006) "Why Harper Picked Lynch as Clerk of the Privy Council," *Globe and Mail*, March 8, Page A13.

Chart 1: Business Sector Output per Hour Growth in Canada and the United States (average annual and annual rates of change, per cent)



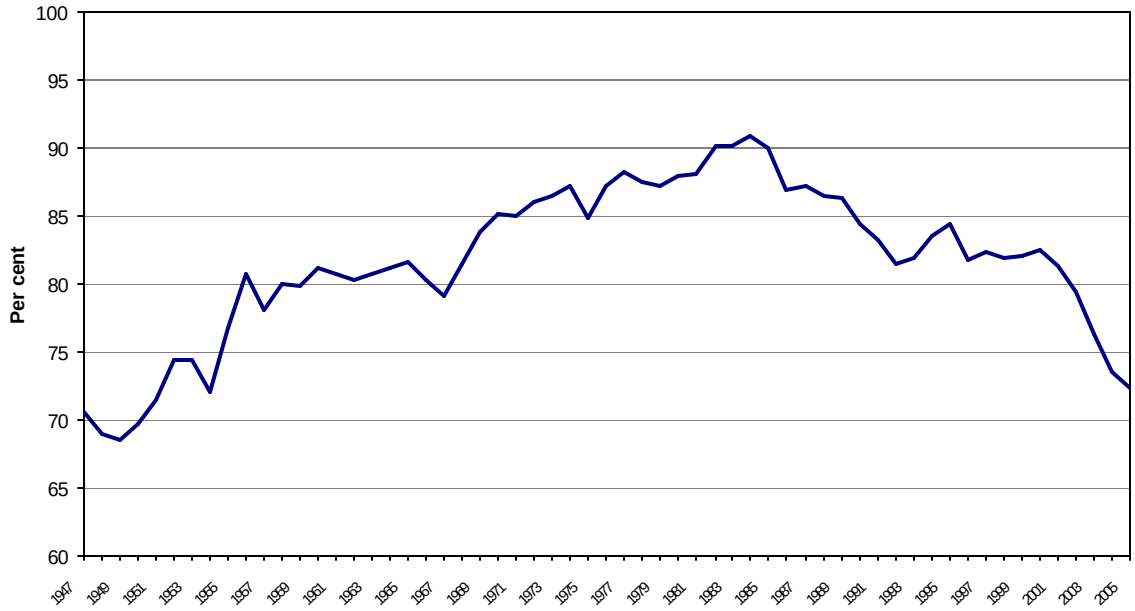
Sources: Statistics Canada and US Bureau of Labor Statistics.

Chart 2: Total Economy Output per Hour Growth in Canada and the United States (average annual and annual rates of change, per cent)



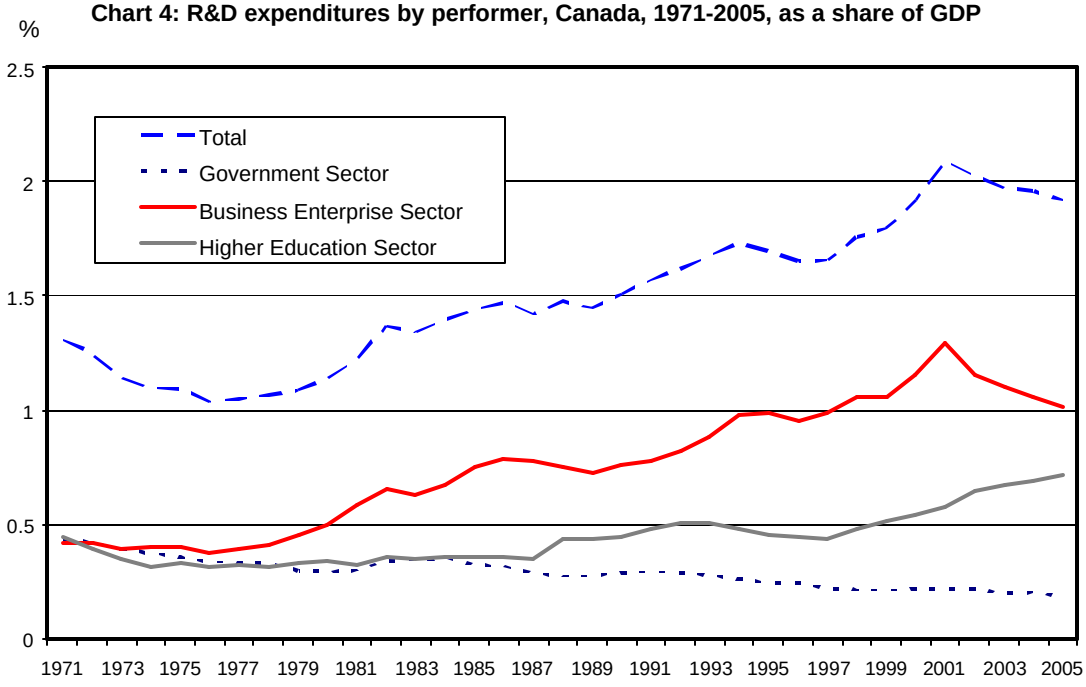
Sources: Statistics Canada and US Bureau of Labor Statistics.

Chart 3: Output per Hour in the Business Sector in Canada as a percentage of the U.S. Level, 1947-2005



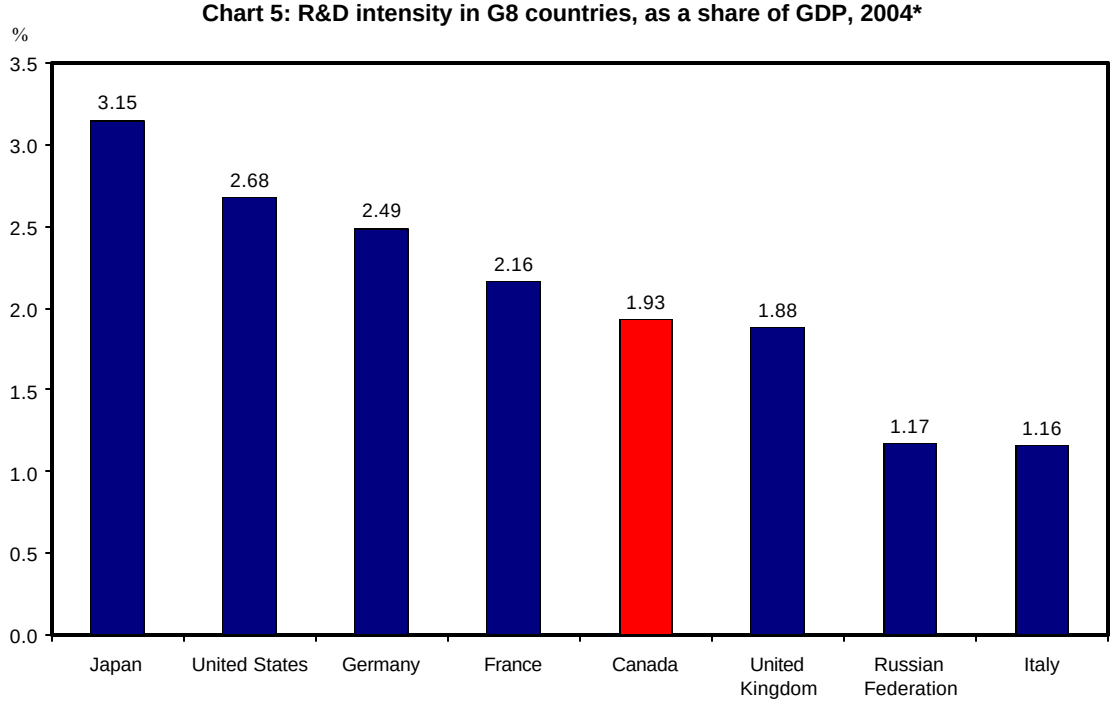
Sources: Centre for the Study of Living Standards based on Statistics Canada US Bureau of Labor Statistics data.

Chart 4: R&D expenditures by performer, Canada, 1971-2005, as a share of GDP



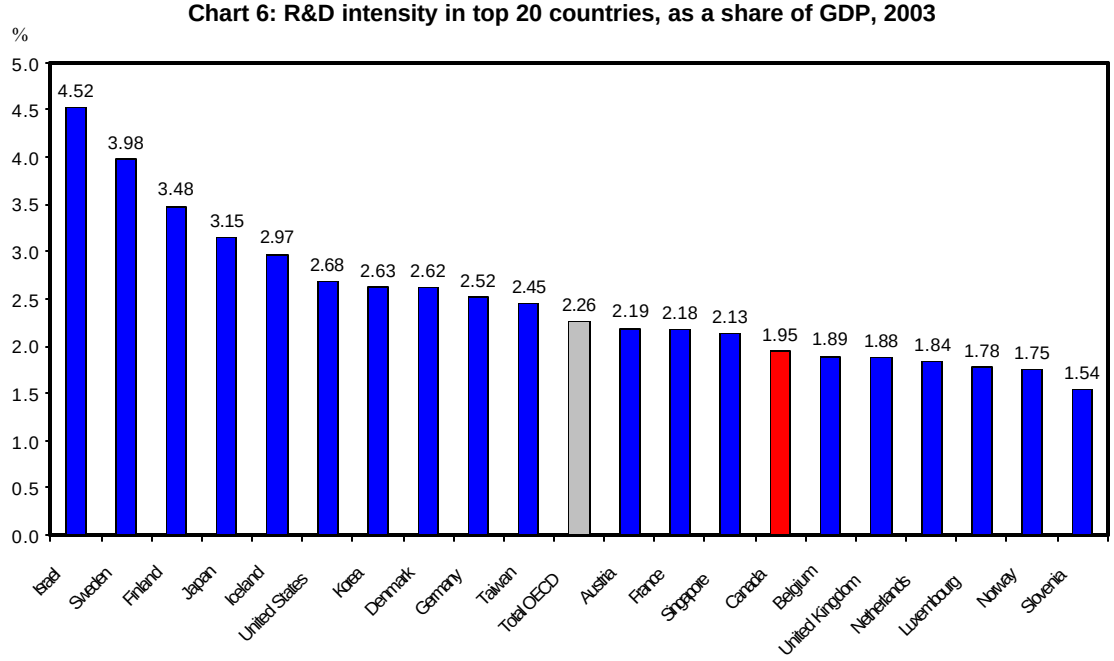
Note: Includes all sectors of funders and all sectors of performers and includes the natural sciences and engineering, social sciences and humanities.

Chart 5: R&D intensity in G8 countries, as a share of GDP, 2004*



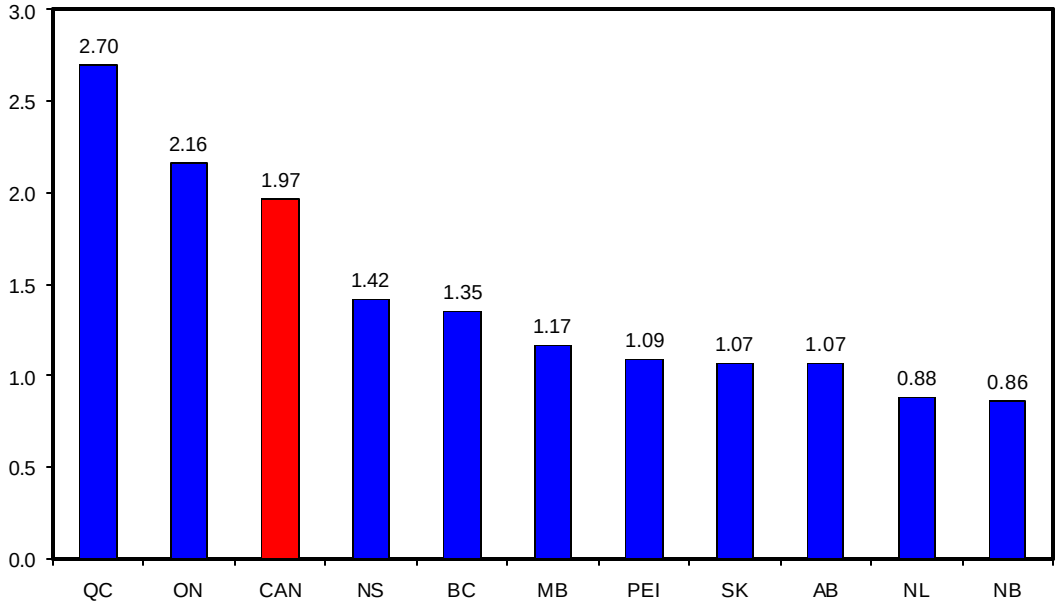
Source : OECD, Science and Technology database.
*2002 for Italy, 2003 for UK and Japan

Chart 6: R&D intensity in top 20 countries, as a share of GDP, 2003



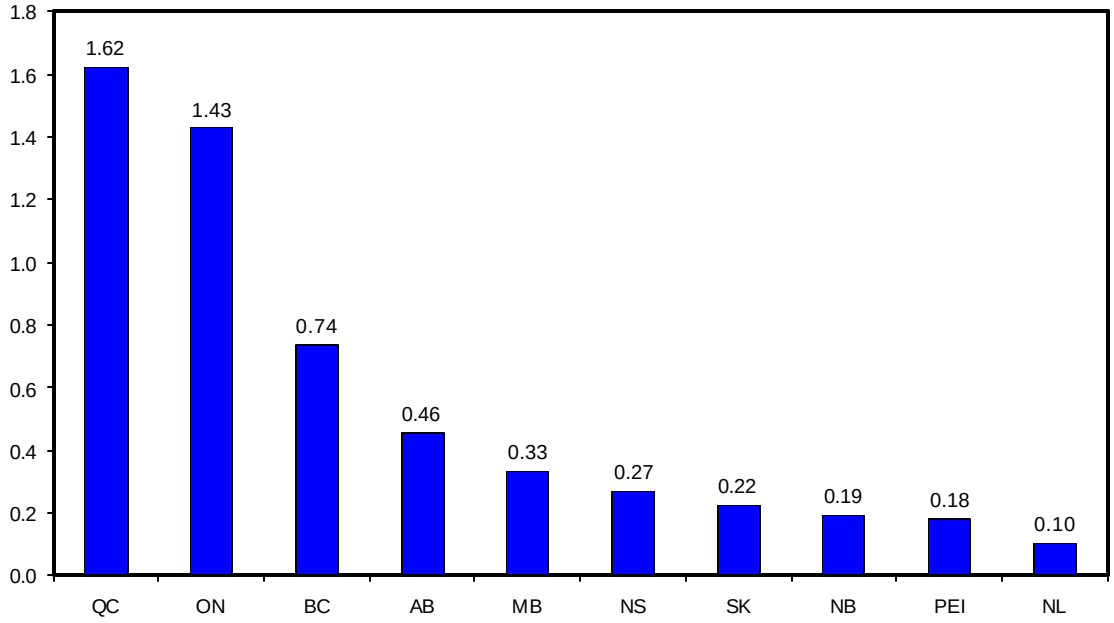
Source : OECD, Science and Technology database, based on the 37 countries for which data were available in 2003.

Chart 7: R&D intensity by province, 2003, as a share of GDP



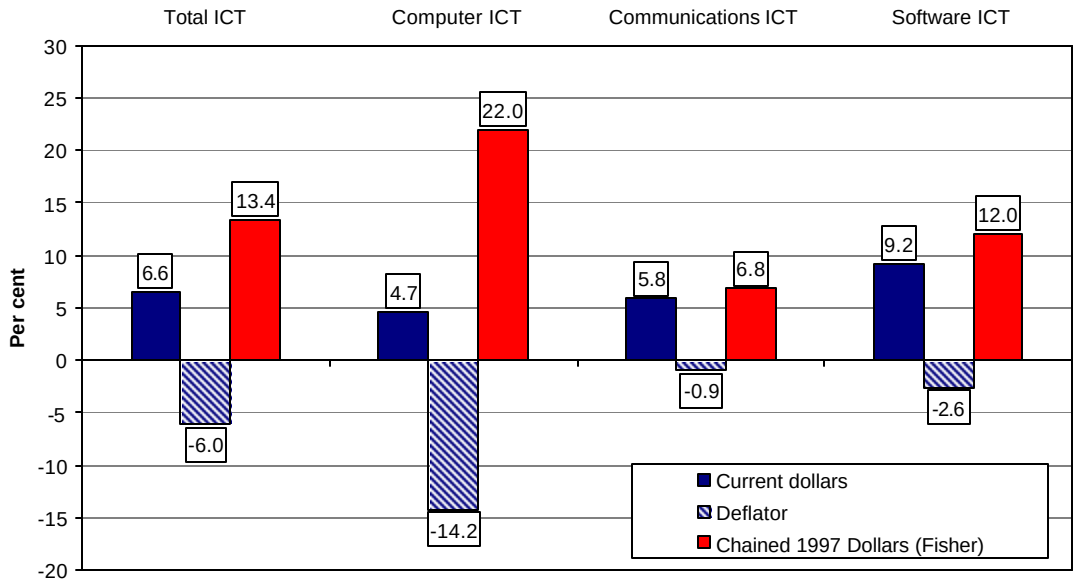
Note 1: Data for Quebec and Ontario exclude the cities of the National Capital Region
Note 2: Includes all sectors of funders and all sectors of performers and includes the natural sciences and engineering, social sciences and humanities.

Chart 8: R&D intensity for business enterprises by province, 2003, as a share of GDP



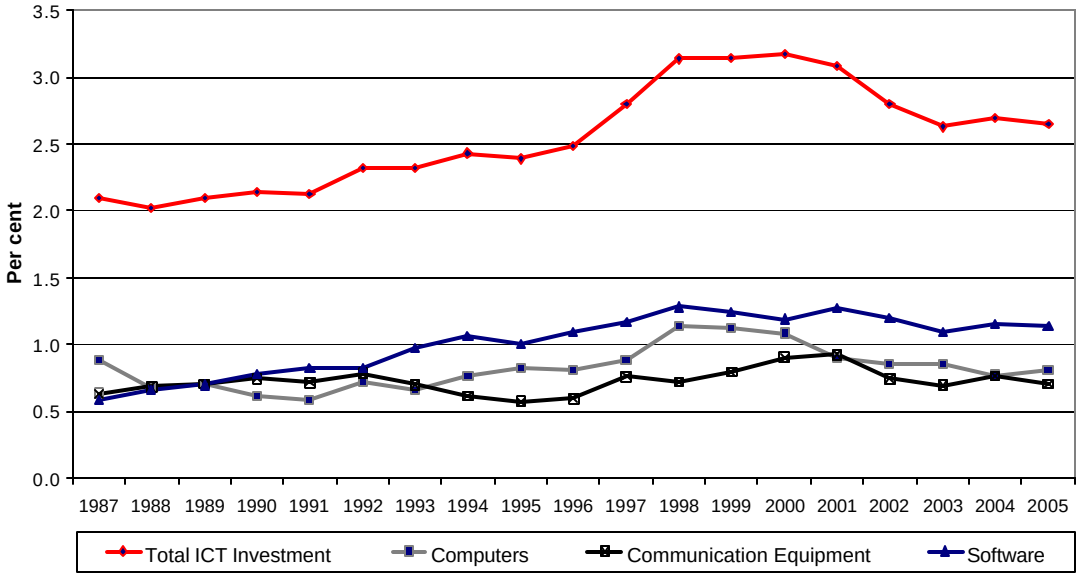
Note 1: Data for Quebec and Ontario exclude the cities of the National Capital Region
Note 2: Includes all sectors of funders and business enterprise performers, and includes the natural sciences and engineering, social sciences and humanities.

Chart 9: ICT Investment by Component, Average Annual Rate of Change, Business Sector, Canada, per cent, 1987-2005



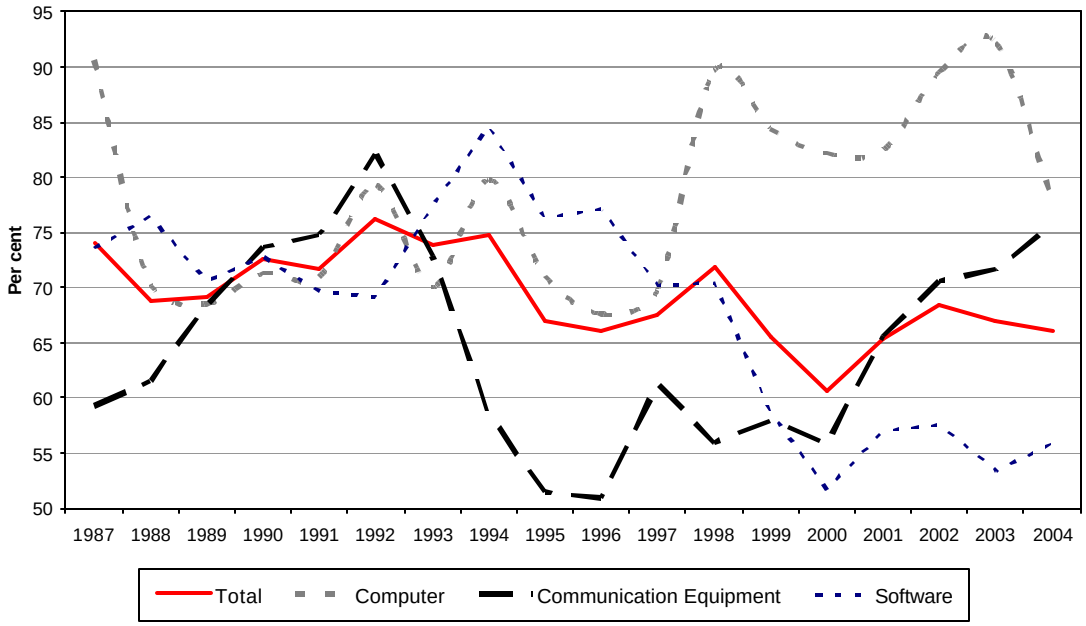
Source: Centre for the Study of Living Standards, based on Statistics Canada data.

Chart 10: Business Sector ICT Investment as a Share of Business Sector GDP, Canada, current dollars, per cent, 1987-2005



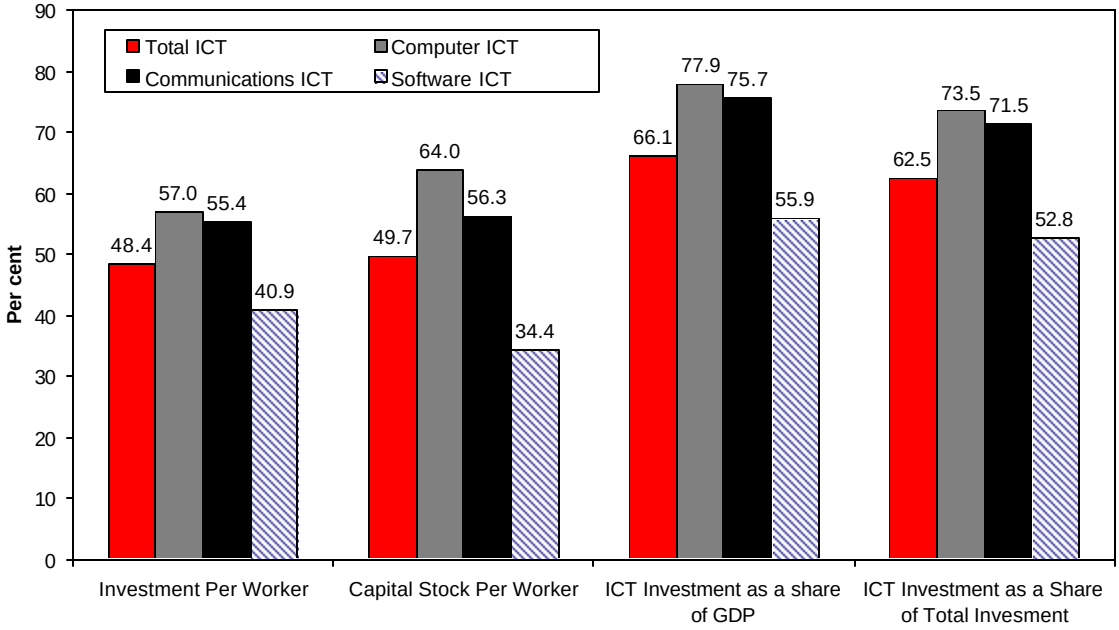
Source: Centre for the Study of Living Standards, based on Statistics Canada data.

Chart 11: ICT Investment as a Share of GDP in the Business Sector in Canada, as a Proportion of the United States, per cent, 1987-2004



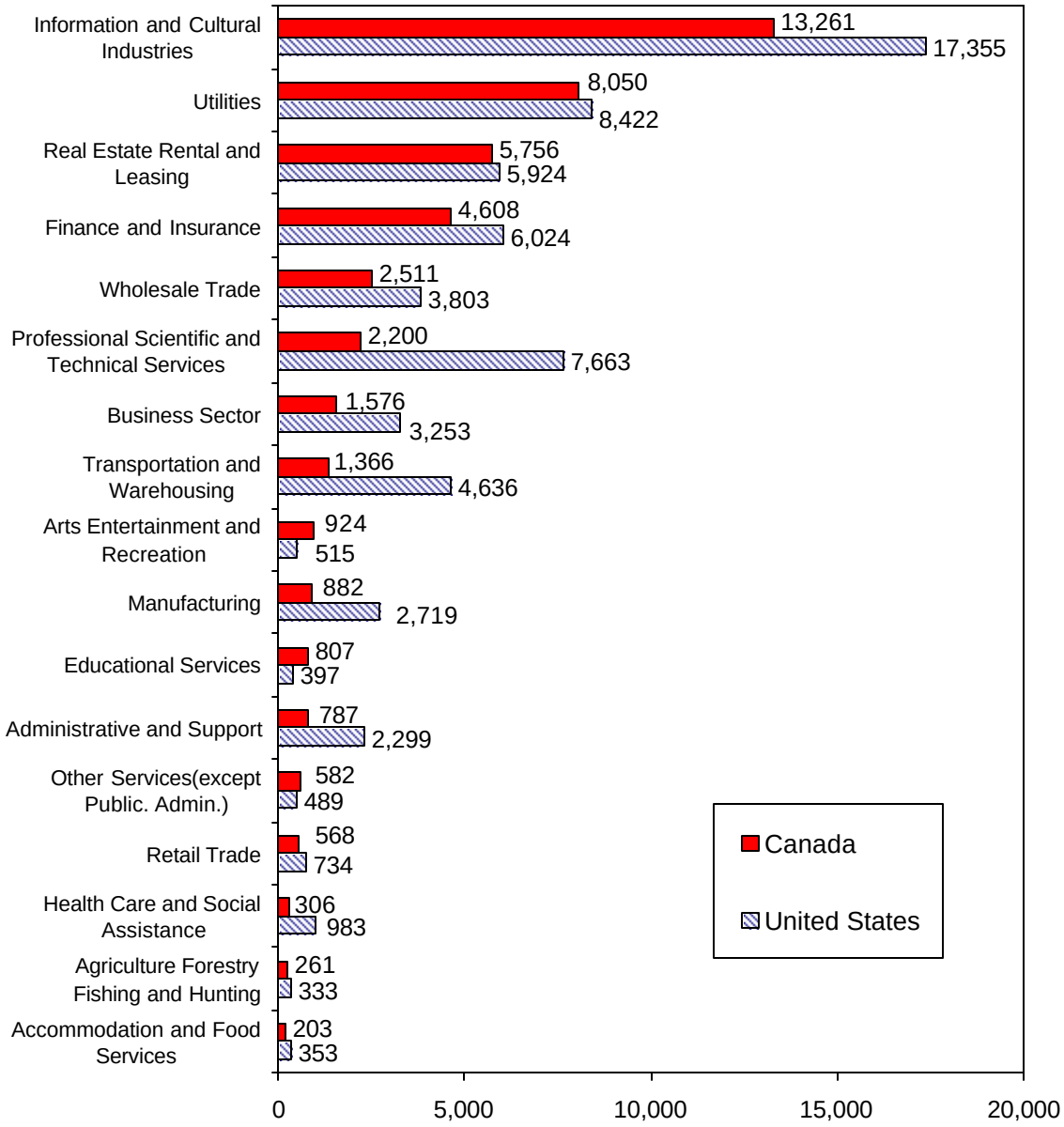
Source: Centre for the Study of Living Standards, based on Statistics Canada and US Bureau of Economic Analysis data.

Chart 12: The Canada-US ICT Gap in the Business Sector , Canada as a Percentage of the United States, 2004



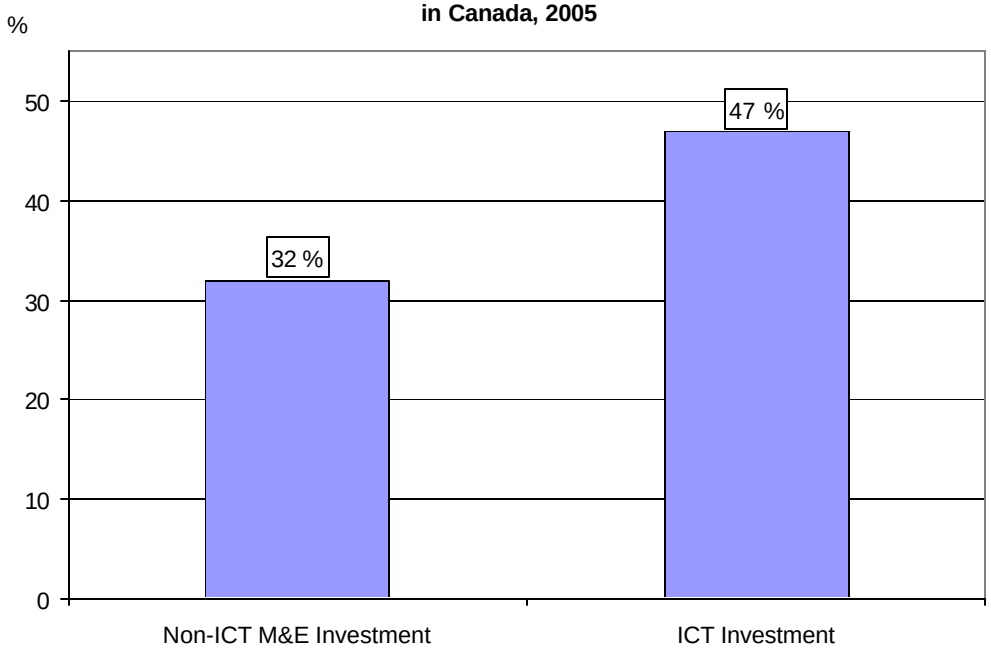
Source: Centre for the Study of Living Standards based on Statistics Canada, US Bureau of Labor Statistics and US Bureau of Economic Analysis.

Chart 13: Total ICT Investment Per Worker by Industry in Canada and the United States, current US dollars, 2004



Source: Centre for the Study of Living Standards based on Statistics Canada, US Bureau of Labor Statistics and US Bureau of Economic Analysis.

Chart 14: Marginal Effective Tax Rate for ICT Investment and non-ICT M&E Investment in Canada, 2005



Source: Finance Canada.