What Explains the Canada-US ICT Investment Gap?

Andrew Sharpe[1]
Centre for the Study of Living Standards

IT IS WIDELY RECOGNIZED that machinery and equipment (M&E) investment intensity is lower in Canada than in the United States (Sharpe, 2004). Indeed, the Minister of Industry highlighted this fact in a recent speech.[2] What is less well known is that it is the information and communications technology (ICT) component of M&E investment that largely accounts for the M&E investment gap. The objective of this article is to shed light on the factors that account for this gap in ICT investment between Canada and the United States.

Given the disappearance of labour productivity growth in the business sector in Canada in 2003 and 2004 (Rao, Sharpe and Smith, 2005) and the large gap in labour productivity levels between Canada and the United States,[3] lagging ICT investment has been identified as a possible cause of both this weak growth and large gap. Indeed, a recent study (Fuss and Waverman, 2005:42) estimates that the lower ICT capital stock intensity accounted for 56 per cent of the Canada-US labour productivity gap in 2003.[4]

In addition, higher rates of ICT adoption have been pointed to as means of improving Canada's productivity performance. An understanding of the causes of the Canada-US ICT investment gap is thus crucial for the correct diagnosis of Canada's productivity problem and the development of effective policies

1 This is an abridged version of a study prepared by the Centre for the Study of Living Standards (CSLS) for the Information Technology Association of Canada (ITAC) and its consortium of funders (Bell Canada, Hewlett Packard, Industry Canada, Intel, Microsoft, Nortel, and SAP Canada). The study is posted at www.csls.ca under reports. The CSLS would like to thank Lynda Leonard and Bernard Courtois from ITAC for their support of this project. The CSLS would like to thank the following people for their assistance in the preparation of the report: Richard Landry, Mychèle Gagnon, Gilbert Paquette, Michel Pascal, and John Foley of Statistics Canada; David Wasshausen from the US Bureau of Economic Analysis; and Gabriel Verret from the University of Ottawa and the following persons for useful comments: Lynda Leonard and Bernard Courtois from ITAC, Frank Lee, John Lester and Benoit Robidoux from Finance Canada, Richard Dion from the Bank of Canada and members of the consortium of funders. Jean-Francois Arsenault, Elad Gafni, Peter Harrison, and Sharon Qiao contributed to the study. Email: andrew.sharpe@csls.ca

2 "As a proportion of GDP Canadian firms invest less in new machinery and equipment than their counterparts in any G7 country. We know that machinery and equipment investment is key to driving new technology deep into the economy, and we're falling short… Investments in, and applications of, information and communications technologies are a major source of productivity improvements. But here again, we're still falling short of the U.S." speech by the Honourable David L. Emerson, Minister of Industry to the Canadian Club, Ottawa, Ontario, November 3, 2005.

3 Accounting to the OECD (2005: Annex Table 2), business sector output per hour in Canada in 2004 was 76 percent of the US level, a gap of 24 percentage points. Canada in 2004 ranked 17th out of 30 OECD counties in terms of labour productivity levels, down from third in 1950 and fifth in 1973.

4 Fuss and Waverman break down the 56 per cent contribution for 2003 into 12 per cent from capital deepening and 44 per cent from ICT spillovers. The spillovers are in turn disaggregated into 2 per cent from telecom penetration and 42 per cent from IT penetration. The IT penetration is further disaggregated into 31 per cent from PC penetration (computers per capita) and 11 per cent from digital/PC interaction. Similar results were obtained for 2000, although the overall ICT contribution to the productivity gap that year was somewhat higher at 60 per cent.

Table 1

ICT Investment by Component, Average Annual Growth Rate in the Business Sector in Canada and the United States, 1987-2004, current dollars

(per cent)

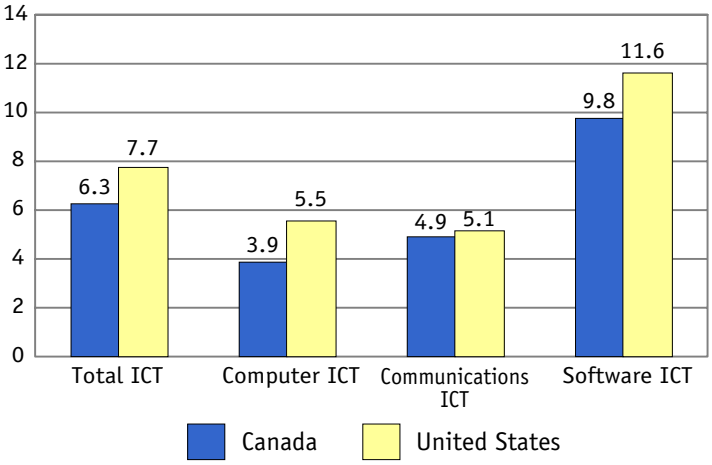
	Total ICT		Computer ICT		Communications ICT		Software ICT	
	Canada	United States	Canada	United States	Canada	United States	Canada	United States
1987-2004	6.26	7.72	3.86	5.53	4.90	5.12	9.76	11.59
1987-1995	6.13	8.76	3.46	7.84	3.13	6.22	11.75	12.54
1995-2000	13.07	14.55	13.20	9.09	17.11	14.34	10.60	18.76
2000-2004	-1.45	-2.15	-5.99	-3.05	-5.41	-7.31	4.88	1.51

Source: CSLS ICT Database, Tables S9-S12.

Chart 1

ICT Investment by Component, Average Annual Growth in the Business Sector in Canada and the United States, 1987-2004, current dollars

(per cent)



Source: CSLS ICT Database, Tables S9-S12.

to reverse this situation and reduce the Canada-US productivity gap.

While research has been conducted on differences in ICT capital growth between Canada and the United States up to 2000 (see the studies in Jorgenson, 2004), there has been much less research on the factors behind lower ICT intensity in Canada.

This article is divided into two main parts. The first part provides an overview of trends in ICT investment in Canada, relative to the United States. The second part discusses possible causes of the Canada-US ICT investment gap, examining potential differences in statistical and methodological methods, economic structure, relative costs and prices, and managerial attitudes and culture, and framework variables.

An Overview of ICT Investment Trends

The article focuses on the business sector, not the total economy and on ICT investment intensity, not capital stock intensity.[5] Non-residential business sector investment is divided into structures and machinery and equipment (M&E), with the latter sub-divided into ICT and non-ICT M&E. ICT has three components: computers, communication equipment, and software.[6]

5 Since it is investment flows that determine the capital stock, trends in Canada-US ICT capital stock intensity are similar to the ICT investment intensity. In addition, different depreciation rates and patterns and service life assumptions used in the estimation of the capital stock between Canada and the United States may account for differences in capital intensity between the two countries.

6 Software is in turn sub-divided into off-the-shelf or prepackaged, customized and own account versions. It should be noted that software until recently was not part of fixed investment as defined by the national accounts. While firms continue to expense software, it is now considered a capital asset from the point of view of the official investment estimates prepared by statistical agencies because of the enlargement of the definition of investment to encompass software.

There are two measures of investment intensity: investment per worker and investment as a share of GDP. Both will be used in this article. While the former is easier to understand, the latter is more relevant for international comparisons because it is not affected by a country's productivity and real income per capita level. Rich countries have much higher levels of investment per worker than poor counties, but may not have a higher share of investment in GDP. ICT investment as a share of GDP is determined by both the overall share of investment in GDP and the share of ICT in total investment. A country might have a low level of ICT investment in GDP, because it fails to invest in all types of investment goods, or because it devotes a lower proportion of its total investment to ICT.

Trends in ICT Investment, Canada and the United States, 1987-2004

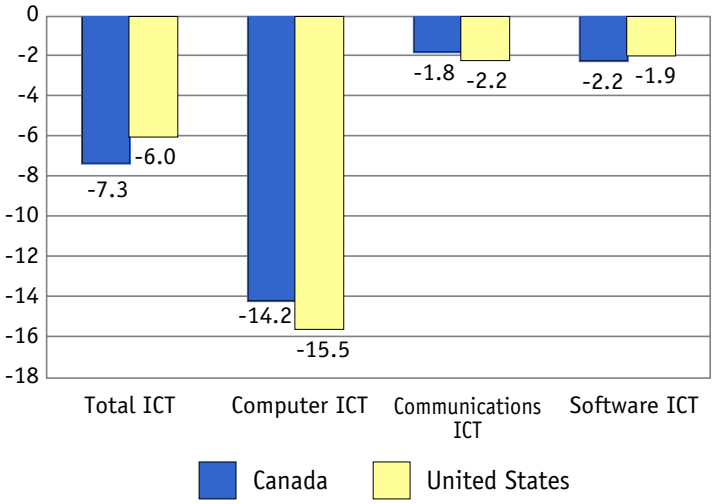
Trends in Current-Dollar ICT Investment

Over the 1987-2004 period ICT investment in current dollars, that is, not adjusted for quality and price change, advanced at a 6.3 per cent average annual rate in the Canadian business sector, below the 7.7 per cent rate in the US business sector (Chart 1). In both countries software investment grew at more than twice the rate of growth in computers and communications equipment investment – at an average annual rate of 9.8 per cent in Canada and 11.6 per cent in the United States. Investment in computers grew at an average annual rate of 3.9 per cent in Canada and 5.5 per cent in the United States. Finally, communications equipment investment growth was almost the same in Canada and the United States – 4.9 and 5.1 per cent per year respectively. The 1995-2000 sub-period saw very rapid growth in all three ICT components in both countries (Table 1). Since 2000, ICT investment has been falling for computers and communications equipment, but has been positive for software.

Chart 2

ICT Investment by Component, Average Annual Deflator Growth in the Business Sector in Canada and the United States, 1987-2004

(per cent)

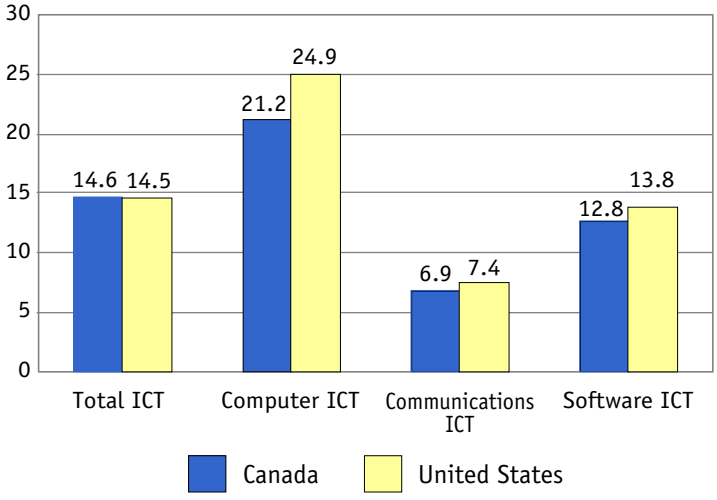


Source: CSLS ICT Database, Table S29.

Chart 3

ICT Investment by Component, Average Annual Growth in the Business Sector in Canada and the United States, 1987-2004, constant (chain) 1997 dollars

(per cent)

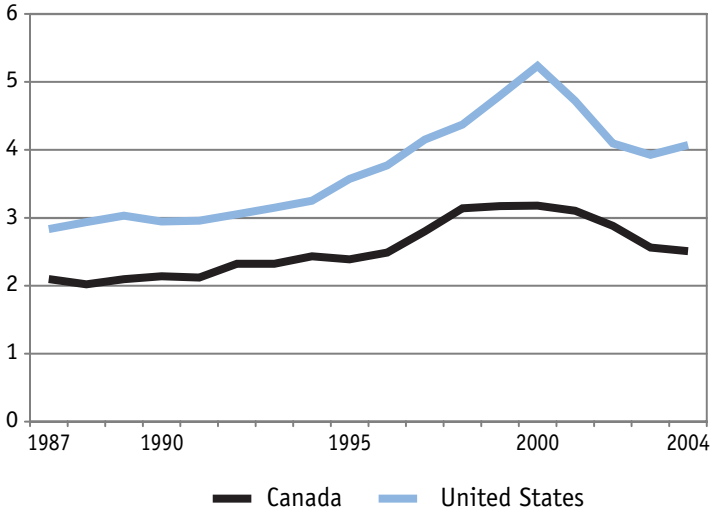


Source: CSLS ICT Database, Tables 13v-16v, 30v-33v.

Chart 4

Total ICT Investment as a Share of Business Sector GDP in Canada and the United States, current dollars, 1987-2004

(per cent)

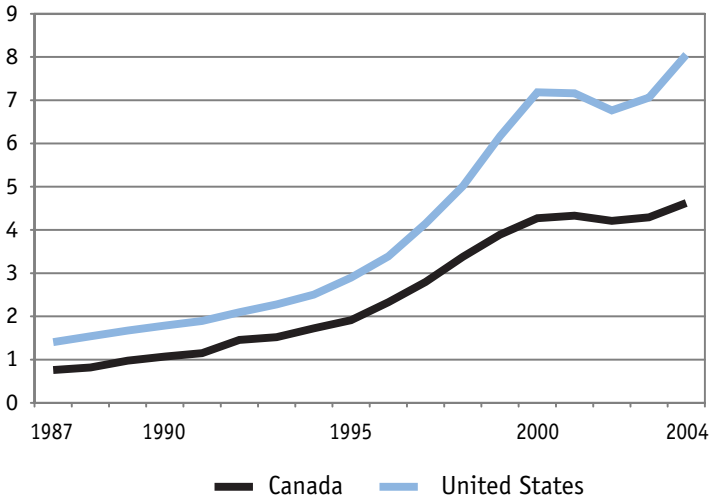


Source: CSLS ICT Database, Table S9.

Chart 5

Total ICT Investment as a Share of Business Sector GDP in Canada and the United States, 1987-2004, constant (chain) 1997 dollars

(per cent)



Source: CSLS ICT Database, Tables 5v and 22v.

Trends in ICT Investment Prices

The prices of ICT investment goods decreased at an average annual rate of 7.3 per cent in Canada and 6.0 per cent in the United States between 1987-2004 (Chart 2). Computers showed by far the greatest average annual decrease in prices, 14.2 per cent in Canada and 15.5 per cent in the United States. This large fall in prices reflected the large adjustment for computer quality improvements. Deflation of communications ICT prices was much more modest, declining 1.8 per cent in Canada and 2.2 per cent in the United States between 1987 and 2004. Software prices exhibited similar small average annual declines of 2.2 per cent in Canada and 1.9 per cent in the United States.

Trends in Real ICT Investment

The real average annual total ICT investment growth rate was very similar in Canada and the United States at 14.6 per cent and 14.5 per cent respectively (Chart 3). Computer ICT investment showed the greatest real average annual growth over the period, 21.2 per cent in Canada and 24.9 per cent in the United States. The United States, at 7.4 per cent, also outpaced Canada, at 6.9 per cent, in real average annual growth in communications investment. In computer investment the US average annual growth rate was 13.8 per cent compared to 12.8 per cent in Canada.

Not surprisingly given the rapid growth, total ICT investment as a share of business sector GDP followed an upward trend in both countries (Charts 4 and 5) over the 1987-2001 period. This trend was much more pronounced in the constant-dollar series because of the much larger growth rates than in the current-dollar series.[7]

7 In current dollars the share of ICT investment in US business sector non-residential investment increased from 20 per cent to more than 30 per cent between 1987 and 2004. In Canada the increase was from 13.2 to 18.5 per cent. ICT investment in the United States increased in real terms to more than 50 per cent of total business sector investment in 2004 from just over 10 per cent in 1987. In Canada there was a similar, yet less dramatic, increase in the share of ICT investment from 5.8 per cent in 1987 to almost 30 per cent in 2004.

The changing relative importance of the components of ICT investment, 1987-2004

The importance of software in current dollar ICT investment has increased dramatically in Canada, rising from around one third at the end of the 1980s to the current proportion of around one half (Charts 6). As software has grown in importance, both computers and communications investment made up a progressively smaller share of total ICT investment. A similar trend took place in the United States.

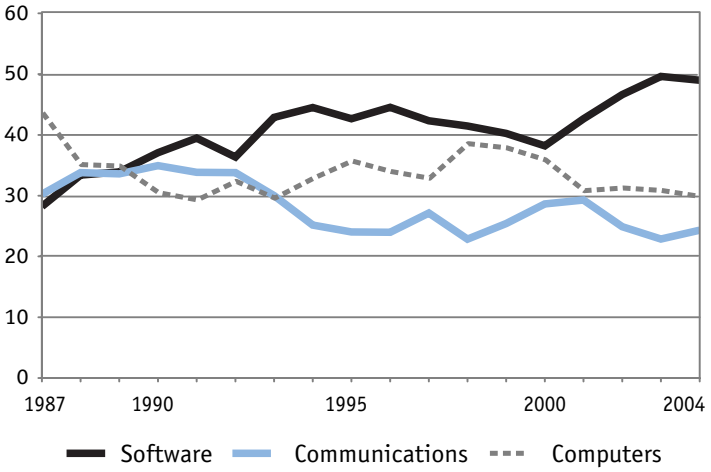
The Canada-US ICT Investment Gap[8]

The ICT Investment Gap in 2004

The gap in ICT investment between Canada and the United States can be measured in several ways — ICT investment per worker, ICT investment as a share of business sector GDP, and ICT investment as a share of total business sector non-residential investment. In each case the Canadian level of investment is expressed as a percentage of the US level. Yet by any measure the gap is significant (Chart 7).

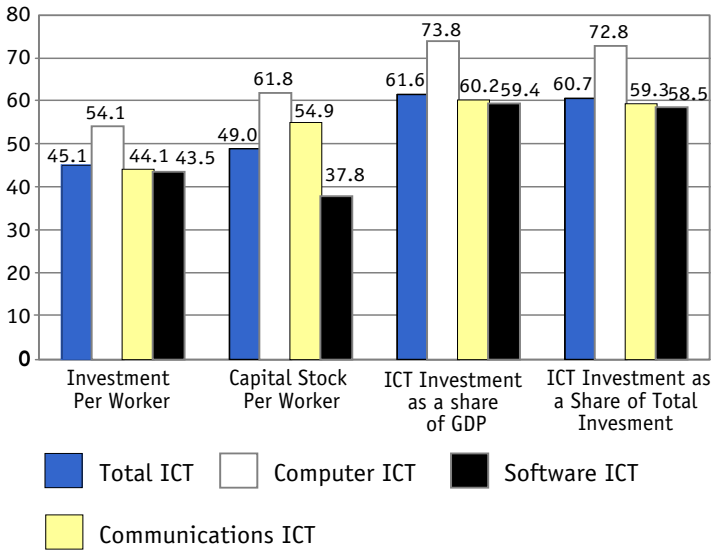
- ICT investment per worker in the Canadian business sector in 2004 was only 45.1 per cent of the US level. This gap affected all three ICT components with computers 54.1 per cent of the US level, communications 44.1 per cent, and software was 43.5 per cent.[9]
- Overall ICT investment as a share of business sector GDP in Canada was only 61.6 per cent of the US level in 2004.[10] Computer ICT investment was 73.8 per cent of the US level; communications investment was 60.2 per cent of the US level; and software ICT investment was 59.4 per cent of the US level.

Chart 6
Components of ICT Investment as a Percentage of Total ICT Investment in Canada, current dollars, 1987-2004
(per cent)



Source: CSLS ICT database, Tables S1-S4.

Chart 7
The Canada-US ICT Gap, Canada as a Percentage of the United States, 2004



Source: CSLS ICT Database, Tables S1-S16.

8 While Canada's ICT investment performance is poor relative to the United States, its international position is much better. For example, Canada ranked eighth out of 17 OECD countries for its share of ICT investment in non-residential fixed investment in 2001. For a detailed discussion of Canada's ranking in terms of ICT investment intensity performance among G-7 and OECD countries, see the unabridged version of the report.

9 ICT capital stock per worker in Canada was 49 per cent of US level in 2004. Computer capital stock per worker was 61.8 per cent, communication equipment 54.9 per cent and software 37.8 per cent of the US level (Chart 7).

10 Due to differences in labour productivity between Canada and the United States and differences in the ratio of the purchasing power parity for ICT investment to the purchasing power parity for GDP, the gap in terms of ICT investment as a share of GDP differs from the gap in terms of ICT investment per worker.

Chart 8
Decomposition of the Canada-U.S Business ICT Investment per Worker Gap, current dollars, 2004
(percentage points)

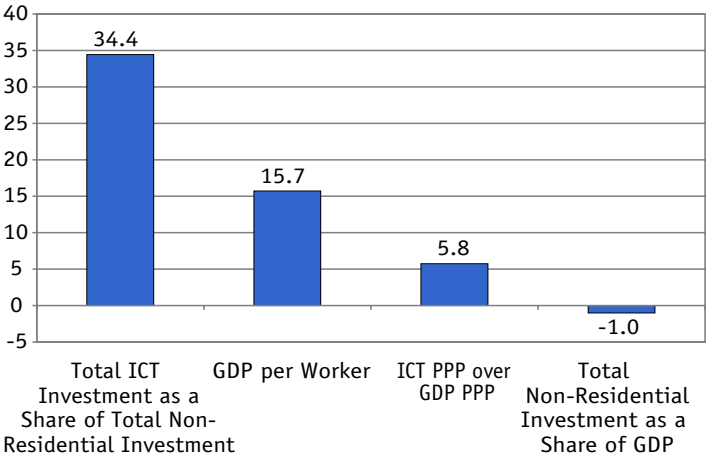
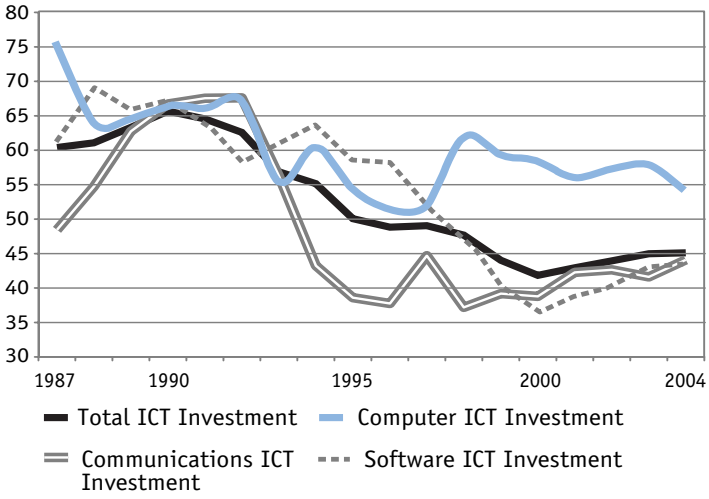


Chart 9
ICT Investment per Worker in the Business Sector in Canada, as a Proportion of the United States, current US dollars, 1987-2004
(per cent)



Source: CSLS ICT Database, Table S1-S4.

- Canada's level of ICT investment as a share of business sector non-residential investment was 60.7 per cent of the US level in 2004. Again, computer investment Canada was closest to the US level at 72.8 per cent, followed by communications at 59.3 per cent and software at 58.5 per cent.

The gap between Canadian and US ICT investment intensity can be decomposed into its constituent factors and the contribution to the gap of each factor can be calculated.[11] These components are the total non-residential business sector investment as a share of GDP, ICT investment as a share of total investment, GDP per worker and the ratio of ICT purchasing power parity to GDP purchasing power parity.

Chart 8 demonstrates that 34.4 percentage points of the Canada-US ICT investment per worker gap of 55 percentage points (66.6 per cent) in 2004 is explained by Canada's lower share of ICT investment in total investment relative to the United States. Canada's higher share of investment in GDP only slightly compensates for this large gap, by 1.0 percentage points. Other factors contributing to the Canada-US ICT investment gap per worker are Canada's lower GDP per worker (labour productivity), contributing 15.7 percentage points, and the fact that the Canada-US PPP for ICT is lower than the Canada-US PPP for GDP, contributing 5.8 percentage points.

Trends in the ICT Investment Gap, 1987-2004

Canada's ICT investment intensity gap with the United States has widened in recent years. In 1990, ICT investment per worker in Canada was 66 per cent of the US level. By 2004, it had fallen to 45 per cent (Chart 9). All three ICT components manifested this trend.

Canadian ICT investment as a proportion of business sector GDP also exhibited a downward trend, falling from 74 per cent of the US level in 1987 to 62 per cent in 2004. Computer and software investment as a share of GDP relative to the US level also fell between 1987 and 2004, but communications investment was stable.

11 See Appendix 2 in the unabridged version of this report for a formal derivation of the contributions to the Canada-US ICT investment intensity gap on a per-worker and on a share of GDP basis.

Table 2
Business Sector Non-Residential Investment

	Proportion Canada/US (per cent)				
			Machinery and Equipment		
Year	Total	Structures	Total M&E	ICT	Non-ICT M&E
per worker (current USD)					
1987	95.9	127.0	79.8	60.4	88.3
2000	79.6	146.7	57.0	41.8	68.6
2001	83.1	151.1	57.5	42.9	68.7
2002	85.4	163.7	58.6	44.0	69.5
2003	87.7	174.6	60.4	45.0	73.9
2004	85.1	162.4	60.1	45.1	70.3
1987-2004 Average*	**91.0**	**150.4**	**69.2**	**52.7**	**78.4**
as a share of business sector GDP (percent; current dollars)					
1987	112.7	141.4	97.9	74.0	108.3
2000	98.3	144.7	82.6	60.7	99.5
2001	104.4	147.9	88.1	65.7	105.2
2002	110.6	157.3	94.1	70.4	111.2
2003	108.6	162.7	90.1	65.3	107.3
2004	101.5	161.5	82.1	61.6	96.0
1987-2004 Average	**109.8**	**161.4**	**90.5**	**69.1**	**102.8**

* PPP adjustments for Canadian structures were extrapolated for years 1987-1991 and 2002-2004 based on Canadian and U.S. non-residential structures deflators.

Source: CSLS ICT database tables S33, S34, S36, S38, S40, S42, S44.

Contribution of ICT to the Canada-US Machinery and Equipment Investment Gap

On a per-worker basis Canadian non-residential business sector investment was only 85.1 per cent of the U.S. level in 2004 (Table 2) However, these aggregate figures mask a more complicated picture. Canadian investment in structures was 162.4 per cent of the US level in 2004. In contrast, Canadian investment in machinery and equipment was substantially lower than the US level at 60.1 per cent in 2004. Finally, when machinery and equipment is decomposed into ICT investment and non-ICT investment, Canadian ICT investment in 2004 was only 45.1 percent of the US level, and non-ICT machinery and equipment 70.3 per cent.

Overall, business non-residential investment in Canada as a share of GDP was 101.5 per cent of the US level in 2004 (Table 2) Again structures investment in Canada was substantially greater than in the United States at 161.5 per cent of the US level as a share of GDP. Total machinery and equipment investment was 82.1 per cent of the US level, but non-ICT machinery and equipment investment was near the US level at 96.0 per cent. ICT investment was only 61.6 per cent of the US level. Thus based on this measure almost the entire M&E investment intensity gap can be accounted for by the ICT gap.

The Canada-US ICT Investment Gap by Industry[12]

At 45.1 per cent of the US level in 2004, the average figure of ICT investment per worker for the Canadian business sector (Chart 10) conceals significant industry variation. Both arts, enter-

12 Some industries are omitted due to lack of Canadian data, usually resulting from confidentiality requirements in industries with small numbers of firms. As is standard practice in this report, for reasons of comparability between Canadian and US data, the health care and social assistance and educational services sectors are omitted.

Chart 10
Total ICT Investment per Worker, by Industry, Canada as a Percentage of the United States Level, current dollars, 2004
(U.S. = 100)

Source: CSLS ICT database Table 9 and 26.

tainment and recreation (192.7 per cent) and other services (122.2 per cent) invested more per worker in ICT than their US counterparts. The industries in Canada that invested the least in ICT relative to their US counterparts were professional scientific and technical services (22.7 per cent), administrative and support (25.0 per cent), accommodation and food services (27.8 per cent), manufacturing (29.1 per cent) and transportation and warehousing (35.3 per cent).[13]

Contributions by Industry to the Canada-US ICT Investment Per Worker Gap

The Canada-U.S. ICT investment per worker gap (55 percentage points) can be decomposed into its industry contributions (Chart 11). In 2004, the industry contributing most to the gap is professional, scientific and technical services at 14.5 percentage points, accounting for more than a quarter of the gap. This large contribution is due both to the large ICT investment per worker gap in the industry ($5,981 US) and the fact it accounts for 8.2 per cent of the total labour force. The second biggest contributor is manufacturing, which accounts for 10.8 percentage points of the ICT investment per worker gap, or about 20.3 per cent.

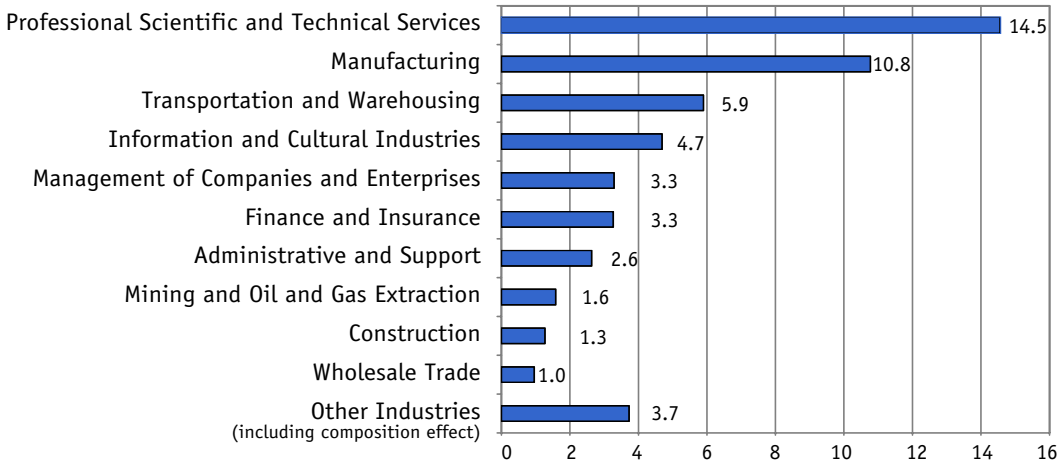
The industry sources of the Canada-US ICT investment per worker vary greatly by ICT component. In 2004, the main contributor to the Canada-U.S. ICT communications investment per worker gap was by far the transportation and warehousing industry accounting for 39.0 per cent of the 56.7 percentage point gap. For the ICT computer investment per worker gap, the finance and insurance industry accounted for 24.4 per cent of the 46.8 percentage points gap. While

13 The unabridged version of the report provided a full discussion of Canada-US ICT investment per worker gaps by industry for the three ICT components as well as for the Canada-US ICT investment as a share of GDP measure.

Chart 11

Contributions by Industry to Canada-US ICT Investment per Worker Gap, Top Ten Industries, current dollars, 2004

(percentage points)



the financial sector is already one of the most computer-intensive sector in both countries, it appears that the American industry is adopting new technologies at a much faster pace than their Canadian counterpart.

The Canada-U.S. ICT software investment per worker gap is the most important of all three components because software accounts for about half of all ICT components. The results of the decomposition are broadly in line with those for total ICT investment. Professional, scientific and technical services and manufacturing are the two main contributor to the software investment per worker gap accounting for 40.6 and 28.8 per cent respectively.

Explanations for the Canada-US ICT Investment Gap

This part of the report provides a detailed discussion of possible causes of the Canada-US ICT investment gap. The explanations are divided into five main areas: statistical and methodological differences, differences in economic structure, differences in relative costs and prices, differences in managerial attitudes and culture, and differences in framework variables. Before beginning the assessment of hypotheses to explain the gap, a brief survey of the factors influencing ICT adoption is provided drawing on CSLS (2005).

An Overview of the ICT Adoption Issue

A recent study conducted by the U.K. Department of Trade and Industry (2004) titled *Business in the Information Age: The International Benchmarking Study 2004* provides insight into the reasons for the adoption of advanced technologies and the barriers to this adoption for 11 OECD countries.[14]

The study investigated the main drivers of ICT adoption among businesses, and identified to what extent these drivers were realized in incidences where technology was implemented. Canadian enterprises identified increased efficiency and reduced cost as the two most important drivers behind the adoption of ICT, with 22 per cent and 15 per cent of all businesses point-

14 A total of 2,716 businesses in the United Kingdom and 500 in each of the 10 other countries were surveyed on ICT usage, plans, and sentiment within their businesses. The survey offers a unique opportunity to benchmark Canadian experience in the area of technology adoption against that of other countries.

ing to these two factors respectively. These perceptions are consistent with the international average of 21 per cent for increased efficiency and 16 per cent for reduced cost. Indeed, improving efficiency was the most commonly cited driver of adoption for all but two of the 11 countries surveyed.

According to the study, costs remain the single most significant barrier to the adoption of ICT technologies for Canadian businesses. Furthermore, by breaking down costs into set-up costs and running costs, the study finds that set-up costs are perceived as a far greater impediment to technological adoption than are running costs. Relative to the other 10 countries analyzed in this study, Canada ranks very high in terms of business perceptions of cost as a barrier. In fact, Canada had the highest percentage of businesses that perceived running costs as a barrier, at 32 per cent in 2004, and ranked second highest in terms of business perceptions toward set-up costs, with 46 per cent of Canadian businesses identifying them as a barrier to ICT implementation.

Another study which sheds light on why Canadian firms may use less ICT than firms in other countries is that of Baldwin and Lin (2002). Based on data from Statistics Canada's 1993 *Survey of Innovation and Advanced Technology*, their study revealed impediments to advanced technology adoption perceived by Canadian manufacturing firms. Impediments to advanced technology use were decomposed into five categories: cost-, institution-, labour-, organization-, and information-related. The most important impediments were cost-related. The costs of equipment and capital were cited by 53 and 47 per cent of firms respectively as impediments. Also important was the cost of technology acquisition, cited by 27.9 per cent of firms. The least important impediments were institution and information related. This finding suggests, at least in the early 1990s, that neither the tax and regulatory environment nor a lack of information among Canadian firms was the primary impediment to advanced technology adoption.

Statistical and Methodological Differences

Definitional Differences in ICT Investment

At the international level there is a degree of consensus about the definition of ICT investment.[15] The detailed list of items included in the definition of ICT investment in Canada and the United States reveals that there does not appear to be any material difference in the way ICT investment is defined between the two countries. All asset categories found in the US definition of ICT have their counterpart in the Canadian list of assets. Discussion with officials at Statistics Canada and the Bureau of Economic Analysis failed to reveal any apparent differences in the definition of ICT investment used by the statistical agencies.

ICT Investment Estimation Methods

Differences in the methodologies used to generate ICT investment estimates could account for the Canada-US ICT investment intensity gap. In Canada, information on capital expenditure on computers, communications equipment and software is gathered through Statistics Canada's the Survey of Capital and Repair Expenditures (CAPEX), which collects data on all asset types. Theses numbers are then adjusted for consistency with the National Accounts based on production, import and export data.

In the United States the method for estimating ICT investment expenditure is somewhat differ-

15 According to the OECD, "ICT investment is defined in accordance with the 1993 System of National Accounts. It covers the acquisition of equipment and computer software that is used in production for more than one year. ICT has three components: information technology equipment (computers and related hardware), communications equipment and software. Software includes acquisition of pre-packaged software, customized software and software developed in house." (OECD 2005)

ent. The BEA classifies investment in ICT under the investment category "information processing (IP) equipment and software." IP equipment and software investment, excluding own-account software, is determined in current prices primarily by the 'commodity-flow' methodology, with periodic benchmarking to the quinquennial I-O (input-output) tables. The commodity flow method is a 'supply-side' approach, which traces commodities from their domestic production or importation to their final purchase (Grimm et al., 2002: 5).

The critical question is whether US indirect supply-side commodity-flow methodology produces different ICT investment estimates compared to those from the Canadian direct demand-side survey methodology. Discussions with officials in both statistical agencies indicated differences in methodologies used to estimate ICT investment appear not to be a source of incomparability between the estimates. But no detailed studies have been done on the issue and further research is required for a definitive answer to the question.

The estimation of own-account software investment is difficult because firms do not make specific capital expenditures on this asset class. These expenditures are estimated in both Canada and the United States from labour costs, specifically, the compensation of computer programmers and computer systems analysts. While there are some differences in the methodologies and assumptions used to construct these estimates in the two countries (Jackson, 2003), they appear to be offsetting and the net effect appears small. Again, further research on Canada-US own-account software comparability is needed before a definitive answer can be reached.

Survey Coverage of ICT Investment

Discussion with Statistics Canada officials has determined that there is some underestimation of ICT investment for the Canadian business sector because of gaps in the CAPEX coverage of certain industries, namely oil and gas extraction, fishing and construction. This results in the complete absence of ICT investment estimates for oil and gas extraction and fishing. In construction, ICT investment estimates are produced based on the level of economic activity in the sector, but these estimates are based on a 20 year old benchmark that likely underestimates ICT spending.

The overall impact of this gaps in ICT investment coverage on business sector ICT investment, and hence on the difference in Canada-US ICT investment intensity, appears small. If ICT investment per worker in oil and gas extraction and construction in Canada were assumed to be equal to one half that of their US counterparts (which is roughly the proportion for business sector ICT per worker), ICT investment in the Canadian business sector, as a share of the US business sector, would be 1.1 percentage points higher (mining and oil and gas extraction contribute 0.7 points and construction 0.4 points).[16] Given the 38 percentage point gap in the Canada-US business sector ICT investment as a share of GDP, this accounts for only around 2 per cent of the gap. This limited contribution reflects the low level of ICT use in construction, and the relatively small proportion of Canadian workers directly employed in mining and oil and gas extraction.

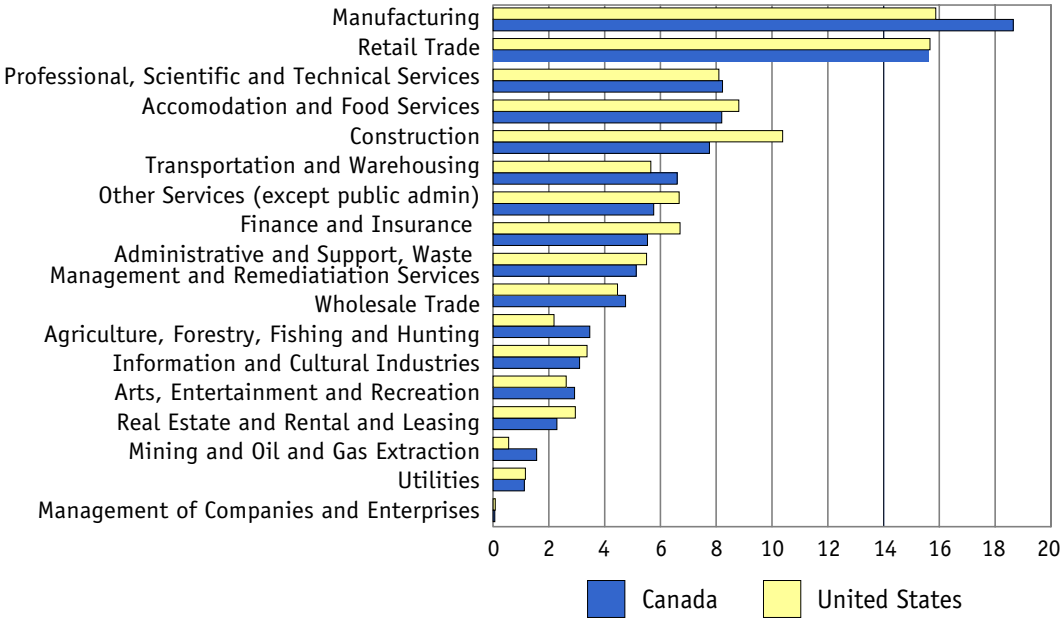
Differences in Economic Structure

Industrial Structure

Differences in industrial structures between Canada and the United States could in principle account for part of Canada's lower ICT investment per worker relative to the United States. ICT investment per worker in the business sector is a weighted average of the level of ICT

16 Fishing is excluded from the calculation because of the very small size of the industry and the lack of estimates for ICT per worker in the industry for both countries. Its inclusion would have no significant effect on the calculations.

Chart 12
Employment Shares by Industry in the Business Sector, Canada and the United States, 2004



Source: Data for Canada is collected from unpublished sources of the Labour Force Survey. Data for the United States is collected from the Current Population Survey available through the Bureau of Labor Statistics.

investment per worker in every industry comprising the business sector, with the number of workers in each industry divided by the total number of workers in the business sector serving as the "weight" for each respective industry. If industries that traditionally utilize above-average levels of ICT per worker represent a smaller proportion of business sector employment in Canada than in the United States, then all else being equal, total ICT intensity would be lower in Canada relative to the United States.

When ICT investment by industry in Canada is weighted by US employment shares in order to simulate total ICT investment in Canada, total business sector ICT investment for 2004 would have increased $1.0 billion from $19.3 billion to $20.3 billion (current US dollars). As the number of workers in the Canadian business sector remains the same, the level of ICT investment per worker would rise accordingly. Differences in industrial structure between the two countries can thus be inferred to account for 2.4 percentage points of the ICT investment per worker gap between Canada and the United States.[17] The greater share of US employment in the very ICT-intensive finance and insurance and information and cultural industries (Chart 12) accounts for this difference.

Differences in Firm Size

Canada has a relatively larger proportion of small firms than the United States. In 2002, 22.7 per cent of Canadian employees were working in firms with fewer than 20 employees (defined as small enterprises), compared to 18.3 per cent in the United States (See Chart 13). Similarly, 36.5 per cent of Canadian employees were employed by firms with 20-499 employees (defined as medium enterprises), compared to 31.8 per cent in the United States. In contrast, the employment share of workers in firms having 500 and more employees (defined as large enterprises) in

17 See the unabridged version of the report for details on this calculation.

Table 3
Advanced ICT Use by Firm Size in Canada, 2001-2003
(per cent)

	Own Website			Sell online			Purchase online		
	2001	2002	2003	2001	2002	2003	2001	2002	2003
Small Firms[1]	24	27	29	6	7	6	20	29	35
Medium Firms[2]	57	62	66	12	13	14	30	47	50
Large Firms[3]	74	77	77	15	16	16	52	57	61
All Firms[4]	29	32	34	7	8	7	22	32	37

Source: Industry Canada (2005) Key Small Business Statistics, Table 14, in which data were from Statistics Canada, Survey of Electronic Commerce and Technology (SECT), 2004.

Notes:

1 Fewer than 20 employees.

2 Firms with 20-499 employees for manufacturing sector and 20-99 for other sectors.

3 Firms with 500 or more employees for manufacturing sector and 100 and more employees for other sectors.

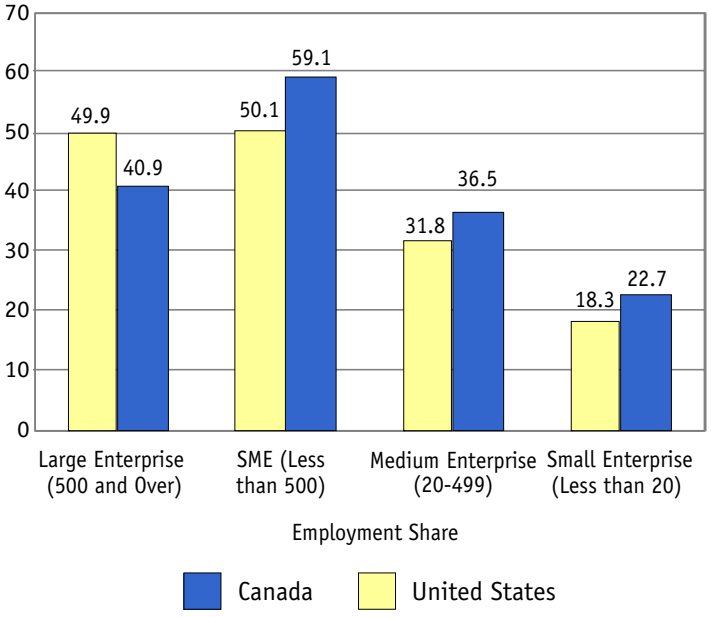
4 Data are weighted by the number of all firms, not weighted by firm size.

Canada (40.9 per cent) was significantly lower than that in the United States (49.9 per cent).

There is a large amount of empirical research that indicates that firm size has an influence on ICT adoption. Data on e-business from Statistics Canada's *Survey of Electronic Commerce and Technology* (SECT) revealed that the adoption of more advanced ICT such as websites and e-commerce was dominated by large firms (Table 3).

Unfortunately, there is no data for Canada currently available on ICT investment by firm size. However, a study on Italy (Fabiani *et al.*, 2005) found that ICT expenditure per worker in firms with 500 or more employees was nearly twice as much as that of firms with less than 500 employees. A survey from Canada Health Infoway also reveals the same investment pattern for 244 Canadian health organizations (Industry Canada, 2003). While small health care organizations (i.e. those with budget less than $75 million) in 2002 only spent $2,400 on IT per clinical FTE, large health care organizations (i.e. those with budget more than $300 million) spent $4,500 per clinical FTE on IT.[18]

Chart 13
Employment Share by Employment Size of Enterprise, Business Sector, Canada and the United States, 2002
(per cent)



Source: Statistics Canada and Bureau of Census.

Why do large firms invest and adopt ICT capital more than small firms? First, compared to small firms, large firms may be more aware and

18 The survey also found that the level of IT spending in the Canadian health care organizations is relatively low: mean spending for organizations surveyed is about 2.5 per cent of operating budget, compared to 5 per cent in the United States.

informed of the latest technological advances. Second, large firms may be more able to handle the level of risk associated with ICT investment than small firms because of their greater resources. Third, larger firms may expect greater benefits from using ICT than smaller firms.

What would the ICT investment gap be if Canada had the same proportion of large firms as the United States? If one follows the results of the Italian study and assumes that large firms spend twice as much as SMEs on ICT investment per worker. ICT investment per worker in Canada as a share of the United States increases by 2.8 percentage points equivalent to 6 per cent of the gap in 2004.[19]

Direct Foreign Investment

One quarter of the assets of non-financial corporations in Canada were under foreign control in 2000 (Baldwin and Gellatly, 2005). This is a much higher proportion than in the United States. Multinationals often purchase ICT assets such as computers, servers and software in the home country for use in the host countries, with the result that these investments may not be recorded as investments in the host country. This could mean that ICT investment is overestimated in the United States and underestimated in Canada, explaining part of the gap. Physical ICT assets such as computers purchased in the United States and shipped to Canada for use by the foreign subsidiary should be captured as imports at the border and recorded as ICT investments in Canada.

The situation is less clear for software purchased in the United States and then shipped electronically to Canada. In principle, such transactions should be recorded by the Canadian subsidiary as an import of software. But it is difficult to distinguish those firms that use software paid for by their US headquarters (thus the value of software might not be accounted for the firm's software investment data) from those that both use and purchase software in Canada. Therefore, there may be underestimation of software investment in Canada because of the large presence of multinationals.

Physical ICT assets such as servers purchased in the United States by multinationals, but which electronically support the Canadian operations from the United States definitely result in less ICT investment in Canada compared to a situation of no multinational operating in Canada. However, the importance of this phenomenon is likely small. More research on this issue is needed.

Differences in Relative Costs and Prices

It has been noted earlier that cost considerations are the major barrier to advanced technology adoption in Canada. Consequently, differences in the relative prices of ICT investment goods across countries may explain differences in rates of adoption.

A study by KPMG and Competitive Advantage (2004) found that in 2003 Canadian labour costs were approximately 80 percent of the US level. Since ICT investment goods are traded on world markets, there tends to be a uniform price in a common currency across countries. This means that the price of labour relative to ICT investment goods is lower in Canada than in the United States, giving firms in Canada less incentive to substitute ICT for labour, leading to less ICT investment. KPMG and Competitive Advantage also found that facility costs, transportation costs, and utilities (energy and telecommunication) costs were lower in Canada, again giving a greater incentive to US firms to adopt ICT where there is a possibility of substituting ICT for any of these inputs.

Differences in Managerial Attitudes and Culture

Some observers believe that Canadian firms behave differently than their US counterparts,

19 See the unabridged version of the report for calculations.

and that these differences account for lower ICT spending in this country. For example, it is often asserted that Canadian businesses are more conservative and risk averse that their US counterparts, due in part to the smaller size of the market. If this were true, this could account for a greater reluctance to be on the cutting edge of perhaps unproven technology and hence lower ICT spending.

It is also sometimes argued that Canadian businesses are less aware of the latest developments, due possibly to a basic lack of interest in ICT, less aggressive marketing and sales promotion by ICT equipment vendors in Canada, or a lower level of technical understanding of ICTs and their benefits in this country.

Finally, it is sometimes said that Canadian managers are more reluctant to undertake the organizational changes and the training investments needed for the effective implementation of ICT and hence invest less in ICT. There may be truth in the above assertions. But they remain speculative in nature because of the lack of hard data for their assessment.

Differences in Framework Variables

In addition to the factors that directly affect ICT investments, such as relative costs, managerial attitudes, and the economic structure of the economy, there are a number of other factors that more indirectly influence ICT investment. These factors include the ICT skills that the workforce possesses, the corporate tax system that affects the incentive to invest, and the level of the competitive intensity of the economy.

ICT Training and Education

The effective use of ICT requires workers with the skills needed to use the new technologies. Canada has a higher proportion of its workforce with post-secondary education than the United States. But this country does less well for university education. For example, only 31 per cent of managers in Ontario have a university degree of any sort versus 46 per cent of US managers (Task Force on Competitiveness, Productivity and Economic Progress; 2004). To the degree that a university education gives a greater appreciation of the benefits of IT adoption, this situation may account for lower ICT spending in this country.

ICT training and education is important in the actual adoption of ICT. Canadian firms tend to invest less than their US counterparts in employee training, so this situation may put them at a disadvantage in the use of ICT. A study by the Canadian e-Business Initiative (2004) focusing on the e-business capabilities of small and medium-sized enterprises (SME) found that 50 per cent of Canadian SMEs had not adopted even a single Internet Business Solution[20] (IBS). The Canadian e-Business Initiative concluded that "Canadian SMEs lag behind their US and EU counterparts in the adoption of operationally-focused IBS" (2004:2) and noted that the lack of internal capability for IBS implementation was found to be one of the main reasons for the lack of IBS adoption.

Differences in Taxes

ICT investment, like all types of investment, is determined by the ex ante expected return on the investment, which is in part determined by the marginal effective tax rate (METR) on ICT business investment. The METR on business investment in 2005 was 35.2 per cent in Canada, compared to 34.5 per cent in the United States, a very small difference (Department of Finance, 2005). This situation reflects significant decreases in taxes in Canada since 2000, including the reduction in the federal general corporate income tax rate, which reduced the METR

20 Internet Business Solutions are defined initiatives that combine the Internet with networking, software and computing hardware technologies, to enhance or improve existing business processes or to create new business opportunities.

by 3.6 percentage points, the elimination of the federal capital tax (2.3 points), and CCA changes (1.4 points). In 2000, there was a larger gap between the Canadian and US METRs.

To assess the link between ICT investment and taxes, one must focus on the tax rate for ICT assets, not the overall tax rate. According to the CD Howe Institute, the METR for ICT investment in Canada was 53.2 per cent in 2005. This rate is higher than the rate for overall business investment because of the short life on ICT assets compared to non-ICT assets. The Department of Finance (2005:53) has recently released a study on the marginal effective tax rates on business investment on machinery and equipment, which includes ICT assets. It estimates that in 2010 the METR for machinery and equipment in Canada will be 32.1 per cent, compared to 35.1 per cent in the United States (Department of Finance, 2005: 53).

Unfortunately, estimates are not yet publicly available for ICT investment. But based on the M&E estimate, it appears that the METR for ICT investment in Canada is comparable if not below that of the United States at this time, and hence cannot explain the current ICT investment shortfall. However, just as the overall METR was higher in 2000 in Canada than in the United States, the METR for ICT was also higher at this time. Thus in the past the higher taxes on ICT assets may have contributed somewhat to lower ICT investment in this country.

Differences in Competitive Intensity

It is now well recognized that competition is a key driver of productivity growth (Lewis, 2004). When firms are under competitive pressures they are more likely to innovate and introduce new productivity-enhancing technologies such as ICT. Consequently, a possible reason for the lower ICT investment in Canada relative to the United States may be less competitive pressure in this country.

It is difficult to capture the intensity of competitive pressures in one country, let alone across countries. Nevertheless many believe that Canadian product markets are in general less competitive than US markets, due to the smaller size of the Canadian market and to a lesser degree, restrictions imposed on foreign investment in Canada. If true, this situation may account for some of the Canada-US ICT investment intensity gap.

Conclusion

This report has been unable to identify one factor that can account for the Canada-US ICT investment gap. Rather it has identified a number of factors which, when taken together, can account for much, but certainly not all, of the current gap, as measured by ICT share of GDP, of around 38 percentage points. These factors were Canada's industrial structure, the firm size distribution of employment, underestimation of ICT investment by Statistics Canada, lower labour costs, and to a lesser extent, the high degree of foreign ownership and smaller proportion of Canadian managers with university education.

A key question is the relevance of these findings for the task of identifying ways to reduce the Canada-US ICT investment gap, a crucial step towards reducing the Canada-US labour productivity gap. Certain of these factors cannot be influenced by policy while others can. The industrial structure reflects Canada's comparative advantage and is not easily amenable to policy initiatives. Equally, the firm size distribution of businesses also reflects structural influences, but can be influenced by tax policy. Indeed, some argue the greater importance of small and medium sized enterprises (SMEs) in Canada relative to the United States reflects the more favourable tax treatment of SMEs in this country. Equally, foreign investment makes an important contribution to both employment and productivity growth in this country and it is

in our interest to encourage it even though it may lead to a downward bias in our official ICT investment estimates.

Higher labour costs would give firms an incentive to adopt labour-saving ICT, but it is certainly not appropriate for government to raise labour costs for business. Rather a higher level of real wages must be earned through productivity advance, which in turn requires more ICT investment.

The one factor that can be influenced by public policy is the proportion of managers with university education. The federal government and provincial governments currently devote significant resources to university education, but additional resources may still be needed to encourage a greater proportion of young Canadians to pursue university education.

Even though the report finds that certain factors such as the level of taxes on ICT investment do not currently explain the Canada-US ICT investment gap, it does not follow that changes to these factors could not affect the gap. For example, the marginal effective tax rate on ICT assets is currently slightly smaller in Canada than in the United States so does not account for the gap. But lower taxes on ICT investment relative to those in the United States could potentially incite additional ICT investment and contribute to a closing of the gap.

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