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AN ANALYSIS OF THE CANADA-U.S. ICT INVESTMENT GAP: AN UPDATE TO 2013

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An Analysis of the Canada-U.S. ICT Investment Gap: An Update to 2013

Abstract

Canada's productivity performance reflects in large part our innovation record, both in terms of business sector R&D and information and communications technology (ICT) investment. The objective of this report is to examine the country's ICT investment performance since 2000. The key finding is that, since the 2008 peak, business sector ICT investment in Canada has performed poorly, both relative to the Canadian non-business sector and to the business sector in the United States. By 2013, four years after the 2009 recession, nominal ICT investment in the business sector in Canada had failed to regain the 2008 level, falling on average 1.0 per cent per year over the 2008-2013 period. In contrast, despite government belt-tightening, nominal investment in the non-business sector in Canada advanced at a 2.0 per cent average annual rate. Equally, the United States, which experienced a more severe downturn than Canada, saw business sector nominal ICT investment grow at a 1.5 per cent average annual rate between 2008 and 2013. The fall in nominal ICT investment in Canada, combined with the increase in the United States, resulted in an 8.5 percentage point fall in the ICT investment per worker in Canada from 59.6 per cent of that of the US business sector in 2008 to 51.1 per cent in 2013. More research is needed to understand the reasons for the weak post-2008 ICT investment performance of Canada's business sector.

An Analysis of the Canada-U.S. ICT Investment Gap: An Update to 2013

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Executive Summary

Canada's productivity performance reflects in large part our innovation record, both in terms of business sector R&D and information and communications technology (ICT) investment. The objective of this report is to examine the country's ICT investment performance since 2000. This report examines trends in information and communication technology (ICT) investment in Canada and the United States, as well as developments in the Canada-U.S. ICT investment gap. Analysis focuses mainly on the period between 2000 and 2013, but some additional information is occasionally provided on patterns since 1987. This report is entirely based on an updated version of the CSLS ICT database, reflecting newly released estimates.

The key finding is that, since the 2008 business cycle peak, business sector investment in Canada has performed poorly, both relative to the Canadian non-business sector and to the business sector in the United States.

Developments in ICT investment in 2013:

- In 2013, nominal ICT investment in the total economy in Canada rose 0.5 per cent to $40.6 billion from $40.4 billion in 2012, down from increases of 4.6 per cent in 2011 and 1.0 per cent in 2012. The 2013 growth rate was below the annual growth rate experienced between 2000 and 2013 (1.6 per cent) and the 2.0 per cent increase for nominal fixed, non-residential investment in 2013.
- In 2013, nominal computer ICT investment fell 8.5 per cent to $9.5 billion and nominal communications ICT investment fell 0.1 per cent to $7.3 billion. In contrast, nominal software ICT investment increased 4.7 per cent to $23.9 billion. Hence, software investment completely drove the increase in nominal total ICT investment.
- ICT prices continued their long-term downward trend in 2013, falling 0.6 per cent due to a 5.8 per cent fall in computer prices. Software and communications prices both rose. (1.4 per cent and 0.6 per cent respectively).

Longer-term developments in ICT investment:

- By 2013, four years after the 2009 recession, nominal ICT investment in the business sector in Canada had failed to regain the 2008 level, falling on average 1.0 per cent per year over the 2008-2013 period. The modest gains in ICT investment in the four years following the recession were insufficient to offset the 9.4 per cent decline in ICT spending in 2009. In the 2000-2008 period nominal business sector investment advanced at a compound average annual rate of 2.7 per cent.

- In contrast, despite government belt-tightening, nominal investment in the non-business sector advanced at a 1.9 per cent average annual rate between 2008 and 2013. In the 2000-2008 period, non-business ICT investment had also exceeded business sector investment, but by a considerably smaller margin (3.6 per cent versus 2.7 per cent).
- ICT prices in the business sector in Canada fell 2.5 per cent per year between 2008 and 2013, down from -5.6 per cent in 2000-2008. The slower rate of price decline was experienced by all three ICT components.
- The smaller decline in ICT prices meant that the fall-off in real investment growth after 2008 in Canada was even greater than the nominal fall. After advancing at 8.8 per cent per year in the 2000-2008 period, real business sector ICT investment rose at only a 1.6 per cent rate between 2008 and 2013.

ICT investment comparisons with the United States for the business sector:

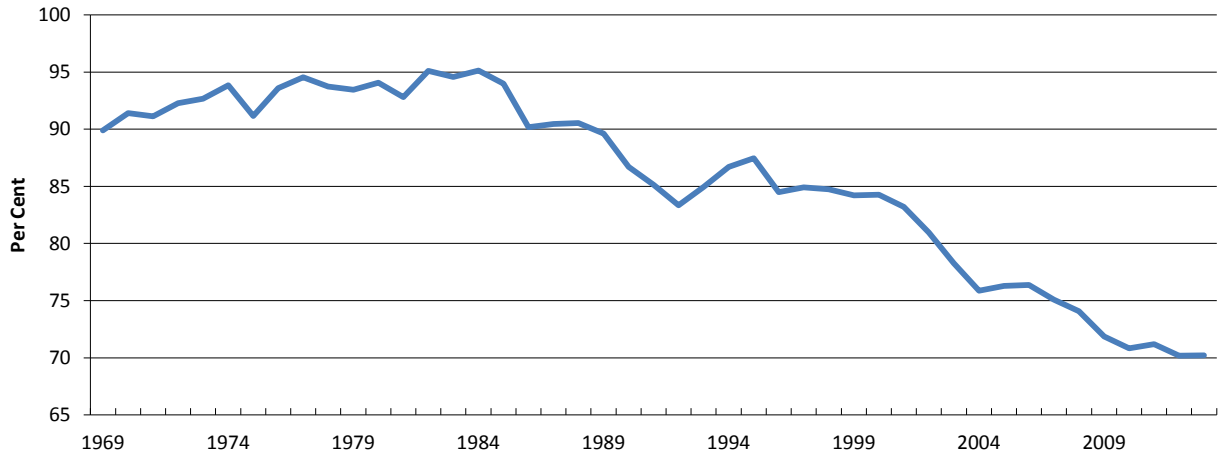
- The U.S. business sector experienced a more severe downturn than Canada during the recession, yet enjoyed superior ICT investment performance. Nominal ICT investment rose 1.5 per cent per year in the United States between 2008 and 2013, compared to -1.0 per cent in Canada. Also, in contrast to Canada (where ICT investment fell after 2008), ICT investment growth in the United States picked up from 0.6 per cent per year in 2000-2008 to 1.5 per cent in 2008-2013.
- ICT prices fell at the same rate in both countries between 2008 and 2013 (2.5 per cent per year) so that the gap in real business sector ICT investment growth between the two countries was the same as for nominal investment (2.5 percentage points).
- Employment growth in the U.S. business sector fell 0.5 per cent per year between 2008 and 2013, in contrast to a 0.4 per cent increase in Canada. This lead to a 2.0 per cent per year rise in nominal ICT investment per worker in the United States, compared to a 1.3 per cent fall in Canada.
- The absolute fall in nominal ICT investment in the Canadian business sector, combined with the rise in the United States, as well as the worse US employment performance, resulted in nominal ICT per worker in Canada falling 8.5 percentage points from 59.6 per cent of that of the US business sector in 2008 to 51.1 per cent in 2013.
- Canada's poor business sector productivity performance in recent years, both in absolute terms and relative to the United States, is likely linked to Canada's weak ICT investment performance. Yet the reasons why nominal ICT investment in the Canadian business sector failed to regain the 2008 pre-recession level by 2013 are poorly understood and merit serious attention.

An Analysis of the Canada-U.S. ICT Investment Gap: An Update to 2013[1]

I. Introduction

Growth in labour productivity determines growth in wages (and therefore living standards) in the long-run. Unfortunately, Canada's performance in terms of productivity has been dismal in comparison to the United States since the mid-1980s. Productivity levels (GDP per hour) in the business sector in Canada represented approximately 95 per cent of productivity levels in the business sector in the United States in the early 1980s. In 2013, productivity levels in Canada relative to the United States had fallen to just about 70 per cent (Chart 1).

Chart 1: Relative Labour Productivity Levels (GDP Per Hour) in the Business Sector in Canada, 1969-2013 (Canada as Percent of the United States)



Source: CSLS (2014)

Since growth in information and communications technology (ICT) investment contributes to labour productivity growth, tracking developments and trends in ICT investment in Canada, and between Canada and the United States, can shed light on an important driver of productivity growth.

This report examines trends in information and communication technology (ICT) investment in Canada and the United States between 1987 and 2013 and developments in the Canada-U.S. ICT investment gap. It is based on an updated version of the Centre for the Study of

[1] This report was prepared by Jasmin Thomas under the supervision of Andrew Sharpe for Industry Canada. For comments, please email jasmin.thomas@csls.ca or andrew.sharpe@csls.ca. The author would like to thank Karine Landry from Industry Canada and her colleagues for comments. The author would also like to thank Matthew Calver for editorial comments.

Living Standards (CSLS) ICT database, reflecting newly released figures.[2] This report focuses on nominal and real ICT investment growth in the business sector, highlighting the effects of the trends in these indicators on the Canada-U.S. ICT investment gap.[3]

The report is structured as followed. Section 2 discusses the data and methodology used during the analysis. Section 3 examines trends and developments in ICT investment in Canada for the total economy for the 2000 to 2013 period. Section 4 undertakes an examination of the trends and developments in Canada and the United States for ICT investment in the business sector (since total economy estimates are not available for the United States). It also investigates the trends and developments in the Canada-U.S. ICT investment gap indicators.

[2] The CSLS database is available at no charge online at: http://www.csls.ca/data/ict.asp. The database provides current and constant price estimates of ICT investment and capital stock by two-digit NAICS industries for three ICT components for the 1980-2013 period for Canada, and the 1987-2013 period for the United States.

[3] For more from the CSLS on ICT, see the following reports: Sharpe, 2005, 2006 and 2010; CSLS, 2008; Sharpe and Arsenault, 2008; Sharpe and De Avillez, 2010; Sharpe and Moeller, 2011; Sharpe and Andrews, 2012; Capeluck, 2012 and 2013.

II. Data and Methodology

The data in this report are drawn from the ICT database for Canada and the United States, developed and maintained by the CSLS. This database is based on estimates of investment and capital stock produced by Statistics Canada and the U.S. Bureau of Economic Analysis. The database provides estimates of ICT investment and ICT capital stock in Canada and the United States by industry. There are 19 two-digit North American Industry Classification System (NAICS) sectors in the US database and 20 two-digit NAICS sectors in the Canadian database.[4] Estimates are also available for total investment and capital stock on a per worker basis. All estimates are expressed in both nominal terms (current dollars) and real terms (chained 2007 dollars in the Canadian database and chained 2009 dollars in the US database). The data are broken down into the three components of ICT: computers, communications equipment, and software.

Total ICT estimates are available from 1980 to 2013 for Canada and 1987 to 2013 for the United States. ICT estimates by industry are available in the United States for 1987 to 2013, but ICT investment per worker estimates by industry are only available for 2002 to 2013. ICT estimates for the majority of the industries are not available in Canada due to privacy policies. Given the time frames discussed above, comparisons between Canada and the United States are made for the period between 1987 and 2013 for the majority of the measures. Since employment by two-digit NAICS industry in the United States is only available starting in 2002, comparisons are undertaken between 2002 and 2013 for industry-level per worker ICT investment. The database is based on information collected primarily from Statistics Canada's CANSIM flows and stocks of fixed, non-residential capital stock tables and the U.S. Bureau of Economic Analysis' fixed asset tables.

Updating the CSLS ICT database is a complex procedure, requiring a number of decisions related to sources and methodology. Below is a brief summary of some of the decisions and key issues. These issues and decisions are discussed in further detail in the body of the report, unless otherwise noted.

- Total ICT investment by industry in Canada is not published due to the confidentiality constraints presented by the Statistics Act. As such, to determine total ICT investment by industry, the estimates for computer, communications and software ICT investment must be aggregated. Unfortunately, for some industries, data on certain ICT investment components (particularly communications investment) has been suppressed. In 2006, 14 industries out of 20 had information on total ICT investment, while in 2013 this number dropped to 6.

- The estimates for nominal and real total ICT investment in both Canada and the United States must also be aggregated manually. Nominal aggregation is straightforward. However, given the specific properties of real estimates, a procedure using Fisher

[4] The United States has 19 two-digit NAICS industries in the CSLS database because information on public administration (government) is not available.

relatives was implemented to ensure appropriate aggregation. However, estimates using the Fisher relative approach are approximate (Appendix 2).

- The CSLS ICT database adopted a Statistics Canada definition of the business sector and the non-business sector, which defines the business sector as the total economy, excluding three two-digit NAICS industries, namely health care and social assistance, educational services, and public administration. For consistency, the same definition was used when constructing the U.S. business sector estimates. It should be noted that there is a second definition of the business sector based on the marketable and non-marketable industries within the NAICS classification system. This definition of the business sector has not been employed because of the difficulty of obtaining a breakdown of business and non-business employment, investment and capital stock by NAICS code in the United States. One example of the impact of this change is that previous CSLS ICT databases used official estimates of business sector employment for the U.S. However, these estimates would have included private practitioners in the health care and educational services sectors. In order to ensure consistency when analyzing business sector per worker ICT investment in this report, new estimates have been constructed that exclude all employment, whether private or public, in health care and educational services in both countries.[5]

- The purchasing power parity exchange rate for machinery and equipment no longer contains software, as intellectual property has become a unique category. The CSLS has not undertaken the construction of a composite purchasing power parity exchange rate to reflect ICT. Hence, the purchasing power parity exchange rate for machinery and equipment is used as a proxy for the ICT purchasing power parity exchange rate.

- Both Statistics Canada and the U.S. Bureau of Economic Analysis undertake revisions to their estimates of ICT investment and capital stock. The impact of these revisions can be quite substantial, especially when it is reflected in the relative measure of ICT investment between Canada and the U.S. (Appendix 1).

- The database on ICT investment in Canada has information on total economy investment (business and non-business sectors combined). Unfortunately, the database on ICT investment in the United States only contains information on ICT investment in the business sector, as estimates for the public sector in the United States are not produced. Hence, the comparison between the two countries can only be performed at the level of the business sector, which excludes health care, educational services and public administration (government).

[5] Changing the employment estimates from official business sector estimates to estimates that exclude all heath care, educational services and public administration employment result in an upward shift in total nominal ICT investment per worker: employment decreased by approximately 7 to 11 per cent in each year between 1987 and 2013 because of the large number of persons in the business sector labour force that are now excluded from CSLS estimates, with an average decrease of 8.63 per cent. As a result, total nominal ICT investment per worker increased by approximately 8 to 11 per cent in each year between 1987 and 2013.

III. An Overview of ICT Investment in Canada

This section aims to provide an overview of recent developments in information and communication technology (ICT) investment in Canada. Special attention will be paid to 2013, in the context of the period between 2000 and 2013. An updated database of ICT investment in Canada, developed and maintained by the Centre for the Study of Living Standards (CSLS), is used for the analysis.

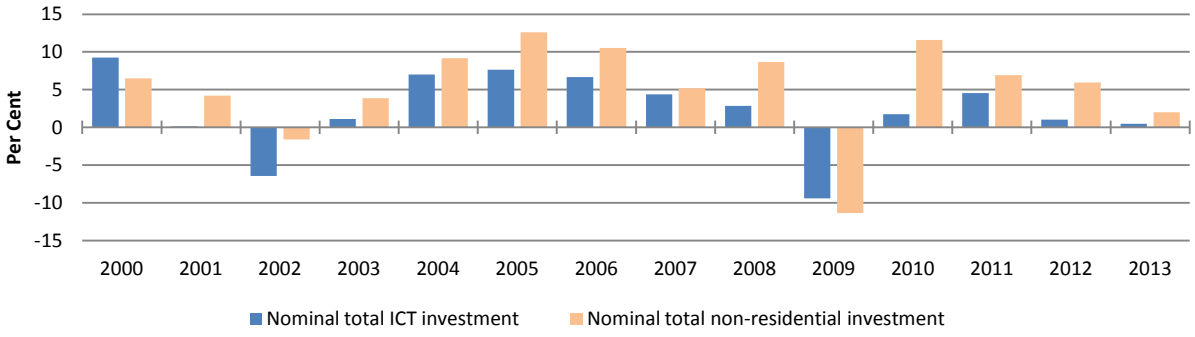
This section has three subsections, all of which focus on analyzing the three components of ICT investment (computers, communication equipment, and software). The first subsection reviews trends in nominal ICT investment in Canada. The second subsection reviews developments in ICT investment prices by ICT component. The third subsection analyzes major developments in real ICT investment.

A. Nominal ICT Investment

i. Total Economy Nominal ICT Investment

In 2013, nominal total ICT investment spending in Canada rose to $40.62 billion from $40.43 billion in 2012, growing 0.47 per cent (Chart 2 and Table 1). This rate of growth is quite weak: it is smaller than the rates of growth in 2012 (1.03 per cent) and 2011 (4.55 per cent); it is also lower than the compound average annual growth rate between 2000 and 2013 (1.55 per cent). In addition, the rate of growth in nominal total ICT investment spending was lower in 2013 than the rate of growth in nominal total economy fixed, non-residential investment (2.00 per cent).

Chart 2: Nominal Total ICT Investment and Nominal Fixed Total, Non-Residential Investment in Canada, Annual Growth, 2000-2013



Source: CSLS ICT Database, Summary Tables

Due to the lowered expectations concerning the profitability of investments and the difficult borrowing conditions brought upon by the recession, nominal total ICT investment plunged 9.42 per cent in 2009. As a result of the magnitude of the damage caused by the recession, nominal total ICT investment has yet to regain the peak of $41.52 billion exhibited in 2008.

Table 1: Growth in ICT Investment in the Total Economy in Canada, 2000-2013				
Year or Time Horizon	Total	Computers	Communications	Software
Nominal ICT Investment Growth (Annual or Average Annual Per Cent)				
2012	1.03	-2.60	2.39	2.33
2013	0.47	-8.45	-0.07	4.70
2000-2008	2.82	1.51	-2.84	7.02
2008-2013	-0.44	-5.91	-0.95	2.55
2000-2013	1.55	-1.41	-2.12	5.28
Nominal ICT Investment Per Worker (Annual or Average Annual Per Cent)				
2012	-0.13	-3.72	1.21	1.15
2013	-0.79	-9.61	-1.33	3.38
2000-2008	0.95	-0.33	-4.60	5.08
2008-2013	-1.17	-6.60	-1.68	1.80
2000-2013	0.13	-2.79	-3.49	3.80
Growth in ICT Prices (Annual or Annual Average Per Cent)				
2012	-1.23	-6.83	-0.05	1.11
2013	-0.57	-5.80	0.58	1.37
2000-2008	-5.53	-11.46	-4.49	-1.82
2008-2013	-2.22	-8.78	-1.16	0.75
2000-2013	-4.27	-10.44	-3.22	-0.84
Real ICT Investment Growth (Annual or Average Annual Per Cent)				
2012	2.29	4.54	2.44	1.21
2013	1.05	-2.82	-0.65	3.29
2000-2008	8.84	14.65	1.73	9.00
2008-2013	1.82	3.15	0.21	1.79
2000-2013	6.09	10.08	1.14	6.17
Real ICT Investment Per Worker Growth (Annual or Average Annual Per Cent)				
2012	1.11	3.34	1.26	0.04
2013	-0.22	-4.04	-1.90	1.98
2000-2008	6.87	12.57	-0.12	7.02
2008-2013	1.07	2.39	-0.53	1.04
2000-2013	4.60	8.54	-0.28	4.68
Employment (Annual or Average Annual Per Cent)				
2012	1.16			
2013	1.28			
2000-2008	1.85			
2008-2013	0.74			
2000-2013	1.42			

Source: CSLS ICT Database, Summary Tables

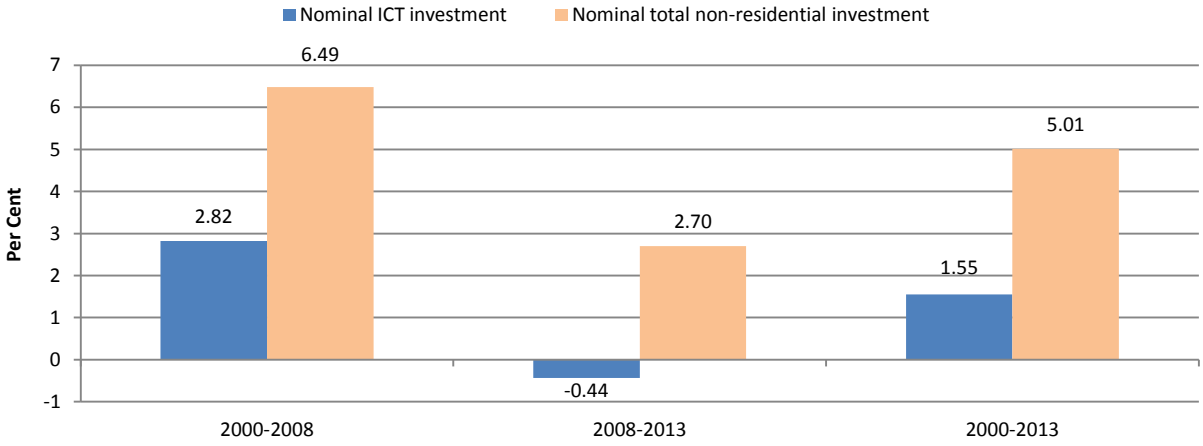
Growth in the first part of the 21st-century (2000-2008) was substantially larger than growth in the latter part (2008-2013). In particular, nominal total ICT investment growth was negative between 2008 and 2013, compared to positive growth between 2000 and 2008 (-0.44 per cent per year and 2.82 per cent per year respectively).

Nominal total fixed, non-residential investment has grown more rapidly than nominal total ICT investment over the period between 2000 and 2013 (5.01 per cent versus 1.55 per cent) (Chart 3). Between 2000 and 2013, nominal total fixed, non-resident investment grew at a compound average annual rate of 5.01 per cent, considerably faster than nominal total ICT investment growth in the same period (1.55 per cent). Nominal total ICT investment has slowed dramatically since 2008: between the two periods under consideration (2000-2008 and 2008-2013), nominal total ICT investment slowed from an annual rate of 6.49 per cent to 2.70 per cent.

In contrast to post-2000 patterns, from 1981 to 2000, nominal total ICT investment was growing at a much faster rate than nominal total fixed non-residential investment (9.37 per cent versus 4.67 per cent) (Chart A3.1).[6] As a result, ICT's share of nominal total fixed non-residential investment grew from 8.59 per cent in 1981 to 19.77 per cent in 2000. Between 2000 and 2013, however, nominal total fixed, non-residential investment has grown more rapidly than nominal total ICT investment. Consequently, ICT's share of nominal total fixed, non-residential investment fell by 6.98 percentage points from 19.77 per cent in 2000 to 12.79 per cent in 2013.

ICT's falling share of nominal total fixed, non-residential investment may, however, give a misleading impression of the state of ICT investment in Canada: even though nominal total ICT investment has grown much more slowly since 2000 compared to previous decades, real ICT investment growth has been fairly strong due to continuously falling ICT prices. Trends in real total ICT investment will be discussed in more detail in the third subsection.

Chart 3: Nominal ICT Investment and Nominal Total Fixed, Non-Residential Investment in Canada, Compound Average Annual Growth, 2000-2013



Source: CSLS ICT Database, Summary Tables

ii. Nominal ICT Investment in the Business and Non-Business Sectors

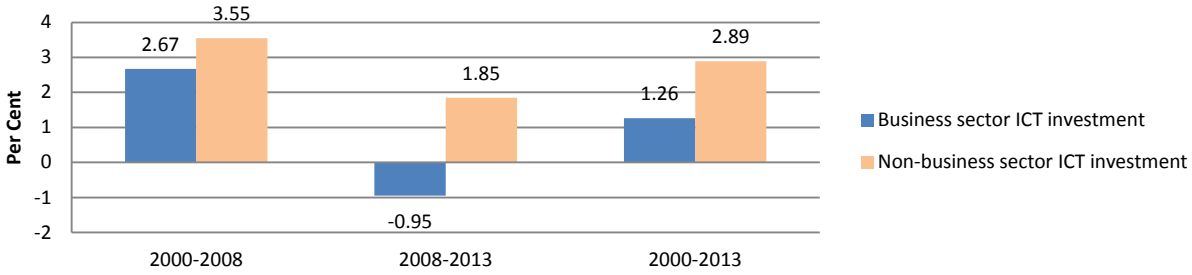
The total economy can be divided into the business and non-business sectors. The business sector represents approximately four-fifths of total economy GDP and includes industries whose outputs are marketed. The non-business sector, on the other hand, includes industries and activities whose outputs are generally not marketed. This section uses the CSLS ICT database's definitions for the business and non-business sectors, which are taken from Statistics Canada's Fixed Capital Flows and Stocks Program,[7] which defines the non-business

[6] Chart numbers that begin with 'A' are found in the Appendix. 'A1' refers to Appendix 1, 'A2' refers to Appendix 2 and 'A3' refers to Appendix 3.

[7] Statistics Canada. Table 031-0003 – Flows and stocks of fixed non-residential capital, by sector of North American Classification System (NAICS) and asset, Canada, annual (dollars), CANSIM (database). Retrieved at: http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0310003&paSer=&pattern=&stByVal=1&p1=1&p2=-1&tabMode=dataTable&csid=

sector as the aggregate of three two-digit NAICS industries: public administration, health care and social assistance, and educational services. The business sector is defined as the aggregate of the remaining two-digit NAICS industries.

Chart 4: Nominal ICT Investment by Sector in Canada, Current Dollars, Compound Average Annual Growth, 2000-2013



Source: CSLS ICT Database, Summary Tables

In 2013, the increase of 0.47 per cent in nominal total ICT investment in the Canadian economy was driven entirely by an expansion of nominal ICT investment in the business sector, as nominal ICT investment in the non-business sector declined. In particular, in 2013, nominal total ICT investment registered 0.73 per cent growth in the business sector, increasing to $32.69 billion from $32.45 billion in 2012, while nominal total ICT investment in the non-business sector fell 0.57 per cent to $7.94 billion from $7.98 billion in 2012 (Chart A3.2). The business sector's growth rate in 2013 (0.73 per cent) is smaller than the compound average annual growth rate in the business sector between 2000 and 2013 (1.26 per cent), but not alarmingly smaller. In contrast, the non-business sector's growth rate in 2013 (-0.57 per cent) is unusual, since the compound average annual growth rate between 2000 and 2013 in the non-business sector is 2.89 per cent (even after the 18.61 per cent decline in 2002) (Charts 4 and 5).[8]

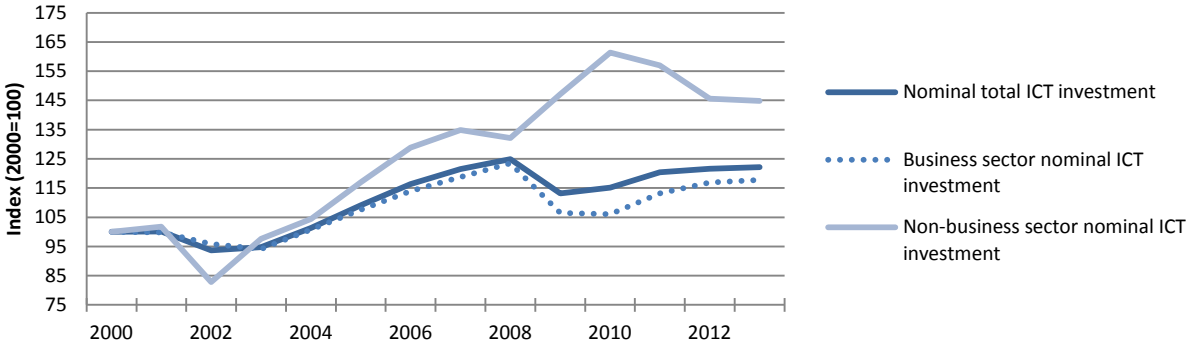
Unlike nominal total ICT investment growth in the business sector, nominal total ICT investment in the non-business sector was countercyclical in 2009, growing 11.31 per cent, compared to a 13.80 per cent decline in the business sector. This trend continued to hold in 2010, where non-business sector growth registered at 9.69 per cent, while business sector growth was still negative (-0.41 per cent). The trend reversed in 2011, with growth of 6.73 per cent in the business sector and a decline of 2.69 per cent in the non-business sector. This pattern of negative growth in the non-business sector and positive growth in the business sector continues up to 2013.[9]

[8] The business sector contributed 0.59 percentage points to the growth of nominal total ICT investment in the total economy, while the non-business sector contributed -0.11 percentage points (Chart A3.2 and Chart A3.3). In 2013, the business sector's contribution to nominal total ICT investment growth in the overall economy (123.94 per cent) was disproportionately large relative to its share of the level of nominal total economy ICT investment (80.46 per cent). The business sector contributed a disproportionately large amount to total economy nominal ICT investment growth because nominal ICT investment in the business sector grew much faster than nominal ICT investment in the non-business sector (0.73 per cent versus -0.57 per cent).

[9] The non-business sector positively contributed to nominal total ICT investment growth in 2009 and 2010, but it diminished nominal total ICT investment growth from 2011 to 2013. It is likely that the strength of non-business

As noted above, in 2013, the level of non-business sector nominal total ICT investment was much smaller than the level of business sector nominal total ICT investment (Chart A3.4). The business sector's share of nominal total ICT investment in the total economy has fallen from 86.90 per cent in 1981 to 83.51 per cent in 2000 and 80.46 per cent in 2013, which implies that non-business sector nominal total ICT investment is becoming a more important source of ICT investment growth.

Chart 5: Trends in Nominal ICT Investment by Sector in Canada, 2000=100, 2000-2013



Source: CSLS ICT Database, Summary Tables

Faster growth in the non-business sector compared to the business sector is quite surprising for a couple of reasons. First, the non-business sector faces little competition, and therefore, it has little incentive to innovate or increase productivity, while in contrast, the business sector faces huge incentives to invest in productivity (to which ICT investment greatly contributes) in order to increase profitability. Second, the non-business sector is often plagued by budget cuts, which can greatly diminish investment. However, despite these reasons, the numbers between 2000 and 2013 do not demonstrate this pattern.

iii. Nominal ICT Investment by Component

Total ICT investment consists of three components: investment in computers, investment in communication equipment, and investment in software. Software represents the largest proportion, accounting for approximately 58.75 per cent of total ICT investment in 2013.[10] In 2013, nominal computer ICT investment fell 8.45 per cent to $9.47 billion, from $10.34 billion in 2012 (Table 1). Nominal computer ICT investment has yet to regain its high of $12.84 billion in 2008. Nominal communication equipment ICT investment fell 0.07 per cent to $7.29 billion from $7.30 billion in 2013. Nominal communication equipment ICT also has not regained its peak from the dot-com boom in 2000. Nominal software ICT investment grew 4.70 per cent in 2013 to $23.87 billion from $22.80 billion in 2012. Nominal software ICT investment surpassed its 2008 peak in 2010, fully recovering from the recession after one year (Charts 6, 7, and A3.5).

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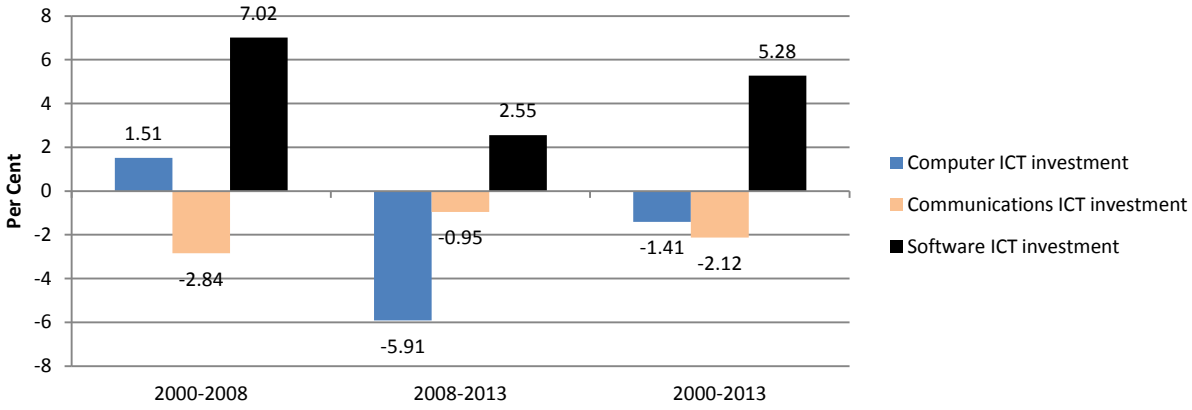
sector nominal total ICT investment in 2009 and 2010 was partially due to the Canadian governments' countercyclical policies.

[10] For more information on software ICT investment and the subcomponents of software ICT investment, see Sharpe (2014).

The pattern of ICT investment growth by component exhibited in 2013 is similar to the pattern of growth by component demonstrated by the compound average annual growth rates between 2000 and 2013. Nominal computer ICT investment fell by 1.41 per cent per year, nominal communications ICT investment fell by 2.12 per cent per year, and nominal software ICT investment grew by 5.28 per cent per year. Within this time horizon, there are a few years that exhibit differences, such as 2011 and 2012. However, for the majority of the period between 2000 and 2013, annual growth rates were positive for nominal software ICT investment, while annual growth rates were negative for nominal communications ICT investment. Nominal computer ICT investment is less consistent, showing negative growth rates in most years since 2008, but growing in most years between 2002 and 2008.

Chart 6: Nominal ICT Investment by Component in Canada, Current Dollars, Compound Average Annual Growth, 2000-2013

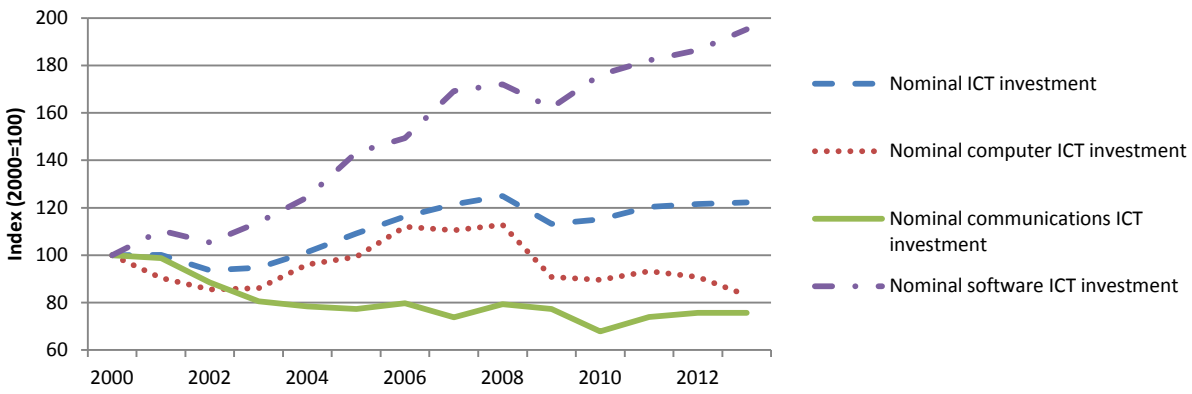


Source: CSLS ICT Database, Summary Tables

In 2013, nominal software ICT investment was by far the biggest ICT investment component, comprising 58.75 per cent of nominal total ICT investment (Chart A3.8). Nominal computer ICT investment accounts for 23.30 per cent of nominal total ICT investment, while nominal communications ICT investment represents 17.95 per cent of nominal total ICT investment. Software was not always the most important component of nominal total ICT investment. In fact, nominal software ICT investment accounted for only 17.68 per cent of nominal total ICT investment in 1981, while nominal computer ICT investment accounted for 40.79 per cent and nominal communication equipment ICT investment accounted for 41.53 per cent. Relative to its 1981 share of nominal total ICT investment, software's importance grew significantly as nominal software ICT investment grew to 22.26 times its 1981 value by 2013, while nominal communication equipment ICT investment was merely 2.89 times its 1981 value by 2013 and nominal computer ICT investment's 2013 value was only 3.82 times larger than its 1981 value.[11]

[11] Of the total 0.47 per cent growth in nominal ICT investment in 2013, computer ICT investment contributed -2.16 percentage points, communications ICT investment contributed -0.01 percentage points and software ICT investment contributed 2.65 percentage points. These numbers are consistent with ICT contributions since 2000. Between 2000 and 2013, of the total 1.55 per cent compound average annual growth, computer ICT investment

Chart 7: Trends in Nominal ICT Investment by Component in Canada, 2000=100, 2000-2013



Source: CSLS ICT Database, Summary Tables

iv. Nominal ICT Investment by Industry

Total ICT investment data was only available for six of the twenty two-digit NAICS industries for which the CSLS collects data because data on communications equipment investment in some industries is suppressed by Statistics Canada to meet the confidentiality requirements of the Statistics Act.[12] Nevertheless, ICT investment increased in four of the six NAICS industries for which total ICT investment data are available (Chart 8). There was substantial variation in the growth rates of nominal ICT investment by industry in 2013.

The industry with the highest growth in ICT in 2013 was finance and insurance (11.79 per cent). This was followed by manufacturing (6.34 per cent), professional, scientific and technical services (2.76 per cent) and public administration (2.52 per cent). The educational services industry exhibited the poorest performance in ICT investment in 2013, down 7.88 per cent from the previous year. Information and cultural industries also demonstrated negative growth, registering -0.82 per cent.[13]

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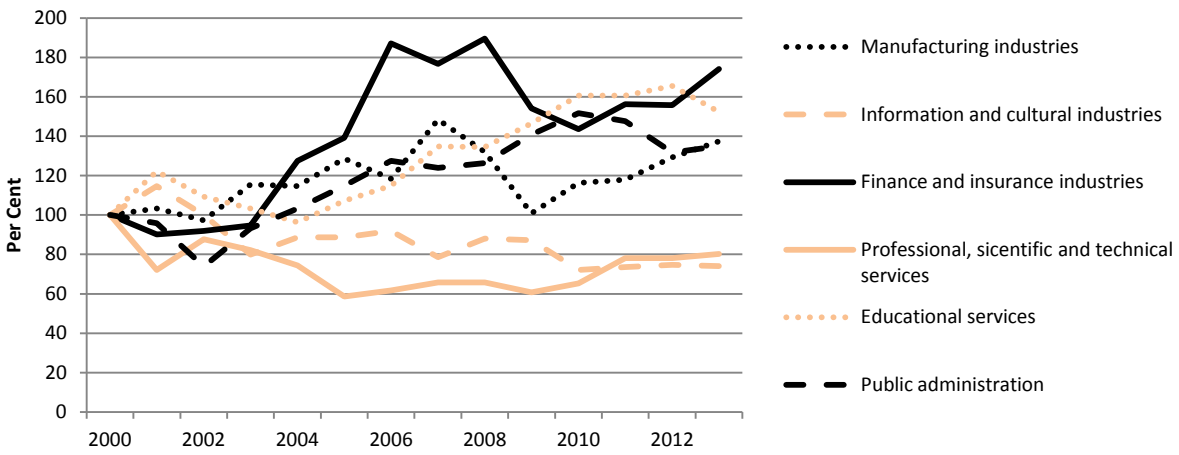
contributed -0.40 percentage points and communication ICT investment contributed -0.49 percentage points, while software contributed 2.45 percentage points. Between 2000 and 2008, nominal computer ICT investment differs from the above pattern, since it contributed 0.49 percentage points to total nominal ICT investment growth. Nevertheless, between 2008 and 2013, the pattern of negative contributions in computers and communications ICT investment and positive contributions in software ICT investment continues (Charts A3.6 and A3.7).

[12] Results by industry are becoming increasingly less available over time. In 2006, there was information on ICT investment for 14 industries. This number dropped to 13 in 2008, 12 in 2009 and by 2013 it was only six.

[13] For detailed information on the levels of ICT investment by industry, see the CSLS database. For a detailed discussion of software ICT investment by industry, see Sharpe (2014).

Chart 8: Trends in Nominal ICT Investment by Industry in Canada, Current Dollars, 2000=100, 2000-2013



Source: CSLS ICT Database, Summary Tables

In the last decade, three industries demonstrated fairly consistent increases in nominal ICT investment levels: educational services, finance and insurance industries and public administration. Given the previous observation concerning business and non-business sector ICT investment growth performance, it is not surprising that two of the three industries demonstrating high ICT investment growth are non-business. The third industry showing strong ICT investment growth between 2000 and 2013 is a business sector industry (finance and insurance), but it was by far the hardest hit by the recession and has yet to regain its peak ICT investment level from 2008. Manufacturing industries also demonstrated increases in ICT investment levels compared to 2000, while professional, scientific and technical services, and information and cultural industries actually exhibited an overall decline in ICT investment between 2000 and 2013 (Chart 8).

v. Nominal ICT Investment as a Share of GDP[14]

In 2013, nominal total economy ICT investment accounted for 2.30 per cent of nominal GDP, down 0.06 percentage points from 2012, despite rising investment. Nominal ICT investment was a lower share of nominal GDP, because nominal GDP increased 2.00 per cent, while nominal ICT investment increased only 0.47 per cent (Chart 9 and Chart A3.10).

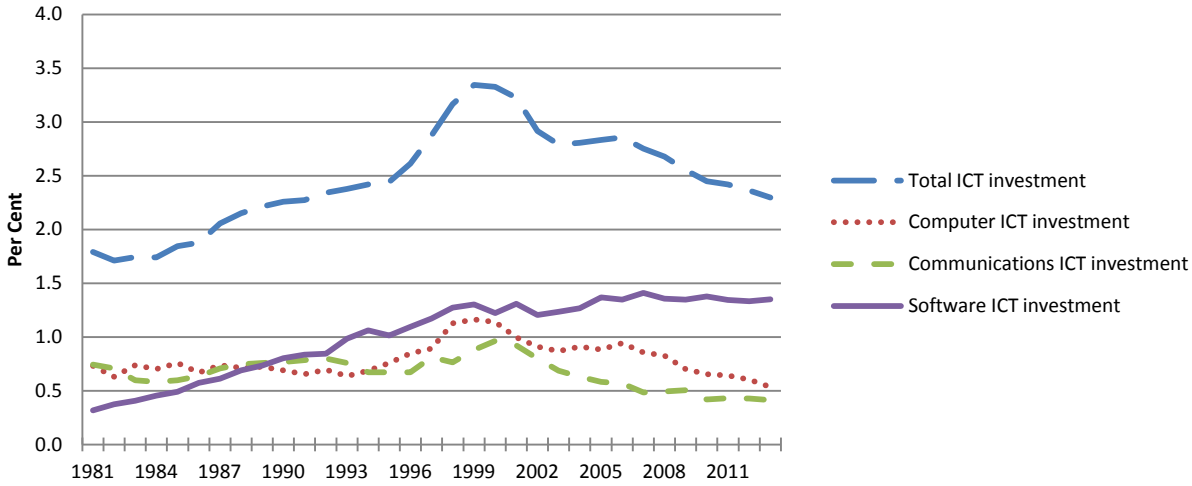
Total nominal ICT investment as a proportion of GDP was relatively stable between 1981 and 1986, fluctuating between 1.71 and 1.88 per cent (Chart 9). In 1987, it surpassed two per cent. Between 1987 and 1999, nominal ICT investment as a percentage of nominal GDP grew every year. In 1999, nominal ICT investment as a share of nominal GDP reached its peak, representing 3.34 per cent. After 1999, the share of nominal ICT investment in nominal GDP fluctuated, but generally followed a downward trend. In 2013, total nominal ICT investment as a share of GDP is at its lowest level since 1991, well below the peak of 3.34 per cent in 1999. These trends in nominal ICT investment as a share of nominal GDP reflect relative trends in ICT investment and nominal GDP.

In 2013, nominal total software ICT investment as a proportion of GDP was 1.35 per cent. The share of nominal total software ICT investment in total nominal GDP has remained relatively stable since 2005, fluctuating between 1.33 and 1.41 per cent. Nominal communications equipment ICT investment represented 0.41 per cent of total GDP in 2013, down 0.02 percentage points from 2012. Since 2007, the share of communications equipment ICT investment in total nominal GDP has been steady, fluctuating mildly between 0.41 and 0.51 per cent. Nominal computer ICT investment accounted for 0.53 per cent of total nominal GDP in 2013. Since 2007, nominal computer ICT investment as a share of nominal total GDP has been consistently declining, falling from 0.94 per cent in 2007 to its current level of 0.53 per cent. Nominal computer ICT investment as a proportion of nominal total GDP has not been this small

[14] In general, nominal ICT investment better reflects the share of resources devoted to ICT investment in the economy because real ICT investment by definition is a function of relative prices and relative prices can greatly impact the GDP shares estimates (e.g. using 1941 prices, agriculture would represent nearly half of the economy, while using nominal prices decreases its share to less than five per cent). Nevertheless, growth accounting uses real growth in calculating the contribution of investment to productivity growth. Hence, below is a brief discussion of real ICT investment as a proportion of GDP. In 2013, real ICT investment expressed as a proportion of real GDP fell 0.03 percentage points to 2.89 per cent. Real ICT investment as a share of GDP grew steadily between 1981 and 2012, temporarily dipping lower only in 2002 and 2009. The rising real share of ICT investment reflects the impact of falling ICT prices. Real software ICT investment as a share of GDP and real computer ICT investment as a share of GDP have continually increased since 1981. Real computer ICT investment as a share of GDP reached a peak in 2012 at 1.07 per cent (it has dipped to 1.02 per cent in 2013). Real software ICT investment as a share of GDP reached a peak of 1.41 per cent in 2013 (it had also reached this peak in 2007, prior to the economic collapse). In contrast, real communications ICT investment as a share of GDP has been fluctuating between 0.44 and 0.52 since it reached its peak of 0.54 per cent in 2000 (Chart A3.25). The rise in real investment in computers as a proportion of GDP is the most dramatic, as it is 102 times larger than in 1981. Real software investment as a share of GDP has also demonstrated surprising growth, as it is 15.67 times larger than it was in 1981. Growth in real communications ICT investment as a proportion of GDP is much less impressive, since it is only 1.63 times larger than it was in 1981. Real business sector ICT investment as a proportion of business sector GDP was 2.87 per cent in 2013, down 0.03 percentage points since 2012. Non-business sector real ICT investment accounted for 3.10 per cent of GDP in the same year, up 0.06 percentage points since 2012. In the non-business sector, real investment as a share of GDP grew every year from 1997 until 2010, excluding 2002, 2008, 2011 and 2012. In the business sector, real investment as a share of GDP has grown steadily since 1982, with exceptions in 2002, 2009 and 2013. Since 2003, the share of the non-business sector has been higher than that of the business sector, excluding 2008 (Chart A3.26).

since 1980. It is important to note that the 2013 figure for nominal software ICT investment as a share of nominal total GDP is 3.29 times higher than that of communications equipment and 2.55 times higher than that of computer equipment.

Chart 9: Trends in Total ICT Investment and ICT Investment by Component as a Proportion of GDP in Canada, Current Dollars, Per Cent, 1981-2013



Source: CSLS ICT Database, Summary Tables

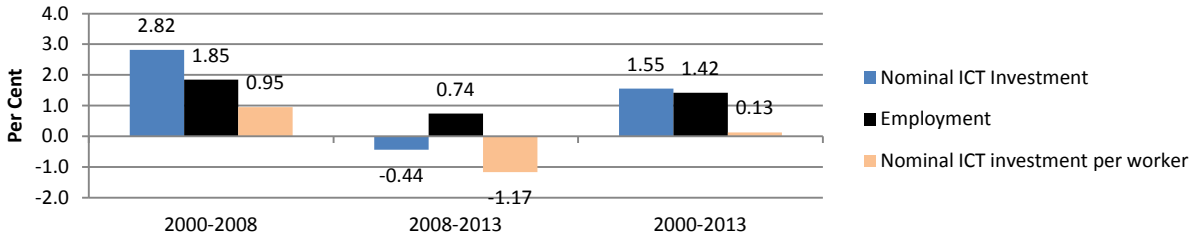
vi. Nominal ICT Investment per Worker

Nominal total ICT investment intensity is defined as nominal total ICT investment divided by the number of persons employed, with employment obtained from the Labour Force Survey. Nominal ICT investment per worker is important because ICT per worker affects labour productivity. In 2013, nominal total ICT investment increased by 0.47 per cent, while the number of people employed increased by 1.28 per cent (Chart A3.11). Hence, nominal total ICT investment per worker declined by 0.79 per cent (Table 1). Between 2000 and 2013, the compound average annual growth rate was only 0.13 per cent, directly reflecting the fact that the growth rate of nominal ICT investment and employment were nearly identical (1.55 per cent versus 1.42 per cent). This low compound average annual growth rate is entirely driven by poor growth between 2008 and 2013: between 2000 and 2008, compound average annual growth rates were 0.95 per cent, while between 2008 and 2013, compound average annual growth rates were -1.17 per cent (Chart 10).

Nominal total ICT investment intensity was $2,291 in 2013, lower than the peak of $2,430 in 2008. Since employment growth has been higher than nominal total ICT investment in the past two years, nominal total ICT investment intensity has registered negative growth (Table 1). Overall, growth in total ICT investment per worker has been volatile between 2000 and 2013, with a positive rate of growth in 2000, negative growth from 2001 to 2003, significant increases between 2004 and 2008, substantial losses in 2009, moderate growth in 2010 and 2011, and

negative rates of growth in 2012 and 2013 (Chart A3.11). In sharp contrast, between 1982 and 2000, nominal investment intensity consistently displayed positive growth.[15]

Chart 10: Nominal ICT Investment, Employment and Nominal ICT Investment Per Worker in Canada, Compound Average Annual Growth, 2000-2013



Source: CSLS ICT Database, Summary Tables

B. ICT Prices

By dividing the nominal estimates of ICT investment by the real estimates of ICT investment, implicit price indices can be obtained for computers, communications equipment, software and total ICT investment (Chart 11).

In 2013, prices of total economy ICT investment goods decreased by 0.57 per cent, which was a small decline compared with 2012, 2011 and 2010 (-1.23 per cent, -3.27 per cent and -7.74 per cent respectively) (Table 1 and Chart 11).[16] It was equally mild in comparison to the compound average annual decreases between 2000 and 2013 (-4.27 per cent per year), 2000 and 2008 (-5.53 per cent per year), and 2008 and 2013 (-2.22 per cent per year). The prices of ICT investment goods are adjusted downwards over time to reflect improvements in quality, so this may suggest that the rate of technology developments in ICT is slowing.[17] The price decrease in 2013 represents an extension of the long-term trend of decreasing prices, as total ICT investment

[15] In 2013, in the business sector, nominal ICT investment intensity declined by 0.66 per cent, while in the non-business sector, nominal ICT investment per worker declined by 1.47 per cent. Nominal computer ICT investment per worker decreased 9.61 per cent in 2013, while nominal communications ICT investment per worker decreased 1.33 per cent. In contrast, nominal software ICT investment per worker increased 3.38 per cent in 2013. Clearly, in 2013, component growth in ICT intensity displayed similar patterns to nominal ICT investment growth: software registers positive growth, while communications equipment and computers display negative growth. The percentage contributions of each ICT investment component to nominal total ICT investment per worker growth are not discussed, as they display a comparable pattern to their contributions to nominal total ICT investment (Chart A3.12 and A3.13).

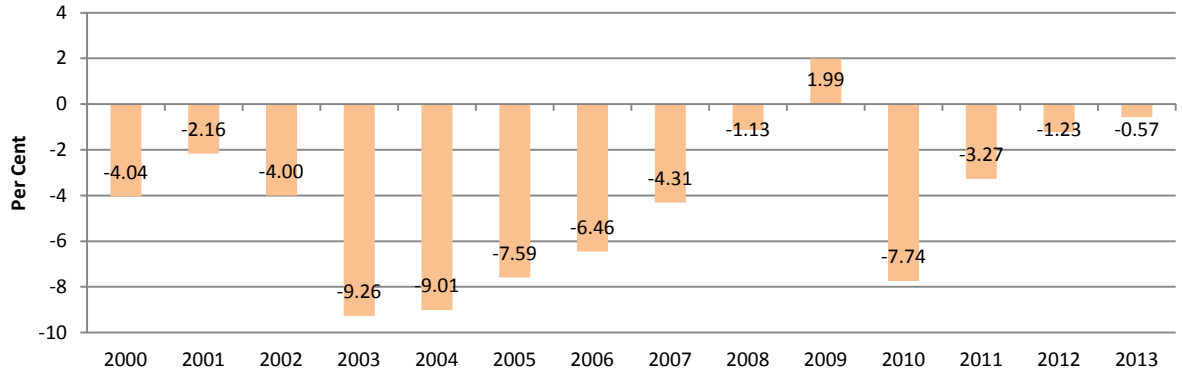
[16] ICT investment prices in the business sector fell 0.68 per cent, while ICT investment prices in the non-business sector fell 3.20 per cent in 2013. Prices in the non-business sector fell to their lowest levels yet, at 59.41 per cent of their level in 2000. Prices in the business sector also registered their lowest level to date, at 55.54 per cent of their level in 2000. Between 2000 and 2013, business sector price levels decreased by 4.42 per cent per year on average, while non-business sector prices decreased by 3.93 per cent (Chart A3.16 and A3.17).

[17] Part of the change in ICT prices in Canada reflects trends in the exchange rate. Since a large share of ICT investment goods (especially computers and communications equipment) is imported, an appreciation of the Canadian dollar lowers the price of these goods. A better indication of overall price trends for ICT goods is developments in the United States. The same trend of a lower rate of decline in ICT prices has been observed there (Chart A3.30).

prices fell to their lowest level to date. In 2013, the price level was 56.7 per cent of the price level in 2000 (Chart 12).

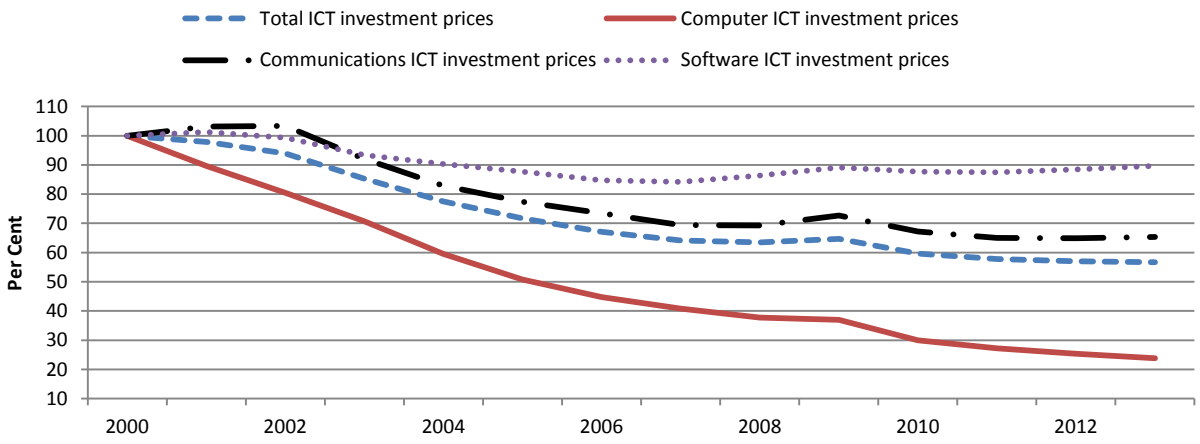
The fall in total ICT investment prices in 2013 was entirely driven by declining computer ICT investment prices (-5.80 per cent), as software and communication equipment ICT prices rose (1.37 per cent and 0.58 per cent, respectively) (Table 1). In 2013, the fall in computer ICT investment prices was slightly lower than the 2012 rate (-6.83 per cent), but significantly lower than the 2011 and 2010 rates (-9.30 per cent and -19.04 per cent, respectively) (Chart A3.15). The decline in computer ICT investment prices in 2013 was also small compared to the compound average annual decrease between 2000 and 2013 (10.44 per cent per year) (Chart 13). Communications equipment and software ICT investment prices also deviated far from the trend in 2013. During the 2000 to 2013 period, communication equipment ICT investment prices experienced a compound average annual decrease of 3.22 per cent and software ICT investment prices experience a compound average annual decrease of 0.84 per cent (Chart 13 and Chart A3.15).

Chart 11: Total ICT Prices in Canada, Annual Growth Rates, Per Cent, 2000-2013



Source: CSLS ICT Database, Summary Tables

Chart 12: ICT Investment Prices by Component in Canada, 2000=100, 2000-2013

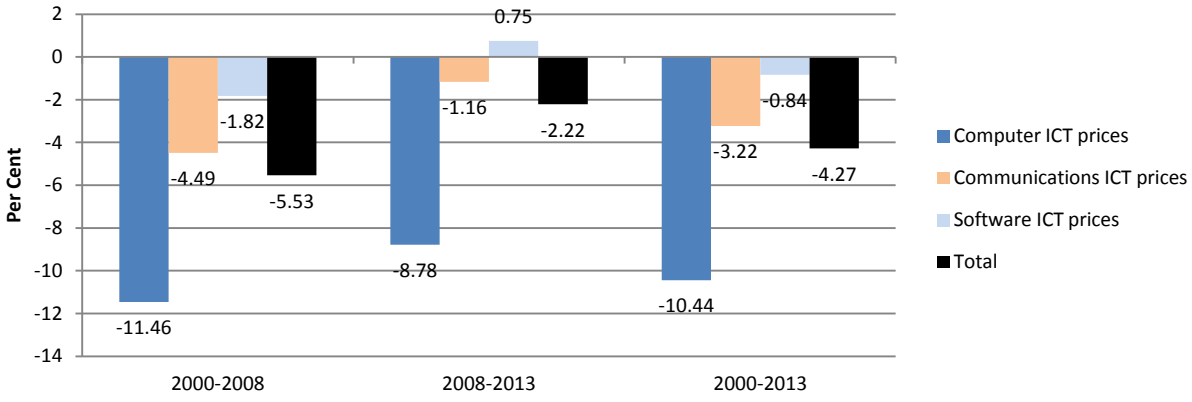


Source: CSLS ICT Database, Summary Tables

Comparing the compound average annual price changes for the ICT investment components between 2000 and 2013 reveals three key trends: prices for all ICT components have declined since 2000; computer ICT investment prices have declined the most, followed by communication equipment ICT prices; and software ICT investment prices declined only modestly between 2000 and 2013. These three key facts are also easily seen when examining trends in indexed price levels (Chart 12). In particular, in 2013, computer ICT investment prices were 23.9 per cent of the price level in 2000, whereas by 2013, communications equipment and software ICT investment prices were 65.3 per cent and 89.6 per cent of their price levels in 2000 (Chart 13).

Since nominal figures capture price and volume effects, tracking price movements when dealing with nominal figures is crucial to derive volume changes. In order to understand changes in the volume of ICT investment, the nominal figures must be adjusted for changes in ICT investment prices to produce real figures. In fact, continually dropping prices caused ICT investment to grow significantly faster in real terms than in nominal terms. Compared to nominal terms, the relative importance of the three ICT investment components to total ICT investment growth are also very different in real terms because the ICT components experienced divergent trends in their price levels. As will be demonstrated, real computer ICT investment growth differs the most from its nominal equivalent as computer ICT investment prices experienced the biggest declines.

Chart 13: ICT Prices by Component in Canada, Compound Average Annual Growth, Per Cent, 2000-2013



Source: CSLS ICT Database, Summary Tables

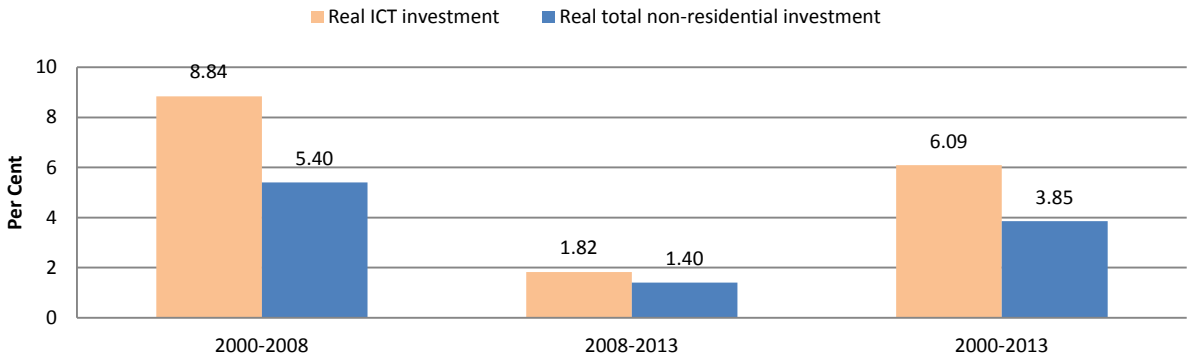
It is important to note that the decline in the price of ICT investment goods during the 2000 to 2013 period embodies both the decline in the absolute price of the components and the increase in their quality. Prices are adjusted for changes in the quality of ICT investment goods to reflect the fact that firms can purchase better products for lower levels of investment. Hence, increases in the level of real ICT investment can be the result of an increase in the quantity produced or purchased; an increase in the quality of the ICT investment goods; or an increase in both quantity and quality.

C. Real ICT Investment

When evaluating trends in ICT investment, it is important to focus on developments in real figures, because real figures represent changes in the quantity of ICT goods purchased and put into production. More importantly, it is real growth that drives real productivity growth. This subsection examines trends in real ICT investment in Canada for the total economy by looking at data measured in chained 2007 dollars.

Total real ICT investment growth rose to $45.97 billion (2007 chained dollars) in 2013 from $45.49 billion (2007 chained dollars) in 2012. As such, real total ICT investment growth in 2013 at 1.05 per cent was weak compared to its recent past performance (2.29 per cent in 2012, 8.09 per cent in 2011 and 10.30 per cent in 2010) (Table 1 and Chart A3.17). Real total ICT investment growth was also well below its compound average annual growth rate of 6.09 per cent between 2000 and 2013.

Chart 14: Real Total ICT Investment and Real Total Fixed, Non-Residential Investment in Canada, 2007 Chained Dollars, Compound Average Annual Growth Rates, Per Cent, 2000-2013



Source: CSLS ICT Database, Summary Tables

Total real ICT investment grew faster in real terms than it did in nominal terms in 2013 (1.05 per cent versus 0.47 per cent) due to the decline in investment prices (-0.57 per cent). This was true for all years between 2000 and 2013, excluding 2009 when ICT investment prices increased. Even though total fixed, non-residential investment growth surpassed total ICT investment in nominal terms, real total ICT investment outperforms real total fixed, non-residential investment, which grew at only 0.20 per cent in 2013 (Table 1 and Chart A3.17). More specifically, real total ICT investment growth (1.05 per cent) is 0.85 percentage points higher than real total fixed, non-residential investment in 2013, while nominal total ICT investment growth was 1.53 percentage points lower than nominal total fixed, non-residential investment growth.

Clearly, there is an extremely large difference between nominal and real total ICT investment growth, resulting entirely from the fact that falling ICT prices drive down estimates of nominal ICT investment growth. Real total ICT investment growth has been consistently higher (or less negative) than the growth in nominal total fixed, non-residential investment over

the entire period between 1982 and 2013. Between 2000 and 2013, real total ICT investment grew at a compound average annual rate of 6.09 per cent, considerably faster than real total fixed, non-residential investment growth in the same period (3.85 per cent per year) (Chart 14). Compared to real total fixed, non-residential investment, there was clearly a bigger fall in real ICT investment between the two periods (2000-2008 and 2008-2013), likely because ICT investment was hit harder by the recession of 2009.

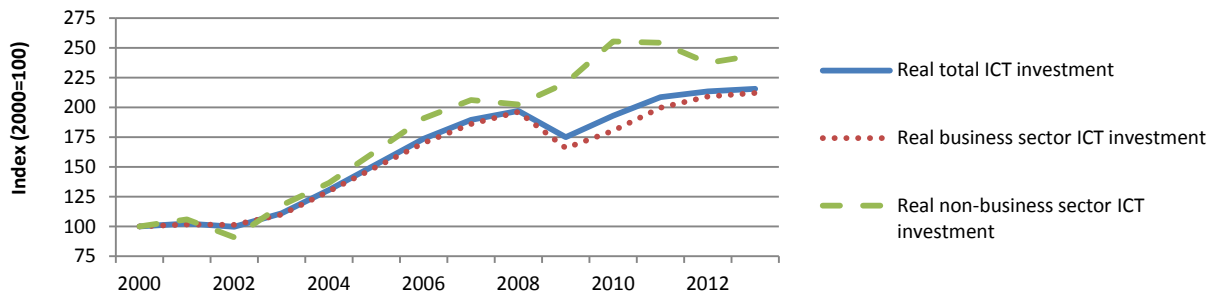
i. Real ICT Investment in Business and Non-Business Sectors

In 2013, business sector real total ICT investment grew 1.42 per cent, while non-business sector real total ICT investment grew 2.71 per cent. This does not differ from earlier trends, since the compound average annual growth rate in ICT investment in the business sector between 2000 and 2013 was lower than the compound average annual growth rates in ICT investment in the non-business sector (5.95 per cent versus 7.09 per cent) (Chart 15b and Chart A3.19). Quite simply, business and non-business sector real total ICT investment growth in 2013 is consistent with the post-2000 pattern of non-business sector ICT investment growth exceeding business sector ICT investment growth.

The non-business sector's surprising and comparatively high growth over the 2000 to 2013 period is demonstrated by Chart 15a and Chart 15b. Non-business sector real total ICT investment grew much faster than business sector real total ICT investment between 2000 and 2013, especially since 2008. In fact, non-business sector real total ICT investment was 2.44 times its level in 2000 by 2013, compared to 2.12 for business sector real total ICT investment and 2.16 for the total economy real ICT investment. Further research is required to fully understand the real total ICT investment growth gap between the business and non-business sectors experienced during the 2000 to 2013 period. [18] As previously mentioned, this more rapid growth in the non-business sector is surprising because the non-business sector has little competition, and therefore little incentive to innovate or increase productivity. Furthermore, it is often plagued by budget cuts, which can greatly diminish investment. It is not surprising that the business sector was hit harder by the recession in 2009 than the non-business sector, given the countercyclical policies that were undertaken by the Canadian government to counteract slowing economy activity.

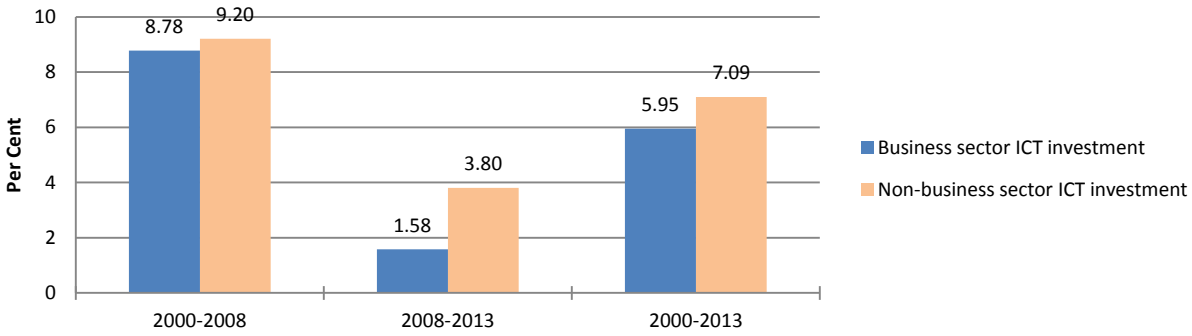
[18] Business sector ICT investment contributed 1.14 percentage points to real total ICT investment growth in the overall economy, while the non-business sector contributed 0.53 percentage points in 2013. The non-business sector contributed less than the business sector, despite growing faster than the business sector. This is because the non-business sector accounts for a very small share of the level of total ICT investment (19.64 per cent) (Chart A3.20). In general, the relative contributions of the business and non-business sectors to total economy ICT investment were very similar in real terms as in nominal terms over the 2000 to 2013 period, because the ICT price movements were quite similar for the two sectors. Business sector total ICT investment contributed the most to real total ICT investment growth due to its higher share of total economy ICT investment, but the non-business sector often contributed a more-than-proportional amount to total economy real ICT investment growth since it grew faster than the business sector real total ICT investment in most years (Chart A3.21). The contributions of each sector over any given period were calculated by taking averages of annual growth rates, not compound average annual growth rates.

Chart 15a: Trends in Real Total ICT Investment by Sector in Canada, 2000=100, 2000-2013



Source: CSLS ICT Database, Summary Tables

Chart 15b: Real ICT Investment by Sector in Canada, Chained 2007 Dollars, Compound Average Annual Growth Rates, Per Cent, 2000-2013



Source: CSLS ICT Database, Summary Tables

ii. Real ICT Investment by Component

In 2013, real ICT investment growth was negative for computers and communications equipment, while it was positive for software. In particular, real computer ICT investment decreased 2.82 per cent to $16.19 billion from $16.66 billion and real communications ICT investment decreased 0.65 per cent to $7.74 billion from $7.80 billion, while software ICT investment increased 3.29 per cent to $22.41 billion from $21.70 billion (Table 1).

The decline in real computer ICT investment in 2013 was smaller than the decline in nominal computer ICT investment (-2.82 per cent versus -8.45 per cent) (Table 1). The difference can be explained by falling computer prices (-5.80 per cent). Since nominal communication equipment ICT investment decreased in 2013 (-0.07 per cent), while communications equipment prices increased (0.58 per cent), real communication equipment ICT investment decreased by more than nominal communication equipment ICT investment (-0.65 per cent). In addition, since nominal software ICT investment increased in 2013 (4.70 per cent),

while software prices increased (1.37 per cent), real software ICT investment growth (3.29 per cent) was smaller than nominal software ICT investment growth.[19]

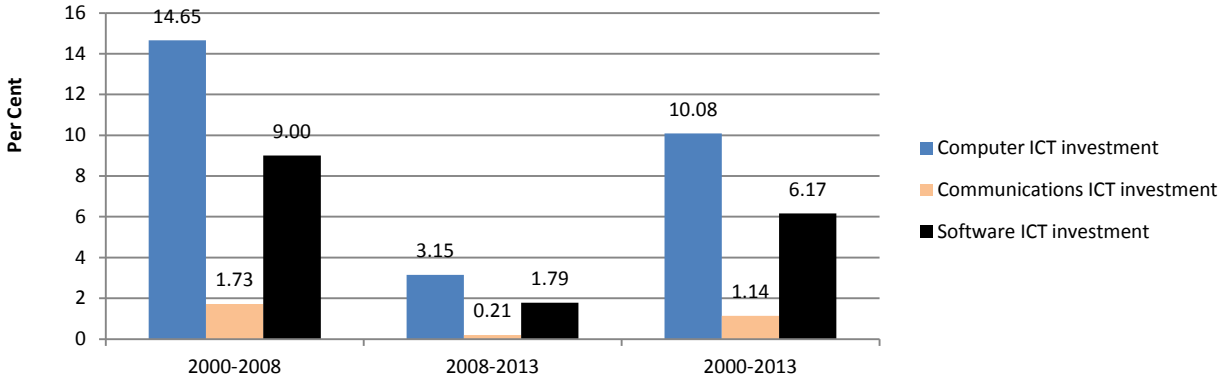
Real computer ICT investment growth is striking. Between 2000 and 2013, the compound average annual rate of growth was 10.08 per cent. More surprisingly, the rate of growth slowed by 1.50 percentage points between the 2000-2008 period and the 2008-2013 period (1.65 per cent to 3.15 per cent) (Chart 16). On the other hand, communications ICT investment compound average annual growth rates are small, since annual growth rates have not been as consistently positive as annual computer ICT investment growth rates over the 2000-2013 period. Between 2000 and 2013, the compound average annual growth rate was only 1.14 per cent for communications ICT investment. Real software investment growth between 2000 and 2013 largely follows historical trends since 1982: real software investment growth rates have been consistently positive since 1982, excluding 2002, 2008 and 2009. Between 2000 and 2013 (Chart 17), the compound average annual growth rate for software ICT investment was 6.17 per cent, with a large fall off after 2008.

Clearly, these three ICT investment components experienced very different growth rates over the 2000 to 2013 period: real computer ICT investment has grown at a much faster rate (10.08 per cent) than both real communication equipment ICT investment and real software ICT investment (1.14 per cent and 6.17 per cent, respectively). Real communication equipment ICT investment has grown at a particularly slow rate between 2000 and 2013. In fact, real computer ICT investment was 3.49 times its level in 2000 by 2013, compared to 1.16 and 2.18 for real communication equipment ICT investment and real software ICT investment, respectively.[20] Despite the fact that the three ICT components have had dissimilar growth rates, each has experienced the same general trend: a reduction in real investment in 2002, followed by growth from 2003 to 2008, a large drop in investment in 2009, strong growth in 2010 and 2011, and a slowdown in investment in 2012 and 2013.

[19] In 2013, investment in software, which contributed 1.86 percentage points to real total ICT investment growth, was the largest force behind real total ICT investment growth in Canada. On the other hand, real communication equipment ICT investment and computer ICT investment actually drew down real total ICT investment, contributing -0.12 percentage points and -0.70 percentage points to real total ICT investment growth, respectively. Their negative contributions result from their negative growth in 2013. Hence, the slowdown in real ICT investment growth in 2013 was caused by declining growth in computer and communication equipment ICT investment: the contribution of computers and communication equipment to real total ICT investment growth in 2013 was lower than in previous years and more than offset the increased contribution of software ICT investment to real total ICT investment, (Chart A3.22). The contribution of the three ICT components to real total ICT investment in the total economy was calculated using the Törnqvist index. The contributions of the three ICT components over any given period were calculated by taking averages of annual growth rates, not compound average annual growth rates.

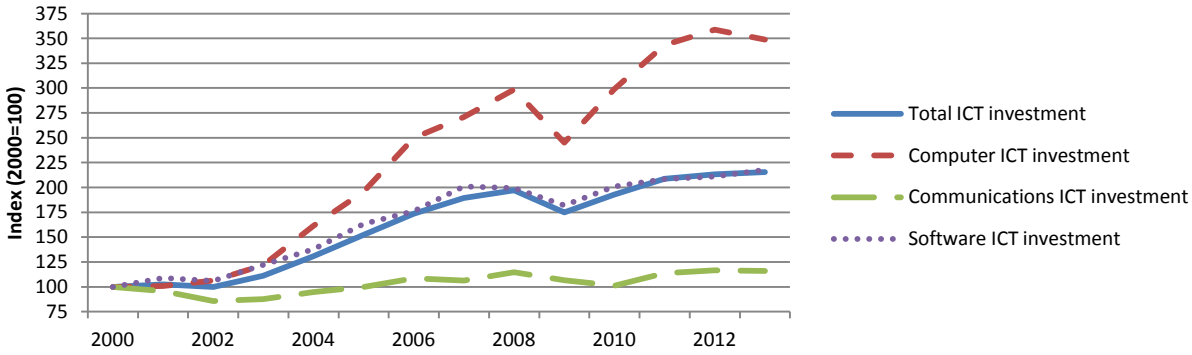
[20] Between 2000 and 2013, computer and software ICT investment contributed the most to real total ICT investment growth. Real communication equipment ICT investment, on the other hand, was a relatively insignificant contributor to real total ICT investment growth. However, this is a broad observation, and there have been years where communications equipment ICT investment has outperformed computer or software ICT investment, but it has never outperformed both. It is important to recall that real computer ICT investment growth was driven only by both high nominal growth rates and by falling prices over the reference period.

Chart 16: Real ICT Investment by Component in Canada, 2007 Chained Dollars, Compound Average Annual Growth Rates, Per Cent, 2000-2013



Source: CSLS ICT Database, Summary Tables

Chart 17: Trends in Real Total ICT Investment by Component in Canada, 2000=100, 2000-2013



Source: CSLS ICT Database, Summary Tables

iii. Real ICT Investment by Industry

There was substantial variation in the growth rates of real ICT investment by industry in 2013 (Chart A3.21), with increases in four of the six NAICS industries for which total ICT investment data are available. The industry with the highest growth in ICT was finance and insurance (11.29 per cent), followed by manufacturing (7.12 per cent), professional, scientific and technical services (5.57 per cent) and public administration (2.16 per cent). The educational services industry exhibited the poorest performance in ICT investment in 2013, down 6.87 per cent. Information and cultural industries also demonstrated negative growth, registering -0.63 per cent.

Between 2000 and 2013, each of the six NAICS industries for which data are available saw their real ICT investment grow quite quickly (Chart A3.22). The only exception was information and cultural industries, which did not demonstrate substantial growth. The finance and insurance industry and manufacturing industry saw their real ICT investment plummet

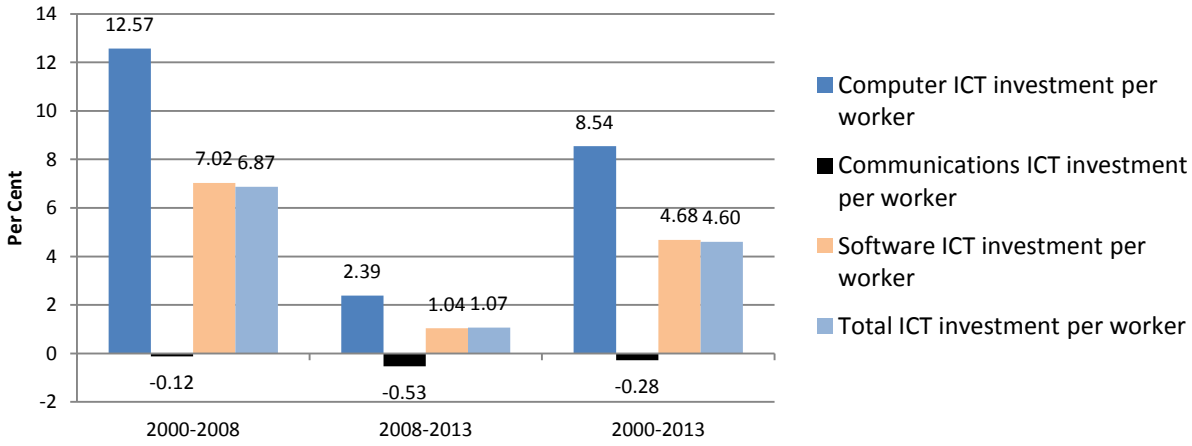
during the recession of 2009. However, both industries have recovered from the slip backwards. Public administration and educational services do not appear to have suffered greatly from the crash in 2009.

v. Real ICT Investment per Worker

Real ICT investment intensity is defined as real total ICT investment divided by the number of persons employed. In 2013, real total ICT investment per worker fell 0.22 per cent (Table 1), based on an increase of 1.05 per cent in real total ICT investment and an increase of 1.28 percent in the number of people employed. This is well below the compound average annual growth rate for the 2000-2013 period (4.60 per cent) (Charts 18 and 19). This negative growth in real total ICT investment intensity is striking, since real total ICT investment per worker has grown in every year since 1981, excluding 2002 and 2009. Real ICT investment intensity was $2,592 in 2013, down from $2,598 in 2012.

Real computer ICT investment per worker fell 4.04 per cent in 2013, after experiencing growth in 2012. Real computer ICT investment intensity was $913 in 2013, down from its highest level of $952 in 2012.[21] Real communications ICT investment per worker in 2013 fell 1.90 per cent, after experiencing growth of 10.98 per cent in 2011 and 1.26 per cent in 2012. Real communications ICT investment intensity was $437, compared to $445 in 2012. Real communications ICT investment intensity reached its peak of $449 in 2008. Real software ICT investment per worker grew 1.98 per cent in 2013: as such, real software investment intensity reached its highest level at $1,264, up from $1,239 in 2012.

Chart 18: Total and Component Real ICT Investment Per Worker in Canada, Compound Average Annual Growth, Per Cent, 2000-2013



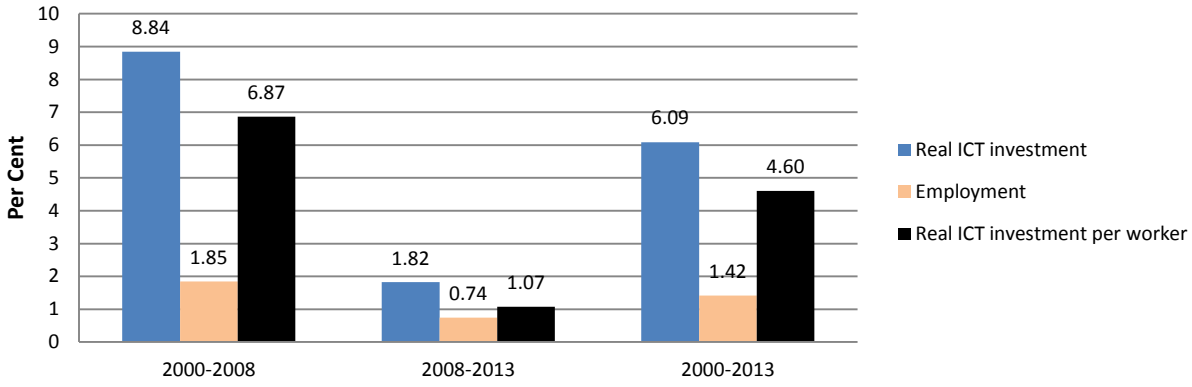
Source: CSLS ICT Database, Summary Tables

ICT investment intensity trends in chained dollars and current dollars do not necessarily demonstrate the same trends reflecting differences in component ICT prices: total ICT investment per worker in current dollars decreased by 0.79 per cent, while total ICT investment

[21] These are Canadian dollar figures.

per worker in chained dollars decreased only 0.22 per cent in 2013. This difference is driven by falling prices. Moreover, the compound average annual growth rate between 2000 and 2013 in current dollar total ICT investment intensity was only 0.13 per cent, while it was substantially higher in chained dollar total ICT investment intensity (4.60 per cent), given the fall in prices. Similarly, growth rates in nominal computer ICT investment per worker are much lower than growth rates in real computer ICT investment per worker (Table 1). However, growth rates in nominal ICT investment per worker for software and communications ICT investment are similar to growth rates in real software and communications ICT investment per worker: communications demonstrates negative growth in investment intensity, while software demonstrates positive growth in investment intensity.

Chart 19: Real ICT Investment, Employment and Real ICT Investment Per Worker in Canada, Chained 2007 Dollars, Compound Average Annual Growth Rates, 2000-2013



Source: CSLS ICT Database, Summary Tables

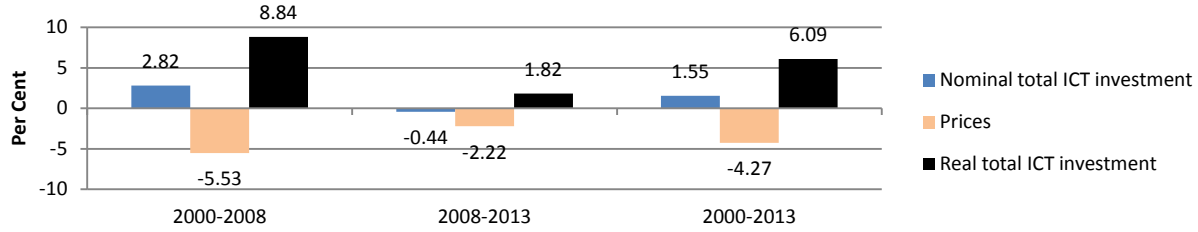
Trends in employment did not change much between the 2000-2008 period and the 2008-2013 period, falling 1.11 percentage points. In contrast, real ICT investment growth plummeted 7.02 percentage points between the two periods. Hence, the drastic difference in the growth rate of real ICT investment per worker between the 2000-2008 and 2008-2013 periods is driven entirely by the large fall in the growth rate of real ICT investment. Between 2000 and 2013, real ICT investment per worker grew more slowly than real ICT investment because employment increased 1.42 per cent per year throughout this period.

D. Summary

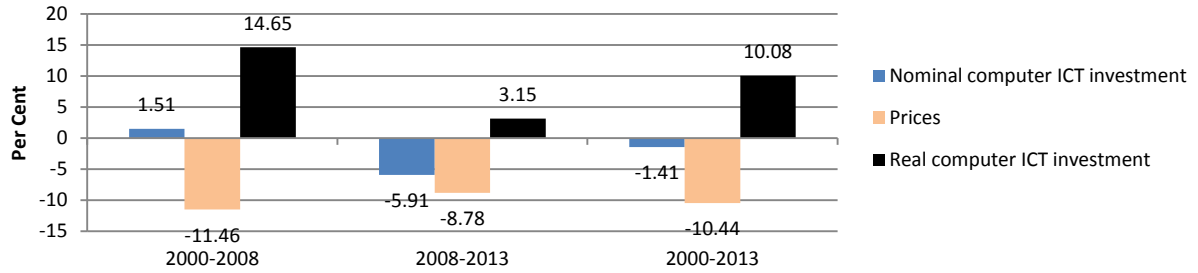
Charts 20a through 20d neatly summarize the information that has been discussed in detail above. Prices are the fundamental difference between nominal and real ICT investment growth.

Chart 20: Difference Between Nominal and Real ICT Investment Growth in Canada, Total and Component, Compound Annual Average Growth, Per Cent, 2000-2013

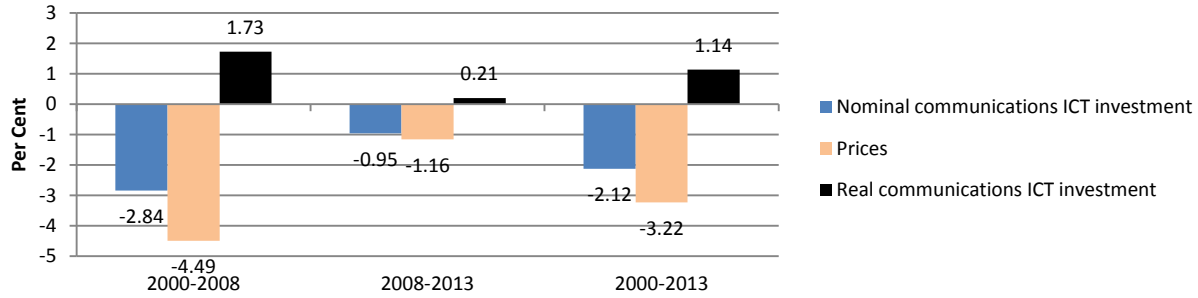
a) Total ICT Investment



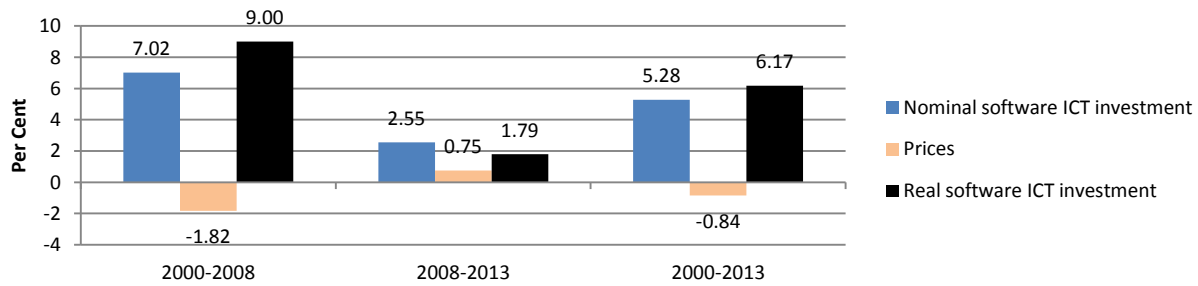
b) Computer ICT Investment



c) Communications ICT Investment



d) Software ICT Investment



Source: CSLS ICT Database, Summary Tables

IV. ICT Investment Trends in Canada and the United States and the Canada-U.S. ICT Investment Gap in the Business Sector

The aim of this section is to provide an overview of recent developments in business sector ICT investment in Canada and the United States, with particular attention paid to the trends in the ICT investment per worker gap between the two countries. The focus is on the business sector because non-business sector data are not available for the United States.[22] Canada has historically had a large gap in the level of ICT investment per worker relative to the United States. Our lower labour productivity level and weaker labour productivity growth is often linked to this phenomenon. Consequently, it is important to monitor (and explain) developments in this gap as part of an overall analysis of Canada's productivity performance.

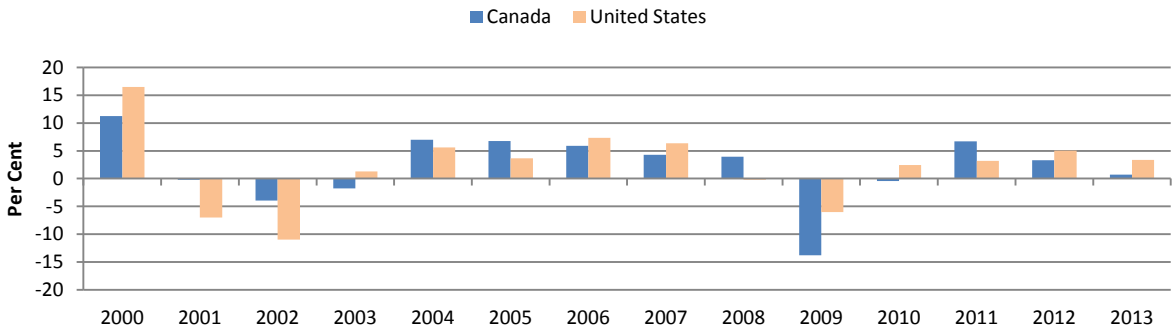
This section is divided into two subsections, all of which offer a focus on ICT investment by component (computer, communications equipment and software) for the business sector. The first subsection compares developments in Canada and the United States concerning nominal and real ICT investment, ICT prices, nominal and real ICT investment per worker, ICT investment shares in business sector GDP, and ICT investment shares in total investment. The second subsection examines the Canada-U.S. gap in ICT investment per worker, ICT capital stock per worker, ICT investment shares in business sector GDP, and ICT investment shares in total investment.

A. ICT Investment in Canada and the United States

i. Nominal ICT Investment Growth

In 2013, business sector nominal ICT investment growth was 0.73 per cent in Canada and 3.35 per cent in the United States (Table 2 and Chart 21), whereas in 2012, business sector nominal ICT investment grew 3.30 per cent in Canada and 5.05 per cent in the United States. Hence, both countries demonstrated slower growth than in the previous year.

Chart 21: Nominal ICT Investment Growth in the Business Sector in Canada and the United States, Annual Growth Rates, 2000-2013



Source: CSLS ICT Database, Summary Tables

[22] In this section, all references to aggregate investment values refer to mean business sector fixed, non-residential investment unless otherwise noted.

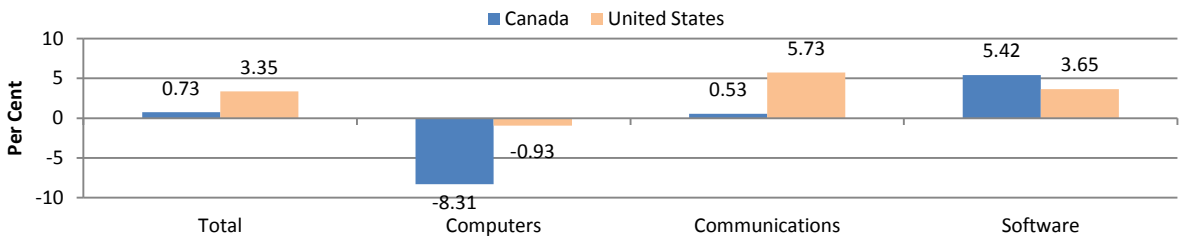
Table 2: Growth in ICT Investment in the Business Sector in Canada and the United States, 2000-2013

Year or Time Horizon	Canada				United States			
	Total	Computers	Communications	Software	Total	Computers	Communications	Software
Nominal ICT Investment Growth, Domestic Currency (Annual or Average Annual Per Cent)								
2012	3.30	-1.04	3.64	5.52	5.05	2.63	5.91	5.40
2013	0.73	-8.31	0.53	5.42	3.35	-0.93	5.73	3.65
2000-2008	2.67	2.34	-2.42	6.23	0.56	-3.23	-3.27	4.18
2008-2013	-0.95	-6.03	-1.60	2.23	1.54	-1.56	0.81	2.67
2000-2013	1.26	-0.96	-2.10	4.67	0.93	-2.59	-1.72	3.59
Nominal ICT Investment Per Worker Growth, Domestic Currency (Annual or Average Annual Per Cent)								
2012	2.42	-1.88	2.75	5.52	2.76	0.40	3.60	3.11
2013	-0.66	-9.57	-0.85	3.97	2.08	-2.14	4.43	2.38
2000-2008	1.03	0.70	-3.98	4.53	0.22	-3.56	-3.59	3.83
2008-2013	-1.30	-6.37	-1.95	1.86	2.02	-1.09	1.29	3.15
2000-2013	0.12	-2.08	-3.20	3.49	0.91	-2.62	-1.74	3.57
Growth in ICT Prices (Annual or Average Annual Per Cent)								
2012	-1.37	-6.83	-0.05	1.11	0.13	-1.40	1.21	0.17
2013	-0.68	-5.80	0.58	1.37	-0.84	-3.19	0.39	-0.66
2000-2008	-5.62	-11.47	-4.50	-1.77	-8.12	-15.66	-10.74	-3.53
2008-2013	-2.48	-8.78	-1.16	0.75	-2.51	-6.27	-3.49	-1.06
2000-2013	-4.42	-10.44	-3.23	-0.81	-6.00	-12.17	-8.02	-2.59
Real ICT Investment Growth, Domestic Currency (Annual or Average Annual Per Cent)								
2012	4.74	6.22	3.69	4.37	4.92	4.09	4.64	5.23
2013	1.42	-2.66	-0.05	4.00	4.23	2.34	5.32	4.34
2000-2008	8.78	15.60	2.19	8.14	9.45	14.74	8.37	7.99
2008-2013	1.58	3.02	-0.45	1.47	4.15	5.03	4.46	3.77
2000-2013	5.95	10.59	1.17	5.52	7.38	10.90	6.85	6.34
Real ICT Investment Per Worker Growth, Domestic Currency (Annual or Average Annual Per Cent)								
2012	3.84	5.31	2.80	3.48	2.63	1.82	2.36	2.93
2013	0.03	-4.01	-1.43	2.56	2.95	1.09	4.03	3.06
2000-2008	7.04	13.75	0.55	6.41	9.08	14.35	8.01	7.62
2008-2013	1.21	2.65	-0.81	1.10	4.64	5.53	4.96	4.26
2000-2013	4.76	9.34	0.03	4.34	7.35	10.87	6.82	6.32
Business Sector Employment (Annual or Average Annual Per Cent)								
2012	0.86				2.23			
2013	1.40				1.24			
2000-2008	1.63				0.34			
2008-2013	0.36				-0.47			
2000-2013	1.14				0.03			
United States Dollar per Canadian Dollar (Annual or Average Annual Per Cent)								
	Exchange Rate				Purchasing Power Parity			
2012	-1.01				-0.21			
2013	-2.99				-0.71			
2000-2008	4.22				1.68			
2008-2013	0.71				0.26			
2000-2013	2.86				1.13			

Source: CSLS ICT Database, Summary Tables

The slowdown in these two countries likely reflects the petering out of the recovery from the 2009 financial meltdown.

Chart 22: Per Cent Change in Nominal ICT Investment in the Business Sector in Canada and the United States, 2013

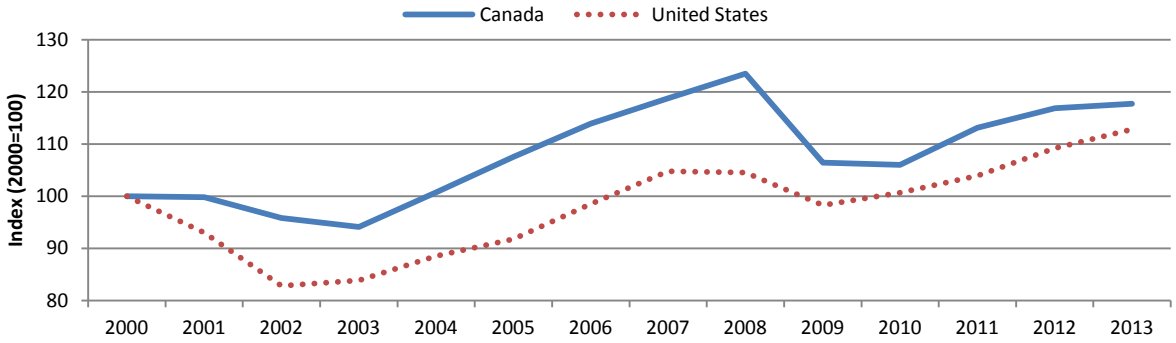


Source: CSLS ICT Database, Summary Tables

At the component level, Canada demonstrated worse performance than the United States in both computer and communications ICT investment in 2013. In the United States, computer ICT investment fell 0.93 per cent, while in Canada it fell 8.31 per cent. In addition, in the United States, communications ICT investment grew 5.73 per cent in 2013, while in Canada growth was much slower at only 0.53 per cent. In contrast, software ICT investment in Canada outperformed software ICT investment in the United States (5.42 per cent versus 3.65 per cent).

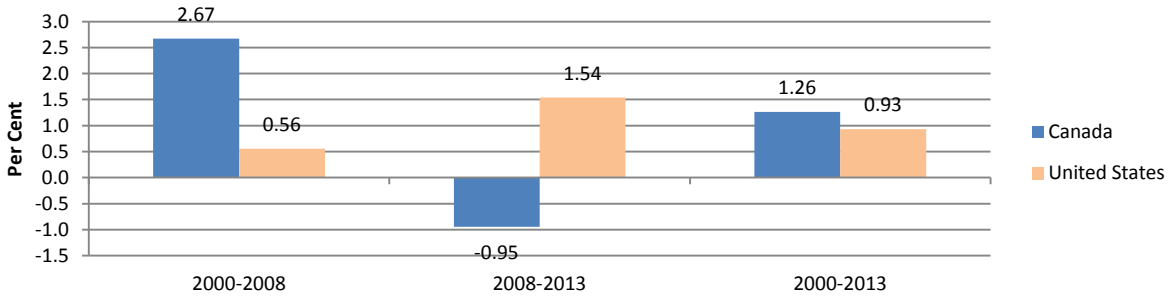
Compound average annual growth in business sector nominal ICT investment was 0.93 per cent per year in the United States between 2000 and 2013, while it was 1.26 per cent in Canada. Hence, the recent results from 2013 are consistent with the longer-term historical trend where Canadian nominal ICT investment in the business sector is greater than American nominal ICT investment in the business sector (Charts 23 and 24). When this period is broken down into two subperiods: 2000 to 2008 and 2008 to 2013, Canada only outperforms the United States between 2000 and 2008 (2.67 per cent per year versus 0.56 per cent per year). The compound average annual growth in Canada between 2008 and 2013 is actually negative (-0.95 per cent per year), while in the United States it is positive (1.54 per cent per year). This is likely explained by Canada's larger decline in nominal ICT investment during the recession of 2009 (Charts 21 and Chart 23). Hence, Canada's stronger nominal ICT investment growth performance is entirely attributable to growth in the first eight years of the century, since Canada has actually performed substantially worse than the United States in terms of nominal ICT investment since the financial crisis in 2009.

Chart 23: Nominal ICT Investment in the Business Sector in Canada and the United States, 2000=100, 2000-2013



Source: CSLS ICT Database, Summary Tables

Chart 24: Nominal ICT Investment Growth in Canada, Compound Average Annual Growth Rates, 2000-2013



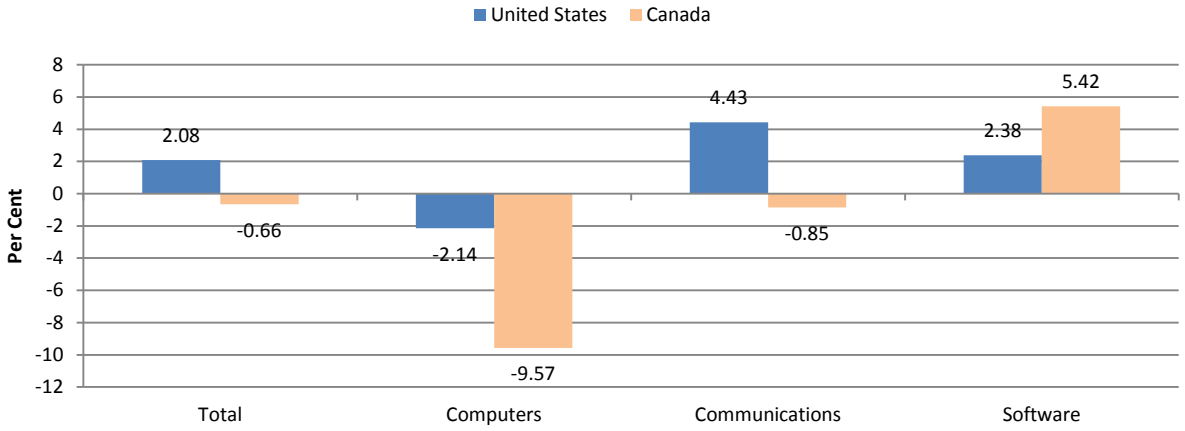
Source: CSLS ICT Database, Summary Tables

ii. Nominal ICT Investment Per Worker

Nominal ICT investment per worker growth is a direct consequence of nominal ICT investment growth and business sector employment growth. In 2013, nominal ICT investment per worker in Canada was smaller than nominal ICT investment per worker in the United States (-0.66 per cent versus 2.08 per cent) (Table 2). Nominal ICT investment by component in Canada was also smaller than nominal ICT investment by component in the United States for all three components.[23] Growth rates for computers and communications equipment nominal ICT investment per worker in Canada were smaller than growth rates in the United States in 2013. However, software nominal ICT investment per worker growth rates in Canada outperformed the United States (Table 2 and Chart 25).

[23] The largest component of ICT investment per worker in 2013 in both countries was software (55.30 per cent in Canada and 62.86 per cent in the United States). In Canada, the smallest component of nominal ICT investment per worker was communications (20.14 per cent), while in the United States, the smallest component of nominal ICT investment per worker was computers (15.50 per cent).

Chart 25: Growth of Nominal ICT Investment Per Worker by Component in the Business Sector in Canada and the United States, 2013

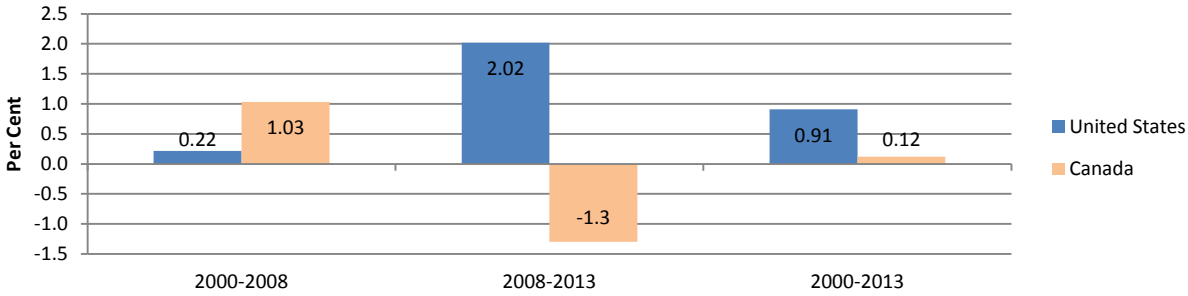


Source: CSLS ICT Database, Summary Tables

Business sector employment in Canada increased 1.40 per cent in 2013, compared to a 1.24 per increase in the United States (Table 2). Given that these employment growth rates are quite similar, it was the nominal investment trends that drove the nominal investment per worker trends in 2013. These trends resulted in a larger difference in nominal ICT investment per worker growth between the two countries (2.08 per cent in the United States versus -0.66 per cent in Canada: a gap of 2.74 percentage points) compared to nominal ICT investment growth (0.73 per cent in Canada versus 3.35 per cent in the United States: a gap of 2.62 percentage points) (Table 2 and Chart 25).

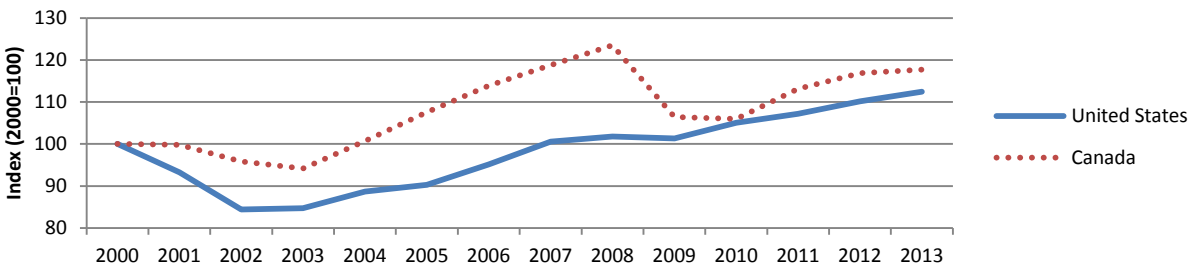
The United States also outperformed Canada in terms of nominal ICT investment per worker throughout the period between 2000 and 2013 (Chart 26a): nominal ICT investment per worker growth was only 0.12 per cent per year in Canada compared to 0.91 per cent per year in the United States. As nominal ICT investment growth was stronger in Canada over this period (1.26 per cent versus 0.93 per cent), the strong performance in the United States can only be explained by its worse employment performance (0.03 per cent versus 1.14 per cent).

Chart 26a: Nominal ICT Investment Per Worker in the United States and Canada in the Business Sector, Compound Average Annual Growth, Per Cent, 2000-2013



Source: CSLS ICT Database, Summary Tables

Chart 26b: Nominal ICT Investment Per Worker in Canada and the United States in the Business Sector, 2000=100, 2000-2013



Source: CSLS ICT Database, Summary Tables

Similarly to many other ICT investment measures, Canada's weak performance compared to the United States in nominal total ICT investment per worker between 2000 and 2013 is also explained by the second period, namely 2008-2013, since Canada actually outperformed the United States in terms of nominal ICT investment per worker between 2000 and 2008. The strikingly lower performance of nominal ICT investment per worker in this period can be explained by two factors: stronger employment growth in Canada compared to the United States between 2008 and 2013 (0.36 per cent versus -0.47 per cent) and lower nominal ICT investment growth in Canada compared to the United States between 2008 and 2013 (-0.95 per cent versus 1.54 per cent). Clearly, the recession wreaked havoc on ICT investment in Canada, but employment in Canada was not hit as hard as employment in the United States.

As noted earlier, the United States experienced faster growth in communications equipment ICT investment and a smaller decline in computer ICT investment relative to Canada, while software ICT investment in Canada grew faster than software ICT investment in the United States in 2013 (Chart 25). Due to the divergent paths of business sector employment growth, the United States' lead was only enhanced in 2013 in both computers and communications ICT investment per worker. Computer ICT investment per worker in the United States fell 2.14 per cent compared to 9.57 per cent in Canada. Communications ICT investment per worker exhibited growth of 4.43 per cent in 2013 in the United States, while communications ICT investment per worker actually fell in Canada in 2013 by 0.85 per cent. In contrast, software ICT investment per worker in Canada actually grew almost twice as fast as software ICT investment in the United States in 2013 (3.97 per cent versus 2.38 per cent). Software ICT investment per worker's divergence is entirely explained by the higher growth rate of software ICT investment in Canada (5.42 per cent versus 3.65 per cent). As previously noted concerning total nominal ICT investment and total nominal ICT investment per worker, the trends in ICT investment by component and by sector for nominal investment and nominal ICT investment per worker are similar because of the similar employment growth exhibited by both two countries.

iii. Nominal ICT Investment Shares in Nominal Business Sector GDP

Between 2000 and 2013, ICT investment as a share of nominal business sector GDP declined much faster in the United States than Canada at the aggregate (1.36 percentage points versus 1.03 percentage points) and at the component level (Table 3). ICT investment declined for

all three components in the United States, and for all components, excluding software, in Canada. The faster nominal GDP growth during this period compared to total nominal ICT investment and ICT investment by component explains the falling shares in both countries. The weak growth of computers and communications ICT investment would also explain these falling shares. In contrast, since software ICT investment performed more strongly than both computers and communications ICT investment, it is no surprise that its share grew in Canada and fell only marginally in the United States.

Table 3: Current Dollar ICT Investment Shares in the Business Sector in Canada and the United States, 2000-2013

Time Horizon or Year	Canada				United States			
	Total	Computers	Communications	Software	Total	Computers	Communications	Software
ICT Investment as a Share of GDP (Per Cent or Percentage Point)								
2000	3.29	1.08	1.03	1.18	4.43	1.09	1.35	1.99
2008	2.71	0.86	0.56	1.28	3.26	0.59	0.73	1.94
2011	2.32	0.65	0.47	1.20	3.09	0.51	0.65	1.93
2012	2.32	0.62	0.47	1.22	3.08	0.50	0.65	1.93
2013	2.26	0.55	0.45	1.25	3.07	0.48	0.66	1.93
Δ (2000-2013)	-1.03	-0.53	-0.58	0.07	-1.36	-0.61	-0.69	-0.06
Δ (2013)	-0.06	-0.07	-0.02	0.03	-0.01	-0.02	0.01	0.00
ICT Investment as a Share of Total Non-Residential Business Sector Investment (Per Cent or Percentage Point)								
2000	20.28	6.65	6.34	7.29	28.54	7.02	8.73	12.79
2008	15.89	5.08	3.31	7.51	23.40	4.24	5.25	13.92
2011	14.15	3.98	2.85	7.32	24.90	4.12	5.22	15.55
2012	13.62	3.67	2.75	7.19	24.00	3.88	5.08	15.04
2013	13.37	3.28	2.69	7.39	23.76	3.68	5.14	14.93
Δ (2000-2013)	-6.91	-3.37	-3.65	0.10	-4.78	-3.34	-3.59	2.14
Δ (2013)	-0.25	-0.39	-0.06	0.20	-0.24	0.20	0.06	-0.11
ICT Component Share of Total Business Sector ICT Investment (Per Cent or Percentage Point)								
2000	--	32.78	31.26	35.96	--	24.61	30.58	44.81
2008	--	31.95	20.82	47.23	--	18.10	22.43	59.47
2011	--	28.16	20.12	51.73	--	16.56	20.98	62.46
2012	--	26.98	20.18	52.84	--	16.17	21.15	62.67
2013	--	24.56	20.14	55.30	--	15.50	21.64	62.86
Δ (2000-2013)	--	-8.22	-11.22	19.34	--	-9.11	-8.94	18.05
Δ (2013)	--	-2.42	-0.04	2.46	--	-0.67	0.49	0.19

Source: CSLS ICT Database, Summary Tables

vi. Nominal ICT Investment Shares in Total Nominal Investment

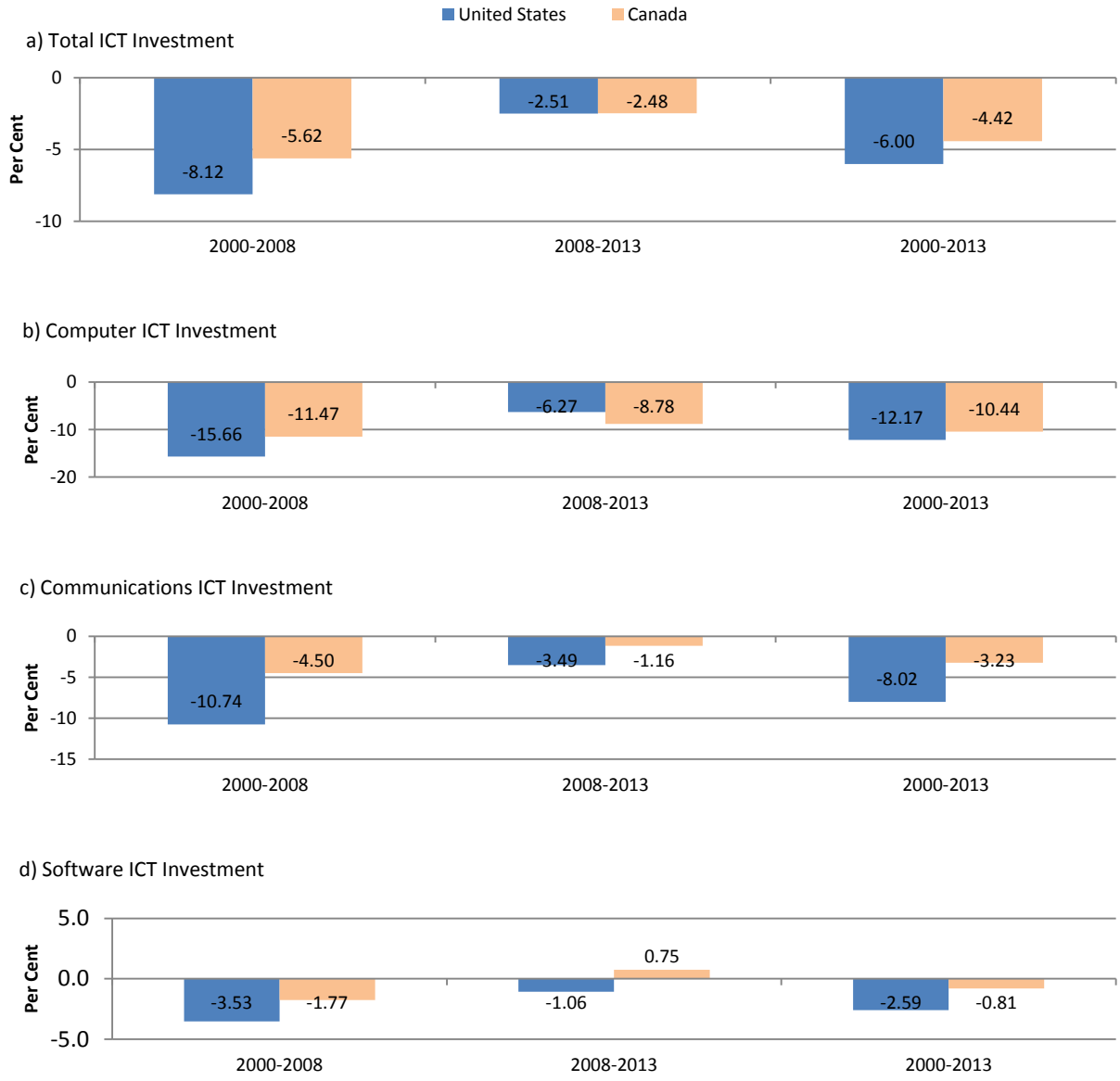
Trends in ICT investment shares in total nominal investment (business sector fixed, non-residential investment) succinctly capture the evolving importance of ICT investment in the overall investment decision of firms. Between 2000 and 2013, ICT investment as a share of total nominal non-residential business sector investment in Canada fell much faster or grew much more slowly than the share of ICT investment in total nominal non-residential business sector

investment in the United States at the aggregate (-6.91 percentage points versus -4.78 percentage points) and the component level (Table 3). This is interesting, given the fact that Canada outperformed the United States when ICT investment was calculated as a share of GDP.

vi. ICT Prices

In 2013, ICT investment prices decreased 0.68 per cent in Canada and 0.84 per cent in the United States. This represents a continuation of the trend of falling ICT prices in both Canada and the United States (Chart A3.28).

Chart 27: ICT Prices in Canada and the United States by Component in the Business Sector, Compound Average Annual Growth, Per Cent



Source: CSLS ICT Database, Summary Tables

In Canada, ICT prices for software grew 1.37 per cent, while they fell in the United States by 0.66 per cent. For communications, ICT prices rose in both countries, albeit relatively faster in Canada (0.58 per cent versus 0.39 per cent). In stark contrast, computer ICT prices fell in both countries, falling faster in Canada (-5.80 per cent) than in the United States (-3.19 per cent) (Chart A3.31, A3.32 and A3.33).

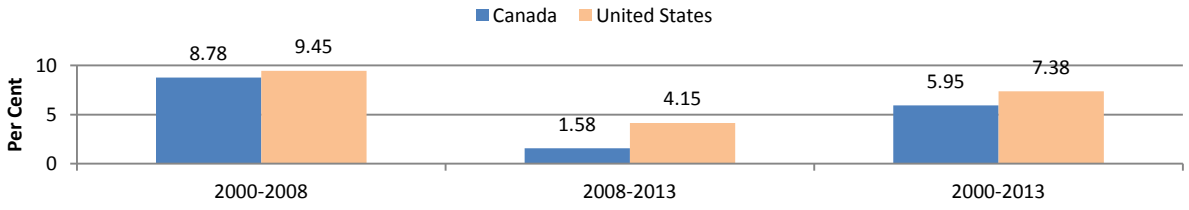
Between 2000 and 2013, ICT prices continually declined, registering positive growth only once in Canada in 2009 (Chart A3.28). In comparison to the United States, ICT investment prices in Canada fell less quickly in all three periods: 2000-2008, 2008-2013 and 2000-2013 (Chart 27).

Capeluck (2012) notes that "since 2003 there has been a clear negative correlation between total ICT prices and changes in the Canada-U.S. exchange rate". This relationship exists because ICT investment goods in Canada are largely imported, and consequently, "an increase in the value of the Canadian dollar effectively decreases ICT prices" (Capeluck, 2012). Hence, it seems like 2013 is not consistent with earlier observations. Given that the Canadian dollar depreciated in 2013 by 2.99 per cent, the correlation suggests that ICT prices in Canada should have increased. However, ICT prices decreased in Canada by 0.68 per cent. This may be explained by software's increasingly important role. In particular, Sharpe and De Avillez (2010) note that the changing valuation of the Canadian dollar should have a smaller effect on software prices, given that imports play a smaller role in the software market than in the market for the other two ICT components. Since software ICT investment continues to represent a growing proportion of total ICT investment in Canada, this may potentially explain why the trend does not hold in 2012 or 2013.

v. Real ICT Investment Growth

In general, falling ICT prices in Canada and the United States have led to relatively robust real business sector ICT investment growth (Table 2 and Chart 28 and Chart A3.32). This trend continued in 2013, as Canada's real ICT investment growth of 1.42 per cent outpaced its nominal ICT investment growth of 0.73 per cent, reflecting the 0.68 per cent decrease in ICT prices. Similarly, the real ICT investment growth of 4.23 per cent in the United States was larger than its nominal ICT investment growth of 3.35 per cent. The larger difference between nominal and real growth rates in the United States compared to Canada can be explained by the more rapidly declining ICT prices in the United States (0.84 per cent versus 0.68 per cent).

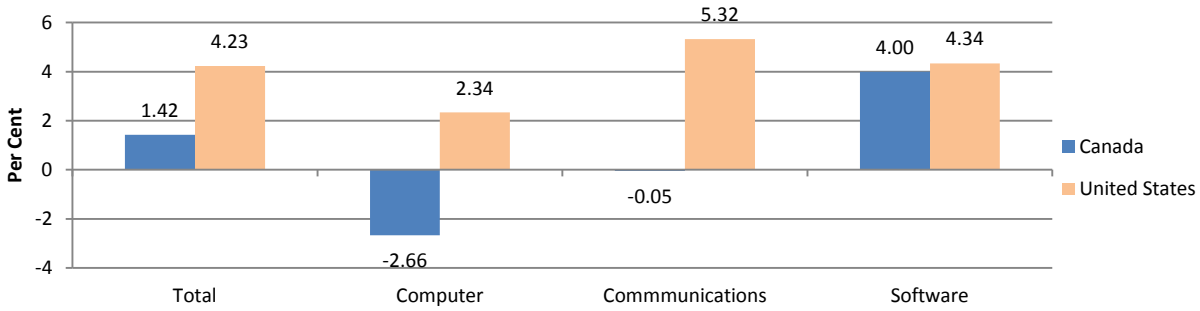
Chart 28: Real ICT Investment Growth in Canada and the United States in the Business Sector, Compound Average Annual Growth, 2000-2013



Source: CSLS ICT Database, Summary Tables

Between 2000 and 2013, the United States outperformed Canada in terms of real ICT investment growth in all three periods: 2000-2008, 2008-2013 and 2000-2013. Moreover, the fall in the compound average annual growth rates between 2000-2008 and 2008-2013 was much larger for Canada than the United States (a decline of 7.20 percentage points versus a decline of 5.30 percentage points). This is yet more evidence that ICT investment in Canada was hit harder than ICT investment in the United States by the recession of 2009.

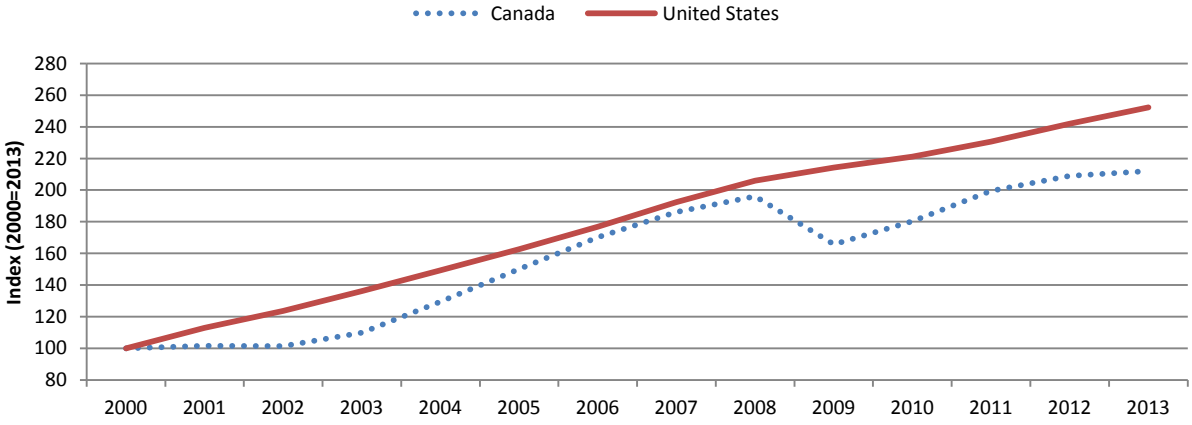
Chart 29: Growth of Real ICT Investment by Component in the Business Sector in Canada and the United States, 2013



Source: CSLS ICT Database, Summary Tables

ICT growth was greater in the United States than Canada in 2013 for every component of real ICT investment (Chart 29). Real software ICT investment is the only component of ICT investment in which Canada came close to demonstrating similar growth relative to the United States. In the other two components, Canada actually registered negative growth, while the United States displayed positive growth. In particular, real computer ICT investment was 2.34 per cent against Canada's -2.66 per cent. Real communications ICT investment was 5.32 per cent, while Canada exhibited -0.05 per cent. Real software ICT investment was 4.34 per cent, while in Canada it was 4.00 per cent (Charts 29 and 30).

Chart 30: Real ICT Investment for Canada and the United States in the Business Sector, 2000=100, 2000-2013



Source: CSLS ICT Database, Summary Tables

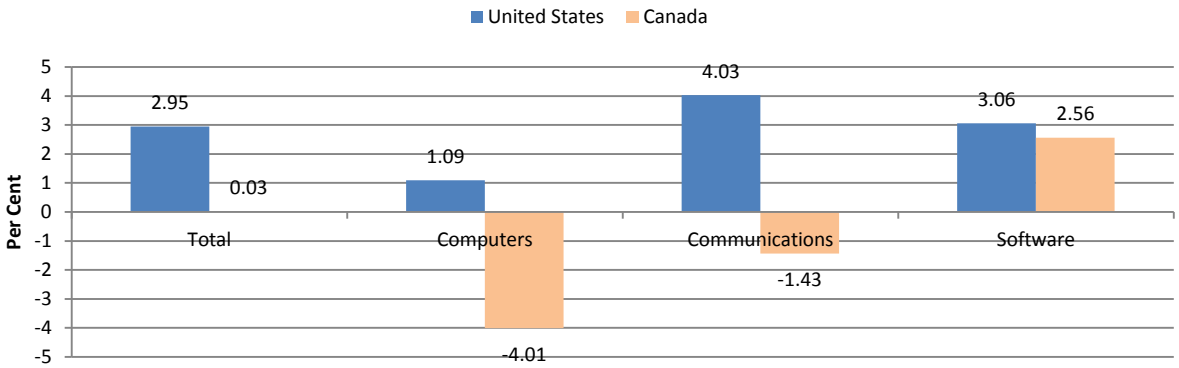
vi. Real ICT Investment per Worker

Real ICT investment per worker growth is a direct consequence of real ICT investment growth and business sector employment growth. As noted earlier, real ICT investment grew in Canada at 1.42 per cent, while it grew at 4.23 per cent in the United States in 2013 (Table 2). The large difference is mainly due to ICT prices falling faster in the United States (0.84 per cent versus 0.68 per cent) (Chart A3.28). In 2013, business sector employment growth in Canada outpaced employment growth in the United States by a small margin (1.40 per cent versus 1.24 per cent). Employment growth, all else constant, will reduce the level of ICT investment intensity. As such, Canadian and American ICT investment per worker growth should be less than real ICT investment growth. Indeed, real ICT investment per worker grew 2.95 per cent (compared to 4.23 per cent growth in real ICT investment) in the United States, while real ICT investment per worker in Canada grew 0.03 per cent (compared to 1.42 per cent growth in real ICT investment).

Stronger performance in the United States on a per worker basis is also obtained for all three ICT investment components (Table 2 and Chart 31a). Real computer ICT investment per worker in the United States grew 1.09 per cent, while it actually fell 4.01 per cent in Canada. Real communications equipment ICT investment per worker in the United States was similarly strong, registering 4.03 per cent compared to Canada's -1.43 per cent in 2013. Finally, software ICT investment per worker in Canada grew only 2.56 per cent, compared to 3.06 per cent in the United States.

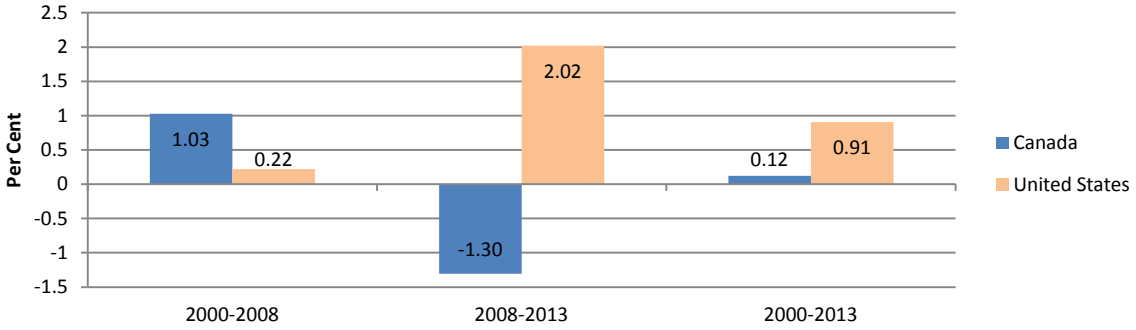
These 2013 results are consistent with the long-term trends. In terms of total real ICT investment per worker and component real ICT investment per worker, the United States continually outperformed Canada throughout the 2000 to 2013 period. Compound average annual growth rates in the United States are consistently higher than Canada's for each component and for total real ICT investment (Table 2). Given trends in total ICT prices, ICT prices by component, total nominal ICT investment and nominal ICT investment by component, stronger performance in real ICT investment per worker in the United States compared to Canada is almost entirely explained by its greater price declines.

Chart 31a: Growth of Real ICT Investment Per Worker in the Business Sector in Canada and the United States, 2013



Source: CSLS ICT Database, Summary Tables

Chart 31b: Growth of Real ICT Investment Per Worker in the Business Sector in Canada and the United States, Compound Average Annual Growth, Per Cent, 2000-2013



Source: CSLS ICT Database, Summary Tables

B. Canada-U.S. Relative ICT Investment and the ICT Investment Gap

The Canada-U.S. ICT investment gap is considered a key factor behind the Canada-U.S. labour productivity gap. This subsection details the trends and developments in the Canada-U.S. gap in business sector ICT investment per worker, ICT investment as a share of nominal GDP, and ICT investment as a share of total investment.[24]

i. Canada-U.S. Nominal ICT Investment per Worker Gap

Three factors determine trends in the Canada-U.S. nominal ICT investment per worker gap: the relative ICT investment growth between the two countries (expressed as the ratio of Canadian ICT investment to U.S. ICT investment); relative business sector employment growth (expressed as the ratio of Canadian employment to U.S. employment); and changes in the machinery and equipment (M&E) purchasing power parity (PPP). The annual PPP for M&E produced by Statistics Canada is applied to Canadian nominal ICT investment to obtain estimates expressed in U.S. dollars, hence, resulting in comparable Canadian and American figures.

In 2013, ICT investment per worker in Canada was US$2,188, while it was $4,279 in the US (Table 4). Computer ICT investment per worker in Canada was $537, compared to $663 in the United States. Similarly, both communications and software ICT investment per worker were greater in the United States: $441 versus $926 and $1,210 versus $2,690, respectively. Clearly, the largest differences between ICT investment per worker in Canada and the United States exist in communications and software ICT investment per worker. The computer ICT investment per worker gap contributed 6.02 per cent to the gap between ICT investment per worker in Canada and ICT investment per worker in the United States in 2013. The communications ICT investment per worker gap contributed 23.19 per cent to the total nominal ICT investment gap in 2013. Finally, the software ICT investment per worker gap contributed 70.78 per cent to the total nominal ICT investment gap between the two countries in 2013. Clearly, software is the largest contributor to the overall ICT investment gap between Canada and the United States.

In Canada, the level of ICT investment per worker in U.S. dollars has yet to recover to its peak in 2008, while ICT investment per worker in the U.S. recovered from the fall by 2010. This quick recovery in the U.S. may partially be explained by poor employment performance in the United States (Table 4). At the component level, computer ICT investment per worker in both countries has yet to return to the levels seen in 2008, but computer ICT investment per worker performance has been less promising since the start of the decade, especially in the United States. In sharp contrast, software ICT investment per worker has fully recovered in both countries from the decline in 2009. However, this is not surprising given the strong growth performance of software ICT investment per worker throughout the first decade of the 21st-century. Communications ICT investment per worker in the United States has performed more strongly than communications ICT investment per worker in Canada since the recession by a substantial

[24] Relative Canada-U.S. ICT investment is a measure of ICT investment in Canada as a proportion of ICT investment in the United States. The ICT investment gap is the difference, namely: one hundred minus the relative measure.

margin. This marked increase in communications ICT investment per worker in the United States is surprising, given the poor performance of communications ICT investment per worker in the first period (2000-2008). [25]

Table 4: ICT Investment Per Worker, Canada and the United States, Business Sector, Current U.S. Dollars, 2000-2013

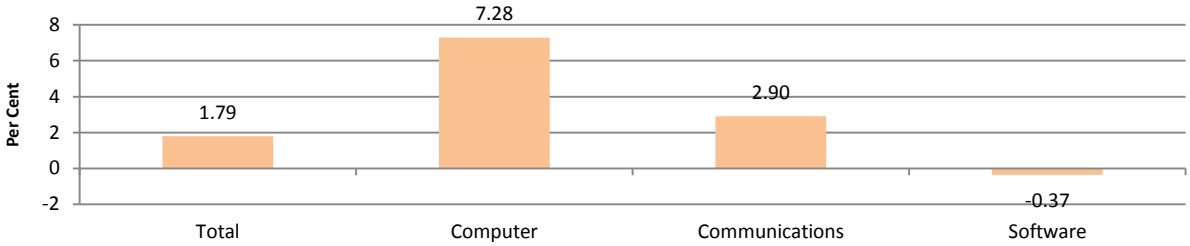
	Total ICT Investment Per Worker		Computer ICT Investment Per Worker		Communications ICT Investment Per Worker		Software ICT Investment Per Worker	
	Canada	United States	Canada	United States	Canada	United States	Canada	United States
2000	1,859	3,762	609	926	581	1,150	669	1,686
2001	1,834	3,527	509	783	600	1,025	725	1,720
2002	1,746	3,212	518	712	536	795	692	1,705
2003	1,766	3,225	554	690	497	771	715	1,764
2004	1,949	3,375	647	709	495	791	808	1,875
2005	2,131	3,436	704	683	496	793	930	1,960
2006	2,251	3,622	794	726	513	867	944	2,030
2007	2,296	3,827	747	726	455	952	1,095	2,150
2008	2,306	3,872	737	701	480	868	1,089	2,303
2009	1,924	3,856	577	679	455	762	893	2,415
2010	1,995	3,997	594	728	391	864	1,009	2,405
2011	2,171	4,079	611	675	437	856	1,123	2,548
2012	2,218	4,192	598	678	448	887	1,172	2,627
2013	2,188	4,279	537	663	441	926	1,210	2,690
Compound Average Annual Growth Rates (Per Cent)								
2000-2008	2.73	0.36	2.40	-3.42	-2.36	-3.46	6.29	3.98
2008-2013	-1.04	2.02	-6.12	-1.09	-1.69	1.29	2.13	3.15
2000-2013	1.26	1.00	-0.96	-2.53	-2.11	-1.66	4.67	3.66

Source: CSLS ICT Database, Summary Tables

[25] The CSLS ICT database also provides estimates of net ICT capital stock per worker. **Canada-U.S. Relative Nominal ICT Capital Stock per Worker**: Canadian nominal ICT capital stock per worker as a proportion of that in the United States exhibited the same trends in 2013 as ICT investment per worker, since changes in investment determine changes in capital stock. Since reaching a peak in 1993, Canada-U.S. relative ICT capital stock per worker shrunk substantially (from 55.61 per cent to 40.77 per cent in 2013). Each component contributed to the increase in this gap, as each component of ICT exhibited an increase in its own measure. Computers demonstrated a 3.48 percentage point increase to a 37.05 per cent gap in PPP adjusted terms (in exchange rate adjusted terms, the gap increased by 5.48 percentage points to 31.47 per cent). Communications equipment registered a 0.40 percentage point increase, reaching 75.62 per cent in PPP adjusted terms (in exchange rate adjusted terms, the gap increased by 1.06 percentage points to 73.46 per cent). Software exhibited a 0.15 percentage point increase, resulting in a gap of 49.23 per cent in PPP adjusted terms (in exchange rate adjusted terms, the gap increased by 1.46 percentage points to 44.73 per cent) (Chart A3.35).

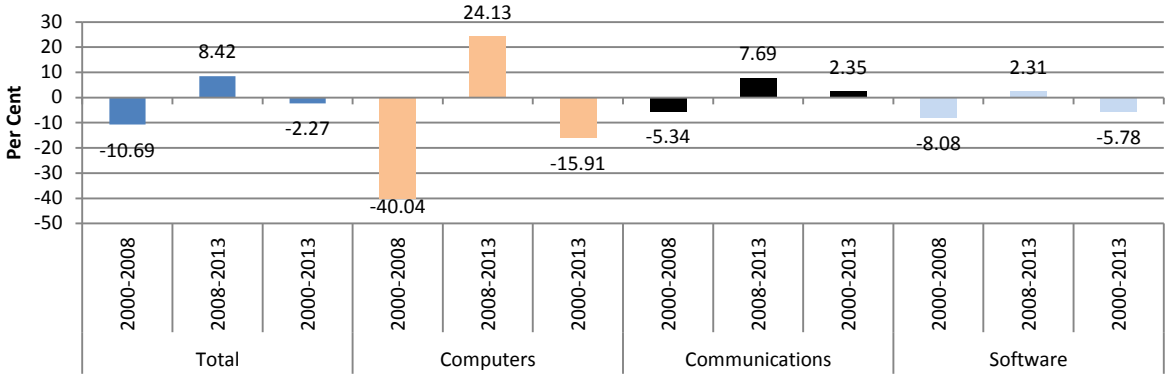
The Canada-U.S. nominal ICT investment per worker gap continued to widen in 2013. ICT investment per worker in Canada was 51.14 per cent in PPP adjusted terms,[26] down from 52.92 per cent in 2012 (Table 4). Hence, the gap in ICT investment per worker between the two countries widened: 1.78 percentage points (Chart 33).

Chart 32a: Percentage Point Change in ICT Investment Gaps in the Business Sector, Canada-U.S., 2013



Source: CSLS ICT Database, Summary Tables

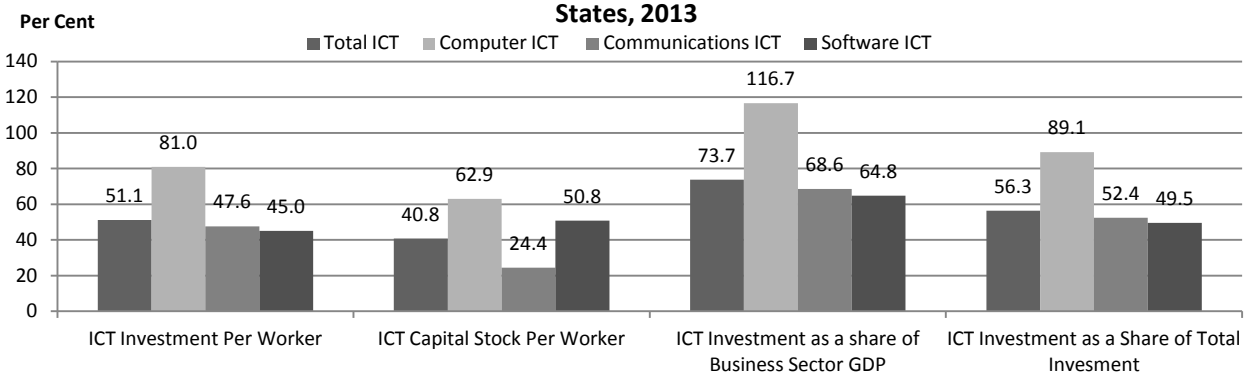
Chart 32b: Percentage Point Change in ICT Investment Gaps in the Business Sector by Component, Canada-U.S., 2000-2013



Source: CSLS ICT Database, Summary Tables

[26] The gap was 55.67 per cent in exchange rate adjusted terms in 2013, down from 58.97 per cent in 2012. The exchange rate adjusted gap widened by 3.30 percentage points.

Chart 33: Relative Canada-U.S. ICT Investment, Canada as a Proportion of the United States, 2013



Source: CSLS ICT Database, Summary Tables

Table 5: Canada-United States ICT Investment Gap in the Business Sector, 2000-2013

	Total	Computers	Communications	Software
Nominal ICT Investment Per Worker in Canada as a Share of Nominal ICT Investment Per Worker in the United States, Per Cent, PPP Adjusted				
2000	48.86	65.08	49.95	39.21
2008	59.56	105.12	55.29	47.30
2011	53.22	90.51	51.02	44.07
2012	52.92	88.27	50.50	44.62
2013	51.14	80.98	47.60	44.99
Δ (2000-2008)	10.69	40.04	5.34	8.08
Δ (2008-2013)	-8.42	-24.13	-7.69	-2.31
Δ (2000-2013)	2.27	15.91	-2.35	5.78
Δ (2013)	-1.79	-7.28	-2.90	0.37
ICT Investment as a Share of Nominal GDP in Canada as a Proportion of that of the United States, Per Cent				
2000	74.22	98.86	75.88	59.57
2008	82.93	146.38	76.99	65.86
2011	75.15	127.82	72.05	62.23
2012	75.15	125.34	71.70	63.36
2013	73.66	116.66	68.57	64.81
Δ (2000-2008)	8.71	47.52	1.11	6.29
Δ (2008-2013)	-9.27	-29.72	-8.42	-1.05
Δ (2000-2013)	-0.56	17.80	-7.31	5.24
Δ (2013)	-1.49	-8.68	-3.13	1.45
ICT Investment as a Share of Nominal Total Investment in Canada as a Proportion of that of the United States, Per Cent				
2000	71.08	94.66	72.66	57.04
2008	67.91	119.86	63.04	53.93
2011	56.81	96.62	54.47	47.04
2012	56.72	94.61	54.12	47.83
2013	56.28	89.13	52.39	49.51
Δ (2000-2008)	-3.17	25.20	-9.62	-3.11
Δ (2008-2013)	-11.63	-30.73	-10.66	-4.42
Δ (2000-2013)	-14.80	-5.53	-20.27	-7.53
Δ (2013)	-0.45	-5.48	-1.74	1.69

Source: CSLS ICT Database, Summary Tables

In PPP adjusted terms, computers and communications equipment contributed the most to the increased gap in nominal ICT investment per worker. In 2013, Canadian computer ICT investment per worker was 80.98 per cent of that in the U.S., down from 88.27 per cent in 2012.[27] Similarly, communications equipment ICT investment in Canada represented 47.60 per cent of communications equipment ICT investment in the U.S. in 2013, compared to 50.50 per cent in 2012. Software ICT investment per worker in Canada was 44.99 per cent of that in the United States in 2013, up from 44.62 per cent in 2012. This last point is a promising development.[28]

The widening of the gap in 2013 was also influenced by the 0.71 per cent decline in the Canada-U.S. PPP for M&E.

Hence, in summary, the increase in the gap in 2013 was generated by a variety of factors. First and foremost, it was influenced by stronger performance in nominal ICT investment per worker in the United States compared to Canada, driven by both stronger growth in Canadian employment in 2013 and stronger growth in American nominal ICT investment in 2013. The gap also widened as a result of a falling purchasing power parity measure. At the component level, similar factors explain the growing gap in computers and communications ICT investment per worker. Software ICT investment per worker, on the other hand, demonstrated stronger nominal ICT investment growth in Canada compared to the United States.

Between 2000 and 2013, the relative ICT investment per worker gap in Canada compared to the U.S. declined by 2.27 percentage points (Table 5). At the component level, both software and computers ICT investment saw their relative gaps decline (5.78 and 15.91 percentage points). In contrast, communications ICT investment actually saw its relative gap increase by 2.35 percentage points. When broken down into two periods, pre-recession and post-recession, all of the advances made in the relative gap measure were concentrated in the 2000 to 2008 period: total ICT investment per worker and ICT investment per worker by component all exhibited decreasing gaps between 2000 and 2008 and increasing gaps between 2008 and 2013.[29]

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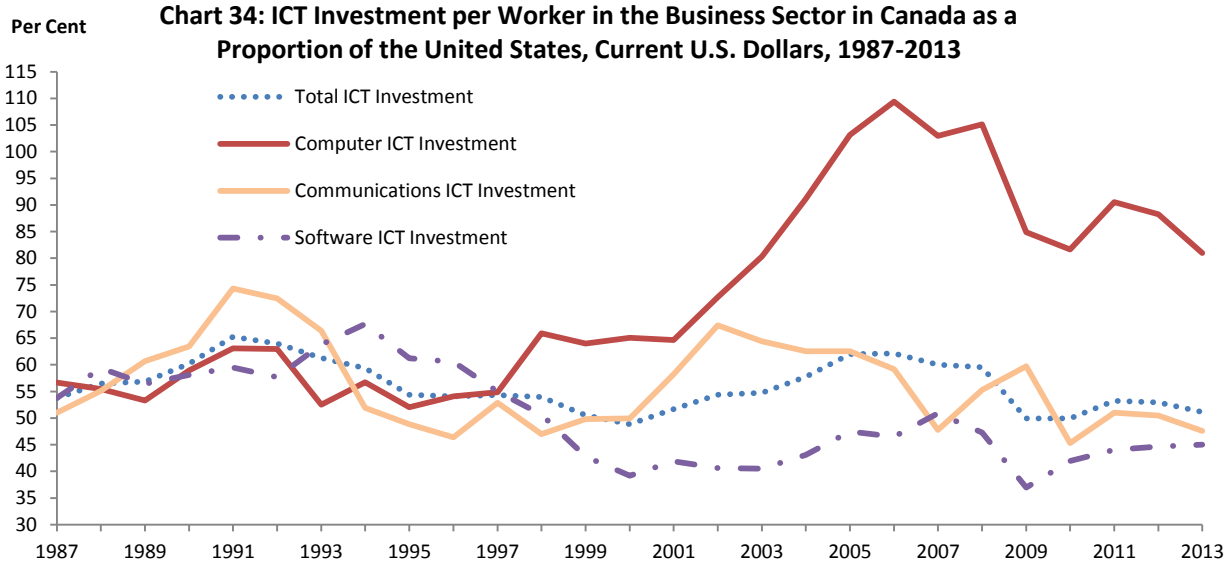
[27] This represents an increase in the gap between Canada and the U.S. in computer ICT investment per worker of 7.28 percentage points.

[28] The widening of the ICT investment per worker gap in exchange rate adjusted terms was mainly driven by trends in computer and communications equipment ICT investment. Nominal computer ICT investment per worker in Canada in 2013 was 88.17 per cent of that in the United States, down from 98.35 per cent in 2012. Hence, the gap increase from 1.65 percentage points to 11.83 percentage points: a change of 10.18 percentage points. Communications equipment ICT investment per worker in Canada in 2013 was 51.82 per cent of that in the United States, down from 56.26 per cent in 2012, resulting in an increase in the gap between communications equipment ICT investment in Canada and the U.S. by 4.44 percentage points. Software ICT investment per worker in Canada also contributed to the trend of the increasing ICT investment gap. In 2013, Canadian software ICT investment was 48.98 per cent of that in the United States, while in 2012, it was 49.72 per cent. The net result was an increase in the software ICT investment gap of 0.74 percentage points. Nevertheless, the software gap increased insignificantly in comparison to the gap in computers and communications ICT investment.

[29] Sharpe and Andrews (2012) develops a methodology to decompose changes in the Canada-U.S. nominal ICT per worker gap into three components: relative rate of growth of nominal ICT investment, relative rate of growth of employment, and change in the PPP for ICT investment (proxied by the PPP for M&E). In addition, it develops a methodology for estimating contributions to the change in terms of their relative importance. This procedure was not taken in this report, but it can provide useful detailed insights into the importance of each factor in the widening or shrinking of the gap measures.



Source: CSLS ICT Database, Summary Tables

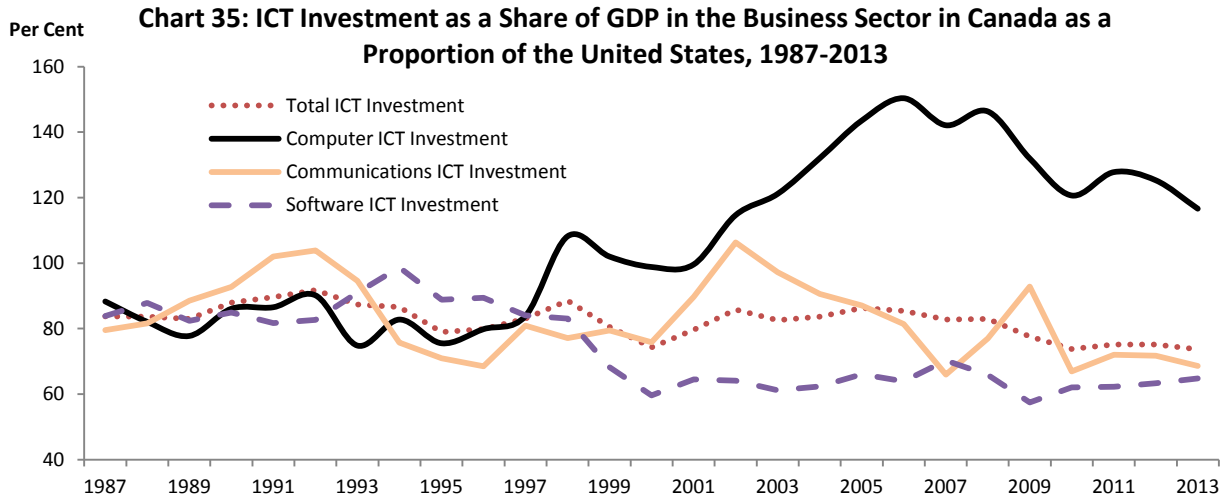
iii. Canada-U.S. Relative ICT Investment as a Share of GDP

Unlike the Canada-U.S. comparisons of investment per worker, the calculation of relative ICT investment as a share of GDP, considered by some to be a measure of relative ICT investment intensity, requires only data on nominal ICT investment and GDP. In 2013, nominal business sector GDP increased 3.36 per cent in Canada and 3.95 per cent in the United States. Similarly, ICT investment growth was faster in the United States relative to Canada: 3.35 per cent versus 0.73 per cent. Consequently, ICT investment as a share of GDP will have decreased in both countries. In Canada, it fell from 2.32 per cent in 2012 to 2.26 per cent in 2013. In the United States, it fell from 3.08 per cent to 3.07 per cent. Since the decline in Canada was larger than the decline in the United States, these trends imply that the relative ICT investment as a share of GDP gap should have increased. Indeed, Canadian ICT investment as a share of total investment relative to American ICT investment as a share of total investment fell from 75.15 per cent in 2012 to 73.66 per cent in 2013: an increase in the gap by 1.49 percentage points.

This widening gap was equally demonstrated by the gaps in computers and communications ICT investment shares in GDP, increasing by 8.68 percentage points and 3.13 percentage points respectively. However, the gap in software ICT investment shares in GDP between Canada and the United States actually decreased in 2013, falling by 1.45 percentage points (Chart 35).

Between 2000 and 2013, total nominal ICT investment as a share of GDP in the business sector in Canada as a proportion of the United States increased by 0.56 percentage points (Table 4). At the component level, both computers and software registered declines: 17.80 percentage points and 5.24 percentage points, respectively. In contrast, communications exhibited an increase (7.31 percentage points). When this period is broken down into the period between 2000 and 2008 and the period between 2008 and 2013, the results are quite striking. Between 2000 and 2008, aggregate and component measures of the gap in ICT investment as a share of GDP all

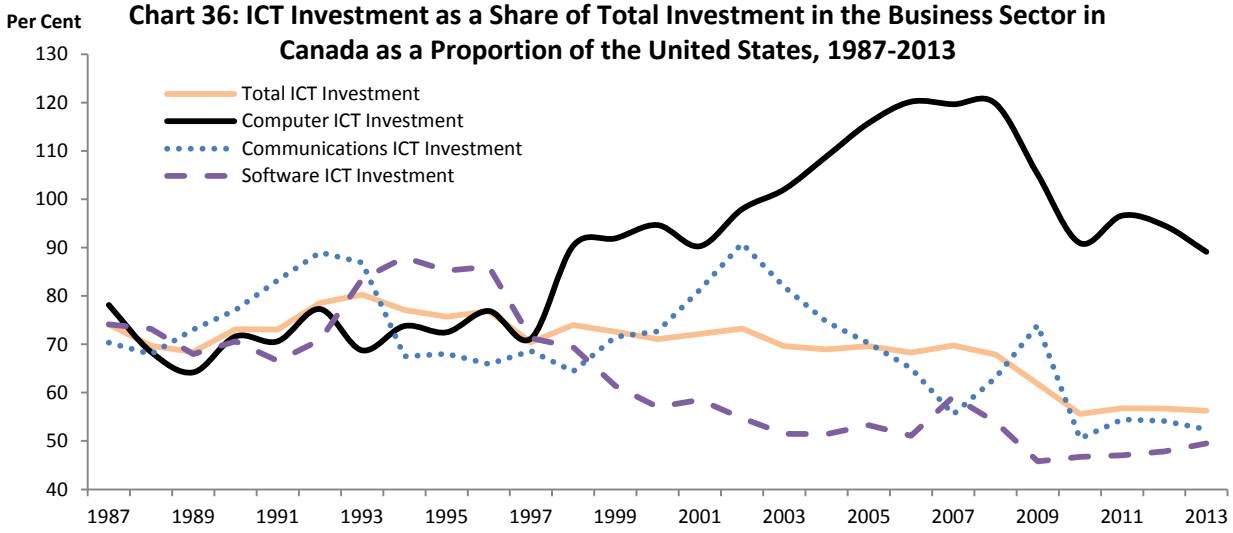
decreased. In contrast, Canadian performance relative to American performance was hit hard post-2008, as aggregate and component measures of the gap in ICT investment as a share of GDP all increased.



Source: CSLS ICT Database, Summary Tables

iv. Canada-U.S. ICT Investment as a Share of Total Investment

This indicator of relative Canada-U.S. ICT investment performance requires only estimates of nominal business sector ICT and total investment for the two countries. In 2013, total nominal investment growth in Canada outpaced total nominal ICT investment growth, leading to a fall in the share of ICT investment in total nominal investment to 13.37 per cent. A similar pattern arose in the United States, since nominal total investment growth also outpaced nominal ICT investment growth in this country.



Source: CSLS ICT Database, Summary Tables

In 2013, nominal total ICT investment only accounted for 23.76 per cent of total nominal investment in the United States. Since the declines in both shares were similar (0.24 percentage points in the United States versus 0.25 percentage points in Canada), Canadian ICT investment as a share of total investment relative to American ICT investment as a proportion of total investment did not demonstrate substantial declines, falling only 0.45 percentage points to 56.28 per cent in 2013. In other words, the gap increased by 0.45 percentage points in 2013 (Chart 36).

Between 2000 and 2013, nominal total ICT investment as a share of total fixed non-residential investment in Canada relative to the U.S. increased by 14.80 percentage points (Table 5). Throughout this period, computers, communications and software ICT investment as a share of total fixed non-residential investment in Canada relative to the U.S. all increased: 5.53 percentage points, 20.27 percentage points and 7.53 percentage points, respectively. Even when the period between 2000 and 2013 is broken down into two periods: 2000-2008 and 2008-2013, Canada's performance is not particularly promising. In both periods, total nominal ICT investment as a share of total fixed non-residential investment in Canada relative to the U.S. increased. At the component level, communications and software ICT investment as a share of total nominal fixed non-residential investment in Canada relative to the U.S. increased as well; the only component that demonstrated a shrinking gap was computers.

VI. Conclusion

Canada's productivity performance reflects in large part our innovation record, both in terms of business sector R&D and ICT investment. The objective of this report has been to examine the country's ICT investment performance since 2000 (Table 6). The key finding is that, since the 2008 peak, business sector ICT investment in Canada has performed poorly, both relative to the Canadian non-business sector and to the business sector in the United States.

By 2013, four years after the 2009 recession, nominal ICT investment in the business sector in Canada had failed to regain the 2008 level, falling on average 1.0 per cent per year over the 2008-2013 period. In contrast, despite government belt-tightening, nominal investment in the non-business sector in Canada advanced at 2.0 per cent per year. Equally, the United States, which experienced a more severe downturn than Canada, saw business sector nominal ICT investment grow at 1.5 per cent per year between 2008 and 2013.

The fall in nominal ICT investment in Canada in the 2008-2013 period, combined with the rise in the United States, resulted in ICT investment per worker falling 8.5 percentage points from 59.6 per cent of that of the U.S. business sector in 2008 to 51.1 per cent in 2013.

In addition to the above key findings, a number of observations on ICT investment developments from the report are highlighted below.

- Nominal software ICT investment in the total economy in Canada showed a strong performance in Canada between 2008 and 2013, advancing 2.6 per cent per year, while computer investment fell 5.9 per cent per year and communications investment 1.0 per cent.

- The pace of decline of business sector ICT prices fell off considerably in Canada after 2008, from -5.6 per cent per year in 2000-2008 to -2.5 per cent per year in 2008-2013. This pattern affected all three ICT components and was also observed in the United States.

- Non-business sector ICT investment growth in Canada was higher than business sector ICT investment growth in the 2000-2013 period and in both the 2000-2008 and 2008-2013 sub-periods. Given the more limited incentives to invest in ICT in the non-business sector, this result seems surprising.

- Statistics Canada is continually providing less information on ICT investment at the two-digit NAICS industry due to the confidentiality constraints of the Statistics Act. As such, evaluating trends and developments at the industry level in nominal and real ICT investment is increasingly difficult.

- Canada's poor productivity performance in recent years, both in absolute terms and relative to the United States, is likely linked to Canada's weak ICT investment performance. Yet the reasons why ICT investment in the Canadian

business sector had failed to regain the 2008 pre-recession level by 2013 are poorly understood and merit serious attention.

Table 6: ICT Investment, Key Figures, Levels, Percentage Point Changes and Compound Average Annual Growth, Canada, Total Economy, 2000, 2013, 2000-2013

		Levels (Millions of Dollars or Per Cent)		Growth Rates (Per Cent Percentage Point Changes)		
Variable	**Category**	**2000**	**2013**	**2000**	**2013**	**2000-2013**
Current Dollar ICT Investment*	Total	33.45	40.62	9.26	0.47	1.55
	Computer	11.38	9.47	7.69	-8.45	-1.41
	Communications	9.63	7.29	20.35	-0.07	-2.12
	Software	12.23	23.87	3.17	4.70	5.28
Chained 2007 Dollar ICT Investment*	Total	21.32	45.97	13.86	1.05	6.09
	Computer	4.64	16.19	23.81	-2.82	10.08
	Communications	6.68	7.74	21.59	-0.65	1.14
	Software	10.29	22.41	0.56	3.29	6.17
Current Dollar ICT Investment Per Worker	Total	2.25	2.29	6.61	-0.79	0.13
	Computer	771	534	5.08	-9.61	-2.79
	Communications	653	411	17.43	-1.33	-3.49
	Software	828	1,346	0.67	3.38	3.80
Canada-U.S. Relative ICT Investment Per Worker	Total	48.9	51.1	-1.6	-1.8	2.2
	Computer	65.1	81.0	1.1	-7.3	15.9
	Communications	50.0	47.6	0.1	-2.9	-2.4
	Software	39.2	45.0	-3.5	0.4	5.8

Source: CSLS ICT Database

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Appendix 1: Impact of Revisions to ICT Investment Estimates

Statistical agencies frequently revise their estimates for total ICT investment and ICT investment by component (Table A1). Since the Canada-U.S. gap is based on estimates for Canada and the United States, changes in these estimates can cause large fluctuations in the ICT investment intensity gap. For example, consider the gap in computer ICT investment between Canada and the U.S. in 2012. Under the revised estimates, ICT investment in Canada represented 88.3 per cent of ICT investment in the United States in 2012 in purchasing power parity adjusted terms. Under the initial estimates, ICT investment in Canada represented 110.5 per cent of ICT investment in the United States in 2012 in purchasing power parity adjusted terms. In other words, under the revised estimates the gap was approximately 11.7 per cent, while under previous estimates the gap was -10.5 per cent. Hence, revisions to the level of computer ICT investment in Canada resulted in a drastic change in the patterns and developments of the Canada-U.S. ICT investment gap.

Table A1.1: Impact of Revision of ICT Estimates by Statistics Canada, Millions of Dollars, 2012	**Initial Estimates[30]**	**Revised Estimates[31]**	**Difference**	**Percent Difference**
Total ICT Investment	33,736	32,448	-1,288	-3.82
Computer ICT Investment	11,037	8,753	-2,284	-20.69
Communications ICT Investment	7,724	6,549	-1,176	-15.21
Software ICT Investment	14,974	17,146	2,171	14.51

Source: CSLS ICT Database, Summary Tables

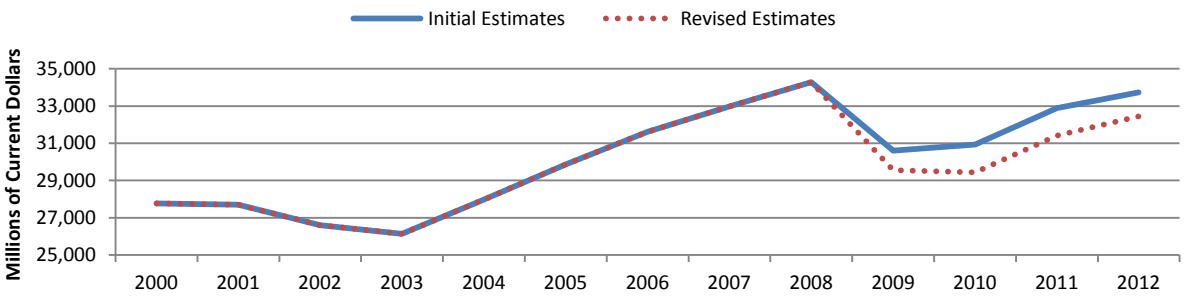
Table A1.2: Impact of Revision of ICT Estimates by the Bureau of Economic Analysis, Millions of Dollars, 2012	**Initial Estimates[32]**	**Revised Estimates[33]**	**Difference**	**Percent Difference**
Total ICT Investment	453,900	433,417	-20,483	-4.51
Computer ICT Investment	76,500	70,103	-6,397	-8.36
Communications ICT Investment	95,800	91,679	-4,121	-4.30
Software ICT Investment	281,600	271,635	-9,965	-3.54

Source: CSLS ICT Database, Summary Tables

The most recent revisions covered the period from 2009 to 2012 (Charts A1.1-A1.4). These revisions can have a significant policy impact and should not be overlooked. Hence, when interpreting the data presented in this report, use caution because estimates can be significantly revised upward or downward. These revisions are especially likely at the disaggregated level. The Bureau of Economic Analysis (BEA) and Statistics Canada have both revised their estimates. However, the BEA revisions are substantially less pronounced compared to the revisions undertaken by Statistics Canada.

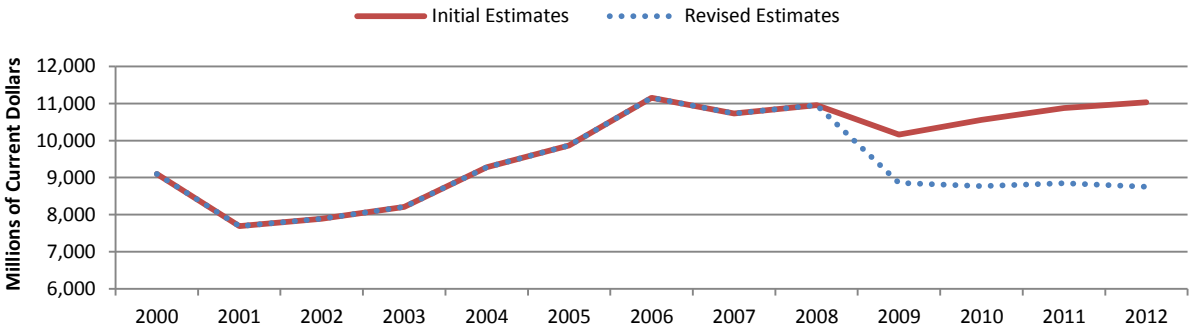
[30] Initial estimates are from the January 2014 CSLS Canadian database, based on Statistics Canada figures.
[31] Revised estimates are from the July 2014 CSLS Canadian database, based on Statistics Canada figures.
[32] Initial estimates are from the January 2014 CSLS Canadian database, based on Statistics Canada figures.
[33] Revised estimates are from the July 2014 CSLS Canadian database, based on Statistics Canada figures.

Chart A1.1: Initial and Revised Estimates of Total ICT Investment in Canada, 2000-2013



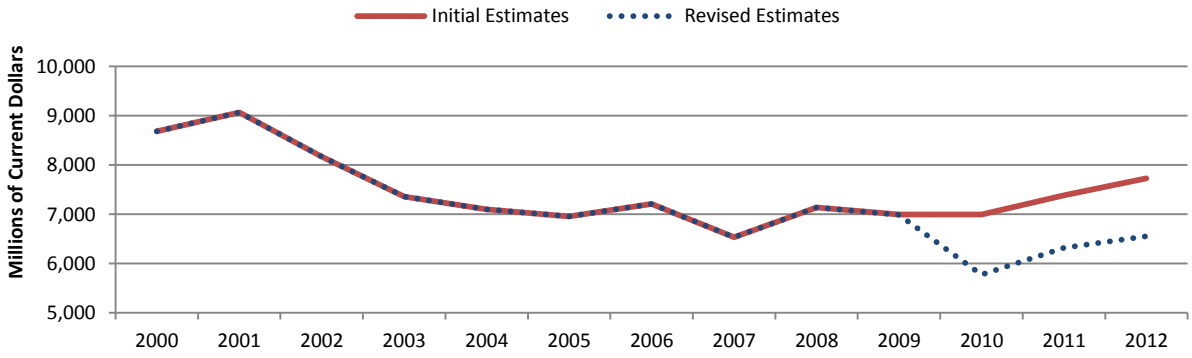
Source: CSLS ICT Database, Summary Tables

Chart A1.2: Initial and Revised Estimates of Computer ICT Investment in Canada, 2000-2013



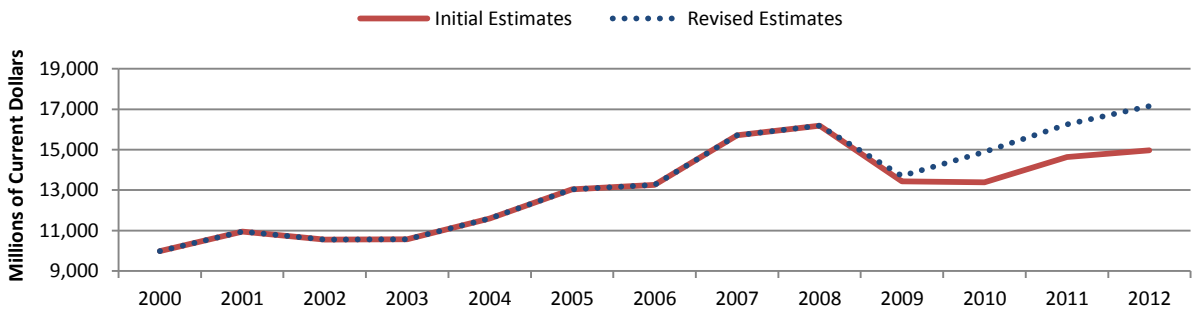
Source: CSLS ICT Database, Summary Tables

Chart A1.3: Initial and Revised Estimates of Communications ICT Investment in Canada, 2000-2013



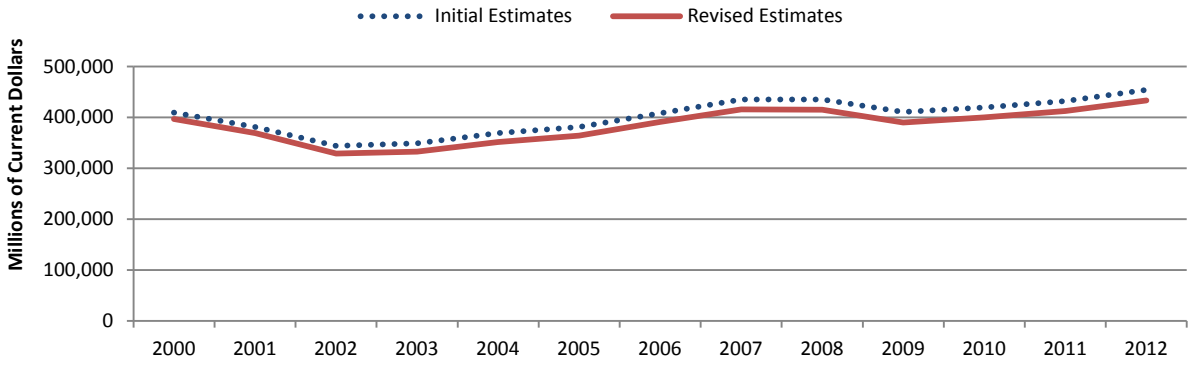
Source: CSLS ICT Database, Summary Tables

Chart A1.4: Initial and Revised Estimates of Software ICT Investment in Canada, 2000-2013



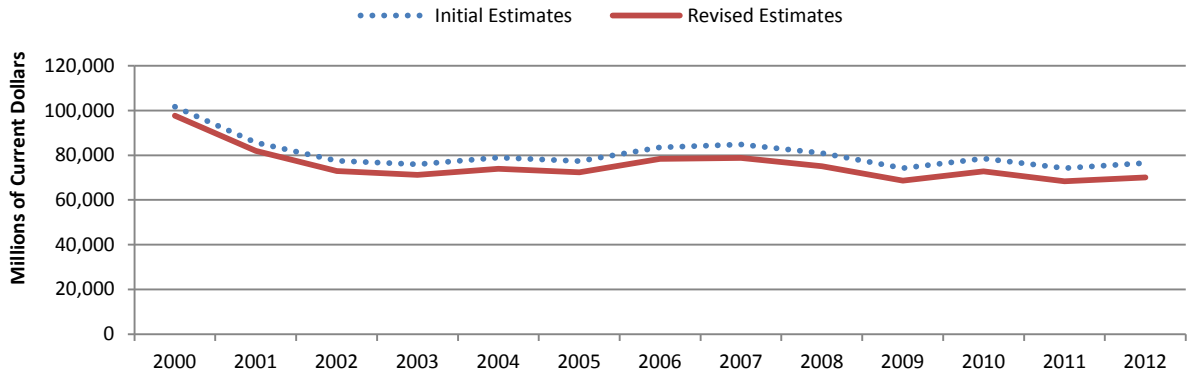
Source: CSLS ICT Database, Summary Tables

Chart A1.5: Initial and Revised Estimates of Total ICT Investment in the United States, 2000-2012



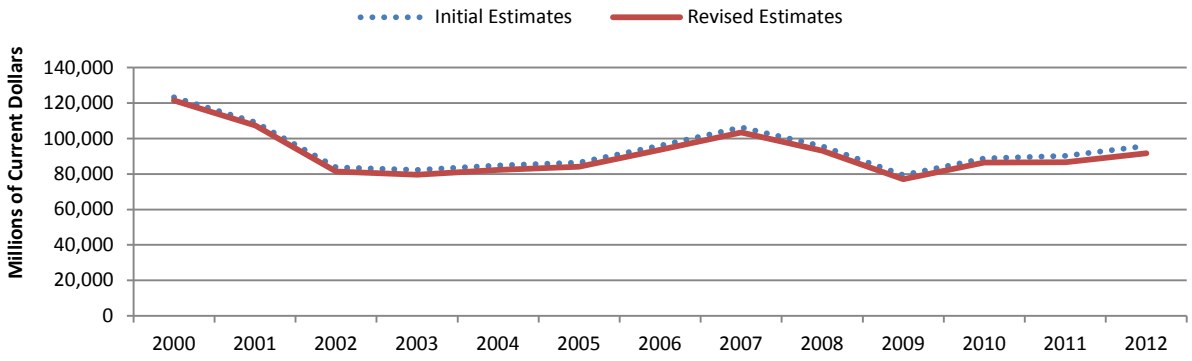
Source: CSLS ICT Database, Summary Tables

Chart A1.6: Initial and Revised Estimates of Computer ICT Investment in the United States, 2000-2012



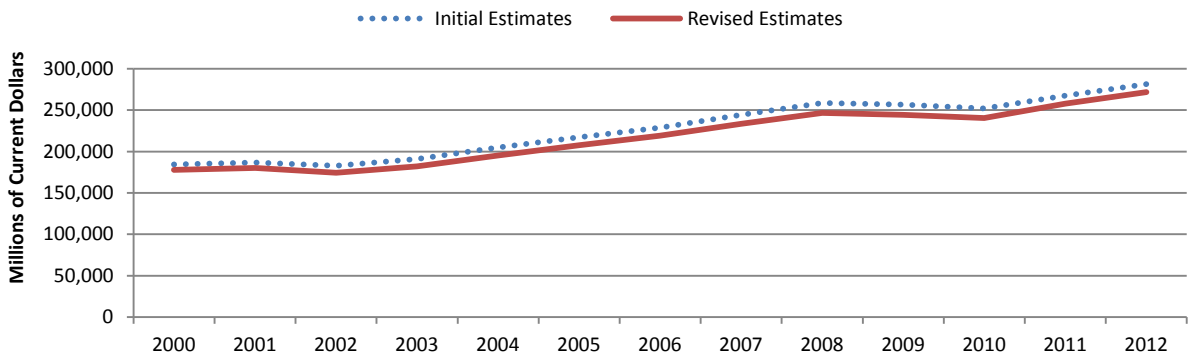
Source: CSLS ICT Database, Summary Tables

Chart A1.7: Initial and Revised Estimates of Communications ICT Investment in the United States, 2000-2012



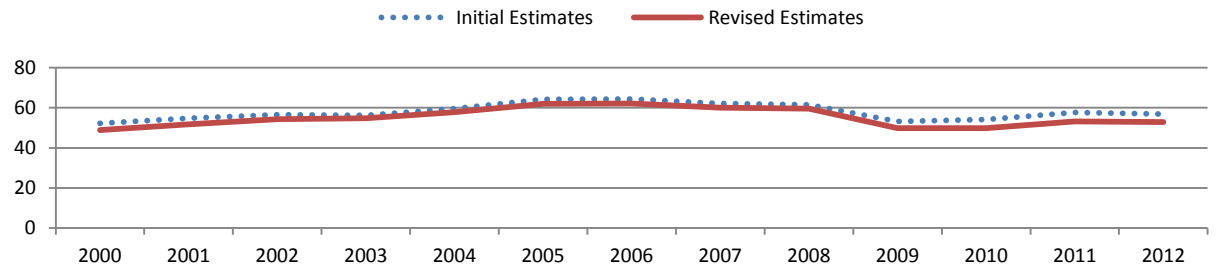
Source: CSLS ICT Database, Summary Tables

Chart A1.8: Initial and Revised Estimates of Software ICT Investment in the United States, 2000-2012



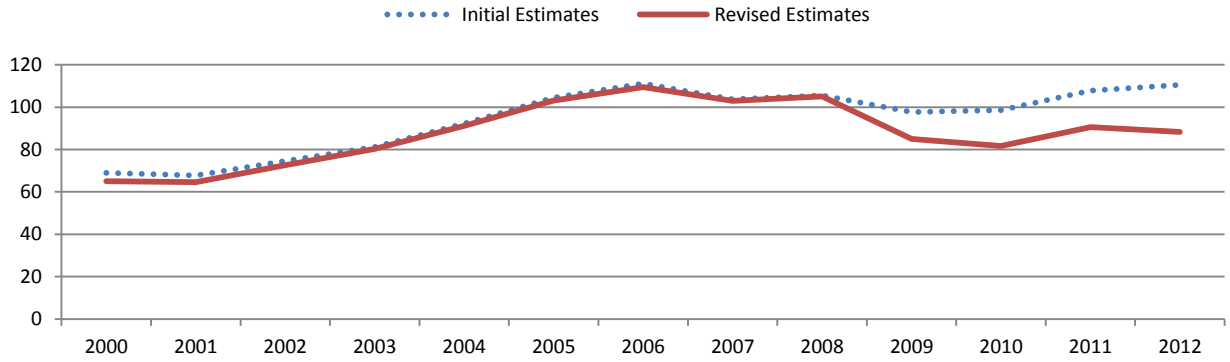
Source: CSLS ICT Database, Summary Tables

Chart A1.9: Initial and Revised Estimates of ICT Invesment in Canada as a Proportion of ICT Investment in the United States, 2000-2012



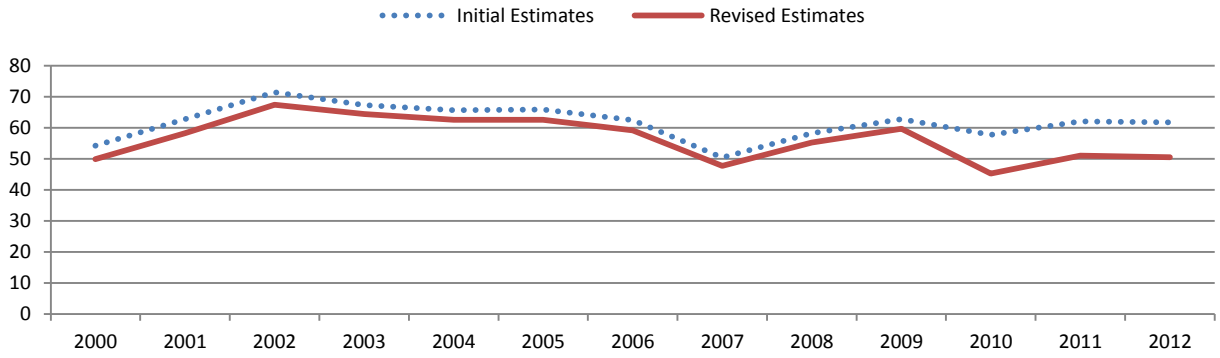
Source: CSLS ICT Database, Summary Tables

Chart A1.10: Initial and Revised Estimates of Computer ICT Investment in Canada as a Proportion of ICT Investment in the United States, 2000-2012



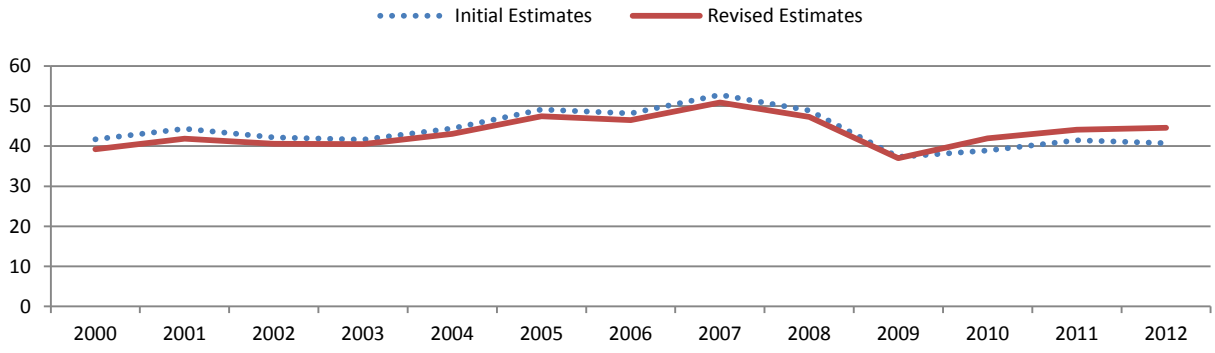
Source: CSLS ICT Database, Summary Tables

Chart A1.11: Initial and Revised Estimates of Communications ICT Investment in Canada as a Proportion of ICT Investment in the United States, 2000-2012



Source: CSLS ICT Database, Summary Tables

Chart A1.12: Initial and Revised Estimates of Software ICT Investment in Canada as a Proportion of ICT Investment in the United States, 2000-2012



Source: CSLS ICT Database, Summary Tables

Appendix 2: Methodology for Updating the ICT Investment and Capital Stock Database for the United States and Canada

The ICT database for the United States requires a substantial amount of work before estimates taken from the BEA and BLS websites can be inputted into the database. The nominal estimates are substantially easier to generate than the real estimates. The estimates of GDP produced by the BEA and the estimates of employment produced by the BLS must also be slightly modified. Below is a brief discussion on the process used to develop estimates of ICT investment and capital stock for the U.S, as well as a brief overview of the procedure used to generate GDP and employment estimates.

A. Nominal Estimates of ICT Investment and Capital Stock

The U.S. Bureau of Economic Analysis (BEA) provides current dollar fixed asset tables by industry and component at the four-digit NAICS level.[34] There are two crucial changes that must be made to this information prior to including it in the CSLS database for U.S. ICT investment and capital stock.[35]

First, the BEA does not provide information on computer and software investment and capital stock at a component level. Both of these broad components are disaggregated into smaller components. Hence, the first step is to generate estimates of computer and software investment and capital stock. For software, this means that prepackaged software (ENS1), custom software (ENS2) and own account software (ENS3) must be aggregated for each four-digit NAICS industry. For computers, EP1A (Mainframes), EP1B (PCs), EP1C (DASDs), EP1D (Printers), EP1E (Terminals), EP1F (Tape drives), EP1G (Storage devices) and EP1H (System integrators) must be aggregated for each four-digit NAICS industry.

Second, the BEA provides estimates at the four-digit NAICS level, while the CSLS database requires estimates at the two-digit NAICS level. Hence, the four-digit NAICS industries must be aggregated into the two digit NAICS industries. The following table provides a nice guide.

Table A2.1: Aggregation of Four-Digit NAICS Industries into Two-Digit NAICS Industries

Two-Digit NAICS Industry	Four-Digit NAICS Industry Codes Beginning With:
Agriculture	11
Mining	21
Utilities	22
Construction	23
Manufacturing	31, 32 and 33
Wholesale trade	41
Retail trade	44 and 45
Transportation and warehousing	48 and 49
Information	51

[34] http://bea.gov/national/FA2004/Details/Index.html

[35] Statistics Canada does not provide estimates of total ICT investment. Hence, ICT is calculated by aggregating the three components: computers, communications and software.

Finance	52
Real estate	53
Professional	54
Administrative	56
Educational	61
Health	62
Arts	71
Accommodation	72
Other	81

Once estimates by component (computer, software and communications) have been obtained at the two-digit NAICS level for both investment and capital stock, the estimates can be inputted into the CSLS database on ICT investment and capital stock in the U.S.

For estimates of total ICT investment and capital stock, the estimates of total ICT by industry must simply be aggregated for the business sector, which includes all two-digit NAICS industries, excluding public administration (government), health care and social assistance, and educational services. Conceptually, the business sector can be defined as including those industries whose outputs are marketed, whereas the non-business sector includes industries and activities whose outputs are generally not marketed. Unfortunately, due to differential public policies concerning the private and public sectors, certain activities, like health care and educational services, are partially marketed in the United States, whereas they are not marketed in Canada (or marketed to a substantially smaller degree). Hence, this definition does not allow for consistency when comparing business sectors between Canada and the United States.

For example, since health care and educational services have a higher private presence in the United States than in Canada, estimates of ICT investment and capital stock can be inflated in the United States relative to Canada, resulting in a poor comparison. Consider the case that might arise if ICT investment and capital stock are extremely high in the United States in private health care. If private health care ICT investment and capital stock were included in estimates of total business sector ICT investment and capital stock, then the measures of ICT investment in Canada relative to the United States would be biased in favour of the United States. In order to avoid this bias, health care has been completed excluded from both Canadian and American estimates. Educational services and public administration have also been removed from the calculation of total business sector ICT investment and capital stock.

B. Real Estimates of ICT Investment and Capital Stock

The U.S. Bureau of Economic Analysis (BEA) provides detailed chain-type index fixed asset tables by industry and component at the four-digit NAICS level.[36] There are a number of crucial changes that must be made to this information prior to including it in the CSLS database for U.S. ICT investment and capital stock.[37]

[36] http://bea.gov/national/FA2004/Details/Index.html

[37] For estimates of total ICT investment and total economy investment in Canada, the following methodology must also be used. Statistics Canada does not provide estimates of total ICT investment and total economy investment.

The changes are identical to the changes made to the nominal (current dollar) estimates, but due to the nature of real (constant dollar) estimates, the procedure is substantially more complicated.

The first step is to generate constant dollar values for each piece of detail. This can be done by multiplying the chain-type quantity index (CTIQ) between 1987 and 2013 for each piece of detail by its respective nominal value (CU) in 2009 (the base year) and dividing by 100.

$$\frac{(CTQI_t * CU_t)}{100}$$

With these values, it is possible to generate implicit-price deflators (IPDs) for each piece of detail. IPDs are calculated as the ratio of current-dollars (CU) and constant-dollars (CO), multiplied by 100.

$$\left(\frac{CU_t}{CO_t}\right) * 100$$

These IPDs can then be used to generate four pieces of information required for the chain-type Fisher formula. Namely, for each piece of detail, the four following estimates must be generated:

$$A = IPD_{t-1} * CO_t$$

$$B = IPD_{t-1} * CO_{t-1}$$

$$C = IPD_t * CO_t$$

$$D = IPD_t * CO_{t-1}$$

Once these four values have been created, the aggregation processes described above can be undertaken. In other words, the estimates A, B, C, and D for each piece of detail can be aggregate across components to generate estimates of computers, software and communications at the four-digit NAICS level. After which, they can be aggregate across industries to generate estimates of computers, software and communications at the two-digit NAICS level.

With these two-digit estimates of computers, communications and software, the chain-type Fisher formula can be implemented:

$$\sqrt{\frac{A}{B} * \frac{C}{D}}$$

The result from the chain-type Fisher formula can be used to create an aggregate quantity index. First, the base year must be chosen (which was 2009 in the most recent CSLS ICT database for the US). Next, the index levels can be computed by multiplying the Fisher relative by the previous period's quantity index when calculating years that come after the base year.

When calculating years that come before the base year, the index levels can be computed by dividing the previous period's quantity index by the Fisher relative.

The final result is an aggregate quantity index with a base year of 2009. By using the 2009 current dollar estimates for computers, software and communications at the two-digit NAICS level, constant dollar estimates for computers, software and communications at the two-digit NAICS level can be obtained.[38] See example below taken from the BEA.

To obtain estimates of total real ICT investment or capital stock, at the stage of aggregation, prior to calculating the Fisher relative, estimates of total ICT investment and capital stock by industry must be aggregated for the business sector, where the business sector includes all two-digit NAICS industries except public administration, health care and educational services.

C. GDP Estimates

The GDP estimates provided by the BEA are given in two segments: 1987-1997 and 1997-2013.[39] For nominal GDP, this division is irrelevant. Estimates are provided at the two-digit NAICS level. To obtain estimates for the business sector, a summation of all two-digit NAICS industries barring health care, public administration (government) and educational services is required.

For real GDP, the estimates for 1987-1997 are given in a different base year (2005) than the estimates for 1997-2013 (2007). To ensure that the estimates reflect the same base year (2009), linkages were done at the disaggregated level. In other words, by determining the factor that exists in the year of overlap (1997) and applying this factor to the values between 1987 and 1997, it is possible to develop estimates for the entire period between 1987 and 2013 in the same base year (2009). This was performed for each two-digit NAICS level for both the chain-type dollars and the chain-type quantity index.

To obtain GDP estimates for the business sector, the process used for the real estimates of ICT investment and capital stock described above is applied. The business sector is defined as the aggregation of all four-digit NAICS industries, excluding health care, educational services and public administration (government).

D. Employment Estimates

The estimates for employment by industry are obtained from the Current Population Survey undertaken by the BLS.[40] Unfortunately, estimates are only available for 1995 to 1999 and 2002 to 2013. As such, growth rates from the BLS total employment time series for private industries were used as a proxy for this subset and applied to the data back to 1987.[41] Growth

[38] The aggregation process described here will yield an approximation of the true Fisher chain-type quantity index. For more information on calculating chain-type Fisher indexes, see J. Steven Landefeld, Brent R. Moulton, and Cindy M. Vojtech, "Chained-Dollar Indexes: Issues, Tips on their Use, and Upcoming Changes," Survey of Current Business (November 2003): 8-16.

[39] http://bea.gov/industry/gdpbyind_data.htm

[40] See table 18 available at: http://www.bls.gov/cps/cps_aa1995_1999.htm

[41] The employment growth rate proxy was obtained from Table B-14 in the *Economic Report of the President, 2014*, published by the Council of Economic Advisers.

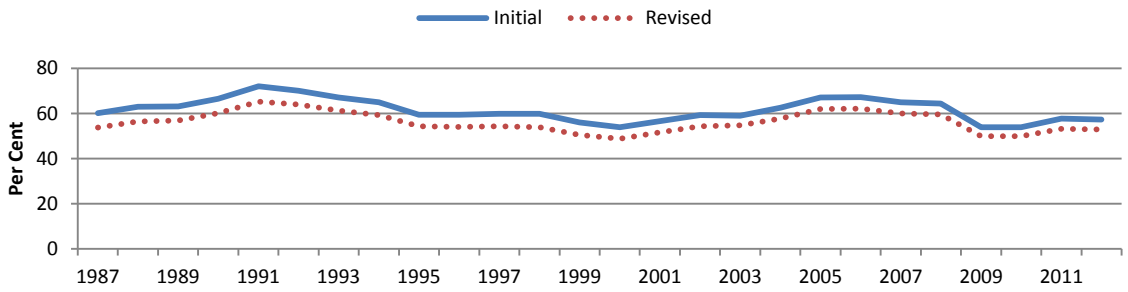
rates from this alternative time series were also used as a proxy to calculate employment in 2000 and 2001 in the business sector.

Estimates are also available at the two-digit NAICS level, but the CSLS database on ICT investment in the U.S. only examines two-digit NAICS industry employment from 2002 to 2013.

The reason that growth rates from a similar business sector employment time series were applied to the CSLS business sector employment time series lies in the difficulty in defining the business sector similarly across both Canada and the United States. Estimates of business sector employment are available for the United States, extending back to 1987, but these estimates would inflate employment, and thereby bias estimates of ICT investment per worker in the United States downwards. To avoid this issue, it was necessary to construct estimates using published data on employment by industry, subtracting health care, educational services and public administration (government). Since estimates at this level of detail are only available for 1995 to 2013, barring 2000 and 2001, growth rates from total employment time series for private industries were assumed as proxies and applied to determine employment between 1987 and 1994, as well as between 2000 and 2001.

The impact of using business sector employment as defined by the CSLS, as opposed to official business sector employment as calculated by the BLS is quite stable over the entire time series. Essentially, employment figures fell across the time period, and consequently, per worker estimates increased. As a result, all else constant, this change from the official business sector employment definition to the CSLS business sector employment definition results in a widening of the ICT investment gap between Canada and the United States (Chart A2.1).

Chart A2.1: Impact of Redefition of Business Sector on ICT Investment in Canada as a proportion of ICT investment in the United States, Per Cent, 1987-2012



Source: CSLS calculations based on Statistics Canada and BEA data.

E. Purchasing Power Parity Exchange Rate Estimates

Software investment was recently reclassified under intellectual property as opposed to machinery and equipment. Hence, at the aggregate ICT level, there is no purchasing power exchange rate.

Prior to the reclassification, machinery and equipment included all three components: software, communications and computers. Hence, using the purchasing power parity exchange rate for machinery and equipment as a proxy for the purchasing power parity exchange rate of ICT was logical.[42] Under the new reclassification, however, the purchasing power exchange rate for machinery and equipment only covers computers and communications. The intellectual property purchasing power parity exchange rate would need to be used for software. Quite simply, the reclassification of software into intellectual property reduces the relevance of the machinery and equipment purchasing power parity index for the CSLS ICT database.

In order to avoid complex calculations of a composite ICT purchasing power parity index, the CSLS ICT database simply uses the machinery and equipment purchasing power parity index as a proxy for the ICT purchasing power parity index. There may be implications to using this as a proxy, but the CSLS has not yet studied whether the use of the machinery and equipment purchasing power parity index upwardly or downwardly biases measures of ICT investment in Canada.

Once all of these changes have been made, the U.S. database maintained by CSLS can be updated to reflect new and revised estimates of ICT investment and capital stock. New and revised measures of ICT per worker and ICT as a share of business sector investment and GDP are also available after undertaking this methodology.

[42] ICT represented approximately one-third of all machinery and equipment. ICT purchasing power parities may have demonstrated different trends than non-ICT purchasing power parties, but this was not studied, since data is not available at this disaggregated level. Fortunately, given the close proximity of the purchasing power parity index and the exchange rate, the implications for time series trends are quite minimal, even though overall levels are affected.

Example: Aggregation of Net Stocks of "Light trucks (including utility vehicles)" and "Other trucks, buses and truck trailers" within the Mining Industry, namely NAICS 2110, 2120 and 2130

NIPA Asset Types	NAICS industry	Chain-Type Quantity Indexes for Net Stocks (Index numbers, 2009 = 100)				Current-Cost Net Stocks (Millions of Dollars)			
		2009	2010	2011	2012	2009	2010	2011	2012
Light trucks (including utility vehicles)	2110	100.000	117.442	136.525	158.228	261	311	370	438
Other trucks, buses and truck trailers	2110	100.000	100.625	104.461	111.052	195	201	214	229
Light trucks (including utility vehicles)	2120	100.000	102.296	136.303	170.556	265	275	375	479
Other trucks, buses and truck trailers	2120	100.000	96.235	103.755	113.753	1,027	1,012	1,118	1,237
Light trucks (including utility vehicles)	2130	100.000	98.648	149.187	197.886	2,159	2,162	3,348	4,532
Other trucks, buses and truck trailers	2130	100.000	104.229	125.260	148.450	2,118	2,261	2,786	3,332

Estimating constant dollars

Estimating IPDs

NIPA Asset Types	NAICS industry	Constant-Dollar Net Stocks [Millions of (2009) Dollars]				IPD's (Index numbers, 2009=100)			
		2009	2010	2011	2012	2009	2010	2011	2012
Light trucks (including utility vehicles)	2110	261	307	356	413	100.000	101.460	103.836	106.060
Other trucks, buses and truck trailers	2110	195	196	204	217	100.000	102.437	105.057	105.749
Light trucks (including utility vehicles)	2120	265	271	361	452	100.000	101.444	103.820	105.980
Other trucks, buses and truck trailers	2120	1,027	988	1,066	1,168	100.000	102.395	104.921	105.885
Light trucks (including utility vehicles)	2130	2,159	2,130	3,221	4,272	100.000	101.511	103.945	106.077
Other trucks, buses and truck trailers	2130	2,118	2,208	2,653	3,144	100.000	102.420	105.013	105.974

Creating an aggregate using the chain-type Fisher formula

NIPA Asset Types	NAICS industry	A				B			
		2009	2010	2011	2012	2009	2010	2011	2012
Light trucks (including utility vehicles)	2110		30,652	36,153	42,882		26,100	31,100	37,000
Other trucks, buses and truck trailers	2110		19,622	20,866	22,750		19,500	20,100	21,400
Light trucks (including utility vehicles)	2120		27,108	36,642	46,924		26,500	27,500	37,500
Other trucks, buses and truck trailers	2120		98,833	109,108	122,573		102,700	101,200	111,800
Light trucks (including utility vehicles)	2130		212,981	326,963	444,089		215,900	216,200	334,800
Other trucks, buses and truck trailers	2130		220,757	271,722	330,179		211,800	226,100	278,600

Example: Aggregation of Net Stocks of "Light trucks (including utility vehicles)" and "Other trucks, buses and truck trailers" within the Mining Industry, namely NAICS 2110, 2120 and 2130 (Continued)

Creating an aggregate using the chain-type Fisher formula (continued)

NIPA Asset Types	NAICS industry	C				D			
		2009	2010	2011	2012	2009	2010	2011	2012
			31,100	37,000	43,800		26,481	31,828	37,792
Light trucks (including utility vehicles)	**2110**		20,100	21,400	22,900		19,975	20,614	21,541
Other trucks, buses and truck trailers	**2110**		27,500	37,500	47,900		26,883	28,144	38,280
Light trucks (including utility vehicles)	**2120**		101,200	111,800	123,700		105,159	103,697	112,828
Other trucks, buses and truck trailers	**2120**		216,200	334,800	453,200		219,163	221,382	341,669
Light trucks (including utility vehicles)	**2130**		226,100	278,600	333,200		216,926	231,823	281,149

Creating an aggregate using the chain-type Fisher formula (continued)

		A				B			
		2009	2010	2011	2012	2009	2010	2011	2012
Sum			609,954	801,454	1,009,396		602,500	622,200	821,100

Creating an aggregate using the chain-type Fisher formula (continued)

		C				D			
		2009	2010	2011	2012	2009	2010	2011	2012
Sum			622,200	821,100	1,024,700		614,588	637,489	833,260

Creating an aggregate using the chain-type Fisher formula (continued)

		2009	2010	2011	2012
Fisher relative			1.012	1.288	1.230

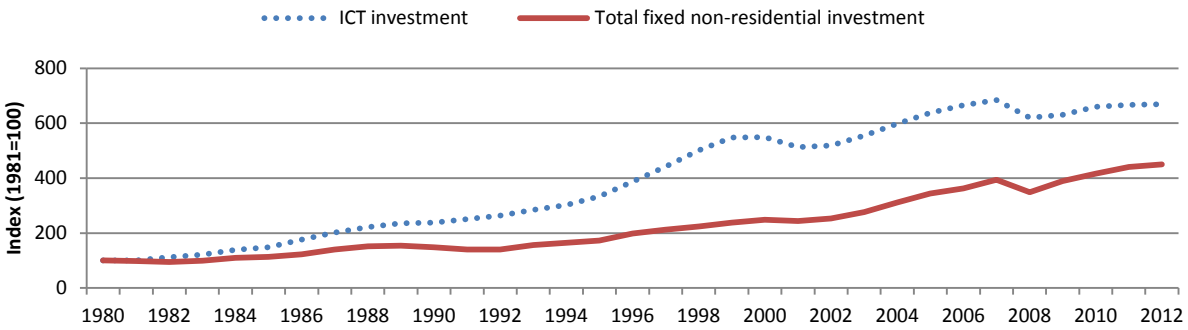
Creating the aggregate quantity index

		2009	2010	2011	2012
Chain-type quantity index (base 2009)		100.000	101.238	130.400	160.332

Source: Bureau of Economic Analysis, Detailed Data for Fixed Assets and Consumer Durable Goods. Non-residential Detailed Estimates. Investment, chain-type quantity indexes. Aggregation Example. http://www.bea.gov/national/FA2004/Details/Index.html

Appendix 3: Appendix Charts

Chart A3.1: Nominal ICT Investment and Nominal Total Fixed Non-Residential Investment in Canada, 1981=100, 1981-2013

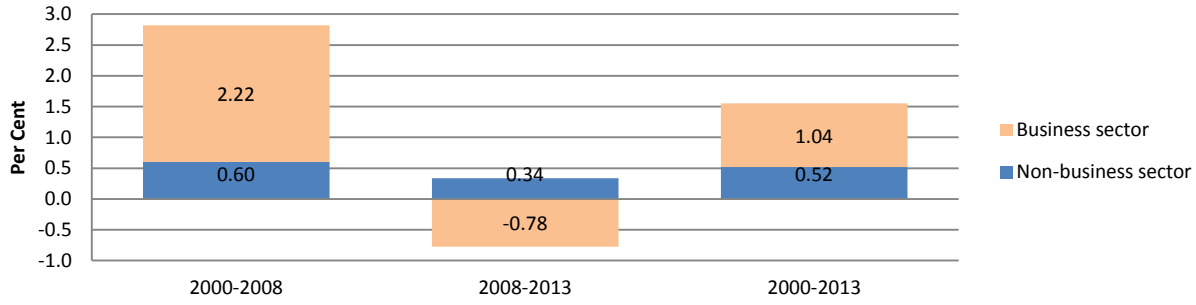


Source: CSLS ICT Database, Summary Tables

Chart A3.2: Nominal ICT Investment by Sector in Canada, Current Dollars, Annual Growth, 2000-2013

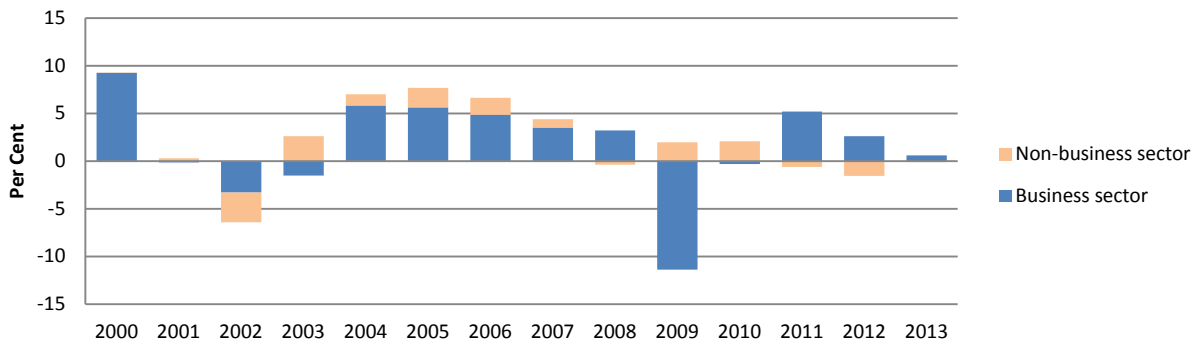
Source: CSLS ICT Database, Summary Tables

Chart A3.3a: Contributions of the Business and Non-Business Sectors to Nominal Total ICT Investment Growth in Canada, Compound Average Annual Growth, 2000-2013



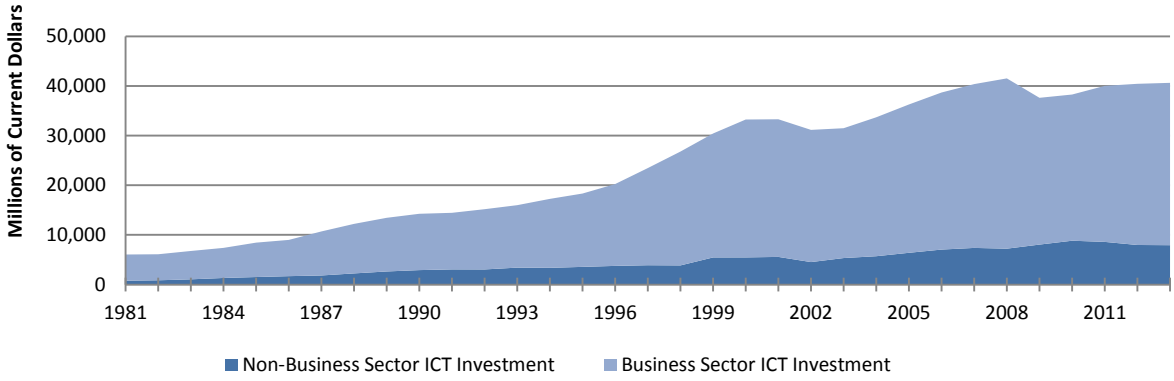
Source: CSLS ICT Database, Summary Tables

Chart A3.3b: Contributions of the Business and Non-Business Sectors to Nominal Total ICT Investment in Canada, Annual Growth, 2000-2013



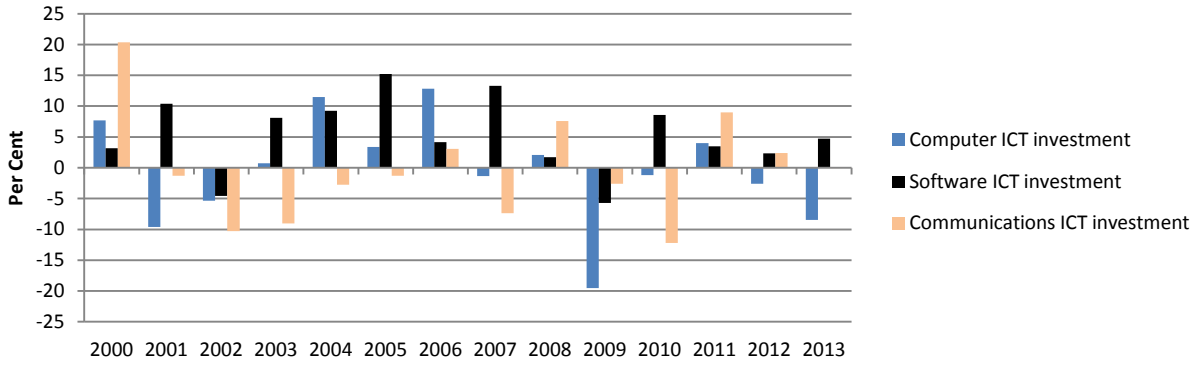
Source: CSLS ICT Database, Summary Tables

Chart A3.4: Contribution of the Business and Non-Business Sectors to Nominal Total ICT Investment Levels in Canada, Millions of Current Dollars, 1981-2013



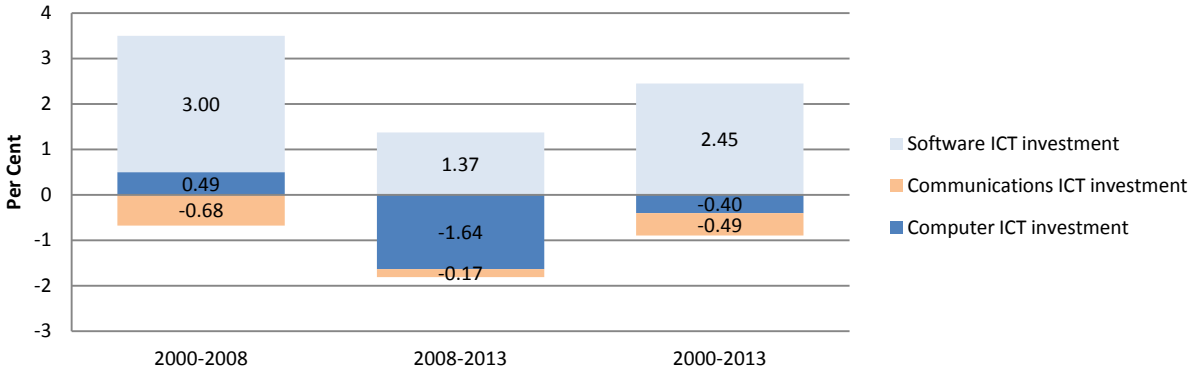
Source: CSLS ICT Database, Summary Tables

Chart A3.5: Nominal ICT Investment Growth By Component in Canada, Annual Growth, 2000-2013



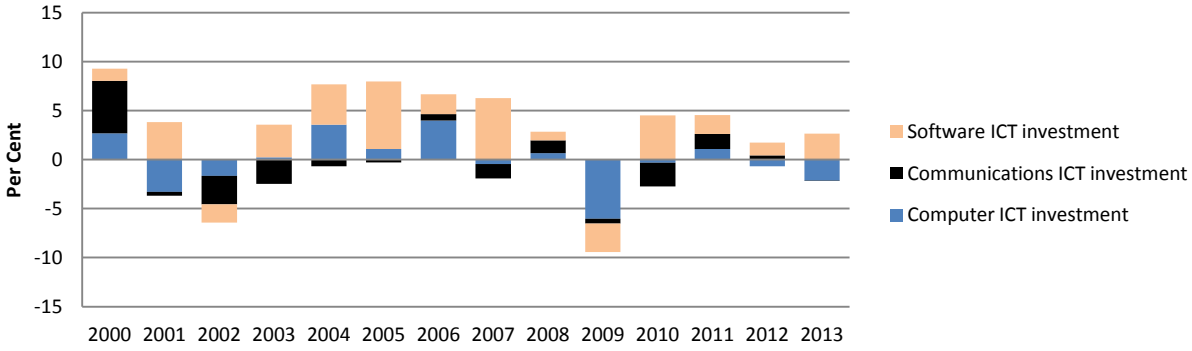
Source: CSLS ICT Database, Summary Tables

Chart A3.6: Contributions of ICT Components to Nominal Total ICT Investment Growth in Canada, Compound Average Annual Growth, 2000-2013



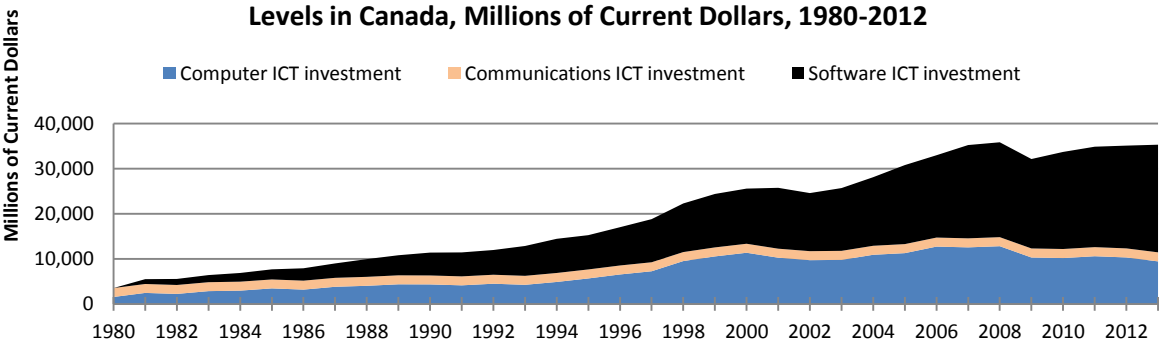
Source: CSLS ICT Database, Summary Tables

Chart A3.7: Contributions of ICT Components to Nominal Total ICT Investment Growth in Canada, Annual Growth, 2000-2013



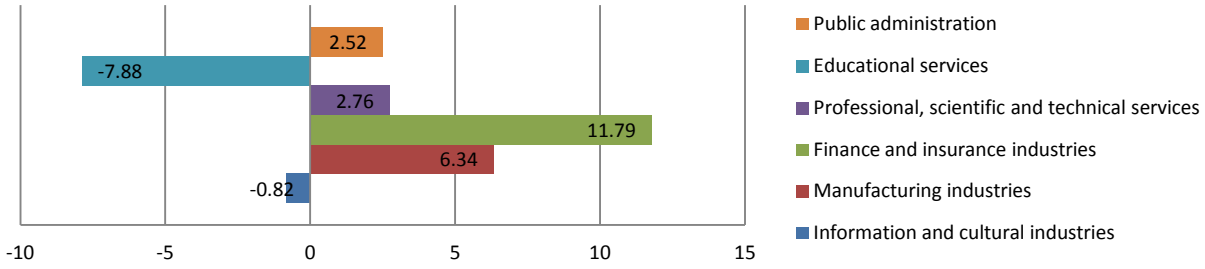
Source: CSLS ICT Database, Summary Tables

Chart A3.8: Contributions of ICT Components to Nominal Total ICT Investment Levels in Canada, Millions of Current Dollars, 1980-2012



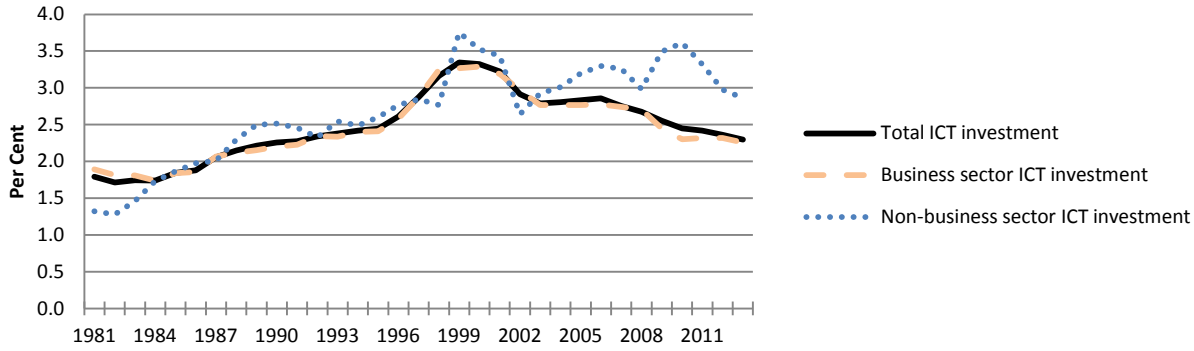
Source: CSLS ICT Database, Summary Tables

Chart A3.9: Total ICT Investment by Industry in Canada, Current Dollars, Annual Growth, 2013



Source: CSLS ICT Database, Summary Tables

Chart A3.10: Total ICT Investment and ICT Investment by Sector as a Proportion of GDP in Canada, Current Dollars, Per Cent, 1981-2013

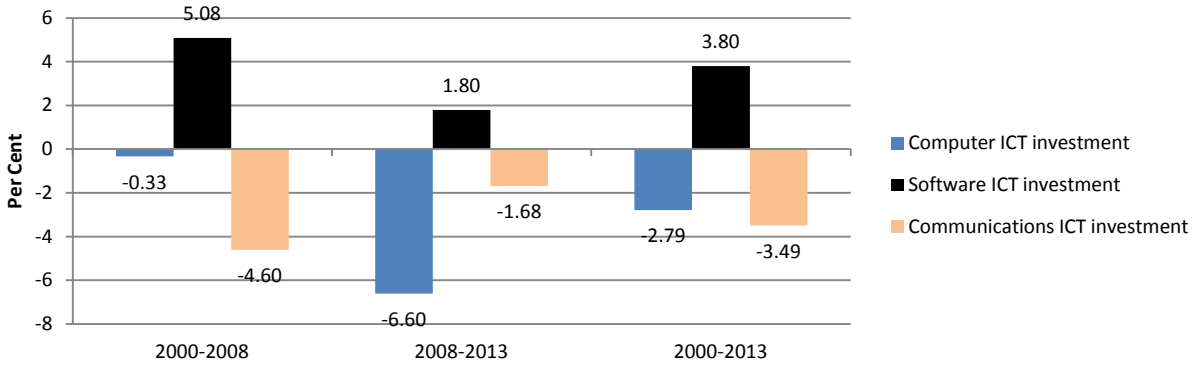


Source: CSLS ICT Database, Summary Tables

Chart A3.11: Nominal ICT Investment Per Worker, Employment and Nominal ICT Investment in Canada, Annual Growth, 2000-2013

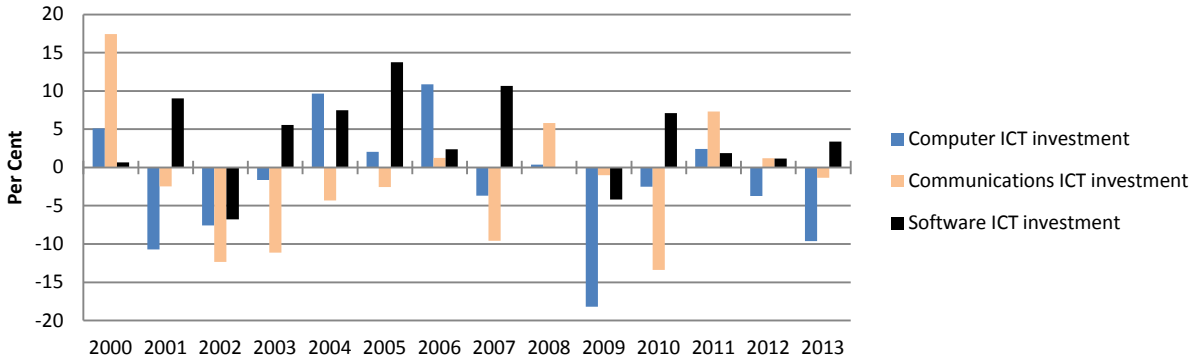
Source: CSLS ICT Database, Summary Tables

Chart A3.12: Nominal ICT Investment Per Worker by Component in Canada, Compound Average Annual Growth, 2000-2013



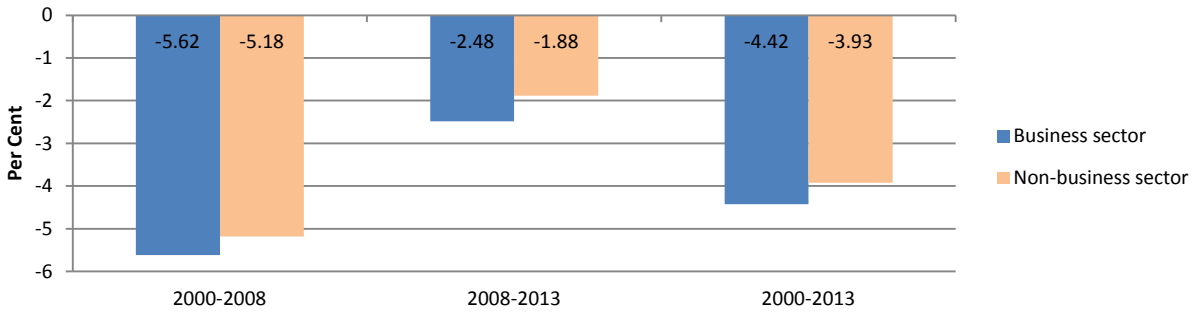
Source: CSLS ICT Database, Summary Tables

Chart A3.13: Trends in ICT Investment Per Worker by Component in Canada, Current Dollars, Annual Growth Rates, 2000-2013



Source: CSLS ICT Database, Summary Tables

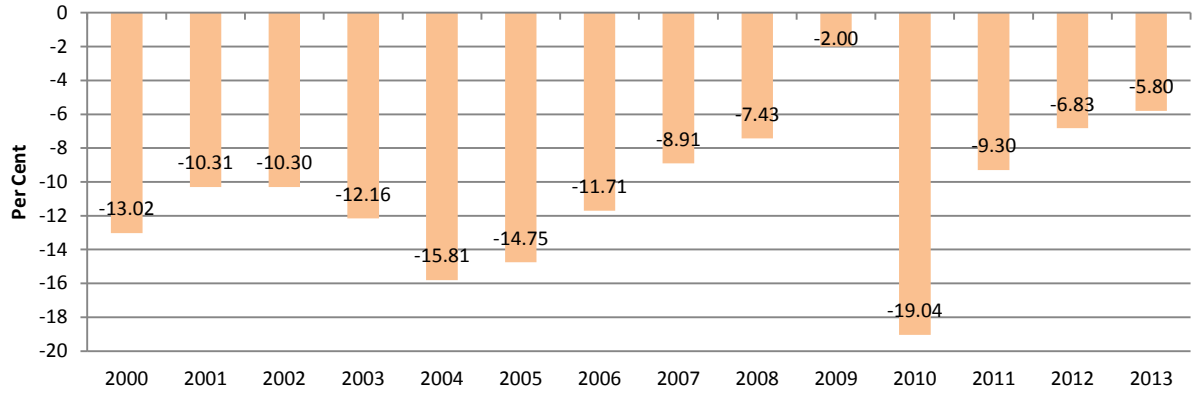
Chart A3.14: ICT Prices by Sector in Canada, Compound Average Annual Growth, 2000-2013



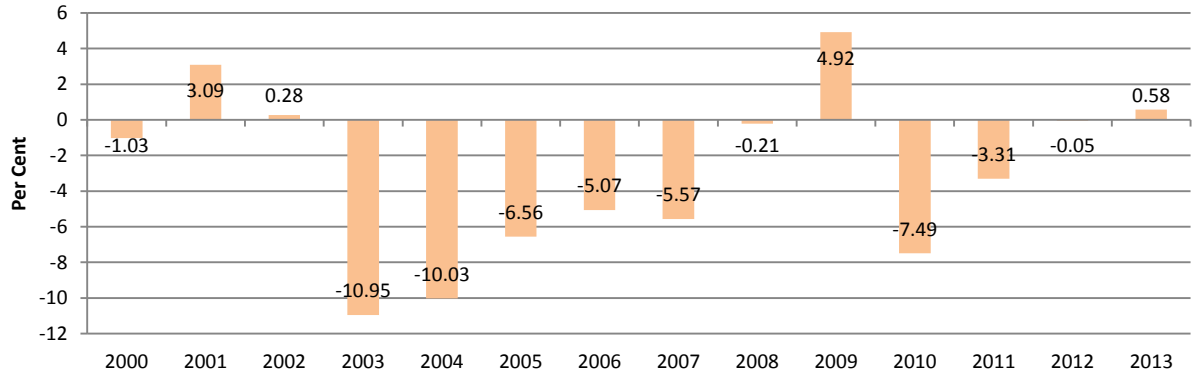
Source: CSLS ICT Database, Summary Tables

Chart A3.15: ICT Prices by Component in Canada, Annual Growth, Per Cent, 2000-2013

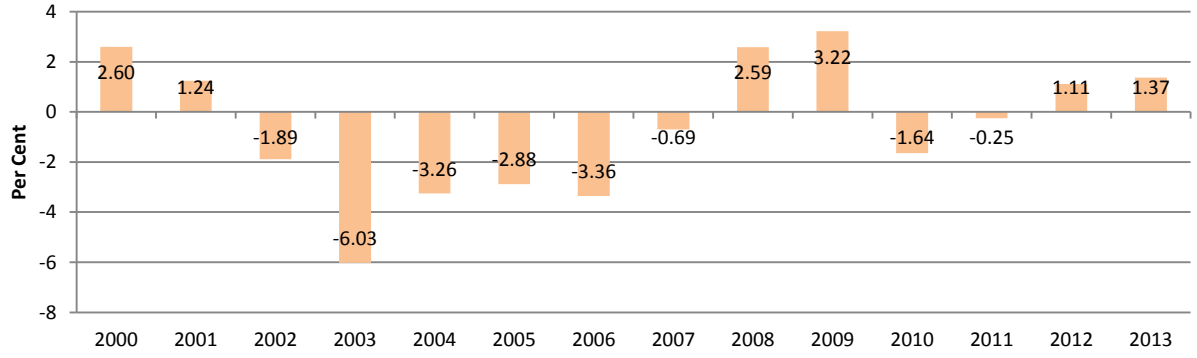
a) Computer ICT prices



b) Communications ICT prices

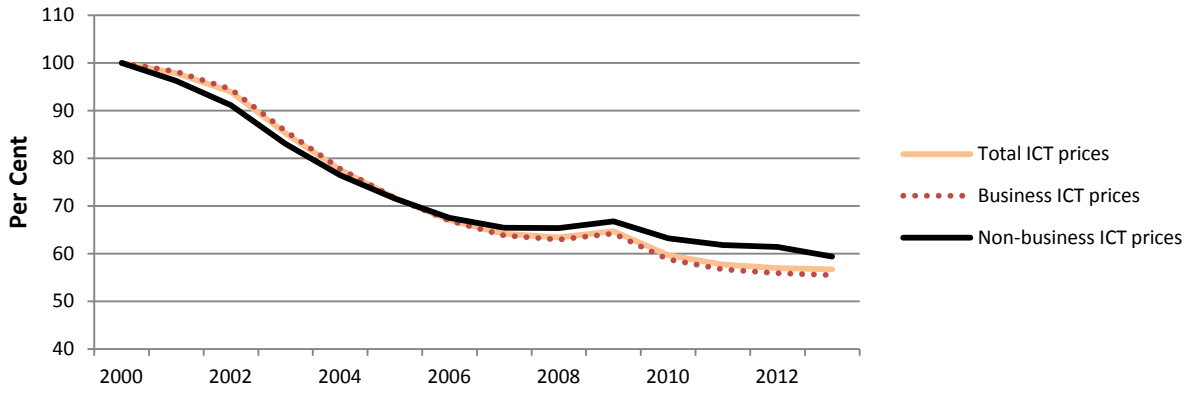


c) Software ICT prices



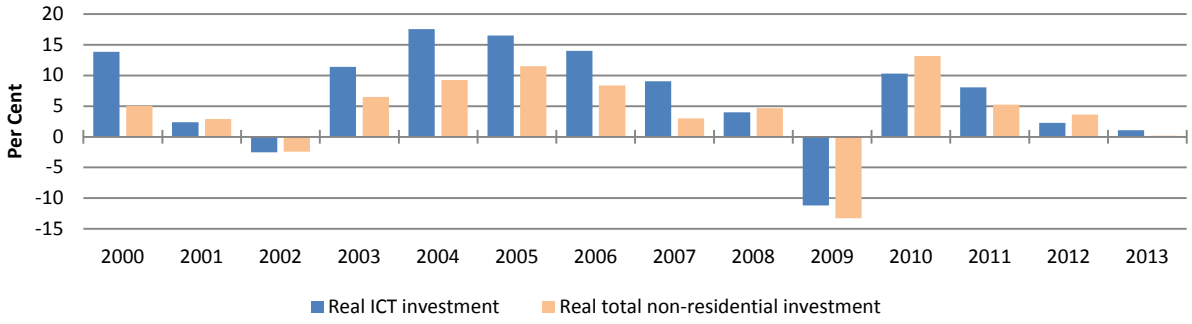
Source: CSLS ICT Database, Summary Tables

Chart A3.16: ICT Investment Prices by Sector in Canada, 2000 = 100, 2000-2013



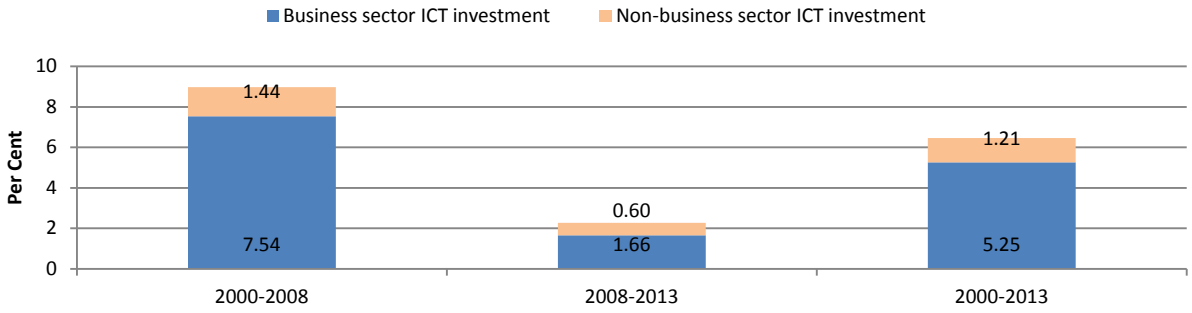
Source: CSLS ICT Database, Summary Tables

Chart A3.17: Real ICT Investment and Real Total Fixed Non-Residential Investment in Canada, 2007 Chained Dollars, Annual Growth Rates, Per Cent, 2000-2013



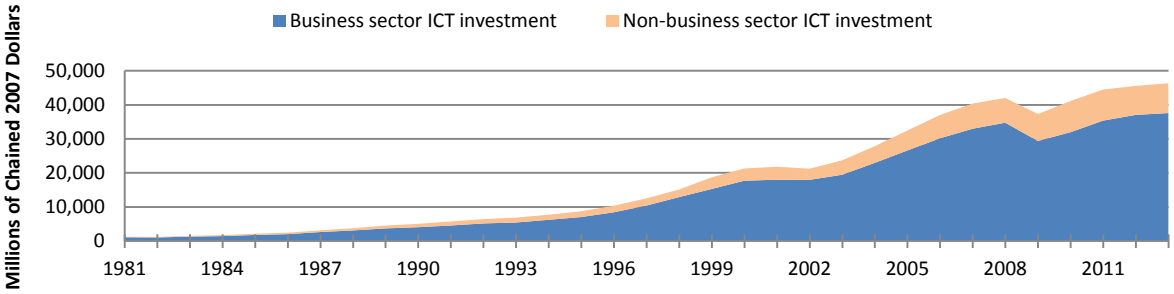
Source: CSLS ICT Database, Summary Tables

Chart A3.18: Contributions of the Business and Non-Business Sectors to Real Total ICT Investment Growth in Canada, 2007 Chained Dollars, Compound Average Annual Growth, Per Cent, 2000-2013



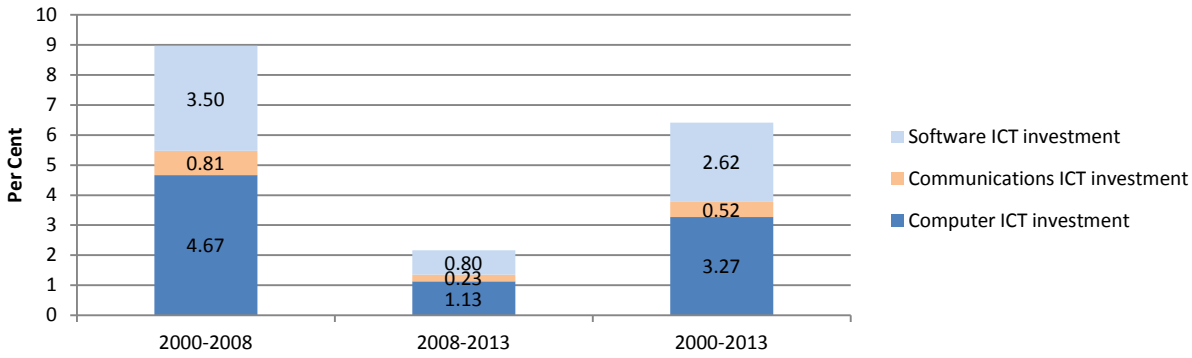
Source: CSLS ICT Database, Summary Tables

Chart A3.19: Contributions of the Business and Non-Business Sectors to Real Total ICT Investment Levels in Canada, Chained 2007 Dollars, 2000-2013



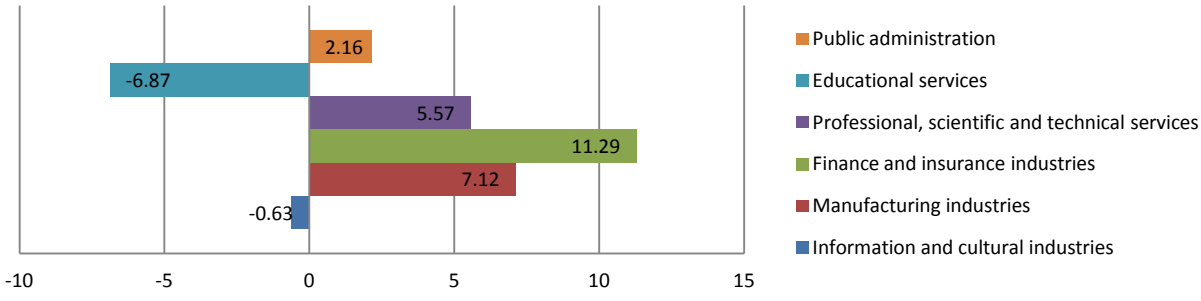
Source: CSLS ICT Database, Summary Tables

Chart A3.20: Contributions of ICT Components to Real Total ICT Investment Growth in Canada, 2007 Chained Dollars, Compound Average Annual Growth, Per Cent, 2000-2013



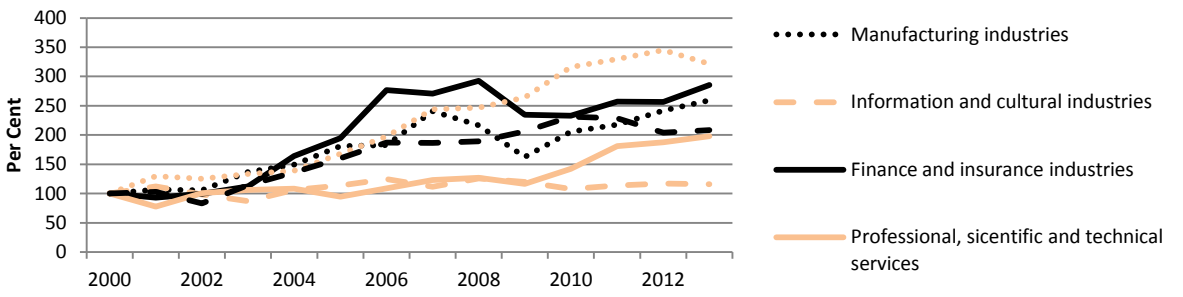
Source: CSLS ICT Database, Summary Tables

Chart A3.21: Total ICT Investment by Industry in Canada, Chained 2007 Dollars, Annual Growth Rates, Per Cent, 2013



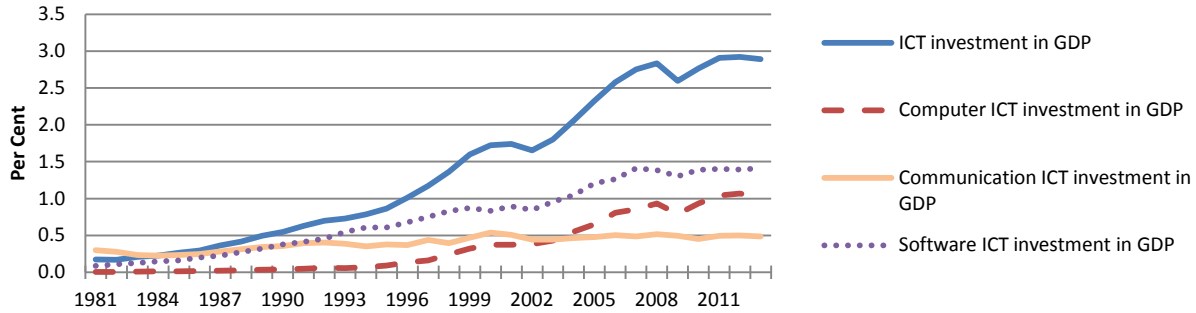
Source: CSLS ICT Database, Summary Tables

Chart A3.22: Trends in Real ICT Investment by Industry in Canada, Current Dollars, 2000=100, 2000-2013



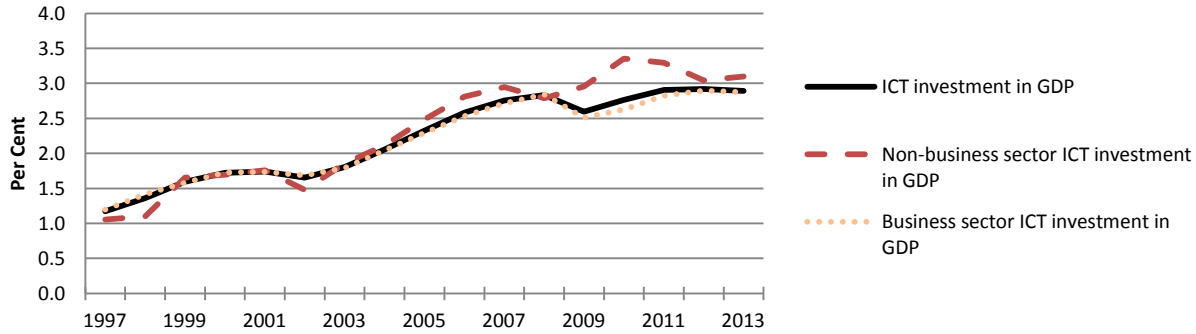
Source: CSLS ICT Database, Summary Tables

Chart A3.23: Trends in Real ICT Investment by Component as a Proportion of Real GDP in Canada, 2007 Chained Dollars, Per Cent , 1981-2013



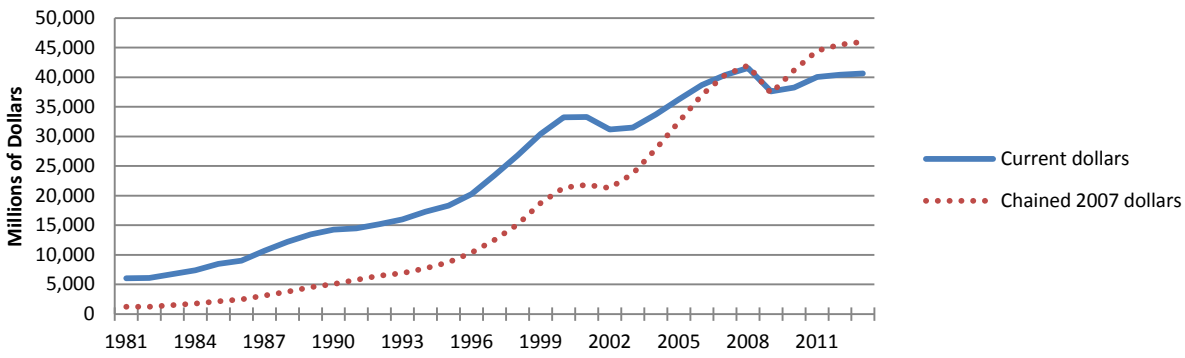
Source: CSLS ICT Database, Summary Tables

Chart A3.24: Real Total ICT Investment and ICT Investment by Sector as a Proportion of GDP in Canada, Chained 2007 Dollars, Per Cent , 1997-2013



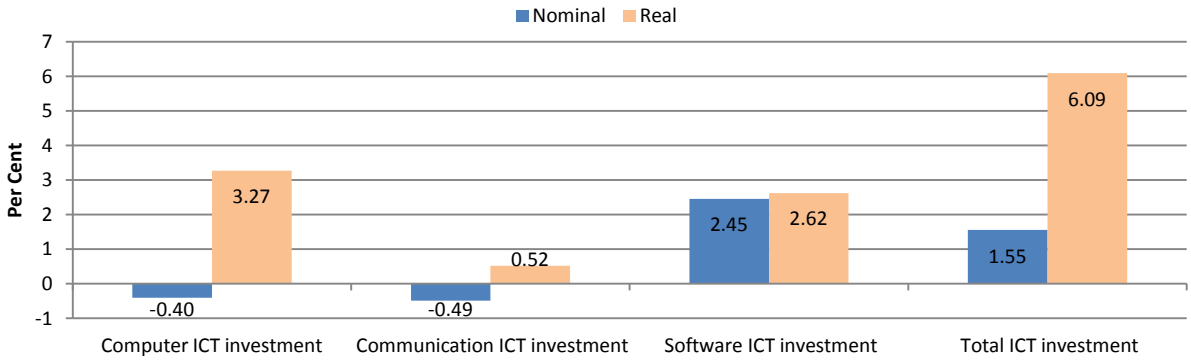
Source: CSLS ICT Database, Summary Tables

Chart A3.25: Real and Nominal Total ICT Investment Levels in Canada, 1981-2013



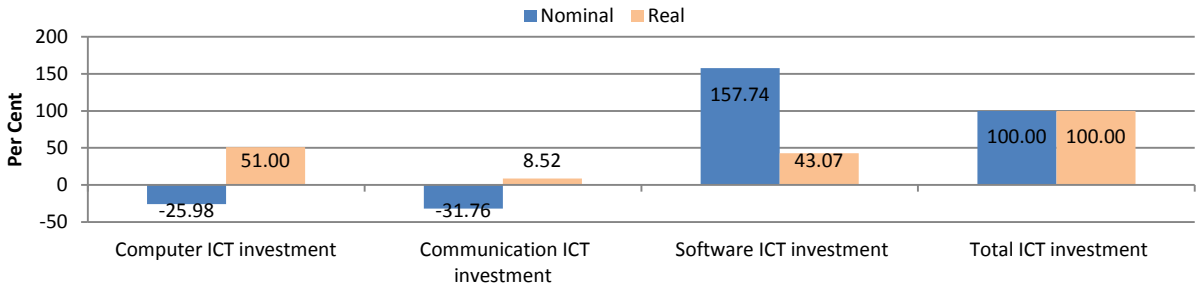
Source: CSLS ICT Database, Summary Tables

Chart A3.26: Difference Between Nominal and Real Investment Figures by Component in Canada, Percentage Point Contributions to Compound Average Annual Growth, Per Cent, 2000-2013



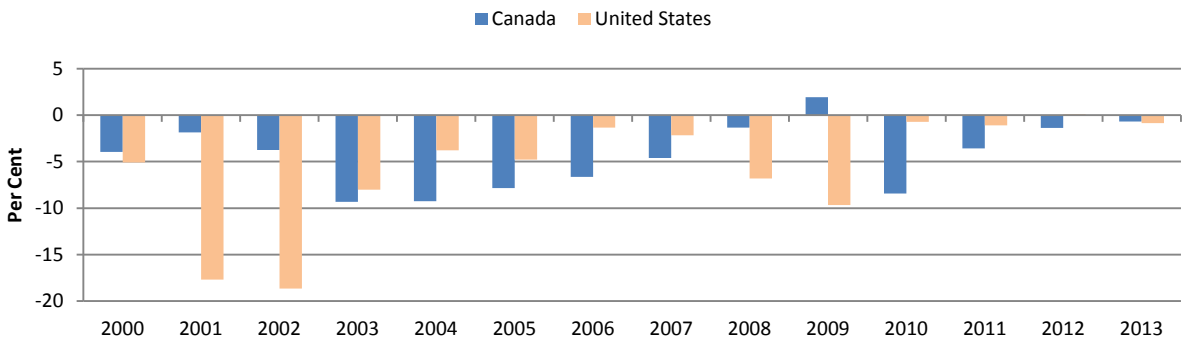
Source: CSLS ICT Database, Summary Tables

Chart A3.27: Difference Between Nominal and Real ICT Investment Figures by Component, Percentage Contribution to Compound Average Annual Growth, Per Cent, 2000-2013



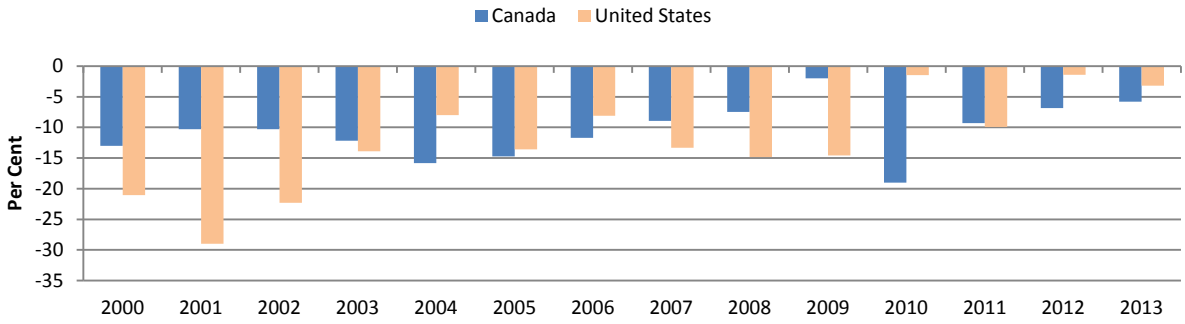
Source: CSLS ICT Database, Summary Tables

Chart A3.28: Total ICT Prices Growth in Canada and the United States in the Business Sector, 2000-2013



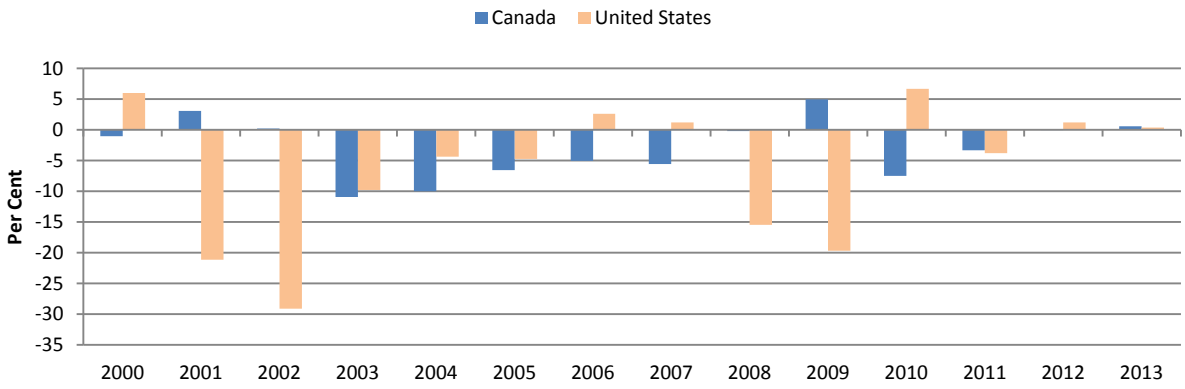
Source: CSLS ICT Database, Summary Tables

Chart A3.29: Computer ICT Prices Growth in Canada and the United States in the Business Sector, 2000-2013



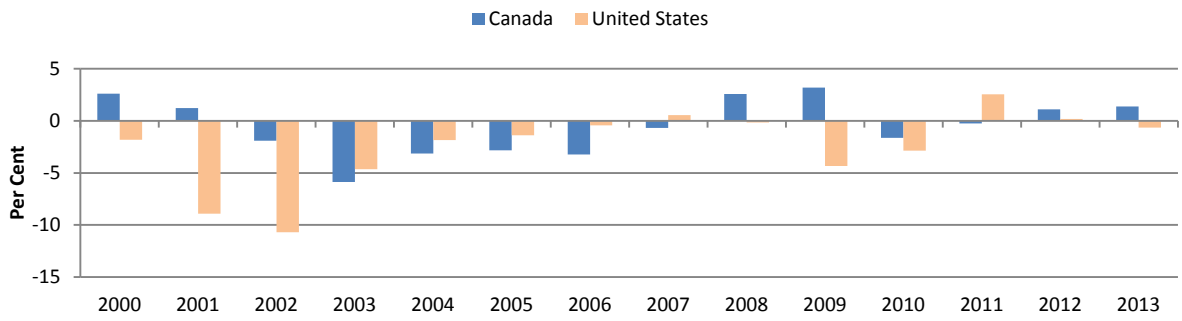
Source: CSLS ICT Database, Summary Tables

Chart A3.30: Communications ICT Prices in Canada and the United States in the Business Sector, 2000-2013



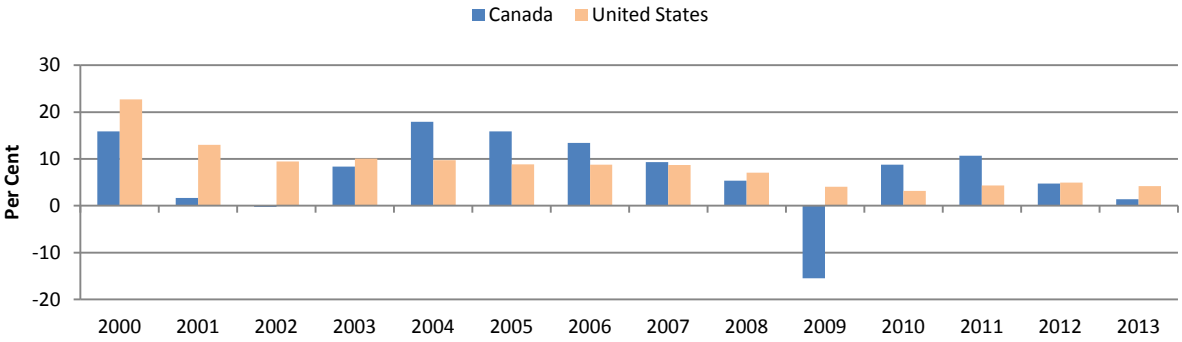
Source: CSLS ICT Database, Summary Tables

Chart A3.31: Software ICT Prices Growth in Canada and the United States in the Business Sector, 2000-2013



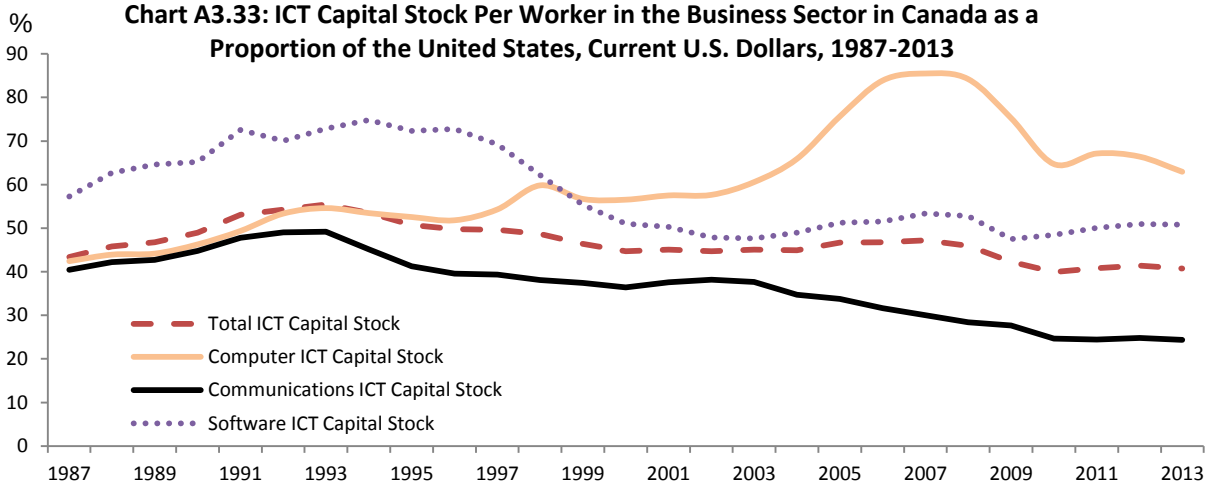
Source: CSLS ICT Database, Summary Tables

Chart A3.32: Real ICT Investment Growth for Canada and the United States in the Business Sector, Annual Growth Rates, 2000-2013



Source: CSLS ICT Database, Summary Tables

Chart A3.33: ICT Capital Stock Per Worker in the Business Sector in Canada as a Proportion of the United States, Current U.S. Dollars, 1987-2013



Source: CSLS ICT Database, Summary Tables