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STUDY OF LIVING
STANDARDS

AN OVERVIEW OF DEVELOPMENTS IN ICT INVESTMENT IN CANADA IN 2008

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An Overview of Developments in ICT Investment in Canada in 2008

Abstract

This report provides an overview of developments in ICT investment in Canada in 2008, based on the most recent update of the Canadian ICT database maintained by the Centre for the Study of Living Standards. The ICT performance of Canada in 2008 was robust. Canada's total ICT investment grew 9.5 per cent in real terms in 2008, on par with the average annual growth rate over the 2000-2008 period. Real ICT investment grew faster than nominal ICT investment because of substantial declines in ICT prices. Growth of ICT investment was faster in the business sector than in the non-business sector; indeed, ICT investment *declined* in the non-business sector. Finally, ICT investment growth in 2008 was driven by growth of investment in communications equipment and software, with investment in computers growing more slowly.

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Executive Summary

This report is based on an updating of the CSLS ICT database for Canada to 2008. The ICT investment database is comprised of three key components – computer equipment, communication equipment, and software investment and measures their trends since 1980. The following gives a brief overview of developments in ICT investment since 2000, focusing particularly on 2008.

- The ICT performance of Canada in 2008 was robust. Indeed, in real terms, total ICT investment grew 9.5 per cent, which was approximately the same as the average annual growth rate from 2000-2008, but below the high of 17.6 per cent in 2004, which was a high point since 1999 when the Canadian economy was in the midst of a technology boom. This increase in real investment was in large part the result of a fall in ICT prices caused by the continued rise of the Canadian dollar in 2008. Because ICT investment goods are internationally traded, a rise in the value of the Canadian dollar generally translates into a commensurate decline in the price of ICT goods.
- In 2008, current dollar total ICT investment was up 3.8 per cent from the previous year. This was below the 2004 growth rate of 7.0 per cent, yet well above the 2002 drop of -6.1 per cent. Overall, the growth in 2008 was above the 2.9 per cent annual average growth which occurred over the 2000 to 2008 period.
- Prices of ICT investment goods declined 5.2 per cent in 2008, which is slightly below the average decline of 6.1 per cent from 2000-2008. All three ICT components showed substantial decline in price from their 2000 levels, with computer prices dropping most dramatically (12.0 per cent per year), followed by communication equipment prices (5.4 per cent per year) and finally software prices (3.2 per cent per year). However, the decline in 2008 was neither a high or a low for any of these components over the 2000-2008 period
- The decline in ICT prices demonstrates that, although levels of investment may appear to be growing at a low rate in current dollar measures, the actual stock of ICT is increasing faster than one may initially infer. The prices have also been adjusted for quality improvements. Therefore, although firms might be spending only slightly more on ICT, they are receiving significantly more out of their dollar.
- Real computer investment in 2008 was up 0.9 per cent, software 8.0 per cent, and communication equipment 16.4 per cent. Comparatively, this was a low for real computer investment and a high for real communication investment over the

2000-2008 period. The growth in real software investment was slightly below the average from 2000-2008. Growth in real total ICT investment in 2008 was about equal to the average annual growth over the 2000-2008 period (9.6 per cent).

- Real investment growth in total ICT in 2008 was mostly attributable to the business sector, whose total ICT investment grew 12.3 per cent in 2008, slightly above the annual average from 2000-2008. In contrast, ICT investment in the non-business sector declined by 3.5 per cent, a rate below that of the five previous years.
- As a share of GDP, real total ICT investment (at 5.1 per cent) was higher in 2008 than for any other year in the 1980-2008 period. This continued a trend of heightened growth since 2002. Broken down, growth rate in communication and software ICT investment have been high, while the growth rate in computer ICT investment has leveled off in recent years. This growth has been supported by the business sector, as the non-business sector ICT investment to GDP growth has slumped in recent years.

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An Overview of Developments in ICT Investment in Canada in 2008

I. Introduction

The aim of this report is to provide an overview of information and communication technology (ICT) investment in Canada in 2008 based on the recent updating of the CSLS ICT database¹ for Canada. ICT investment is important because ICT has been shown to be a significant determinant of labour productivity.² Microsoft CEO Steve Ballmer made this point in a recent article in *The Globe and Mail*:

What kind of investments will lead to sustainable growth that drives greater prosperity and expanded economic opportunity in local communities? I believe the right answer is investment in innovation, particularly information technology innovation. Why? Because information technology innovation is the key to improving productivity and productivity is the foundation for real economic growth. (Ballmer, 2009)

In the academic literature, Fuss and Waverman (2005) demonstrate that differences in ICT stocks accounted for 56 per cent of the Canada-US labour productivity gap in 2000, and 60 per cent of the gap in 2003. ICT exhibits the properties of a 'general purpose technology' (Helpman and Trajtenberg, 1998; Abdi, 2008); its productivity benefits increase as it spreads throughout the economy. Since labour productivity growth is the primary long-run driver of increasing living standards, Canada's ICT investment is an important contributor to the economic welfare of Canadians.

ICT investment can be analyzed along four dimensions. First, data can be expressed in nominal (current dollar) or real (constant dollar) terms; the latter controls for changes over time in nominal prices. Second, investment can be analyzed in the business and non-business sectors. Third, ICT investment can be broken down into its three components: investment in computers, software, and communications equipment. Finally, investment can be analyzed by industry.

We explore ICT investment along all four dimensions in this report. First, we review developments in current dollar ICT investment in 2008. We look at ICT investment by component and by industry, ICT investment as a share of GDP, ICT investment in both the business and non-business sector, and ICT investment per worker. The report then reviews

¹ <http://www.csls.ca/data/ict.asp>. The database provides estimates of ICT investment and ICT capital stock in Canada and the United States by industry, broken down into 20 NAICS industrial subcategories, as well as on a per worker basis. The data are broken down by the three ICT components: computers, communications, and software and are expressed in both current and 2002 chained dollars. ICT estimates by industry are available for the period 1980 to 2008. Estimates of ICT per worker are only available from 1987 to 2008 for certain industries due to the unavailability of consistent employment estimates for years before 1987.

² For a discussion of the productivity benefits of ICT, see Section I of Sharpe and Arsenault (2008).

the major developments in the price of ICT investment by component. Finally, the report reviews developments in constant dollar (chained \$2002) ICT investment, again focusing on ICT investment by component, ICT investment as a share of GDP, ICT in both the business and non-business sectors and ICT investment per worker. Our focus in every case is on ICT investment in 2008, although we do provide context by discussing trends since 2000.

Our main findings are as follows. First, Canada's total ICT investment grew 9.5 per cent in real terms in 2008, on par with the average annual growth rate over the 2000-2008 period (9.6 per cent). Real ICT investment grew faster than nominal ICT investment because of substantial declines in ICT prices. Second, growth of ICT investment was driven by the business sector. Real business sector ICT investment grew by 12.3 per cent in 2008; in the non-business sector, real ICT investment *declined* by 3.5 per cent. This indicates that Canada's public sector is lagging behind in its adoption of ICT. Finally, real investment in communications equipment and software enjoyed strong growth rates of 16.4 and 8.0 per cent, respectively, in 2008. Real investment in computers grew more slowly; it increased by just 0.9 per cent in 2008.

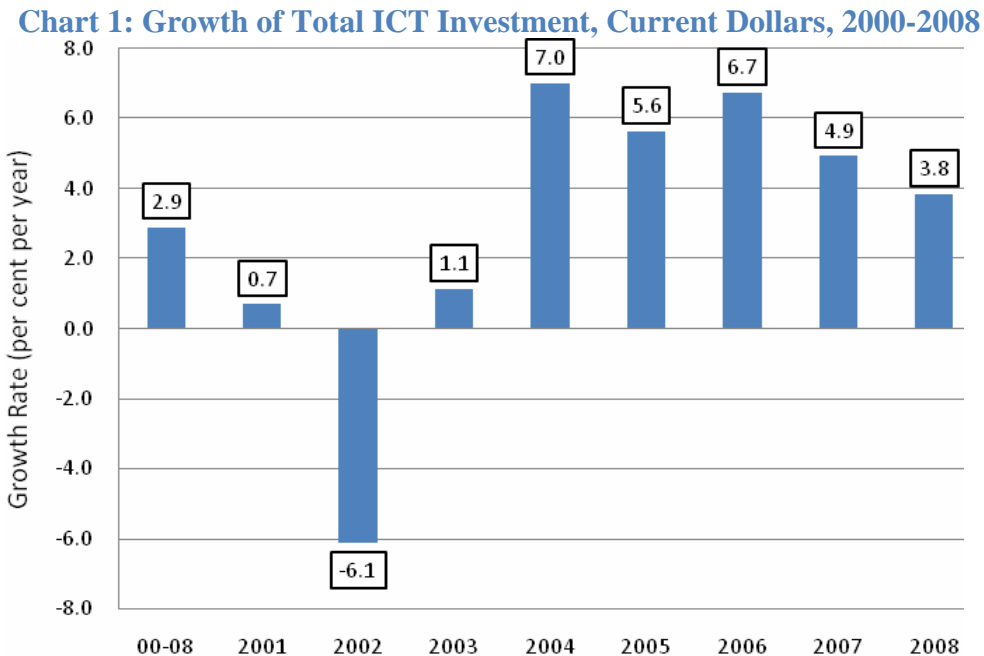
II. Nominal ICT Investment

Total current dollar ICT investment grew by 3.8 per cent in 2008. While this growth was slow relative to the preceding few years – ICT investment grew by 4.9 per cent in 2007 and by over five per cent in each year from 2004 to 2006 – it was nevertheless above the average annual growth rate of 2.9 per cent for the 2000-2008 period. Current dollar ICT investment growth was weak in the early years of the decade and was negative in 2002 (Chart 1 and Summary Table 1), but it has since recovered and 2008 continues the recent trend of strong growth.

A. Nominal ICT Investment by Component

Total ICT investment consists of three components: computer investment, communication equipment investment and software investment. Current dollar investment in computer equipment declined by 11.0 per cent in 2008, but this was more than offset by investment increases of 15.9 and 7.5 per cent in communications equipment and software, respectively.

The 11.0 per cent decline in current dollar computer investment in 2008 followed a 7.1 per cent decline in 2007. Computer investment has exhibited a poor performance in current dollar terms since 2000, with an average annual decrease from 2000 to 2008 of -1.9 per cent (Chart 2). Despite this trend, there was positive growth in 2003 thru 2006: growth was an impressive 10.9 per cent in 2004. However, the trend has reversed since 2006, and in 2008, current dollar computer investment was at 86 per cent of its 2000 level.



Source: Table 1a

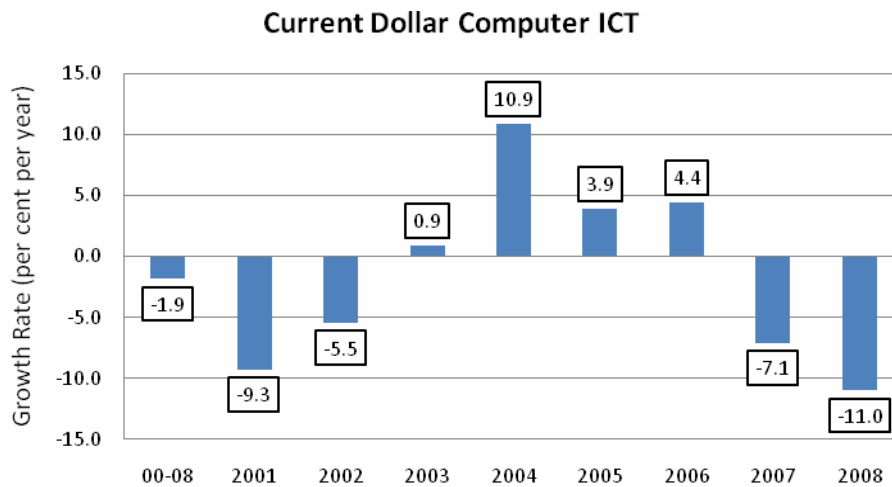
Summary Table 1: Developments in Canadian ICT Investment, 2000-2008

	Total ICT Investment	Business Sector	Non-business Sector	Computers	Communications Equipment	Software
	Growth of Nominal (Current Dollar) Investment (per cent)					
2008	3.8	6.2	-7.1	-11.0	15.9	7.5
2001	0.7	-0.2	5.5	-9.3	0.1	10.4
2002	-6.1	-3.6	-18.6	-5.5	-9.6	-4.5
2003	1.1	-1.9	18.6	0.9	-10.5	8.1
2004	7.0	7.2	6.2	10.9	-3.3	9.3
2005	5.6	5.5	6.0	3.9	-2.7	10.4
2006	6.7	6.2	9.4	4.4	7.0	8.2
2007	4.9	5.1	4.1	-7.1	11.0	10.5
2000-08*	2.9	3.0	2.4	-1.9	0.6	7.4
	Growth of Real (2002 Constant Dollar) Investment (per cent)					
2008	9.5	12.3	-3.5	0.9	26.3	8.0
2001	3.2	1.9	9.9	1.2	-2.9	9.0
2002	-2.1	0.3	-13.9	5.4	-9.8	-2.7
2003	11.4	8.1	30.2	14.8	0.5	15.0
2004	17.6	18.1	15.3	31.7	7.5	12.9
2005	14.4	14.6	13.4	21.7	4.1	13.8
2006	15.0	14.5	17.3	17.9	12.7	13.8
2007	9.1	9.6	6.8	2.3	16.4	10.6
2000-08*	9.6	9.8	8.7	11.5	6.3	9.9

The strong growth of communications investment in 2008 continues a trend that began in 2006; current dollar investment in communications equipment grew by 7.0 per cent in 2006 and 11.0 per cent in 2007 (Chart 2). This represents a striking reversal from the pre-2006 trend. Indeed, the modest growth in communication equipment investment since 2000 – an average annual growth rate of just 0.6 per cent – highlights the extent to which Canada suffered from the slump in the technology sector, particularly from 2000-2005. Over the 2001-2005 period, communication investment increased only in 2001 (0.1 per cent). Indeed, communication investment fell 9.6 per cent in 2002, 10.5 per cent in 2003, 3.3 percent in 2004 and 2.7 per cent in 2005. During this period, the level reached a low in 2005 at 76.2 per cent of the 2000 level of investment. However, the reversal of these negative trends starting in 2006 points to stronger prospects for communications investment going forward. In 2008, communication investment surpassed the 2000 level, reaching an all-time high.

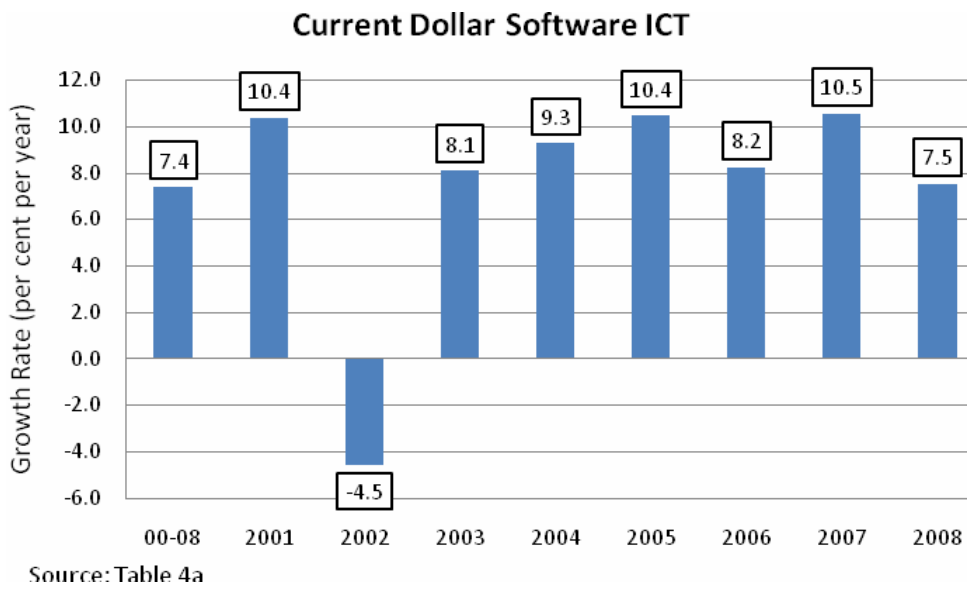
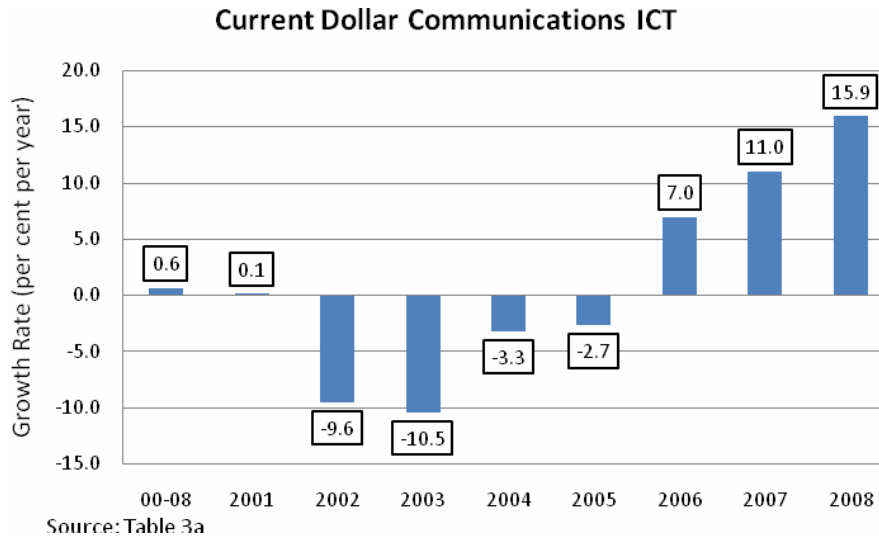
The 7.5 per cent growth of current dollar investment in software in 2008 was on par with the 7.4 per cent average annual growth of software investment over the 2000-2008 period (Chart 2). Unlike the other two components of ICT, software investment growth has been strong since 2000 (with the exception of one year of negative growth in 2002). In particular, it grew by 10.5 per cent in 2007 and 8.2 per cent in 2006. Although software investment growth was strong over the 2000-2008 period, however, it still remained well below the average annual growth rate of 13.7 per cent recorded between 1981 and 2000.

Chart 2: ICT Investment by Component, Current Dollars, 2000-2008



Source: Table 2a

Chart 2 (continued): ICT Investment by Component, Current Dollars, 2000-2008



B. Nominal ICT Investment in Business and Non-business Sectors and by Industry

Total ICT investment can also be divided into the business and non-business sectors. The business sector represents approximately 80 per cent of the total economy and is comprised of industries whose output is marketed. The non-business sector is made up of the public administration, healthcare and social assistance and educational services industries, whose output is generally not marketed.

In 2008, the business sector increased its ICT investment by 6.2 per cent, up from the 2007 rate of 5.1 per cent and roughly equal to the level in 2006 (Chart 3). Strong 2008 growth continued a trend of positive growth in recent years; business sector ICT growth grew by 5.1 per cent in 2007 and has increased by more than five per cent in each year since 2004. This positive growth performance is partly offset by the negative performance experienced at the beginning of the decade (in 2001, 2002 and 2003), leading to an average annual growth rate of 3.0 per cent for the 2000-2008 period.

In contrast, current dollar ICT investment in the non-business sector declined by 7.1 per cent in 2008 (Chart 3). This was a reversal from positive growth of 4.1 per cent in 2007. Since 2000, nominal ICT investment has fluctuated more from year to year in the non-business sector than in the business sector. The average growth rate of ICT investment in the non-business sector for the 2000-2008 period was 2.4 per cent, with 2002 experiencing the greatest fall (18.6 per cent). After the 2002 decline, investment increased 18.6 per cent in 2003 and then slowly increased each year until it declined again in 2008.

Chart 3: Growth of ICT Investment by Sector, Current Dollars, 2000-2008

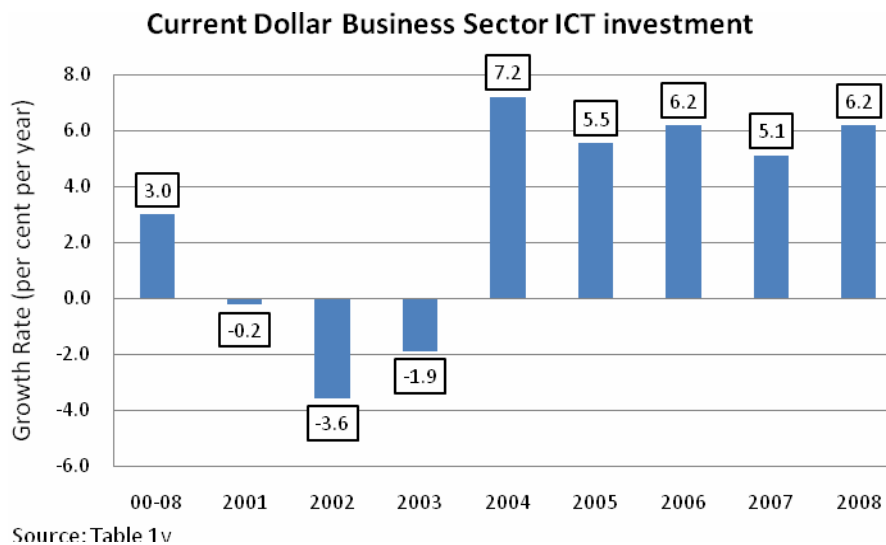
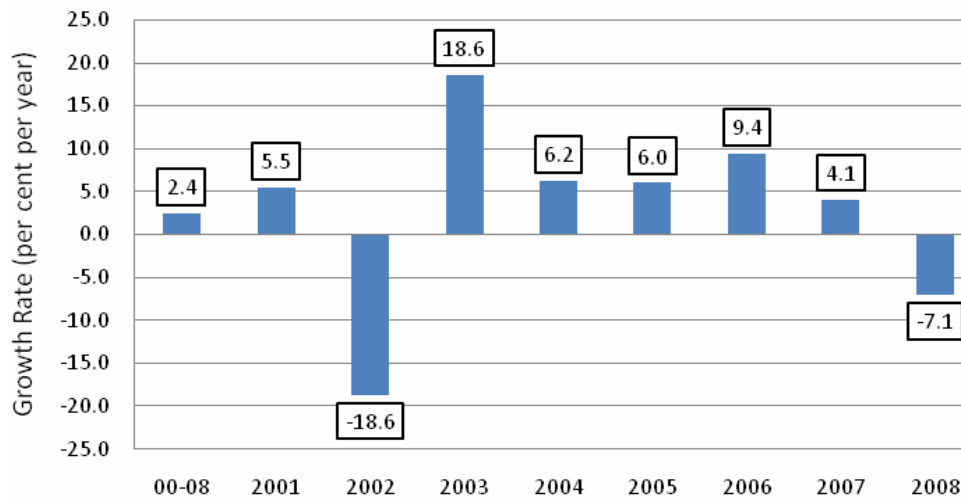


Chart 3 (continued): Growth of ICT Investment by Sector, Current Dollars, 2000-2008

Current Dollars Non-Business Sector ICT Investment



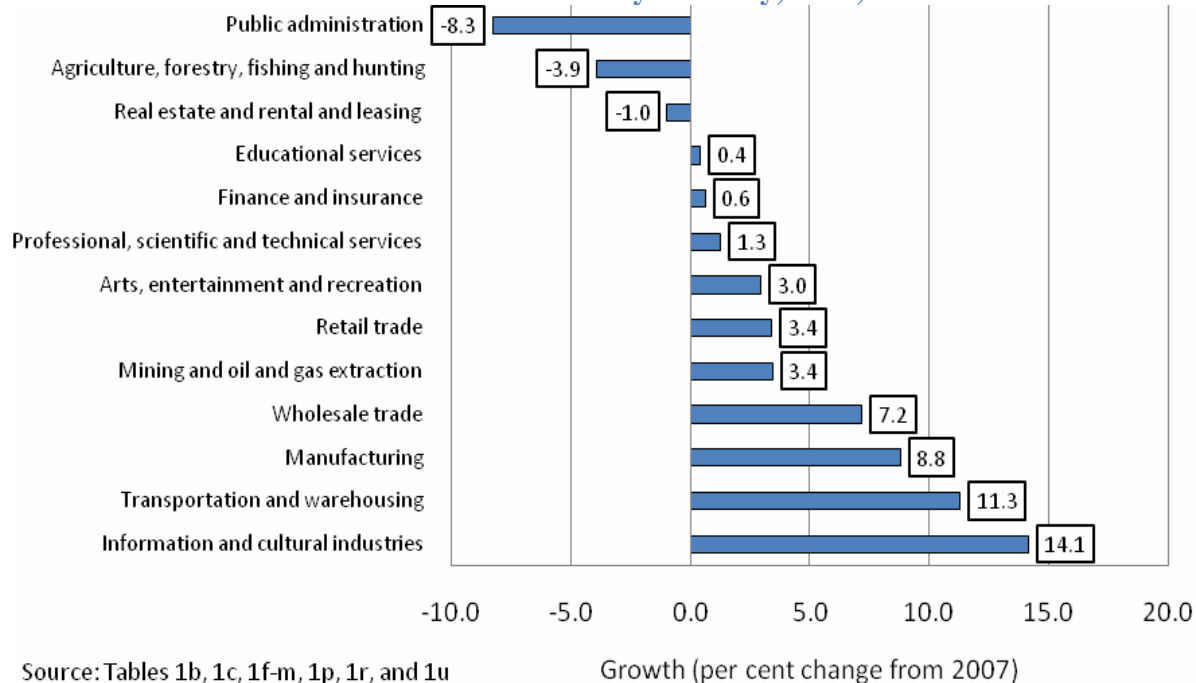
Source: Table 1w

Despite a decline from 2007, the level of non-business ICT investment in 2008 remained 21.3 per cent higher than that of 2000. However, the corresponding figure for the business sector was 26.5 per cent. The non-business sector is falling further behind the business sector in terms of ICT investment; in 2008, there was a 13.2 percentage-point gap in investment growth between the business and non-business sectors.

Although the business sector experienced an overall increase in ICT investment growth in 2008, there was variance in the levels of growth experienced by individual industries within the sector (Chart 4).³ The industries with the largest increases in 2008 were information and cultural industries, which experienced an increase of 14.1 per cent, followed by transportation and warehousing, with a growth rate of 11.3 per cent. ICT investment declined in two business sector industries; agriculture, forestry, fishing and hunting saw a decline of 3.9 per cent and real estate and rental and leasing saw a decline of 1.0 per cent.

Public administration, a part of the non-business sector, had the largest decline in ICT investment of any industry in 2008; ICT investment fell by 8.3 per cent in the industry. Meanwhile, educational services experienced small but positive growth of 0.4 per cent in current dollar ICT investment.

³ As stated above, Statistics Canada did not release data for NAICS two-digit industries on total ICT in 2008. This was done in an attempt to prevent the residual calculating of ICT investment and capital stock levels in telecommunication for the industries in which it was deemed confidential. The figures in Chart 4 were calculated through CSLS summing the data released by each of the three components. As a result, the figures for the following industries excluded data on communication ICT: utilities, construction, management of companies and enterprises, administrative and support waste management, healthcare, accommodation and food service, and other (except public administration). In 2007, these seven industries made up approximately 5.1 per cent of the communication equipment ICT spending.

Chart 4: Growth of ICT Investment by Industry, 2008, Current Dollars

C. Nominal ICT Investment as a share of GDP

In 2008, total nominal ICT investment as a proportion of GDP was 2.7 per cent (Chart 5). This was the lowest share since 1996. The overall trend in total nominal ICT investment as a proportion of GDP was relatively stable before 1996, fluctuating between 1.6 and 2.5 per cent, but it reached a historic high at 3.2 per cent of GDP in 1999 and has generally been on the decline since.

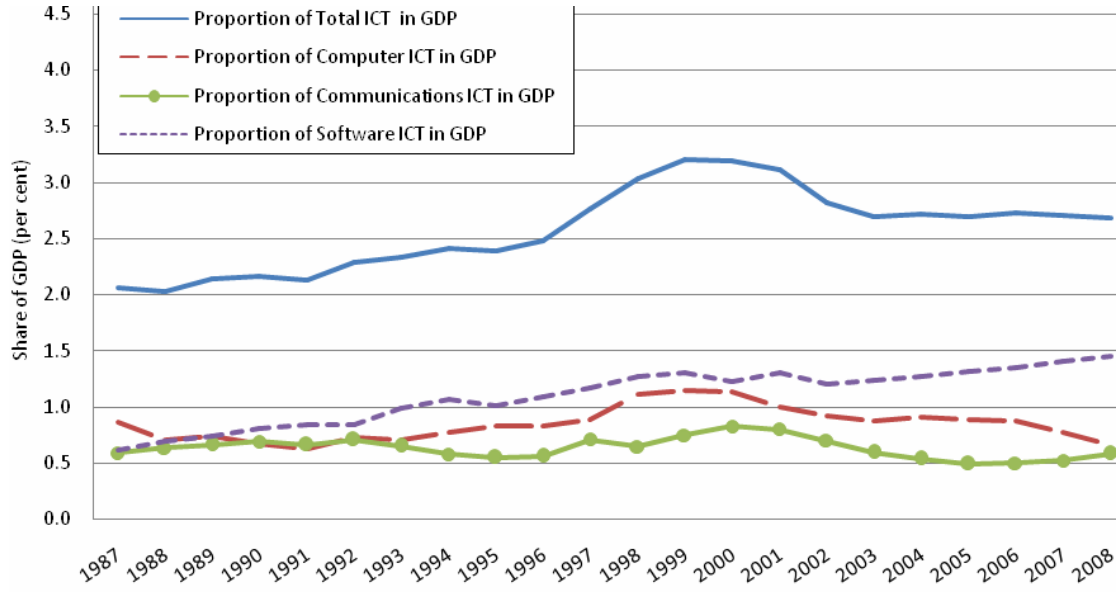
ICT investment in the business sector as a proportion of business sector GDP followed a similar growth path (

Chart 6). It stood at 2.7 per cent in 2008, down from its peak of 3.2 per cent in 2000. In the non-business sector, ICT investment peaked in 1999 at 3.2 per cent. The share for 2008 cannot be calculated because data on non-business sector GDP are available only to 2005. Since the 1980s, ICT investment as a proportion of GDP in the non-business sector has generally been slightly above that of the business sector.

Chart 5 illustrates the trends in ICT investment by component as a share of nominal GDP. In 2008, software investment as a proportion of GDP was 1.5 per cent, more than double that of the communications and computer components. Since 1988, software investment has accounted for the largest share of GDP, rising from below 1 to its 2008 level of 1.5 per cent. After peaking near the beginning of the decade at 1.2 per cent in 1999 for computers, 0.8 per cent in 2000 for communication equipment and 1.3 per cent in 2001 for software, investment as a proportion of GDP declined for all three components, although it has since risen higher than that peak for software. The shares seem to have leveled off

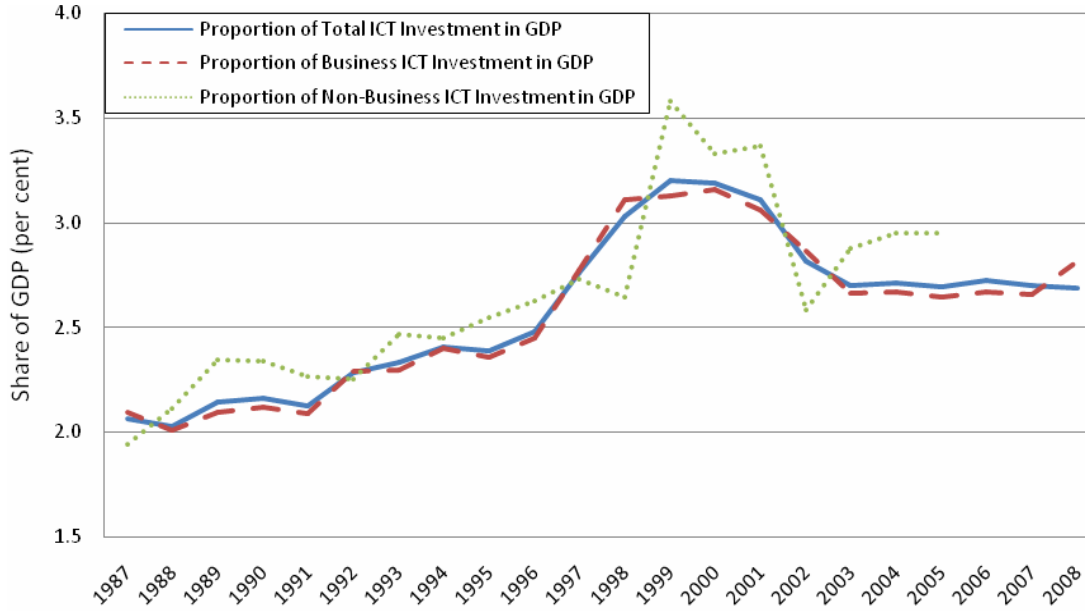
somewhat in the last few years for computers and communications each between 0.5 and 1 per cent of GDP.

Chart 5: ICT Investment by Component as a Proportion of GDP, Current Dollars, 1987-2008



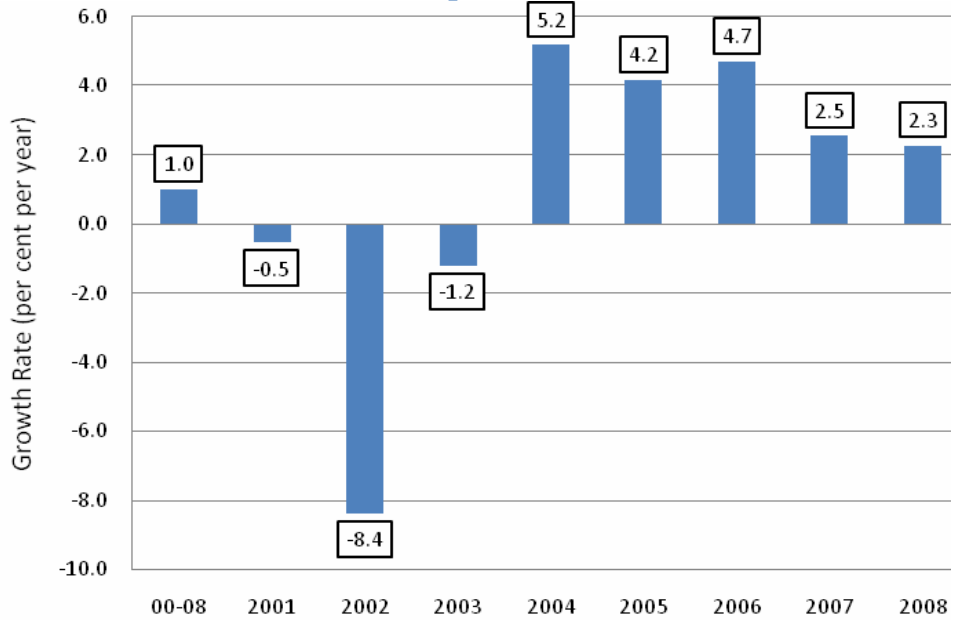
Source: Tables 1a, 2a, 3a, and 4a

Chart 6: ICT Investment as a Proportion of GDP for Business Sector and Non-Business Sector, Current Dollars, 1987-2004



Source: Tables 1a and 1v-w

Chart 7: Growth of ICT Investment per Worker, Current Dollars, 2000-2008



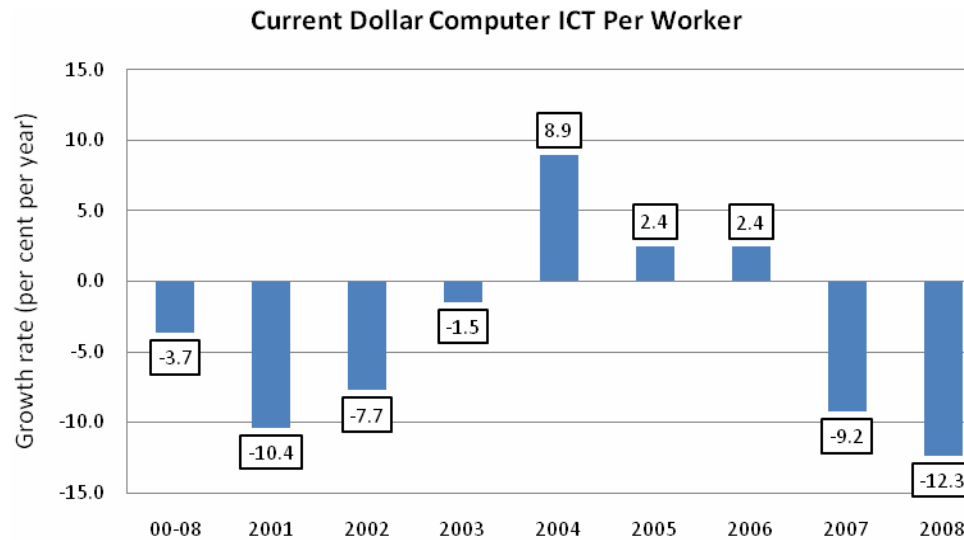
Source: Table 9a

D. Nominal ICT Investment per Worker

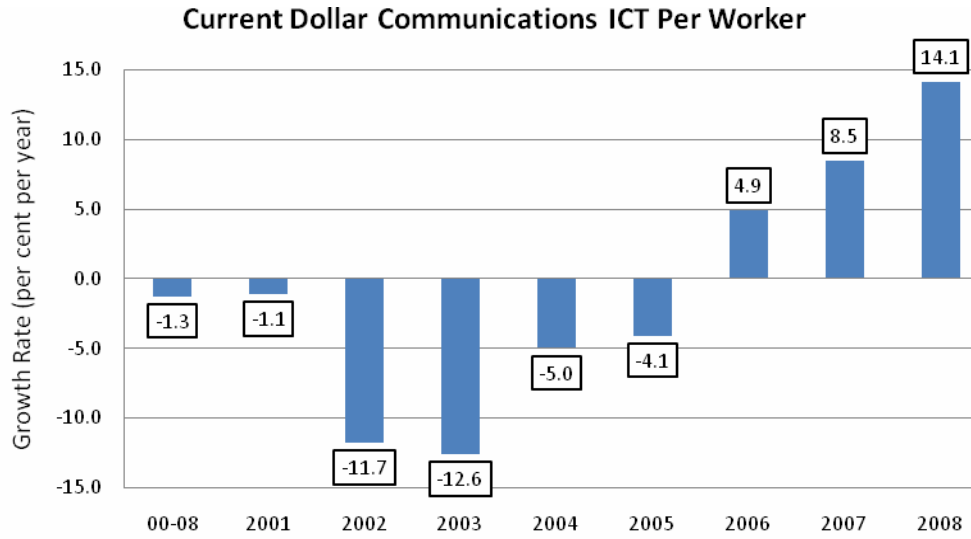
The change in ICT investment intensity is determined by nominal ICT investment and the growth rate of employment. Total ICT investment per worker in current dollars increased 2.3 per cent in 2008 (Chart 7). This was down from growth of 2.5 per cent in 2007 and 4.7 per cent in 2006, but it was still above the average annual growth rate of 1.0 per cent for the 2000-2008 period. Overall, annual growth in total ICT investment per worker has been volatile since 2000. The largest fall in ICT investment occurred in 2002 (8.4 per cent). There has been positive growth since 2003; the highest annual growth in per-worker ICT investment was 5.2 per cent in 2004. Nominal investment per worker in 2008 was 8.3 per cent above its 2000 level.

Chart 8 illustrates the growth of nominal ICT investment per worker by the three ICT components. It is unsurprising that the trends are the same as those for total ICT investment by component, which we discussed above (Chart 2). Per-worker nominal investment in computers fell by 12.3 per cent in 2008, but investment in communications equipment and software grew by 14.1 and 5.9 per cent.

Chart 8: Growth of ICT Investment Per Worker by Component, Current Dollars, 2000-2008

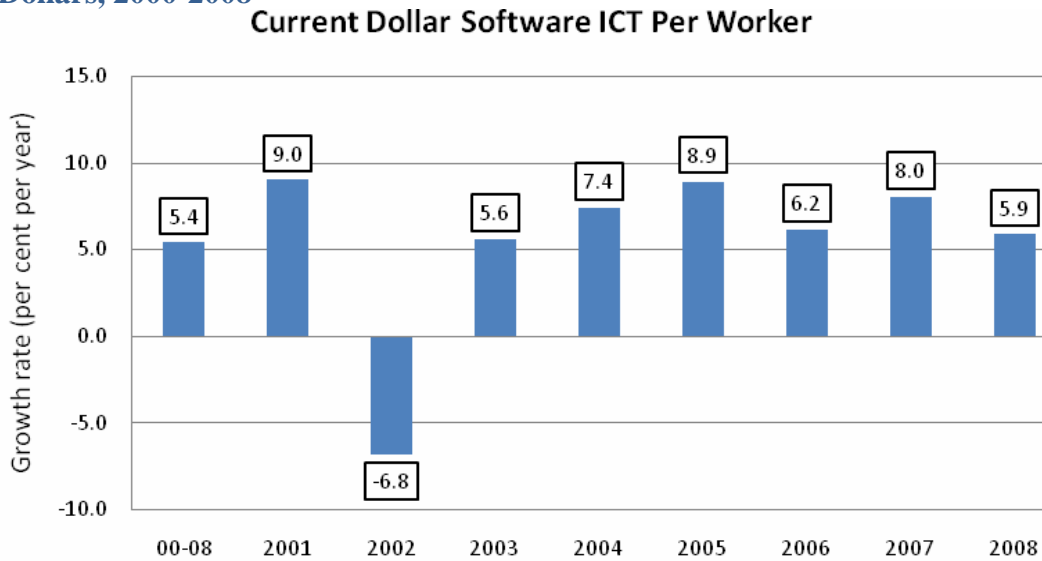


Source: Table 10a



Source: Table 11a

Chart 8 (continued): Growth of ICT Investment Per Worker by Component, Current Dollars, 2000-2008



Source: Table 12a

III. ICT Prices

By comparing the current dollar estimates of ICT investment with the 2002 chained dollar figures, it is possible to obtain computer, communication equipment, software and total ICT trends in price. Prices of ICT investment goods declined 5.2 per cent in 2008, which was slightly below the annual average rate of decline from 2000 to 2008 (-6.1 per cent). Prices for all three components of ICT declined in 2008, although to varying degrees (Chart 9).

In 2008, the price of a computer was 36.0 per cent of what it would have been in 2000. Computer equipment prices dropped by 11.8 per cent in 2008, on par with the average 12.0 per cent annual decline over 2000-2008. The rate of decline varied from year to year with no clear trend between 2000 and 2008, but it was consistently high. The annual rate of price decline fell below 10 per cent only once, when prices fell by 9.2 per cent in 2007.

Communications equipment prices fell by 8.3 per cent in 2008. This continued the downward trend in communications equipment prices in recent years; prices fell by 4.7 per cent in 2007 and 5.1 per cent in 2006 (Chart 9). After a slight increase in prices in 2001 and in 2002, communication prices dropped dramatically by 11.0 per cent in 2003 and continued to fall into 2008, with prices of communications goods in 2008 at 64.2 per cent of their 2000 level. The average annual price change from 2000-2008 was -5.4 per cent.

Software prices have also fallen, with 2008 prices representing 82.8 per cent of the 2000 level. The 2008 price decline of 0.5 per cent was not as substantial as the 2000-2008 average decrease of 2.3 per cent per year, but it was marginally faster than the 2007 decline of just 0.1 per cent. Software prices have fallen every year since 2002, with the greatest annual price decline occurring in 2003 when prices fell by 6.0 per cent.

To summarize: Prices of all ICT components declined in 2008, with computer prices falling the most, followed by communication equipment and finally software. Further, the prices of all three components have declined over the 2000-2008 period. These price declines are important to note when looking at investment in current dollars because, although investment may have been growing at a relatively low rate (3.9 per cent in 2008 and 2.9 per cent annually for the 2000-2008 period), this measure captures both a price and a volume effect. The fact that prices are continually dropping implies that the volume and quality of capital is increasing faster than the nominal investment figures imply when taken at face value.

The decline in the price of ICT goods 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 goods to reflect the fact that firms can now purchase much more powerful products for lower levels of investment. Hence, increases in the level of real ICT investment can be the result of either (i) an increase in the quantity, (ii) an increase in the quality of ICT goods purchased or (iii) an increase in both quantity and quality. In general, an increase in real ICT investment is the result of both an increase in the quantity purchased and an increase in the quality of goods purchased.

Chart 9: Trends in Price of ICT Goods by Component, 2002 base year, 2000-2008

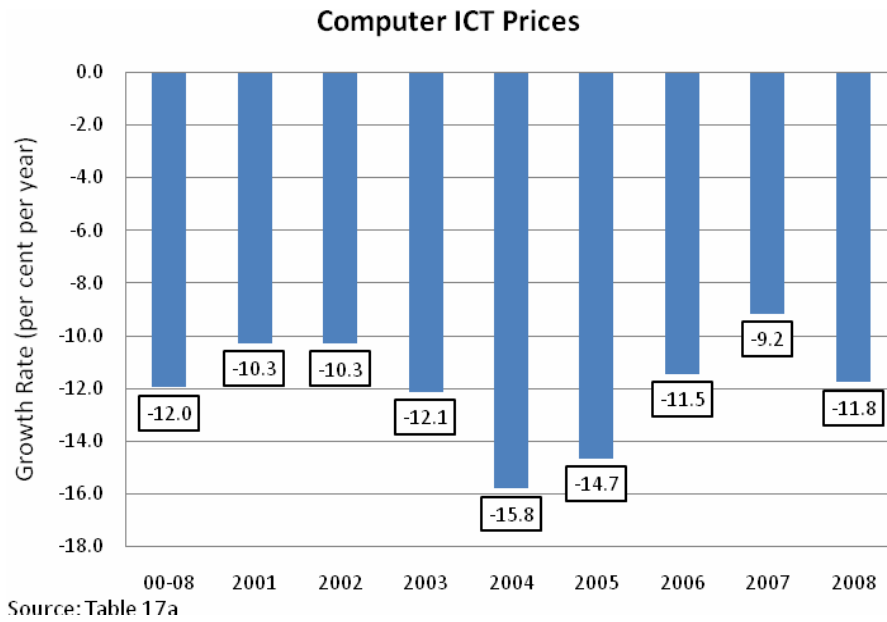
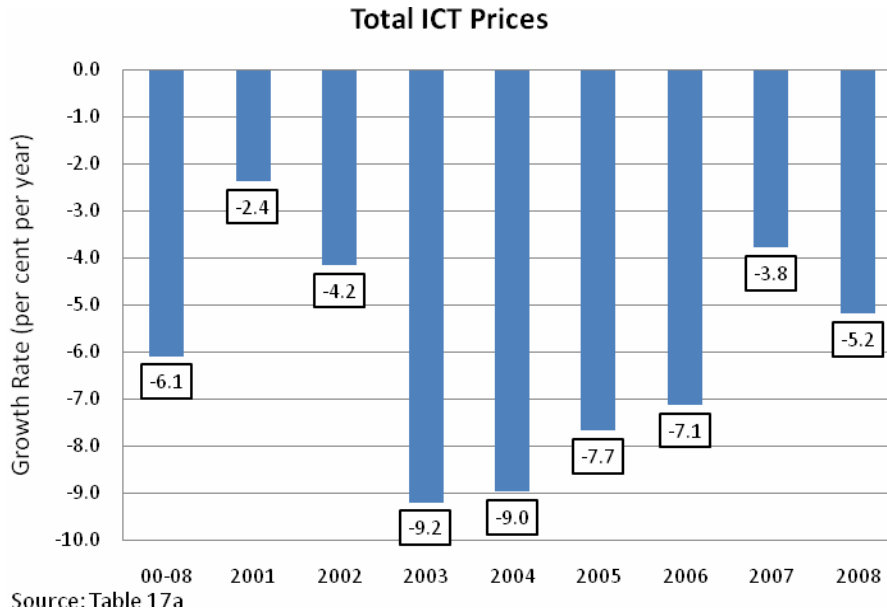
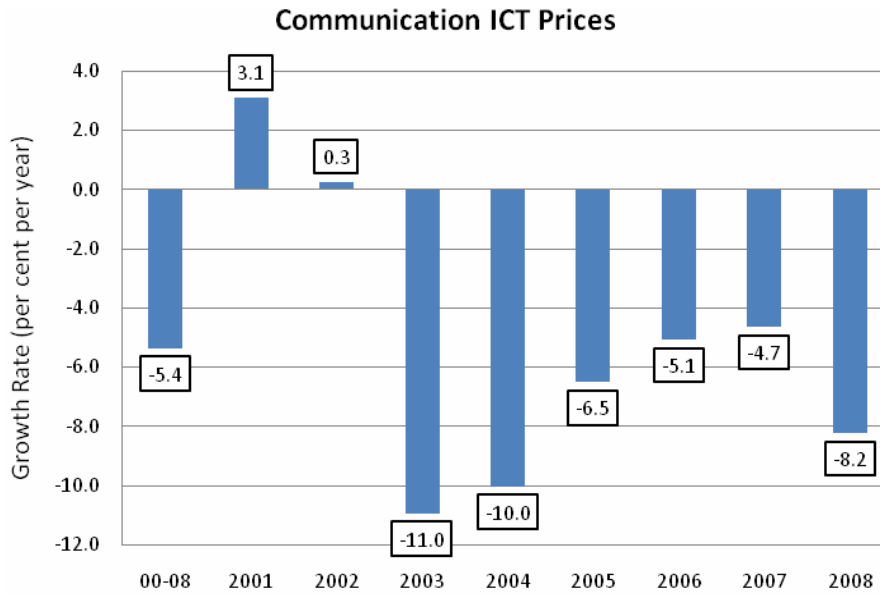
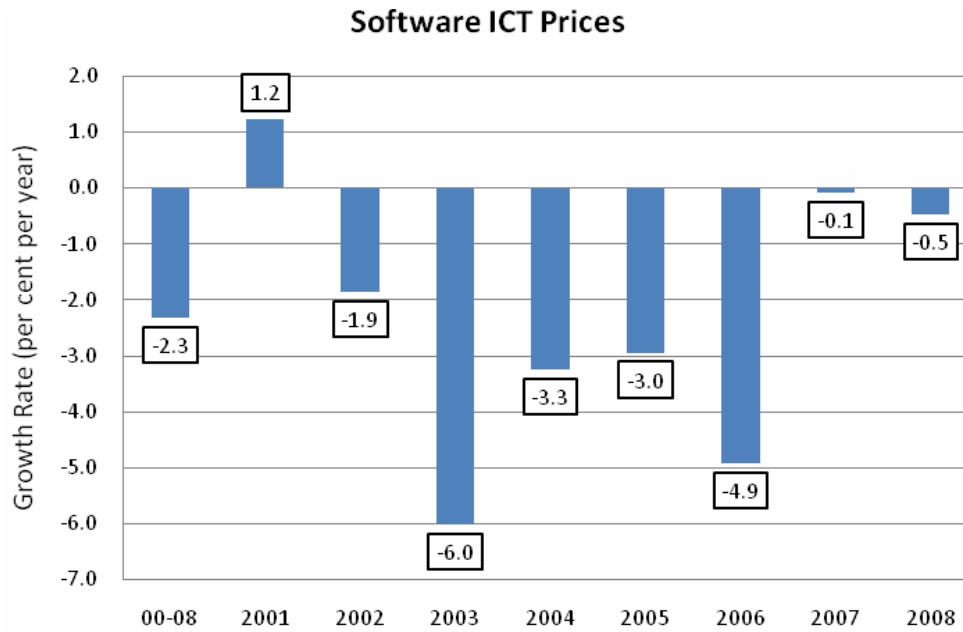


Chart 9 (continued): Trends in Price of ICT Goods by Component, 2002 base year, 2000-2008



Source: Table 17a



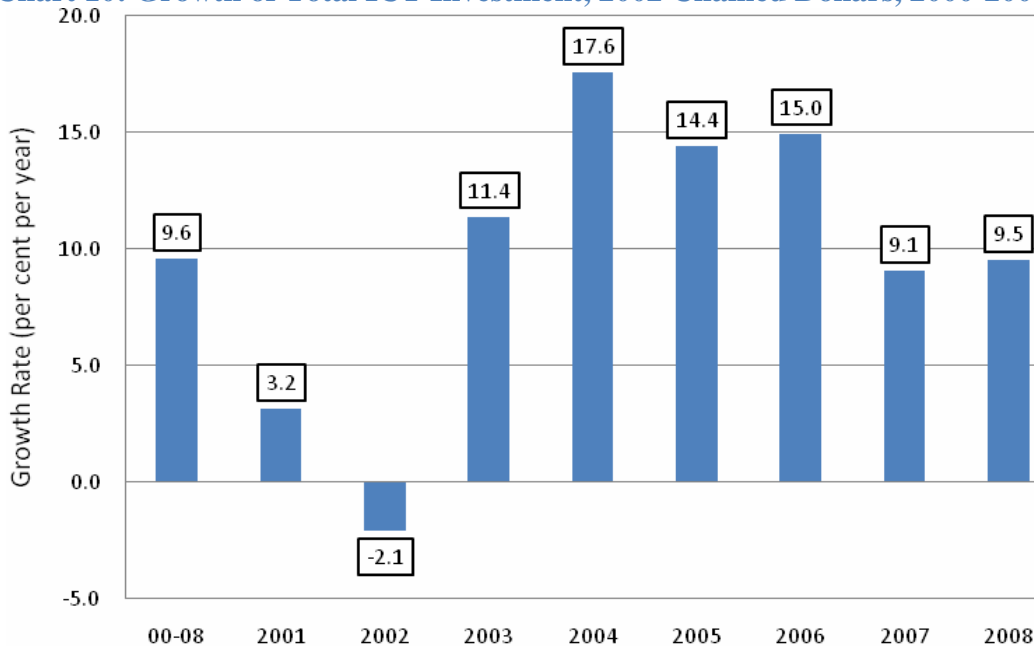
Source: Table 17a

IV. Real ICT Investment

This section examines trends in real ICT investment by looking at data measured in 2002 chained dollars. Total ICT investment figures in 2002 chained dollars at the two-digit industry level are no longer available through Statistics Canada effective as of the 2006 production year. Therefore, growth in ICT investment is only analyzed at the total economy, business sector and non-business sector levels.⁴

In 2008, the growth rate of real ICT investment was 9.5 per cent, down from a high since 2000 of 17.6 per cent in 2004 (Chart 10). Although the growth of investment over the last decade has been substantial, it was higher in the past. The average annual growth rate was 21.3 per cent for the 1980-1989 period, 16.0 per cent for the 1990-1999 period and 9.6 per cent for the 2000-2008 period. Total ICT in real terms has experienced substantial growth since 1980 with a peak in its growth rate at 45 per cent in 1981. Growth has been positive since 1980 for all years except 1982 and 2002 when total ICT declined by 1.6 per cent and 2.1 per cent, respectively.

Chart 10: Growth of Total ICT Investment, 2002 Chained Dollars, 2000-2008



⁴ As stated above, Statistics Canada did not release data on total ICT by industry in either current or constant dollars in 2008. This was done in an attempt to prevent the residual calculating of ICT investment and capital stock levels in telecommunication for the industries in which it was deemed confidential.

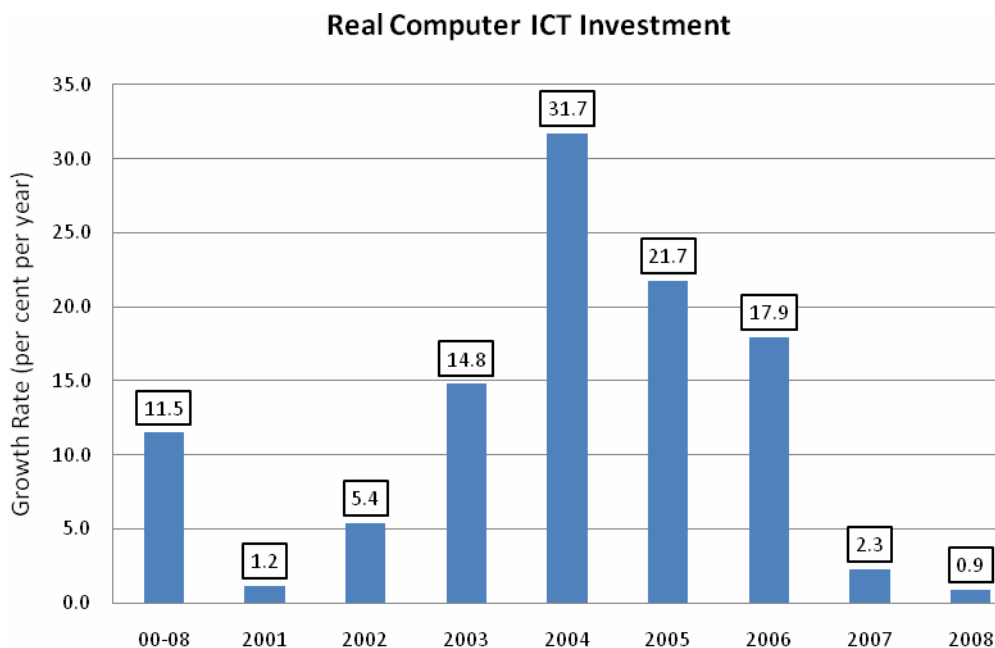
A. Real ICT Investment by Component

Real investment in computers increased in 2008 by only 0.9 per cent, the smallest increase in any year since 2000 and one of the lowest since 1980 (Chart 11). After experiencing relatively low rates of growth in 2001 and 2002, computer investment increased dramatically over the 2003-2006 period. Investment growth peaked at 31.7 per cent in 2004, but by 2007 it had fallen to just 2.3 per cent. The average annual growth rate of investment in computers was 11.5 per cent over the 2000-2008 period because of the high rates between 2003 and 2006.

The communications component exhibits the opposite pattern. In 2008, real investment in communications equipment increased by 26.3 per cent, up from 16.4 per cent growth in 2007 (Chart 11). The 2008 growth rate was the highest in any year since 1980. Real communications investment grew by 6.3 per cent per year on average over 2000-2008, but this good performance was almost entirely due to strong growth since 2006. Investment growth was negative in 2001 and 2002, but it has been positive since 2003 and has accelerated in every year since 2005.

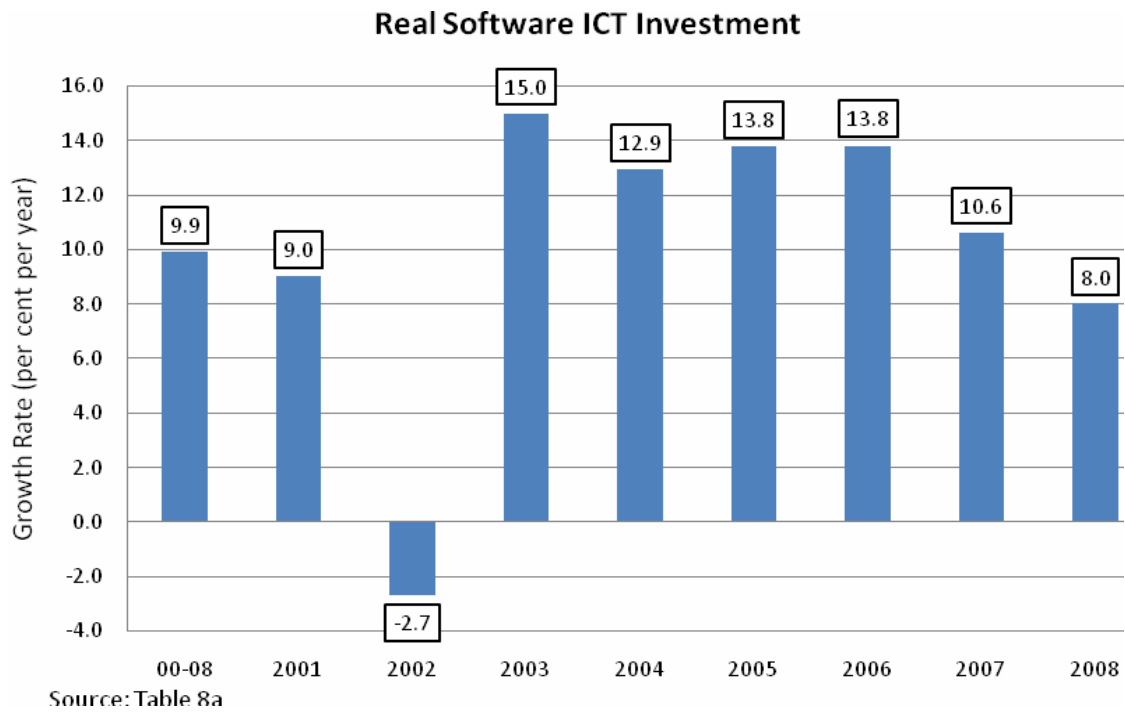
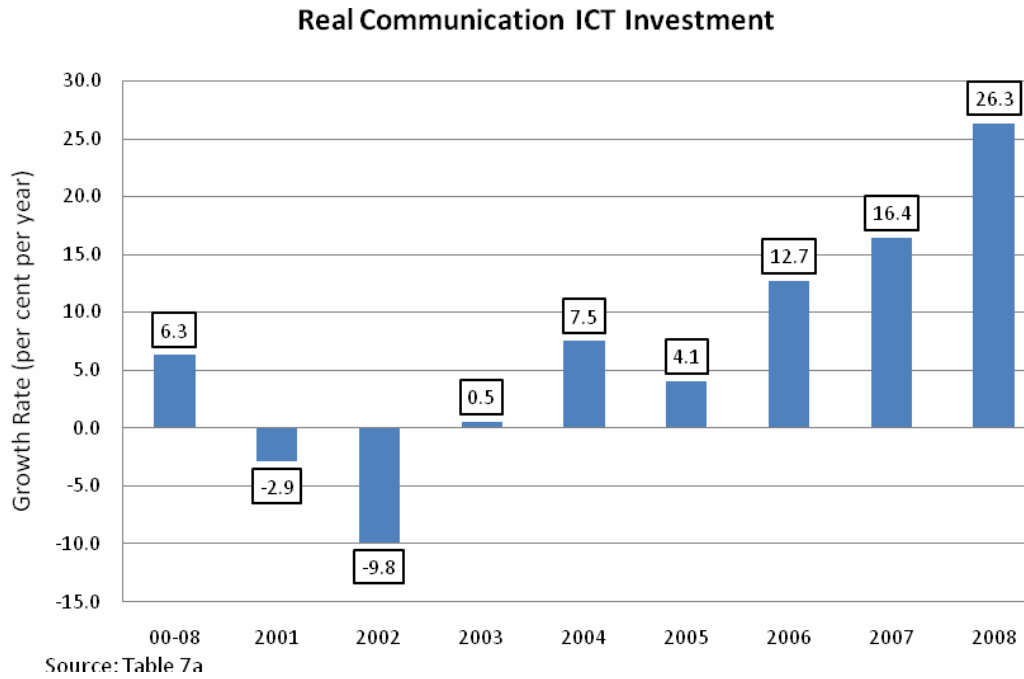
In 2008, real investment in software increased 8.0 per cent, below the average annual growth over the 2000-2008 period (9.9 per cent). Other than a fall in 2002, software investment has been growing consistently since 2000 in real terms, with growth rates above ten per cent in most years (Chart 11).

Chart 11: Growth of Total ICT Investment by Component, 2002 Chained Dollars, 2000-2008



Source: Table 6a

Chart 11 (continued): Growth of Total ICT Investment by Component, 2002 Chained Dollars, 2000-2008



Real ICT investment growth in 2008 was almost exactly as strong as the average for the 2000-2008 period. Overall, communication investment experienced the greatest increase in 2008, followed by software equipment and finally computer investment. Over the 2000-2008 period, the weakest performance was in 2002, for both current and chained dollar estimates, with both communication equipment and software experiencing their lowest rate of growth and computer investment and under average rate of growth since the beginning of the decade. On the whole, the average annual growth experienced by the three components in real terms since 2000 illustrates that ICT investment is growing healthily in Canada.

B. Real ICT Investment in the Business and Non-Business Sectors

In 2008, real business sector ICT investment grew by 12.3 per cent while non-business sector investment declined by 3.5 per cent (Chart 12). Investment growth is not always faster in the business sector – the non-business sector’s ICT investment grew slightly faster in 2001, 2003 and 2006 – but since 1980, growth in the business sector has generally been higher than in the non-business sector. Over the 2000-2008 period, the non-business sector grew on average 8.7 per cent per year, 1.1 percentage points slower than the business sector (9.8 per cent per year).

Chart 12: Growth of Total ICT Investment, Business and Non-business Sectors, 2002 Chained Dollars, 2000-2008

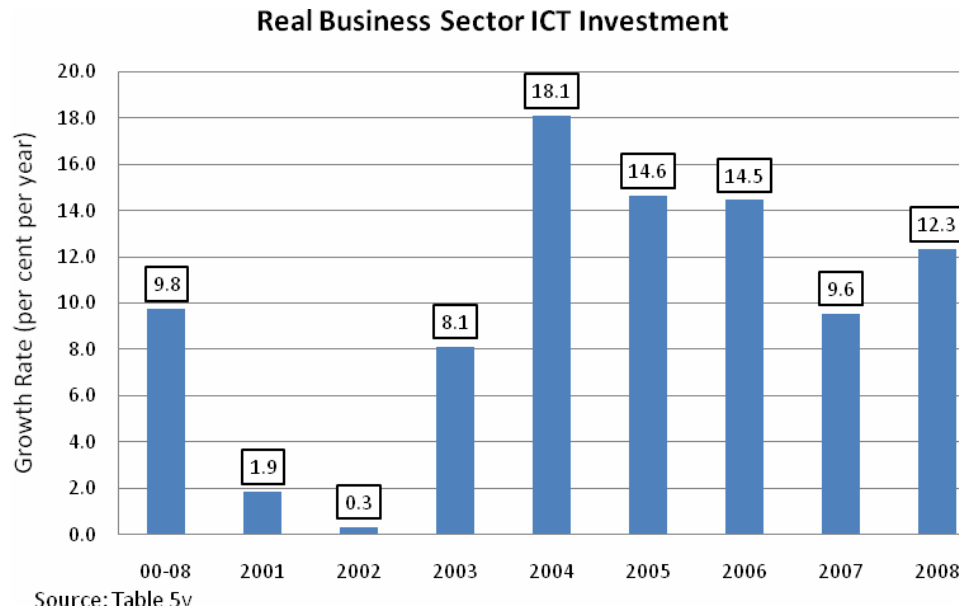
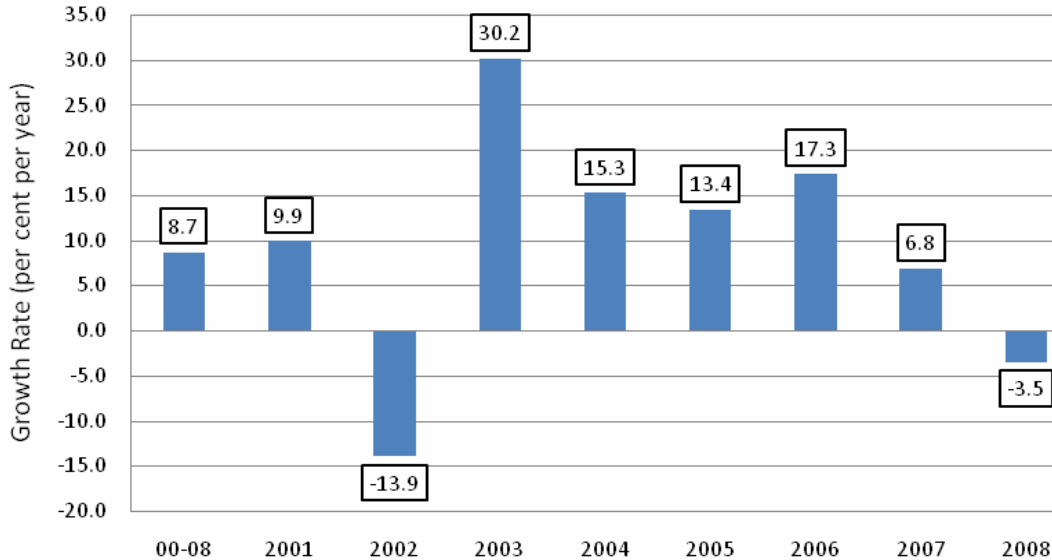


Chart 12 (continued): Growth of Total ICT Investment, Business and Non-business Sectors, 2002 Chained Dollars, 2000-2008

Real Non-Business Sector ICT Investment



Source: Table 5w

C. Real ICT Investment as a Share of GDP

In 2008, total chained dollar ICT investment was 5.1 per cent of real GDP in Canada, an impressive 0.4 percentage-point increase over the previous year. Real ICT investment as a share of GDP has experienced steady growth since 1987 (Chart 13). The share was steady around one percent from 1987 to 1994, after which it increased to reach 2.0 per cent in 1997. By 2000, the share had reached 3.0 per cent and, despite a small 0.1 percentage point fall in 2002, total ICT investment represented 4.0 per cent of GDP in Canada by 2006 and surpassed 5.0 per cent in 2008.

In the business sector, investment as a share of GDP followed a similar course to that of the total economy (Chart 14). The share reached 5.2 per cent in 2008, and has grown steadily since 1980 with the exception of a very slight 0.1 percentage point decline in 2002. In the non-business sector, growth of total ICT investment as a share of GDP has also been positive for every year but 2002 and 2008, when the share fell by 0.5 and 0.3 percentage points respectively. From 2003 to 2007, the share in the non-business sector was slightly higher than that of the business sector. In 2008, non-business sector ICT investment represented 4.6 per cent of non-business sector GDP.

By examining trends in real investment for computers, communication equipment and software as a proportion of total GDP, we can see that overall levels of investment as a proportion of GDP have increased significantly over the years for all components (Chart 13).

Chart 13: ICT Investment by Component as a Proportion of GDP, 2002 Chained Dollars, 1987-2008

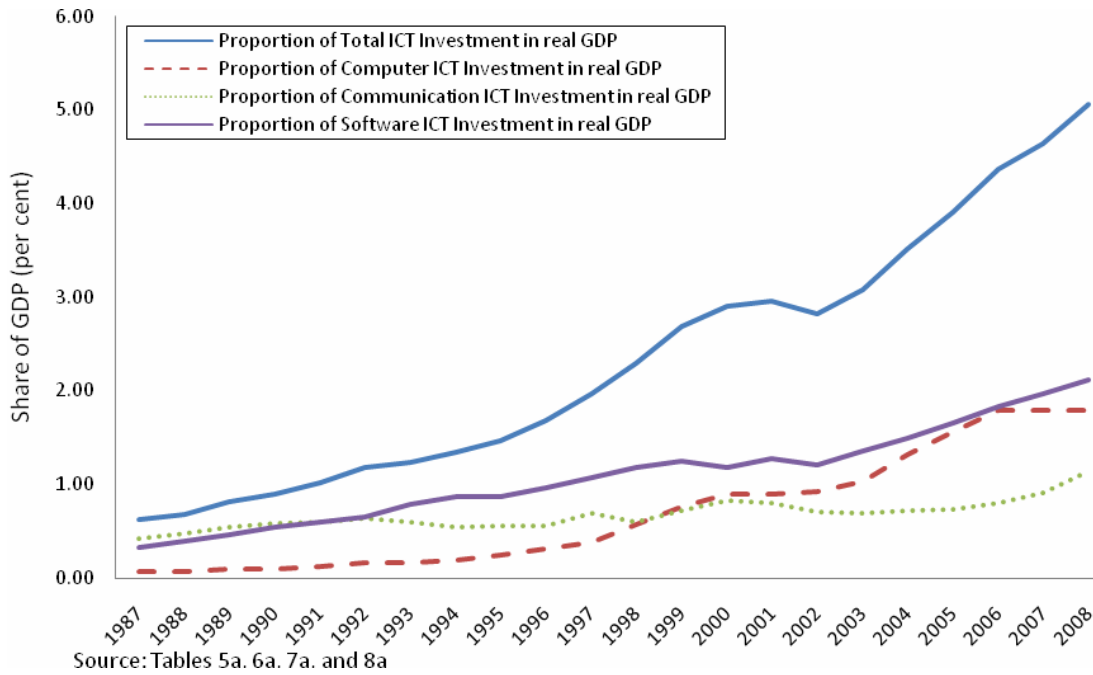
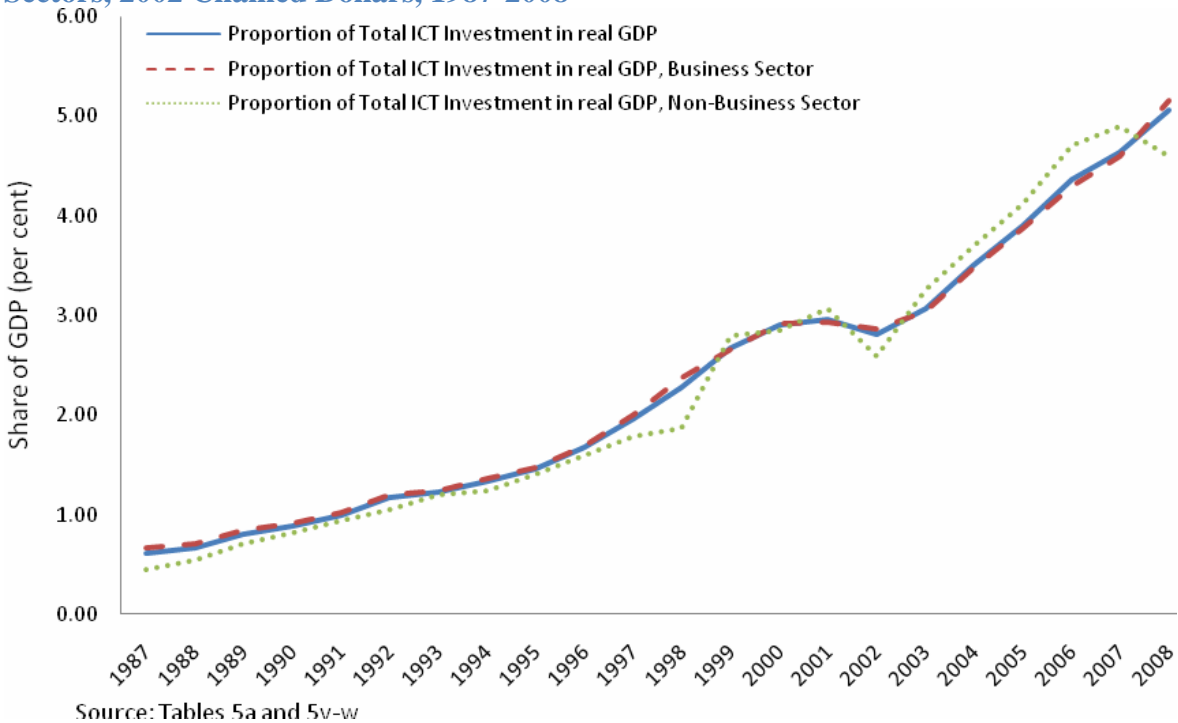


Chart 14: ICT Investment as a Proportion of GDP, Business and Non-business Sectors, 2002 Chained Dollars, 1987-2008

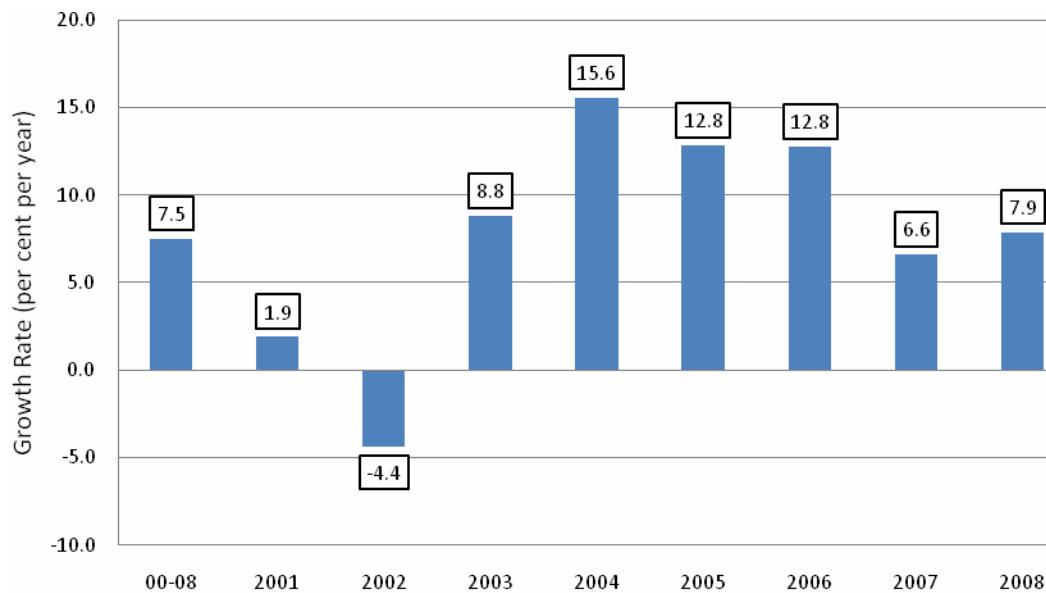


The rise of real computer investment as a proportion of GDP is most dramatic. Indeed, computers have become a much more important element of both business and non-business life. The proportion of real computer investment in total GDP has increased from 0.1 in 1987 to 1.8 per cent in 2008. Real software investment as a proportion of GDP has also increased over 1987-2008, but at a much steadier rate, with investment as a proportion of GDP increasing from 0.3 per cent in 1987 to 2.1 per cent in 2008. Finally, real communications investment as a proportion of GDP has experienced the least overall change between 1987 and 2008, as it began at 0.4 per cent in 1987 and reached 1.1 per cent in 2008.

D. Real ICT Investment Per Worker

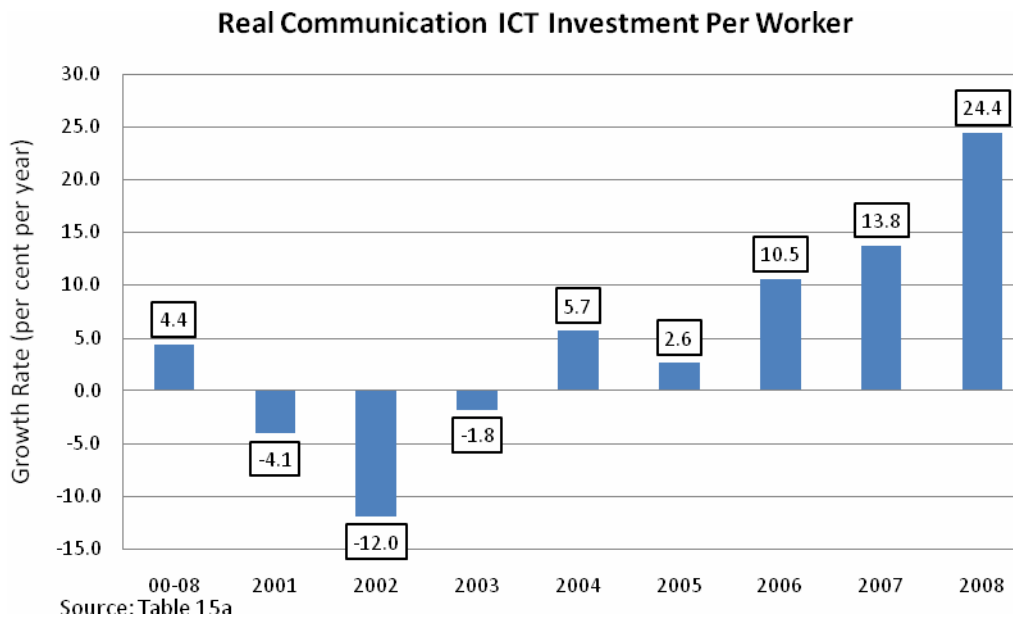
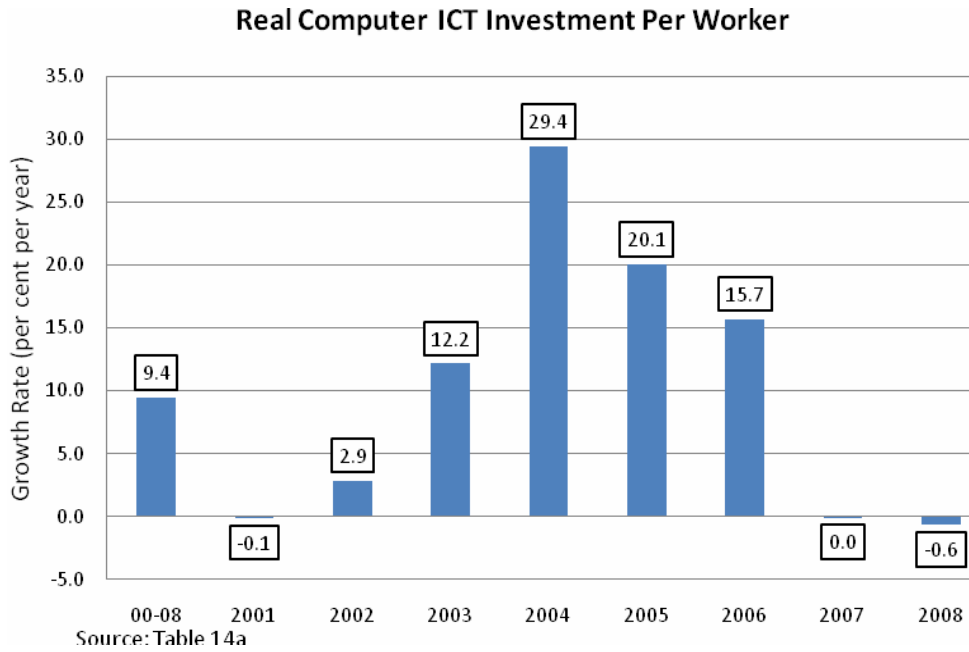
Real investment per worker growth was strong in 2008, with total ICT investment per worker growing 7.9 per cent and two of the three components growing strongly (24.4 per cent for communication and 6.4 per cent for software) (Chart 15 and Chart 16). It should also be noted that real ICT investment per worker grew at 7.5 per cent per year between 2000 and 2008. Also interesting is the fact that investment patterns in chained dollar and in current dollar do not at all correspond. Total ICT investment per worker in current dollars grew 8.3 per cent during the 2000-2008 period, an average annual increase of 1.0 per cent. Current dollar investment per worker by component actually fell for computer and communication equipment. In contrast, real investment per worker exhibited higher average annual growth over the 2000-2008 period. Average annual real total ICT investment per worker growth was 7.5 per cent, real computer investment per worker growth was 9.5 per cent, real communications equipment per worker investment growth was 4.4 per cent and real software investment per worker growth was 7.9 per cent.

Chart 15: Growth of ICT Investment per Worker, 2002 Chained Dollars, 2000-2008

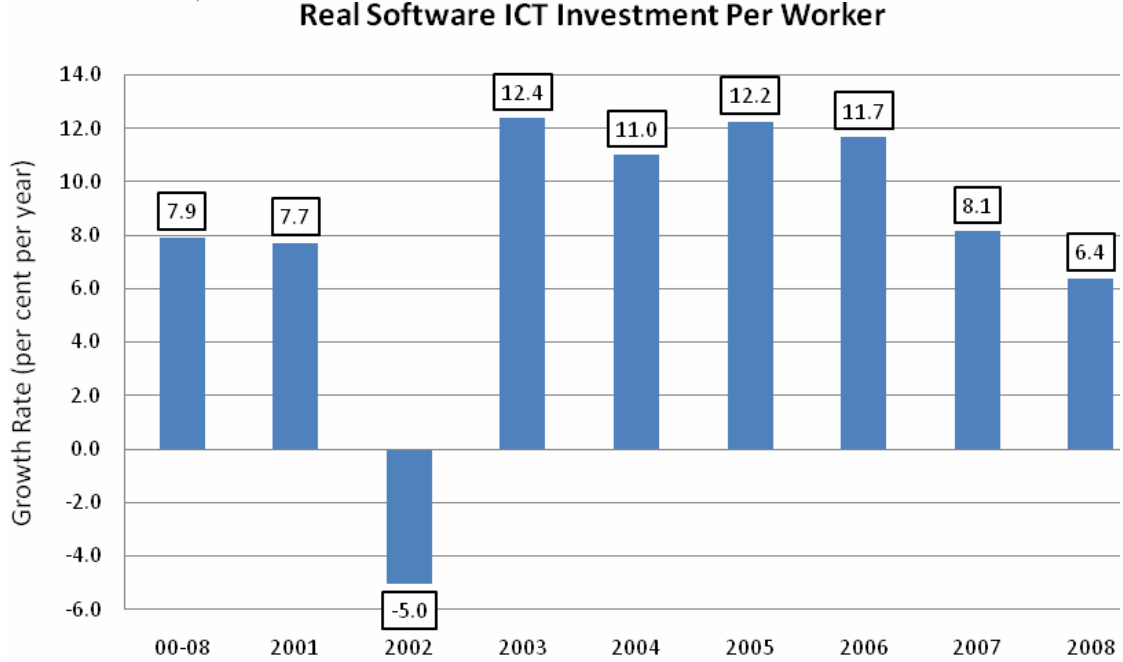


Source: Table 13a

Chart 16: Growth of ICT Investment per Worker by Component, 2002 Chained Dollars, 2000-2008



**Chart 16 (continued): Growth of ICT Investment per Worker by Component, 2002
Chained Dollars, 2000-2008**



Source: Table 16a

V. ICT Investment Relative to Total M&E Investment

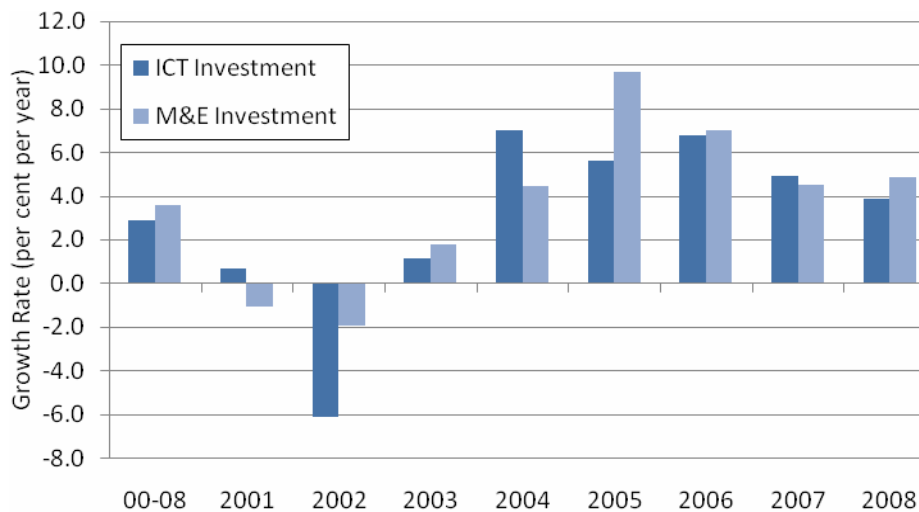
ICT investment is a component of machinery and equipment (M&E) investment. Investment in M&E has been shown to have a strong positive relationship with economic growth and productivity growth.⁵ Since ICT investment is particularly important, the composition of M&E investment is of interest. How does Canada's ICT investment performance compare to its overall M&E investment performance?

Chart 17 illustrates the patterns of recent growth in nominal investment in ICT and total M&E. Current dollar investment in total M&E increased by 4.8 per cent in 2008, one percentage point faster than the 3.8 per cent growth of nominal ICT investment over the same year. This implies that investment in non-ICT forms of M&E increased faster than investment in ICT. This is also true for the 2000-2008 period as a whole. Average annual growth of total M&E investment over the period was 3.6 per cent, compared to 2.9 per cent for ICT investment. However, M&E investment growth did not exceed ICT investment growth in every year over the period. Nominal ICT investment outgrew nominal M&E investment in 2001, 2004, and 2007.

Recall, however, that ICT prices declined precipitously over the 2000-2008 period. If ICT prices are declining relative to the prices of other types of M&E, then the figures illustrated in Chart 17 overstate real M&E investment growth relative to ICT investment growth.

Chart 18 shows the recent growth of investment in total M&E and ICT in real terms. The chart reveals that the pattern in Chart 17 – faster growth in overall M&E

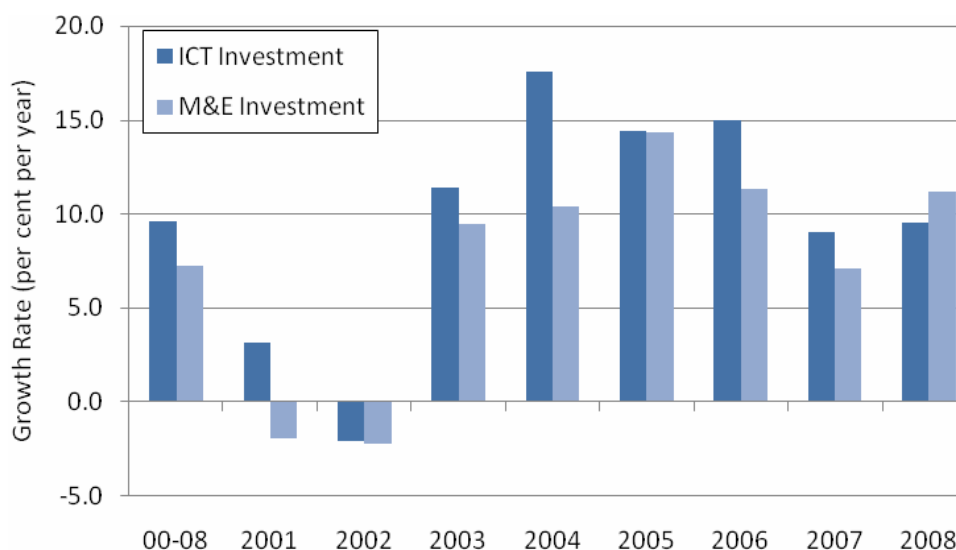
Chart 17: Growth of Investment in ICT and M&E, Current Dollars, 2000-2008



Source: Table 1a and Statistics Canada CANSIM series v43983313

⁵ The classic reference on this issue is DeLong and Summers (1991). See Section I of Sharpe and Arsenault (2008) for a brief overview of the literature on M&E investment and economic growth.

Chart 18: Growth of Investment in ICT and M&E, 2002 Chained Dollars, 2000-2008



Source: Table 5a and Statistics Canada CANSIM series v43990977

investment than in ICT investment over the 2000-2008 period – is mostly a reflection of the large decline of ICT prices over the period. In 2002 chained dollars, investment in ICT grew faster than overall M&E investment over the 2000-2008 period. The average growth rate of real ICT investment over the period was 9.6 per cent per year, compared to 7.3 per cent for overall M&E investment. This implies that firms have been increasing their real accumulation of ICT relative to other forms of M&E. Because ICT prices have fallen so dramatically, firms were able to buy relatively more ICT even though they increased their expenditures faster on non-ICT M&E than on ICT.

In terms of real investment, 2008 was an unusual year. Overall M&E investment grew by 11.2 per cent in 2008, 1.6 percentage points faster than ICT investment, which grew by 9.5 per cent (Chart 18). Prior to 2008, the last year in which real ICT investment grew more slowly than total M&E investment was 1988.

One might have expected investment in M&E to decline in 2008, or at least slow down, because of the global economic downturn that began during the year. Chart 18 shows that this did not occur. The growth rate of real investment increased in 2008 (relative to 2007) both for ICT and overall M&E. However, while ICT investment growth increased only 0.4 percentage points (from 9.1 per cent in 2007 to 9.5 per cent in 2008), investment growth in overall M&E increased by 4.1 percentage points, from 7.1 per cent in 2007 to 11.2 per cent in 2008. This implies that there was a large increase in the growth of real investment in non-ICT M&E in 2008, an increase which did not occur in ICT investment. One possible explanation is that firms cut planned investment increases in ICT due to the recession but did not make similar cuts in other forms of M&E.

We do not have data adequate to assess the validity of that explanation. If firms are indeed cutting ICT investment relative to other forms of investment, it is a potentially

worrying trend. The global recession that began in 2008 has worsened in 2009, and Statistics Canada projects that total nominal M&E expenditures will decline by 6.7 per cent over the year (Statistics Canada, 2009).⁶ It remains to be seen how these cuts will be distributed between ICT and non-ICT forms of M&E. Since most of the investment cuts in 2009 are projected to occur in the manufacturing and oil and gas extraction sectors,⁷ where M&E investment is presumably more likely to be devoted to heavy machinery than to ICT, there is still some room for optimism regarding the growth of ICT investment relative to other forms of M&E.

⁶ In particular, the data we cite in this section regarding projected M&E expenditures for 2009 are from Statistics Canada data series v753952, v753931, and v753973. The figures include expenditures on new capital and on the repair of old capital.

⁷ According to Statistics Canada (2009), nominal M&E expenditures in Canada's oil and gas sector is projected to fall by 24 per cent in 2009 relative to 2008. Falling oil prices in the latter part of 2008 led to the cancellation or postponement of many large investment projects in the sector. M&E spending in the manufacturing sector is projected to decline by 9.2 per cent from its 2008 level as a result of falling demand for manufacturing firms' output.

VI. Conclusion

The ICT investment performance of Canada in 2008 was robust. Indeed, in real terms, total ICT investment grew 9.5 per cent, approximately equal to the average annual growth level since 1999 when the Canadian economy was in the midst of a technology boom. This increase in real investment was in large part the result of a fall in ICT prices, caused in part by the continued rise of the Canadian dollar in 2008. Because ICT investment goods are internationally traded, a rise in the Canadian dollar generally translates into a commensurate decline in the price of ICT goods. In current dollars, total ICT investment increased 3.8 per cent in 2008.

These estimates suggest that while firms are not increasing their ICT budgets by much, they are getting much more in return for the amount they invest. The rise in the Canadian dollar has allowed firms to increase the amount of ICT equipment they acquire.

The most revealing indicator, in considering the state of ICT investment in Canada, is the proportion of real investment to GDP over recent years. As Chart 13 shows, total ICT investment as a share of real GDP has grown at a heightened rate, particularly since 2002. Of the three components to ICT, both software and communication to real GDP have had strong growth in recent years, while that of computer investment has levels off in the past two years. Meanwhile, growth in business sector ICT investment as a share of GDP has been strong since 2002. That of the non-business sector has dropped in the past two years.

As a matter of policy, it would be best to find the root of the lags in growth of computer and non-business ICT investment. Perhaps government investment in ICT – or lack thereof – is the issue.⁸ Aside from this, robust growth in communications, software and the business sector's ICT to GDP ratio bode well for Canada's future productivity performance.

⁸ Public investment spending by all levels of government in Canada are projected to increase by 10.5 per cent in 2009 (Statistics Canada, 2009). However, two-thirds of these expenditures will occur in the transportation and utilities industries, so it is not clear that they will help ameliorate the non-business sector's lagging ICT investment performance.

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