Future Productivity Growth in Canada: Comparing to the United States

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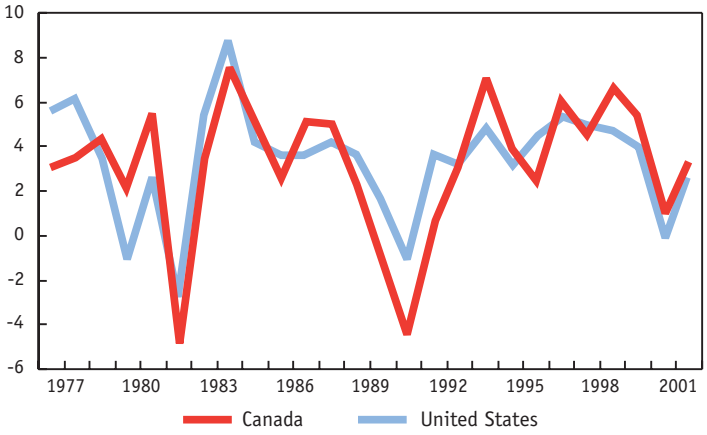
The growth resurgence in the United States in the second half of the 1990s has attracted a great deal of interest among leading productivity experts. From their research we have learned a great deal about what is driving productivity growth in the United States. There has also been some very good research done on the Canadian experience using similar methodologies to the U.S. studies. As Canada's neighbour and largest trading partner, the United States provides the obvious benchmark of comparison.

This commentary begins by quickly reviewing some facts about the sources of growth in the United States and Canada in the second half of the 1990s, with particular emphasis on the role of productivity growth. The second section takes a closer look at productivity growth in the United States and Canada through the window of growth accounting studies. The third section reviews some of the broader determinants of productivity growth, and compares Canada to the United States along these dimensions. Finally, the conclusion provides an assessment of the prospects for future productivity growth in Canada.

Chart 1
Business Sector Output Growth in the United States and Canada: 1977-2002



Sources: Statistics Canada and U.S. Department of Labour, Bureau of Labour Statistics.

Some Facts

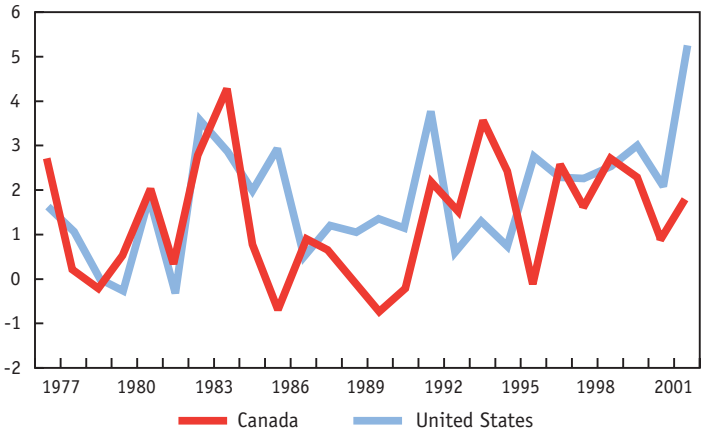
Output growth surged in both the United States and Canada in the second half of the 1990s. Over the 1995 to 2000 period, growth in business-sector output averaged 4.7 per cent in the United States and 5.0 per cent in Canada.[1] Chart 1 plots business-sector output growth in Canada and the United States and reveals that growth picked up a little later in Canada than in the United States, but in recent years it has been stronger in Canada than in the United States. Indeed, over the period 1996 to 2002, growth in

Canada was almost a full percentage point higher on average — 4.5 per cent in Canada compared to 3.6 per cent in the United States.

Output growth can be divided into two sources — growth in labour inputs and growth in labour productivity. Charts 2 and 3 compare the growth in labour productivity and labour inputs in the United States and Canada. Through the second half of the 1990s, labour productivity and labour inputs both grew strongly in the United States and Canada. Comparing the United States and Canada we see also that productivity growth made a larger contribution to higher output growth in the United States, whereas strong growth in labour inputs was more important in Canada. Indeed, from 1995 to 2000, labour productivity in the business sector averaged 2.6 per cent in the United States compared to 1.8 per cent in Canada. Over the same period, hours worked in the business sector grew at an average rate of 2.0 per cent in the United States compared with 3.1 per cent in Canada.

In summary, there are different ways to grow. Growth in the United States and Canada came from both growth in labour inputs and growth in labour productivity, but productivity growth was relatively more important in the United States and growth in hours worked was relatively more important in Canada. Next let us dig deeper on productivity growth.

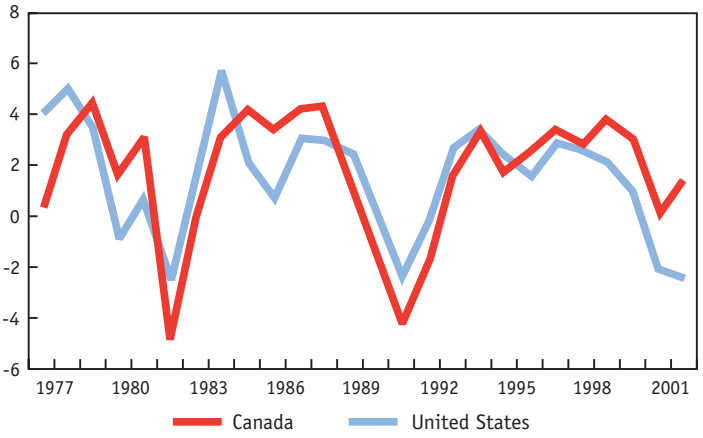
Chart 2
Business Sector Labour Productivity[a] Growth in the United States and Canada: 1977-2002



Note: a Labour productivity is defined as output per hour worked.

Sources: Statistics Canada and U.S. Department of Labour, Bureau of Labour Statistics.

Chart 3
Growth in Hours Worked in the United States and Canada: 1977-2002



Sources: Statistics Canada and U.S. Department of Labour, Bureau of Labour Statistics.

Productivity Growth in the United States and Canada Compared

As the above figures reveal, labour productivity is highly cyclical. The typical cyclical pattern is for productivity growth to rebound sharply early in a recovery (e.g. 1983 and 1992), and then to weaken as the expansion matures (e.g., 1987-1990). The usual story is that labour productivity declines late in the cycle as the unemployment rate falls and labour quality declines. In the most recent U.S. expansion, productivity growth increased late in the cycle. So the question is how did the U.S. economy escape the usual cyclical pattern of declining productivity growth as the expansion matured?

The consensus that has emerged in the literature, based on both aggregate growth accounting studies and more disaggregated evidence, is that the effects of declining labour quality on productivity were more than offset by an acceleration in the productivity gains in the *production* of infor-

Table 1
Alternative U.S. Growth-Accounting Studies

	Jorgenson, Ho and Stiroh[a] (1995-2001)	Oliner and Sichel[b] (1995-2001)	Armstrong et al.[c] (1995-2000)
Average labour productivity growth	2.02	2.43	2.7
Contributions from:[d]			
Capital Deepening	1.39	1.19	1.1
ICT capital deepening	0.85	1.02	1.0
Other capital deepening	0.54	0.17	0.1
Labour quality	0.22	0.25	0.3
TFP growth	0.40	0.99	1.4
ICT-producers	0.41	0.77	
Other	- 0.01	0.23	
Total contribution from ICT (capital deepening + TFP)	1.26	1.79	

Notes:

a Jorgenson et al. use a broader measure of output than other studies.

b Non-farm business sector.

c Business sector (Source: *The Daily*, Statistics Canada (12 July 2002)).

d Contributions are reported in percentage points. The separate contributions may not add to total due to rounding.

Table 2
U.S. — Canada Differences in Sources of Business-Sector Productivity Growth (1995-2000)[a]

	U.S.	Canada	Difference: U.S. less Canada
Average labour productivity growth	2.7	**1.8**	0.9
Contributions from:[d]			
Capital Deepening	1.1	**0.5**	0.6
ICT capital deepening	1.0	**0.5**	0.5
Other capital deepening	0.1	**0.0**	0.1
Labour quality	0.3	**0.3**	0.0
TFP growth	1.4	**1.1**	0.3
ICT-producers	0.6	**0.2**	0.4
Total contribution from ICT (capital deepening + TFP)	1.6	**0.7**	0.9

Notes:

a Calculated from *The Daily*, Statistics Canada (July 12, 2002).

b Numbers may not add to total due to rounding.

c Estimates of TFP growth in the ICT-producing sector are taken from Oliner and Sichel (2002) and Muir and Robidoux (2001). For comparability with the Muir-Robidoux number for Canada, the U.S. estimate excludes computer software and telecom equipment.

mation and communications technology (ICT) and increased investment in and *use* of new ICT in the rest of the economy. Dale Jorgenson (2001) has stressed that this was driven by an acceleration in the rate of price decline of computers from about 15 per cent a year to 25 per cent a year which was the result of shortening the product cycle for semi-conductors from 3 years to 2 years.

Table 1 reports the results of three growth accounting studies on U.S. data — Jorgenson, Ho and Stiroh (2003), Oliner and Sichel (2002) and a study conducted by Armstrong, Harchaoui, Jackson and Tarkhani (2002) at Statistics Canada.[2] The numbers differ somewhat due to different concepts of output and different vintages of data revisions, but the message is the same. The two biggest contributors to labour productivity growth from 1995 to 2000 were capital deepening in ICT, and growth in total factor productivity (TFP) in the ICT-producing sector. Moreover, as shown in these studies, together these two contributors explain most if not all of the *increase* in labour productivity growth in the United States relative to the previous 20 years.

Table 2 reports comparable results for the United States and Canada based on the study by Armstrong et al.[3] Focusing first on Canada, three conclusions emerge. First, the main sources of productivity growth in Canada over the 1995 to 2000 period were capital deepening, which contributed 0.5 percentage points, and TFP growth which contributed 1.1 percentage points. Second, capital deepening was all in ICT. So as in the United States, investment in ICT played an important role in labour productivity growth over this period. Third, TFP growth in ICT-producing sectors is only a small part of total TFP growth — 0.2 points of the 1.1 percentage points.[4]

Comparing Canada to the United States points out that ICT played a much larger role in the productivity growth in the United States. The contribution of ICT-capital deepening to

productivity growth in Canada from 1995 to 2000 is half that in the United States. Similarly, more TFP growth came from ICT-producing sectors in the United States than in Canada.[5] This greater role of ICT in the United States may be related in part to structural differences between the Canadian and U.S. economies.

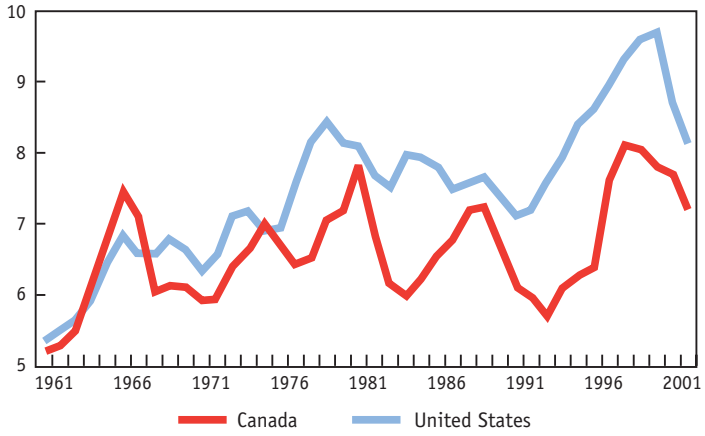
One structural factor may be the greater importance of small firms in Canada. Baldwin and Sabourin (1998) examine plant-level data in the manufacturing sector and find a significant positive relationship between the use of computer-based technologies and labour productivity growth in the Canadian manufacturing sector. They also find that small firms have been slower to adopt new technologies than large firms. When combined with the fact that small firms account for a larger share of manufacturing output in Canada than in the United States, this may be one structural reason why investment in ICT, while an important contributor to productivity growth in Canada, has not been as important as in the United States.

The smaller contribution of the ICT-producing sector to TFP growth in Canada appears to reflect two additional structural factors. First, industries producing ICT goods account for a smaller share of output in Canada than in the United States. Second, while rates of productivity growth in ICT-manufacturing are high in Canada, they are not as high as in the United States. This appears to reflect differences in the types of ICT goods produced in the two countries. In particular, the biggest productivity gains in ICT have been in the production of semi-conductors which is concentrated in the United States.

Beyond ICT — Broader Determinants of Productivity Growth Compared

While the recent U.S. experience has thrown the spot light on ICT, the broader productivity literature highlights a number of determinants. Three of these stand out as critical factors for Canada's continued productivity performance.

Chart 4
Nominal Business Investment in Machinery and Equipment as Share of Nominal GDP
(per cent)

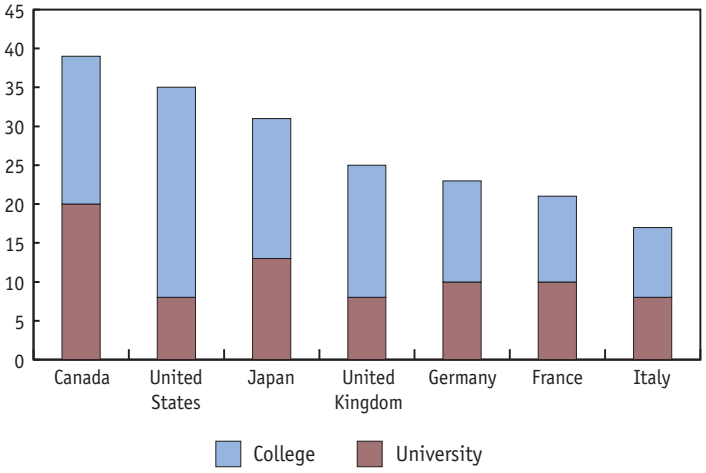


Sources: Statistics Canada and U.S. Department of Commerce, Bureau of Economic Analysis, "Survey of Current Business".

Investment in Machinery and Equipment

The ratio of business investment in machinery and equipment (M&E) to GDP tends to be an important determinant of productivity growth in cross-country studies. As shown in Chart 4, investment in M&E began rising as a share of output in the United States in 1992. Four years later in 1996 (Chart 2), productivity growth in the United States began to increase. In Canada, investment in M&E as a share of output has also risen, but the increase started later and has not been as pronounced. The later start in Canada appears to reflect the fact that the Canadian economy was weaker in the mid-1990s than the U.S. economy and is consistent with the fact that productivity was slower to pick-up in Canada. The later start may also suggest there is more productivity payoff to come in the near term if the lags between investment and productivity growth in the United States can be

Chart 5
Percentage of the Population Aged 25 to 64 with Completed Post-Secondary Education, 1999



Source: OECD.

used as a guide for Canada (see Macklem and Yetman, 2001).

Human Capital

Human capital or the average skill level of workers has been increasing over time. By most measures, the average skill level of workers is very comparable in the United States and Canada. In particular, the average number of years of formal education has been very similar in the United States and Canada. By some measures Canada may have an edge, but by others the United States is ahead. As shown in Chart 5, almost 40 per cent of Canadians aged 25 to 64 have completed some form of post-secondary education. This is the highest proportion among the OECD countries. There are also some compositional differences between Canada and the United States. A considerably higher percentage of Canadians have a non-university post-secondary education, and a lower percentage have a university degree. Canada also has a lower proportion of people with advanced research degrees, and, once at work, Canadian workers receive less employer-sponsored training than do their American counterparts.

Openness to Trade and Investment

Openness to trade contributes to productivity growth by facilitating the diffusion of technologies and is typically found to be an important determinant of productivity growth in cross-country studies. Low trade and regulatory barriers also promote a more efficient allocation of resources and the achievement of economies of scale in production.

By any standard, Canada is a very open economy and has become more open in the last decade and a half. Following the Free Trade Agreement (FTA) with the United States and subsequently the extension to include Mexico under the North American Free Trade Agreement (NAFTA), trade as a share of GDP in Canada rose from about 50 per cent in 1990 to about 80 per cent in recent years.[6]

At the micro level, there is also compelling evidence of the importance of trade to productivity growth. In his study of the effects of the FTA, Trefler (1999) finds that tariff reductions increased labour productivity in the manufacturing sector. Baldwin and Gu (2003) report that productivity growth in Canada has been stronger in export-oriented manufacturing plants. In addition, Baldwin and Dhaliwal (2001) report that productivity growth has been stronger in foreign controlled establishments in the manufacturing sector suggesting that trade and foreign direct investment are important sources of technology transfer. Using industry data, Gera, Gu and Lee (1999) find that spillovers from foreign R&D spending that are embodied in imported intermediate inputs are a positive contributor to productivity growth in Canada. This likely provides some offset to the relatively low level of domestic R&D spending in Canada.

Summary and Conclusions

There are a number of reasons to be optimistic about productivity growth in Canada. There are also some reasons to be cautious. Needless to say, predictions about productivity growth are subject to considerable uncertainty.

On the positive side:

- Investment in machinery and equipment increased as a share of GDP over the 1990s. Given the lags between the timing of investment and the realization of productivity gains, this increased investment should continue to support higher trend productivity growth in the near term.
- Canada has a high exposure to international trade and investment. Empirical evidence indicates that this openness promotes the diffusion of knowledge and new technologies.
- Canada's macro-policy framework of low, stable inflation and improved fiscal positions provides a good supporting environment for efficient decision-making by firms.
- U.S. productivity growth was surprisingly strong through 2001 and 2002, despite the cyclical downturn in economic activity, and has grown strongly through the first half of 2003. This suggests that a significant part of the increase in U.S. productivity growth will be sustained. The longer the productivity resurgence lasts in the United States, the greater are likely to be the spillovers to Canada.
- Sharpe (2003) estimates the level gap between productivity in Canada and the United States to be somewhere between 10 and 20 per cent. This suggests that Canada can grow by adopting state of the art technologies and processes that already exist. Canada is, therefore, less reliant than the productivity-leading United States on the product cycle for semi-conductors.

There are also some reasons to take a more cautious perspective on future trend productivity growth in Canada relative to the United States:

- ICT-producing industries, which have made major contributions to the high productivity growth in the U.S. manufacturing sector, account for a smaller share of Canadian output. Moreover, although productivity gains in ICT production have also been strong in Canada, they have been significantly lower than in the United States. Some of this difference in growth rates appears to reflect structural differences in the composition of ICT output.
- Canada has a larger proportion of small firms and small firms tend to adopt new technology more slowly than larger firms.
- Canada has a relatively low rate of domestic R&D spending.

Overall, the Bank of Canada's projection is that trend output in Canada — what we usually call potential output — is growing at about 3 per cent. This can be roughly divided into 1 per cent growth in trend labour inputs with the remaining 2 per cent coming from trend labour productivity growth. This rate of trend labour productivity growth is somewhat above the average productivity growth experienced in Canada from 1975 to 1995, but in line with the experience in recent years.

Looking ahead, growth in potential output of about 3 per cent is a reasonable forecast through to roughly the end of the current decade. Thereafter, growth in labour inputs is expected to decline as the baby-boom generation moves into retirement and is replaced with a smaller cohort of workers entering the labour force. Thus, potential output growth is likely to decline unless productivity growth picks up or immigration increases.

Public policy has an important role to play and considerable progress has already been made with both macro and micro policies. Going forward, public policy can support productivity growth by reinforcing and enhancing the factors discussed above that have contributed to produc-

tivity growth. This includes continued progress on multilateral trade liberalization, secure and enhanced access to U.S. markets, low inflation, prudent fiscal management, renewed efforts to reduce structural rigidities in the economy and improve flexibility, effective capital market regulation that enhances the efficient provision and allocation of capital, good corporate governance, strong primary and secondary school systems that develop life-long learning skills, a post-secondary system that provides well-trained graduates and a home base for advanced research, and employer-sponsored training to maintain and improve skills while working.

Notes

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1 The focus on the business sector facilitates Canada-U.S. comparability based on published sources. Throughout this commentary, growth over the period A to B refers to the level in period B over the level in period A, all divided by the number of years from A to B. Labour inputs are measured as hours worked and labour productivity is measured as output per unit of labour input. Data sources are provided in the accompanying figures.

2 The Jorgenson, Ho and Stiroh study reported is the latest available update of their on-going work in this area — see also Jorgenson, Ho and Stiroh (2002). Similarly, the numbers reported in Table 1 for Armstrong et al. are drawn from an update to the original article. This update is published in Statistics Canada's *Daily*, July 12, 2002.

3 Khan and Santos (2002) also provide a Canada-U.S. comparison of the contribution of ICT to productivity growth and come to similar conclusions.

4 The estimate of TFP growth in the ICT-producing sector is drawn from Muir and Robidoux (2001) since Armstrong et al. do not separate out TFP growth in the ICT-producing sector from overall TFP growth.

5 In his commentary on future productivity growth in this issue, Robidoux (2003) also makes this point, but puts the emphasis on the improvement in TFP growth in Canada in the non-ICT-producing sector with particular focus on the service sector.

6 The trade share is defined as the sum of exports and imports divided by GDP.

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