An Analysis of the Labour Productivity Growth Slowdown in Canada since 2000

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THE RECENT BEHAVIOUR OF AGGREGATE labour productivity in Canada has been puzzling. After increasing at a 2.8 per cent average annual rate in the 1996-2000 period, output per hour growth in the Canadian business sector since 2000 has averaged a very weak 0.9 per cent per year. In 2003 and 2004, output per hour growth appears to have virtually disappeared. In contrast, the United States has experienced output per hour growth of 3.8 per cent per year since 2000. This divergence in productivity growth between the two countries is unprecedented and somewhat of a mystery given that the conditions driving productivity growth appear similar in the two countries. The objective of this article is to attempt to shed light on the current perplexing behaviour of labour productivity growth in Canada.[2]

Labour productivity growth will be the fundamental determinant of future improvements of living standards in Canada because further increases in both the employment/population ratio and average hours worked are expected to be limited. Productivity growth provides the resources to finance increased investments in education, health, the environment, infrastructure, and social programs, all crucial for improving quality of life of Canadians. From this perspective, current productivity developments are troubling, and if they continue, Canada's future prosperity is threatened, both in absolute terms and relative to other countries. Consequently, it is very important to assess whether current trends are short-term in nature and will soon be reversed, or more ominously, whether they are permanent.

This article is divided into three major sections. The first section reviews trends in output, employment and labour productivity in Canada and the United States, compares these developments to those experienced during comparable phases of earlier business cycles, and examines the

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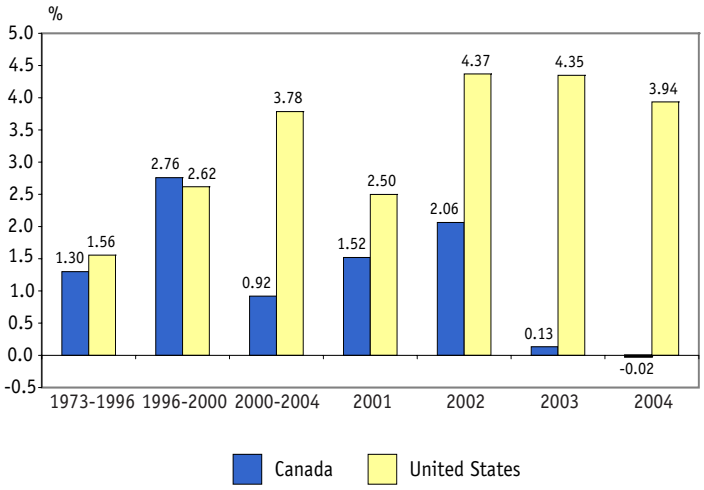
2 For an earlier analysis of the productivity deceleration in Canada and productivity acceleration in the United States, see Sharpe (2004).

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



Sources: Statistics Canada, Canadian Productivity Accounts (CANSIM Table 383-0008, quarterly data converted to annual averages) and the U.S. Bureau of Labor Statistics, Major Sector Productivity and Costs Program. Consistent with data released on June 9, 2005 in Canada and June 2, 2005 in the United States.

industry and regional composition of the post-2000 labour productivity growth slowdown in Canada. The second section assesses a number of possible explanations of the post-2000 productivity growth slowdown in Canada. Factors that are felt to be potential candidates for explaining slower productivity growth in Canada since 2000 include the business cycle, the capital-labour ratio, R&D intensity, outward orientation, profitability, commodity prices, the ageing of the labour force, and educational attainment. Factors which are thought unlikely to have contributed to the slowdown include the exchange rate, self-employment, and inter-industry employment shifts. The final section concludes.

Recent Economic Trends in Canada and the United States

Labour Productivity

Aggregate labour productivity can be measured at the total economy and business sector level.[3] Each measure has strengths and weaknesses. The strength of the business sector definition of aggregate labour productivity is that output measurement problems are less severe than for the total economy measure, which includes the non-business sector where output is proxied by labour input.[4] The official measure of aggregate labour productivity produced by both Statistics Canada in Canada and the Bureau of Labor Statistics in the United States is for the business sector. This is the measure used in this article. It is important to underline that the productivity estimates discussed in this article are subject to revision, and these revisions can be significant. Indeed, in the six years between 1997 and 2003, there was an average annual upward revision of one percentage point between initial and current productivity estimates (Kaci and Maynard, 2005).

Business sector output per hour growth has decelerated significantly in Canada since 2000 (Chart 1). After averaging 2.8 per cent per year in the 1996-2000 period,[5] output per hour growth fell to 0.9 per cent per year in the 2000-2004 period, a slowdown of almost 2 percentage points.[6] This growth rate is nearly identical to the 1.0 per cent rate recorded in 1989-1996 and slightly below the 1.3 per cent rate recorded from 1973 to 1996. The years 2001 and 2002 saw moderate productivity growth: 1.5 per cent and 2.1 per cent respectively. It has been the two years since then when productivity growth has faltered, advancing a meagre 0.1 per cent in 2003 and an

3 See Smith (2004) for a detailed discussion of issues related to the appropriate measurement of aggregate labour productivity.

4 The strengths of the total economy measure are that it is consistent with GDP per capita and improves international comparability since, unlike the business sector, the definition of what industries are included in the total economy does not differ across countries.

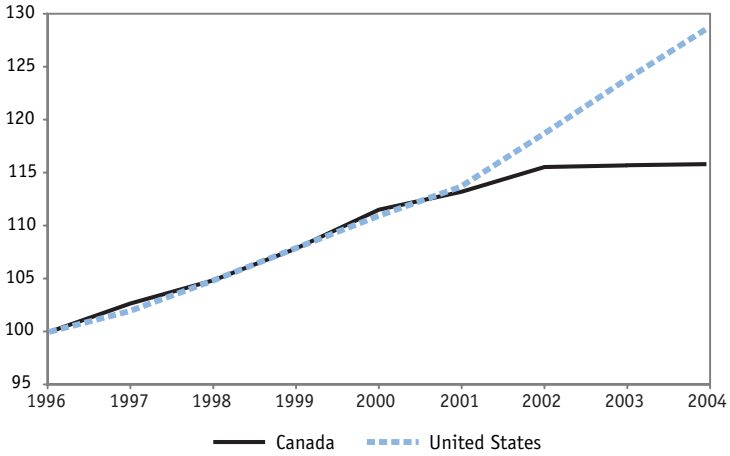
5 All growth rates in the text have been rounded to one decimal place. Estimates to two decimal places are presented in the charts and tables and are used for the calculation of differences in growth rates between periods. All growth rates in the article are compound (geometric) growth rates which use the first year of the period as the base year.

even worse 0.0 per cent in 2004 according to revised estimates released on June 9, 2005.[7]

In contrast to the post-2000 productivity growth fall-off in this country, aggregate labour productivity growth has picked up significantly in the United States. After a relatively lacklustre performance during the first half of the 1990s, business sector output per hour growth accelerated during the second half of the decade, increasing at a 2.6 per cent annual rate between 1996 and 2000. After 2000, productivity growth surged again, averaging a phenomenal 3.8 per cent per year over the four year 2000-2004 period, a performance not seen in fifty years. After advancing 2.5 per cent in 2001, output per hour growth exploded in 2002 to 4.4 per cent and maintained this pace in 2003 (4.4 per cent), falling off slightly in 2004 (3.9 per cent).

Between 1996 and 2000 labour productivity in Canada and the United States was on the same growth path, as shown in Chart 2. Since then these two paths have diverged significantly and by 2004 a very large growth gap had emerged. Based on a 1999 benchmark estimate of 82 per cent for business sector output per hour in Canada as a percentage of that of the United States (Rao, Tang, and Wang, 2004), recent productivity developments have seen Canada's business sector productivity relative plunge to 74 per cent of its U.S. counterpart in 2004 (Chart 3), the lowest level recorded since the mid-1950s.[8]

Chart 2
Business Sector Cumulative Output per Hour Growth in Canada and the United States, 1996-2004
(1996=100)



Sources: Statistics Canada, Canadian Productivity Accounts (CANSIM Table 383-0008, quarterly data converted to annual averages) and the U.S. Bureau of Labor Statistics, Major Sector Productivity and Costs Program. Consistent with data released on June 9, 2005 in Canada and June 2, 2005 in the United States.

Output Growth

Output growth in the business sector in Canada since 2000 has been less than half the pace of the second half of the 1990s (Chart 4). From 2000 to 2004, output growth averaged 2.4 per cent per year, compared to 5.8 per cent in the 1996-2000 period. The annual growth pattern has been very uneven, with relatively weak growth (1.6 per cent) in 2001 followed by stronger growth in 2002 (3.2 per cent), then by another year of mediocre economic activity (1.6 per cent) and finally a return to relatively strong growth (3.1 per cent) in 2004.

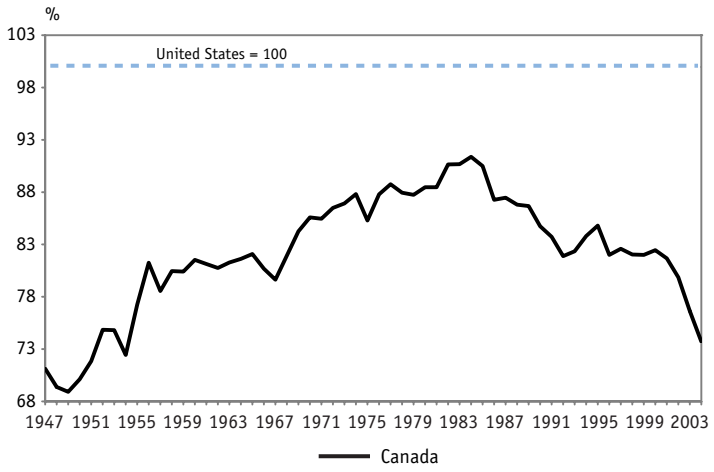
Business sector output growth in the United States since 2000 has been at 2.8 per cent per year, almost as weak as in Canada and well down from

6 Statistics Canada official productivity estimates for the total economy show very similar trends to that for the business sector. Total economy output per hour increased at a 1.0 per cent average annual rate over the 2000-2004 period, almost identical to the business sector rate of 0.9 per cent. In 2000-02, total economy output per hour grew an average 1.7 per cent per year, comparable to the 1.8 per cent rise for the business sector. Total economy output per hour increased at a 0.3 per cent average annual rate between 2002 and 2004, slightly above the 0.1 per cent average for the business sector.

7 Business sector output per hour growth in the first quarter of 2005 in Canada continued at a weak pace: 0.2 per cent or 0.7 per cent on an annualized basis. In contrast, productivity growth was three times stronger in the United States: 0.6 per cent or 2.4 per cent on an annualized basis (Statistics Canada, 2005).

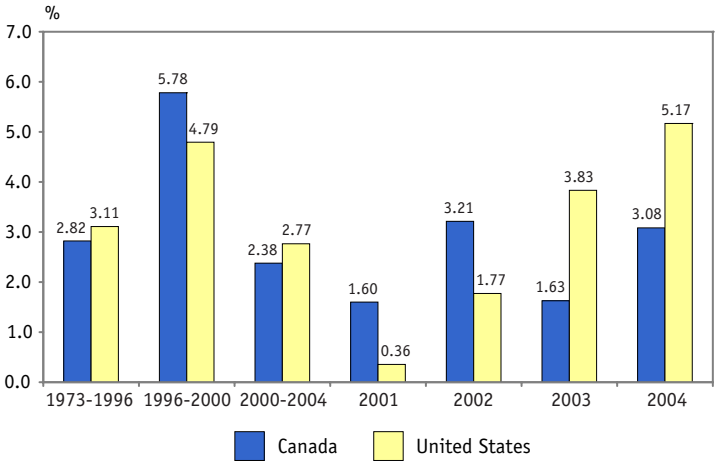
8 It is not just against the United States that Canada's relative labour productivity level has deteriorated, but also against other developed countries. According to the productivity data base maintained by the Groningen Growth and Development Centre (www.ggdc.nl), Canada in 2004 ranked 18th out of 23 OECD countries in terms of the level of GDP per hour worked, down from fifth in 1950.

Chart 3
Output per Hour in the Business Sector in Canada as a percentage of the U.S. Level, 1947-2004



Sources: CSLS Aggregate Income and Productivity Database (http://www.csls.ca/data/ipt1.asp), Table 7a, updated for consistency with the productivity releases of June 9, 2005 in Canada and June 2, 2005 in the United States.

Chart 4
Output Growth in the Business Sector in Canada and the United States
(average annual and annual rates of change, per cent)



Sources: Statistics Canada, Canadian Productivity Accounts (CANSIM Table 383-0008, quarterly data converted to annual averages) and the U.S. Bureau of Labor Statistics, Major Sector Productivity and Costs Program. Consistent with data released on June 9, 2005 in Canada and June 2, 2005 in the United States.

the pace in the second half of the 1990s (4.8 per cent). But the annual growth pattern has differed markedly from that experienced in Canada. Output growth was very weak in 2001 (0.4 per cent) and has steadily become stronger as the decade has progressed, rising to 1.8 per cent in 2002, 3.8 per cent in 2003, and a robust 5.2 per cent in 2004.

Hours Worked and Employment

Because of variations in average hours, total hours worked is a more appropriate measure of labour input than employment for labour productivity calculations. Business sector hours worked in Canada advanced at a 1.4 per cent average annual rate from 2000 to 2004, down significantly from the 3.0 per cent rate in 1996-2000 (Chart 5). With the weakness in economic activity in 2001, hours growth was basically flat (0.1 per cent). It then picked up to 1.1 per cent in 2002, increased again in 2003 to 1.5 per cent despite the relatively weak output growth, and then more than doubled to 3.1 per cent in 2004.

Business sector employment (or jobs) growth in Canada also fell off considerably after 2000, advancing at a 1.7 per cent average annual rate in 2000-2004 compared to 3.1 per cent in 1996-2000 (Chart 6). The annual growth pattern for employment was much more even than it was for output. After weak employment growth in 2001 (0.8 per cent), employment growth rebounded in 2002 to 2.3 per cent and stayed roughly in this range in 2003 and 2004 (1.8-1.9 per cent).

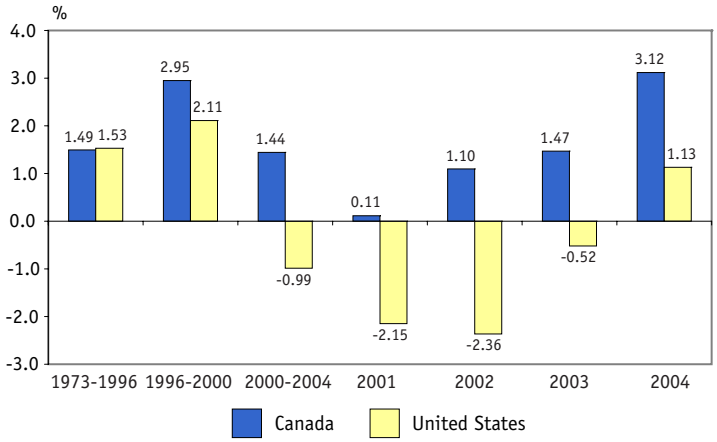
Differences between growth rates for total hours worked and employment reflect differences in average hours. In the 2000-2004 period, average hours hence fell 0.2 per cent per year, although the annual pattern was very uneven. Jobs growth exceeded total hours growth by a significant margin in 2001, 2002 and 2003, so average hours fell in all three years (0.7 per cent in 2001, 1.2 per cent in 2002, and 0.3 per cent in 2003). This pattern was reversed in 2004 when growth in total hours worked greatly exceeded employment growth, resulting in a 1.3 per cent increase in average hours worked.

Business sector hours worked in the United States actually fell at a 1.0 per cent average annual rate over the 2000-2004 period, compared to a 2.1 per cent average annual rate of increase in 1996-2000. This decrease in total hours worked also lies in stark contrast to the increase in total hours in Canada, especially given that both countries experienced on average the same output growth over the period. Total hours worked fell more than 2 per cent in both 2001 and 2002, with the loss dropping to 0.5 per cent in 2003 before reverting to an increase of 1.1 per cent in 2004.

The decline in business sector employment in the United States after 2000 was less dramatic than that of hours. Employment fell at an average rate of 0.5 per cent from 2000 to 2004, well down from the robust 2.1 per cent rate of employment growth in 1996-2000 and in marked contrast to the 1.7 per cent increase in employment in Canada after 2000. Again, the employment loss was largely concentrated during the first two years of the period (-0.8 per cent in 2001 and -2.2 per cent in 2002) as employment losses were minor in 2003 (-0.2 per cent) and returned to employment gains in 2004 (1.2 per cent).

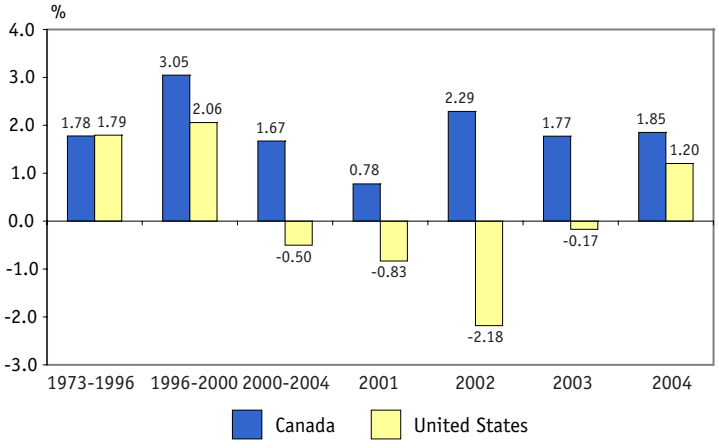
As was the case in Canada, average hours worked have fallen in the U.S. business sector since 2000, by 0.5 per cent per year. The largest fall took place in 2001 (1.3 per cent) followed by 2003 (0.4 per cent). The other two years saw little change.

Chart 5
Growth in Total Hours Worked in the Business Sector in Canada and the United States
(average annual and annual rates of change)



Sources: Statistics Canada, Canadian Productivity Accounts (CANSIM Table 383-0008, quarterly data converted to annual averages) and the U.S. Bureau of Labor Statistics, Major Sector Productivity and Costs Program. Consistent with data released on June 9, 2005 in Canada and June 2, 2005 in the United States.

Chart 6
Growth in the Number of Jobs in the Business Sector in Canada and the United States
(average annual and annual rates of change)

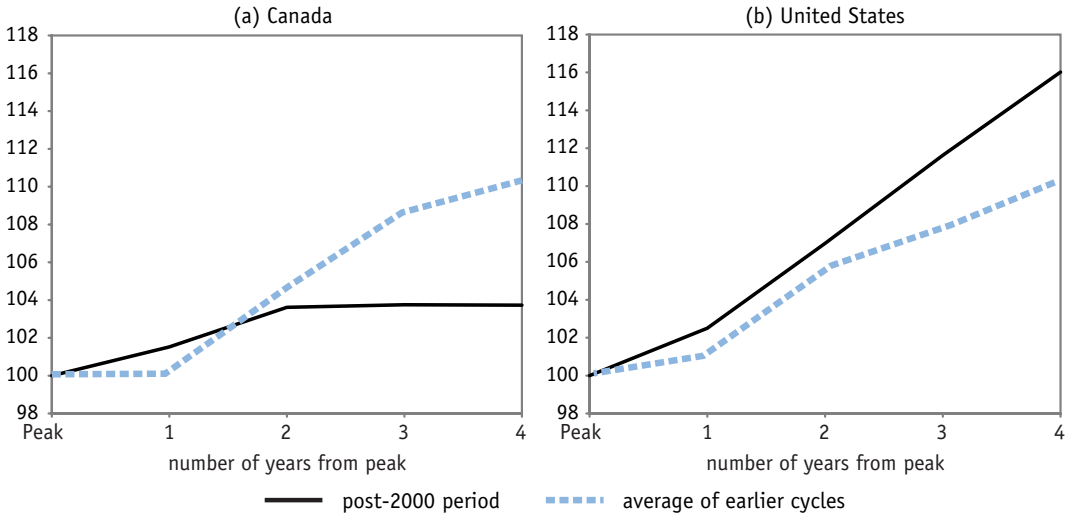


Sources: Statistics Canada, Canadian Productivity Accounts (CANSIM Table 383-0008, quarterly data converted to annual averages) and the U.S. Bureau of Labor Statistics, Major Sector Productivity and Costs Program. Consistent with data released on June 9, 2005 in Canada and June 2, 2005 in the United States.

Has Productivity Growth in Canada and the United States Since 2000 been Consistent with that Experienced During Comparable Phases in Earlier Business Cycles?

Business sector labour productivity growth in Canada since 2000 has differed markedly from that experienced during comparable phases of previous business cycles. Between the 2000 output peak and 2004, output per hour advanced only 3.7 per cent (Chart 7). But for earlier post-

Chart 7
Output per Hour in the Business Sector During Post-War Business Cycles for Canada and the United States, Index
(peak year=100)



Sources: Statistics Canada, Canadian Productivity Accounts (CANSIM Table 383-0008, converted from quarterly to annual averages) and the U.S. Bureau of Labor Statistics, Major Sector Productivity and Costs Program. Consistent with data released on June 9, 2005 in Canada and June 2, 2005 in the United States.

Notes: The criterion used to identify peak years was that either output in the business sector fell between a given year and the next year or the decline in annual growth in business sector output between a given year and the next year was greater than or equal to the decline in annual growth in business sector output between 2000 and 2001. Candidate years for Canada based on this criterion were 1953, 1956, 1966, 1973, 1981, 1989, 1990 and 2000. 1956 and 1990 were discarded to avoid overlap. Candidate years for the United States were 1948, 1953, 1955, 1957, 1966, 1969, 1973, 1974, 1979, 1981, 1984, 1990 and 2000. 1955, 1957, 1969, 1974, 1979 and 1984 were discarded to avoid overlap.

war business cycles in Canada, output per hour was on average 10.5 per cent higher four years after the business cycle peak. This much weaker productivity growth since 2000 cannot easily be explained by poor macroeconomic conditions. Business sector output growth was 9.9 per cent between 2000 and 2004, only slightly behind the 11.8 per cent average for comparable periods of earlier business cycles. This means that the productivity elasticity, that is the proportion of output growth arising from productivity growth, was only 0.38 in the 2000-2004 period, less than one half the average of 0.89 recorded during the comparable phase of previous business cycles.

The contrast between business sector output per hour in Canada and the United States in 2000-2004 is even more puzzling when put in the context of past business cycles. Canada and the United States have typically had quite similar experiences in terms of business sector output and output per hour growth after post-war output peaks. However, the U.S. experience during the post-2000 period has been characterized by above average productivity growth – 16.0 per cent compared to an average 10.3 per cent for past business cycles four years after the output peak (Chart 7). This is the direct opposite of Canada's experience. These patterns suggest that there may be something unusual about productivity growth since 2000 in both Canada and the United States relative to comparable phases of earlier business cycles.

Industry Dimensions of the Post-2000 Productivity Growth Slowdown in Canada

The post-2000 productivity growth slowdown in Canada was generally pervasive, taking place in 12 of 15 two-digit NAICS business sector industries (the exceptions were information and cultural services, finance, insurance and real estate, and arts, entertainment and recreation), as shown in Appendix Table 1. The largest fall-offs in productivity growth rates between 1997-2000 and 2000-2004 were in goods-producing industries: mining and oil and gas extraction (8.2 percentage points), agriculture, forestry, fishing and hunting (5.3 points), utilities (4.1 points), manufacturing (3.5 points), and construction (3.4 points).

In terms of the relative industry contributions to the post-2000 slowdown,[9] the manufacturing sector accounted for 42.3 per cent, followed by mining and oil and gas extraction (28.6 per cent) and construction (12.4 per cent).

Within the manufacturing sector, the computers and electronics industry – which includes the manufacturing of information and communications technologies (ICT) – was responsible for about one third of the decline in manufacturing productivity growth between the two periods.[10] Labour productivity growth in this industry fell a massive 18 percentage points from 13 per cent per year in 1996-2000 to -5 per cent in 2000-2004.[11]

In terms of the further deceleration in productivity growth from 1.8 per cent per year in 2000-02 to 0.1 per cent per year in 2002-04, all industries except manufacturing and agriculture, forestry, fishing and hunting contributed. Finance, insurance and real estate made the largest contribution (48.8 per cent), followed by information and cultural services (24.9 per cent) and mining and oil and gas extraction (24.8 per cent).

Provincial Dimensions of the Post-2000 Productivity Growth Slowdown

The post-2000 productivity growth slowdown was also generally pervasive across Canadian provinces, with the exception of Newfoundland, Prince Edward Island and New Brunswick (Appendix Table 2).[12] The provinces with the largest productivity growth declines between 1996-2000 and 2000-04 were Alberta and Ontario (about 1.9 points each). These two provinces accounted for 77 per cent of the fall-off, although they represent about 53 per cent of national output and a slightly smaller propor-

9 The absolute contribution to business sector labour productivity growth of a given industry is calculated as the labour productivity growth of that industry multiplied by the industry's share of business sector output in the first year of the growth rate. Absolute contributions to the change in business sector labour productivity growth between periods are calculated as the difference between absolute contributions to business sector labour productivity growth in each period for each industry. Relative contributions to the change in business sector labour productivity growth between periods are calculated as absolute contributions to the change divided by the change itself.

10 Official productivity data are not currently available to 2004 for detailed manufacturing industries so these observations are based on productivity estimates calculated from national accounts by industry and LFS hours estimates.

11 According to a more precise definition of ICT-producing industries (see Beckstead and Brown, 2005), the contribution of ICT manufacturing to the overall business sector productivity slowdown may be even greater than suggested by the estimates discussed above. However, it should be noted that data are only available based on this more precise definition for the 1997-2003 period, and that the unavailability of hours data based on this definition has meant that the labour input measure is inconsistent with that used elsewhere in this article. It should also be noted that these same data are available for the ICT-producing service industry, and show that labour productivity in this industry does not seem to have contributed at all to the business sector slowdown (also as evidenced by the small contribution from the information services industry in Appendix Table 2).

12 Statistics Canada does not release business sector labour productivity estimates on a provincial basis. Provincial productivity estimates discussed in this section are for the total economy and were complied by the Centre for the Study of Living Standards from GDP by province estimates from the national accounts and hours estimates from the Canadian Productivity Accounts.

tion of national employment and hours worked. All provinces except Manitoba and Saskatchewan also experienced slower productivity growth in 2002-04 than in 2000-2002.

Explanations for the Post-2000 Productivity Growth Slowdown in Canada

Labour productivity growth is influenced by a host of microeconomic and macroeconomic factors. They affect productivity in many complex, interactive and dynamic ways. Hence, it is extremely difficult to disentangle precisely the influence of each factor. This section assesses possible explanations of the post-2000 labour productivity slowdown in Canada. Based on the accepted or established relationship between the variable and productivity growth and current trends in the variable in question, potential candidates for explaining slower productivity growth in Canada since 2000 include the business cycle, capital-labour ratio, R&D intensity, profitability, outward orientation, commodity prices, the ageing of the labour force, commodity prices and educational attainment. Based on current trends, factors which are thought unlikely to have contributed to the slowdown, or likely to have offset the influence of negative factors, include the exchange rate, self-employment, inter-industry employment shifts.

Factors Potentially Slowing Down Productivity Growth in Canada after 2000

Cyclical Factors

Labour productivity growth and output growth are positively correlated in both the short run and the long run, but for different reasons. In the short run, a slowdown in output growth will generally have a negative impact on labour productivity growth because of the costs associated with adjusting inputs to changes in business conditions. An acceleration of output growth will have a positive effect for the same reason. This positive short-run association between output growth and productivity growth runs from changes in output to changes in productivity. On the other hand, the long-run causality behind the positive association between output growth and productivity growth is more ambiguous. It may run from changes in trend productivity growth to changes in potential output growth, but it may also arise from the long-run positive effects strong demand and hence output growth have on productivity arising through increasing returns and learning by doing.

During 2000-04, real output growth in the Canadian business sector averaged 2.4 per cent per year, less than half of the growth in the second half of the 1990s and below potential growth which is estimated to be around 3 per cent. This suggests that a part of the post-2000 productivity slowdown may reflect lagged and incomplete adjustment of labour and capital input to the slowdown in output growth. But this argument may not be completely compelling for two reasons. First, the slowdown in output growth also occurred in the U.S. business sector, yet its productivity growth actually accelerated. Second, the slowdown in output growth in Canada may actually reflect a decline in trend productivity growth. As noted earlier, the productivity elasticity in the post-2000 period was only 0.38, less than half of the value for comparable phases of earlier business cycles. This suggests that Canada's post-2000 experience may be unique, making a business cycle explanation of the productivity slowdown unconvincing.

Capital-Labour Ratio

Capital accumulation contributes to labour productivity growth via two key channels. First, an increase in the capital-labour ratio increases labour productivity by giving each worker more capital and hence making her more productive. Second, capital, especially machinery and equipment (M&E), embodies productivity-enhancing

technological change. Therefore, growth in the capital-labour ratio, a process called capital deepening, indicates a faster pace of adoption of new technologies and promotes faster labour productivity growth.

Capital stock in the Canadian business sector, including structures and M&E capital, increased at an average annual rate of 2.2 per cent per year during 2000-04, compared to 3.4 per cent per year in the second half of the 1990s (Table 1). However, the growth in the capital-labour ratio actually increased during 2000-04, relative to 1996-2000, because of the greater slowdown in hours growth, which fell from 3.0 per cent to 1.4 per cent per year. Trends in capital deepening therefore made a small negative contribution to the post-2000 labour productivity growth slowdown in the business sector.

It is important to note that the pick-up in growth in the capital-labour ratio in the post-2000 period relative to 1996-2000 was entirely due to the rebound in the structures capital-labour ratio. The growth in the M&E capital-labour ratio, on the other hand, declined from 3.3 per cent per year in the second half of the 1990s to 1.8 per cent per year during 2000-04.[13] Similarly, the ICT capital-labour ratio, an important component of M&E capital intensity, increased at less than half the pace of the earlier period (6.2 per cent versus 13.1 per cent per year). Estimates based on a simple growth accounting framework attribute 10 per cent of the productivity growth slowdown to slower M&E capital intensity growth or, based on an alternative breakdown, 6 per cent to slower ICT capital intensity growth (Table 1).

But these estimates may be too small given that M&E and ICT capital inputs are the carriers of technology. The slower growth in the stocks of these kinds of capital may reflect slower rates of technology adoption and diffusion in the Canadian business sector, and may therefore have contributed significantly more to the productivity growth slowdown than suggested by growth accounting estimates.

On the other hand, it has been argued that M&E investment affects productivity growth with a significant lag (Leung, 2004). From this perspective, the post-2000 slowdown in M&E capital intensity growth may not have contributed to the productivity slowdown during 2000-04, but may reduce future labour productivity growth.

R&D Intensity

One of the key drivers of the pace of technological change is research and development (R&D) intensity, defined as the ratio of R&D expenditures to GDP. The performance of R&D also gives Canadian firms the absorptive capacity to adopt technologies developed in other countries. Therefore, a fall in R&D intensity in Canada can adversely affect technology development and technology transfer, and hence productivity growth.

Business sector R&D is much more closely related to productivity growth than non-business sector R&D (OECD, 2003:84-86). Business sector R&D intensity doubled from 0.80 per cent in 1981 to a peak of 1.61 per cent in 2001 before falling to 1.35 per cent in 2003 (Chart 8). This rapid R&D intensity growth up to 2001 likely contributed significantly to productivity advance during the period. The end of this growth since 2001 may thus have eliminated an important source of productivity advance and may account for part of the post-2000 productivity growth slowdown. But if R&D spending

13 In addition to being affected by the business cycle, trends in the capital-labour ratio are also influenced by relative factor prices. The rate of increase of nominal hourly labour compensation in the Canadian business sector fell from 3.9 per cent per year in 1996-2000 to 2.0 per cent in 2000-04. The rate of increase in the private M&E investment deflator went from -1.1 per cent per year in 1996-2000 to -2.4 per cent in 2000-04. The greater percentage point fall in hourly compensation implies that the relative price of labour declined relative to capital, which would tend to slow the rate of growth of the M&E-labour ratio. This is what happened.

Table 1

Sources of Labour Productivity Growth in the Business Sector in Canada

(average annual rate of growth)

	1989-1996	1996-2000	2000-2004	changes between 96-00 and 00-04	2000-2002	2002-2004	changes between 00-02 and 00-04
Output	1.47	5.78	2.38	-3.40	2.40	2.35	-0.05
Total Hours	0.49	2.95	1.44	-1.51	0.60	2.29	1.69
Employment	0.60	3.05	1.67	-1.38	1.53	1.81	0.28
Capital Stock	2.18	3.37	2.18	-1.19	2.31	2.04	-0.27
Machinery and Equipment	3.00	6.37	3.27	-3.10	3.33	3.20	-0.13
Structure	1.90	2.23	1.71	-0.52	1.88	1.54	-0.34
ICT capital stock	11.01	16.39	7.74	-8.65	9.10	6.40	-2.70
Non-ICT capital stock	1.91	2.69	1.75	-0.94	1.81	1.68	-0.13
Output per hour	0.97	2.76	0.92	-1.84	1.79	0.06	-1.74
Capital per hour	1.68	0.41	0.72	0.32	1.69	-0.24	-1.94
Machinery and Equipment per hour	2.50	3.33	1.80	-1.53	2.71	0.89	-1.83
Structures per hour	1.40	-0.70	0.26	0.96	1.27	-0.73	-2.00
ICT capital per hour	10.46	13.05	6.21	-6.84	8.45	4.02	-4.42
Non-ICT capital per hour	1.41	-0.25	0.30	0.55	1.20	-0.59	-1.80
Total factor productivity	0.18	2.57	0.57	-1.99	0.99	0.17	-0.82
	percentage point contributions to output per hour growth						
Capital per hour	0.79	0.19	0.35	0.15	0.80	-0.12	-0.92
M&E per hour	0.30	0.44	0.26	-0.18	0.38	0.13	-0.26
Structures per hour	0.49	-0.24	0.09	0.33	0.42	-0.24	-0.66
ICT capital per hour	0.16	0.33	0.22	-0.11	0.28	0.14	-0.14
Non-ICT capital per hour	0.64	-0.11	0.13	0.25	0.53	-0.26	-0.79
Total factor productivity	0.18	2.57	0.57	-1.99	0.99	0.17	-0.82
	per cent contributions to output per hour growth						
Output per hour	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Capital per hour	81.4	6.9	37.5	-8.3	44.9	-207.1	53.0
Machinery and Equipment per hour	30.9	15.9	28.1	9.8	21.4	229.0	14.8
Structures per hour	50.5	-8.7	9.5	-17.8	23.5	-437.7	38.3
ICT capital per hour	16.2	11.9	23.7	6.0	15.7	256.8	8.0
Non-ICT capital per hour	66.1	-4.1	14.4	-13.3	29.6	-471.5	45.7
Total Factor Productivity	18.6	93.1	62.5	108.3	55.1	307.1	47.0

Sources: Statistics Canada, Canadian Productivity Accounts and published and unpublished data from the Capital Stock Division (CANSIM Tables 383-0008 converted to annual averages, 383-0013 and 031-0002). Data downloaded on and consistent with the productivity release of June 9, 2005.

Notes: Total factor productivity growth rates are calculated as the difference between output per hour growth rates and the absolute (weighted) contributions of total capital per hour to output per hour growth. Absolute contributions of capital per hour are calculated as the growth rates of total capital per hour weighted by the time-varying capital elasticity. The capital elasticity is assumed to be equal to the proportion of capital costs in total costs (from the KLEMS data set maintained by Statistics Canada's Productivity Program, with data available for 1997-2003 only). The proportion in 1997 has been used for the 1989-1996 period, the average proportion for 1997 and 2000 for 1996-2000, the average for 2000 and 2003 for 2000-2004, the average for 2000 and 2002 for 2000-2002, and the average for 2002 and 2003 for 2002-2004. Absolute contributions for the components of total capital intensity are based on the total capital elasticity and the share of each type of capital in total capital based on chained-dollar data. While the data have been calculated such that the relative contributions of total factor productivity and capital per hour sum to 100, it is important to note that the decomposition is not exact due to non-additivity related to the use of chained-dollar data and compound (geometric) average annual growth rates. This non-additivity is captured in the total factor productivity growth rates. The contributions of the components of total capital intensity do not sum exactly to those for total capital intensity due as well to non-additivity related to the use of chained-dollar data and compound growth rates.

affects technology development and transfer and hence productivity growth with a significant lag, the strong R&D intensity growth up to 2001 might have been expected to boost productivity in 2001-04 or later.

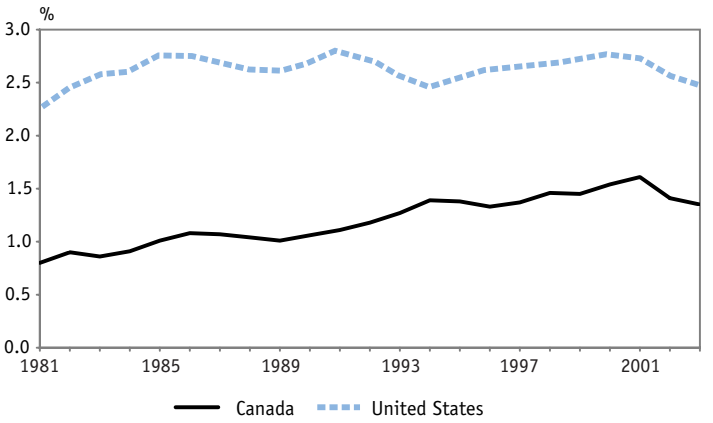
Since Canada imports most of its technological innovations from the United States, a case can be made that it is business sector R&D in that country that is more important for Canadian productivity growth than our own R&D effort (Bernstein, 2000). A fall in R&D intensity in the United States would then have negative consequences for Canada's productivity performance. U.S. business sector R&D intensity did fall from a peak of 2.76 per cent in 2000 to 2.47 per cent in 2003 (Chart 8), a period when productivity growth in Canada fell off considerably. The major weakness of this explanation is that the post-2000 fall in U.S. R&D intensity appears to have had no effect on U.S. productivity growth, which accelerated during this period. It seems implausible that U.S. R&D trends would affect Canada, but not the United States.

Profitability and Cost-cutting Pressures

Since 2000, profits have been at record levels in Canada, averaging 12.4 per cent of GDP. In contrast, profits have been at low levels in the United States, averaging 8.7 per cent (Chart 9). It may not be coincidental that during this period labour productivity growth decelerated in Canada but accelerated in the United States, as profitability affects firm behaviour, which in turn influences productivity.

The near-record low profits[14] in the United States appear to have prompted employers to undertake workplace reorganization and to downsize employment levels in an attempt to

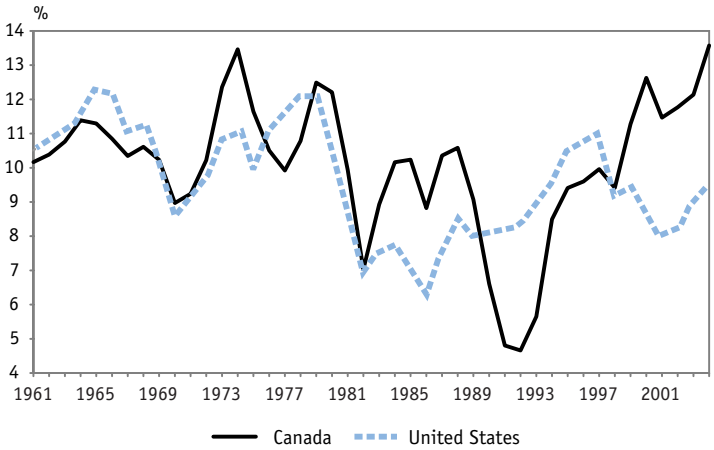
Chart 8
Business Enterprise Research and Development Expenditure as a Proportion of Business Sector Value Added, Canada and the United States, 1981-2003



Sources: *Main Science and Technology Indicators* Volume 2004, Release 02, OECD.

Notes: U.S. GERD and BERD figures exclude most or all capital expenditures, and so are likely underestimated relative to the Canadian figures.

Chart 9
Corporate Profits as a Proportion of National Income, Canada and the United States, 1961-2004

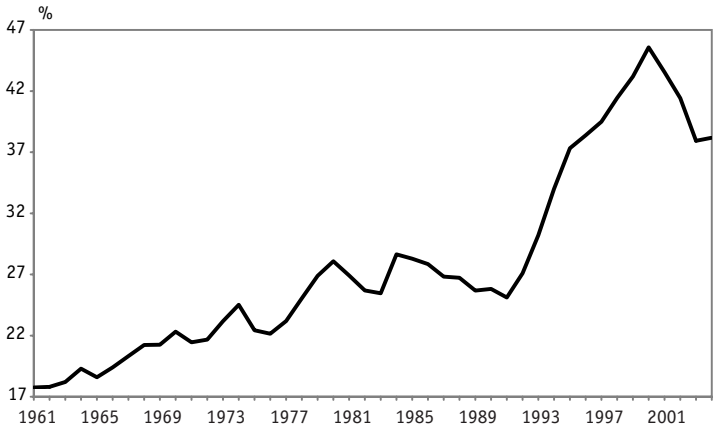


Sources: Income-based GDP from Statistics Canada, CANSIM Table 380-0016 and the U.S. Bureau of Economic Analysis, NIPA Table 1.12, lines 1 and 44. Data downloaded on June 9, 2005.

Note: Profits are before taxes, without inventory valuation and capital consumption adjustments.

14 The low profits in the United States reflect the competitive environment due to relatively high rates of nominal wage increases (4.0 per cent per year in 2000-04), and greater international competition and outsourcing (Gordon, 2003). Canada's higher profit levels may reflect lower nominal wage increases (2.2 per cent per year in 2000-04), a less competitive corporate environment, less offshoring of economic activities (Canada is a net beneficiary of offshoring), and an industrial structure with greater importance of natural resource industries that have recently benefited from high commodity prices.

Chart 10
Exports as a per cent of GDP, Canada, 1961-2004



Sources: Expenditure-based GDP in current dollars from Statistics Canada, CANSIM Table 380-0017. Data downloaded on June 9, 2005.

reduce costs. The declines in U.S. employment in 2001, 2002, and 2003 (Chart 6) attest to this desire on the part of employers to run a lean operation. Indeed, Gordon (2003:247) cites the unusual degree of downward pressure on profits as one of the two most compelling hypotheses to explain the post-2000 productivity growth acceleration in the United States.[15]

Canadian employers may have been more complacent regarding workplace re-organization and employment levels due to record high profits. Employment growth has been fairly robust since 2000 in this country. In other words, decisions made by firms and managers based on cost pressures (or lack thereof) can affect labour productivity through hiring and lay-off decisions, at least in the short term.

The importance of M&E and ICT investment for productivity growth is now widely accepted. But economists have only recently begun to explore the idea that additional investments in workplace re-organization and human resource management are necessary to seize the full long-term productivity benefits of new technologies.[16] If such organizational innovation is indeed important for productivity growth, Canada's poor productivity growth since 2000 may be a result of a lack of workplace innovations to support the more efficient use of new technologies. In contrast, the strong U.S. productivity growth since 2000 may mean that productivity-enhancing workplace change is taking place, driven by cost pressures.

Outward Orientation

Canada is a small open economy. It benefits heavily from foreign technologies and know-how. Research strongly suggests that the increased trade and foreign direct investment orientation have contributed significantly to Canada's productivity growth, by bringing in state of the art technologies and knowledge.

In the 1980s and 1990s, and particularly in the second half of the 1990s, Canada's trade and foreign direct investment (FDI) orientation increased considerably. But since 2000, these trends have been reversed. Canada's exports increased from 25.1 per cent of GDP in 1991 to a peak of 45.6 per cent in 2000 and by 2004 had fallen to 38.2 per cent (Chart 10).[17] FDI rose from 9.5 per cent of the total economy capital stock in 1985 to 18.1 per cent in 2000 and has since stabilized (Chart 11).[18] These trends suggest that the boost to productivity growth provided by the increasing outward orientation of

15 The other compelling hypothesis, according to Gordon, is that intangible capital (business re-organization, new business processes, retraining, and general acquisition of human capital) acted as a source of dynamic adjustment in the response of productivity growth to the boom in ICT capital investment. This intangible capital, necessary for the effective use of ICT investment, was not counted as an input in the second half of the 1990s so productivity growth was overestimated.

16 For evidence to this effect, see McKinsey Global Institute (2001), Gordon (2003), Leung (2004), Turcotte and Whewell Rennison (2004), and Gera and Gu (2004).

17 A more appropriate measure of export orientation is the ratio of value added contained in exports to GDP since total exports includes the value of imported intermediate goods. This ratio has also risen significantly in recent years, but not by as much as the exports/GDP ratio.

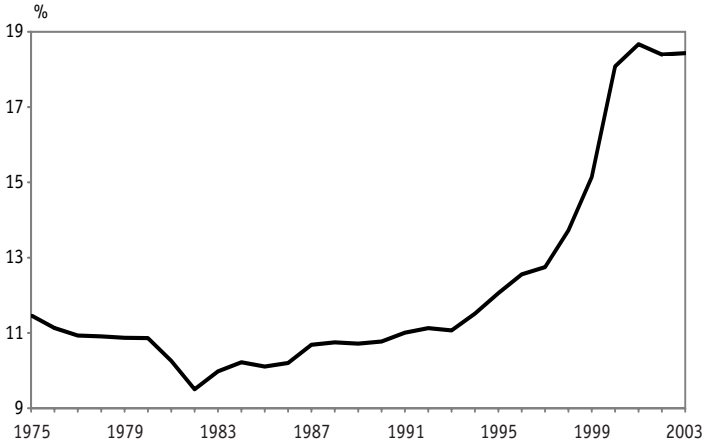
the Canadian economy in the 1980s and 1990s may have now petered out. This situation may have been a factor behind slower productivity growth since 2000.

Prices of Energy and Other Raw and Primary Commodities

Another explanation of the post-2000 labour productivity growth deceleration in Canada may be the boom in commodity prices that has occurred in the past several years. As commodity prices rise, natural resource extraction industries have an incentive to exploit ever more marginal resources, since even minimal increases in production can have a large positive impact on profits. In general, profitability trumps productivity as an objective for firms. Normally the two objectives go hand in hand, but when they diverge, as for example when commodity prices are extremely high, the productivity of the natural resource sector suffers. This feeds into poorer productivity growth in the natural resource sector as a whole and, in turn, at the aggregate level (CSLS, 2004). It is important to not however that a productivity deterioration arising from higher commodity prices is not necessarily bad for income because of the improvement in the country's terms of trade.

Evidence from the industry sources of productivity growth presented in Appendix Table 1 supports this hypothesis. The mining and oil and gas extraction industry, which is dominated by the oil and gas component, had a very poor productivity performance in 2000-2004, with output per hour falling 3.4 per cent per year. This coincided with an increase in the energy component of the Bank of Canada's Commodity Price Index of 3.5 per cent per year. Conversely, productivity growth in this industry was an impressive 4.8 per cent per year in 1997-2000,

Chart 11
Stock of Foreign Direct Investment as a per cent of Total Economy Captial Stock, Canada, 1975-2003



Sources: Statistics Canada, stock of FDI and geometric end-year net capital stock data in current dollars, CANSIM Tables 376-0037 and 031-0002. Data downloaded on June 9, 2005.

when the energy price index declined by 2.8 per cent per year. The turnaround in the productivity performance of this industry between periods, accounting for 28.6 per cent of the post-2000 business sector productivity growth slowdown, hence directly corresponds to the turnaround in energy prices.

Indeed, the poor productivity growth of the mining and oil and gas extraction industry in 2000-2004 was concentrated in the second part of the period (-6.3 per cent per year in 2002-04 versus -0.5 per cent in 2000-2002), when energy prices experienced a massive 32 per cent increase. This pattern strongly suggests that price trends directly contributed to the deterioration in labour productivity in the mining and oil and gas extraction industry after 2002.

Ageing of the Labour Force

Changes in the demographic structure of the workforce can influence productivity growth. For instance, an increase in the share of young

18 While a large part of the decline in the stock of FDI as a proportion of total capital stock can be attributed to the drought in cross-border mergers and acquisitions experienced across many other countries after 2000, data show that there was also a substantial decline after 2000 in FDI flows into Canada unrelated to sales and acquisitions.

people in the workforce may reduce labour productivity because of the fewer years of work experience of younger workers. Equally, an increase in the share of older workers could potentially decrease productivity due to the putative lower energy levels and outdated skills of older workers. However, there is no consensus among researchers about the impact of ageing on productivity.

The share of persons 55 years and over in total employment in Canada increased by 2.7 percentage points between 2000 and 2004, compared to less than 1 percentage point during 1996-2000, suggesting that this factor could have played a role in the recent productivity growth slowdown. But this explanation is not very compelling for two reasons. First, the evidence that older workers are a serious drag on productivity is weak. Second, the United States also experienced a comparable increase in the 55 and over employment share, yet saw productivity growth accelerate.[19]

Educational Attainment

Human capital accumulation, proxied by educational attainment and investment in skills development, is essential for innovation and the commercialization, adoption and diffusion of technologies. Therefore, one would expect a positive relationship between human capital accumulation and productivity growth. In addition, research suggests that returns to university education are considerably higher than non-university education.

The proportion of workers with a university degree among employed persons 25 and over in Canada grew at an average annual rate of 1.9 per cent in the 2000-2004 period. This trend undoubtedly contributed to productivity growth. But the rate of increase in the university trained was slower after 2000 than in the second half of the 1990s when it increased at 2.6 per cent per year. In the United States, where labour productivity growth accelerated after 2000, the rate of growth in the university educated workforce did not fall off. These trends suggest that the slowdown in the rate of growth in the university-educated workforce in Canada may have contributed to some degree to this county's slowdown in labour productivity growth.

Factors Potentially Increasing Labour Productivity Growth in Canada after 2000

The Canada-U.S. Exchange Rate

An appreciation in the exchange rate, such as Canada has experienced since 2002, can have several indirect and offsetting effects on productivity. First, imported capital goods become cheaper, which is reflected in a greater incentive to substitute away from labour and towards capital than would have existed otherwise. Second, unit labour cost pressures increase as the appreciating exchange rate boosts costs in terms of a common currency. This gives firms a greater incentive to boost labour productivity to reduce unit labour costs.[20] Third, export-oriented firms and industries experience a drop in sales, as orders become more expensive for buyers from outside the country. This limits the scope for firms to improve productivity through long production runs, spreading of fixed costs and elimination of slack. Fourth, net FDI flows into Canada can decrease, as Canadian assets become more expensive to foreign investors, which can deprive Canadian firms of the latest technologies and best practices.[21]

On balance, it could be expected that the former two positive effects of an appreciation of the exchange rate on productivity growth will

19 Of course, the productivity-reducing impact of an ageing workforce in the United States could have been offset by other factors.

20 However, as was discussed above, corporate profits have been extremely high in Canada on average since 2000, which may have dulled the incentive for firms to seek cost savings.

outweigh the latter negative effects. However, Chart 12 shows that the large appreciation in the Canadian dollar after 2002 corresponds exactly with the apparent evaporation of productivity growth. This correlation may be largely spurious, with the small net positive effect of the exchange rate on productivity growth being completely offset by other unrelated negative factors. The bottom line is that no strong links can be found between exchange rate developments and the post-2000 labour productivity growth slowdown.

Self-employment

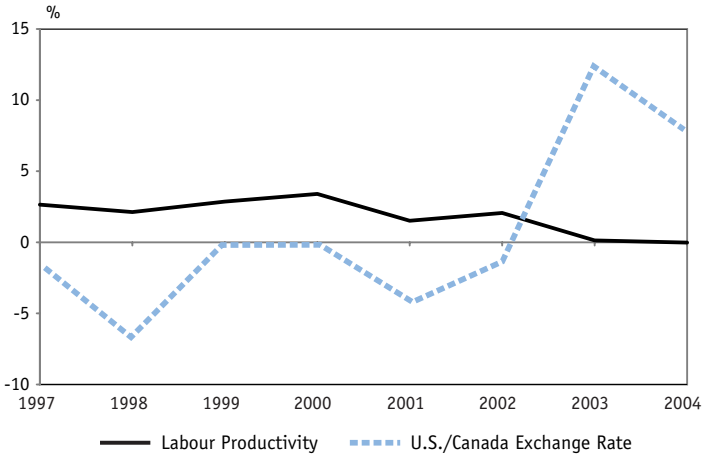
The self-employed tend to have lower earnings, and hence lower productivity, than paid workers. Other things equal, an increase in the share of self-employed in total employment will negatively affect measured labour productivity growth. A recent Statistics Canada study (Baldwin and Chowan, 2003) showed that the faster growth in the number of self-employed, particularly the own-account self-employed, contributed significantly to slower productivity growth in Canada in the 1990s relative to the United States. But the post-2000 productivity growth slowdown in Canada cannot be attributed to the growth in self-employment, because the share of this group in total employment has actually fallen since the late 1990s, from 15.9 per cent in 2000 (and 16.7 per cent in 1999) to 15.2 per cent in 2004. This development would have increased productivity growth holding all other factors constant.

Inter-industry Shifts in Labour Input

Inter-industry shifts in labour input affect business sector labour productivity growth because of differences in productivity levels and growth rates across sectors. In the post-war period, shifts in employment from agriculture to manufacturing raised aggregate productivity growth in Canada and other OECD countries. Some have argued that the recent appreciation of the Canadian dollar, the rise in real commodity prices and other factors could have caused employment to shift away from manufacturing industries and towards resource and service industries.

These employment shifts might have had an adverse impact on business sector labour productivity growth in the post-2000 period, because service industries, on average, are less productive and experience slower productivity growth than manufacturing industries, while resource industries tend to experience slower

Chart 12
Annual Growth Rates in Canadian Output per Hour and the U.S./Canada Exchange Rate, 1996-2004



Sources: Statistics Canada, Canadian Productivity Accounts (CANSIM Table 383-0008, converted from quarterly to annual averages) and an exchange rate series compiled by the Bank of Canada (CANSIM Table 176-0064, noon Canada/U.S. rate converted to annual averages and inverted). Data downloaded on June 9 2005.

21 Two other effects on productivity growth of an appreciation in the exchange rate are possible but unlikely. If Canadian manufacturing firms are able to diversify away from export-oriented activities in response to the appreciation, and if the less export-intensive activities are also low-productivity activities or if there are adjustment costs in terms of productivity due to this diversification, productivity will fall as a result of these shifts in production. Also, rapid and large movements in the exchange rate can complicate the measurement of price deflators and profit margins and thereby underestimate growth in GDP. Statistics Canada officials have indicated that this does not appear to be currently the case.

than usual productivity growth in times of high commodity prices due to the incentive to exploit marginal reserves. However, the empirical evidence cautions against taking these generalities for granted. Shifts in hours of work across the industry aggregates shown in Appendix Table 1 actually made a positive, although small, contribution to business sector labour productivity growth in 2000-2004. This was due in part to growing hours shares in the mining and oil and gas extraction industry and in the finance, insurance and real estate industry. Despite poor productivity growth in these industries in 2000-2004, both have very high productivity levels compared to the business sector average, which accounts for the positive reallocation of hours worked effect in combination with the growing hours shares of these industries.

Summary of Factors Potentially Explaining the Post-2000 Productivity Growth Slowdown in Canada

In summary, the following factors appear to have played some role in the post-2000 productivity growth slowdown in Canada: the slowdown in output growth; the slowdown in the growth of the M&E capital stock, and in particular the ICT capital stock; the fall-off in outward orientation; the fall in business sector R&D intensity; the rapid increase in commodity prices, especially energy prices, since 2000; high business sector profitability; and the slower growth in the proportion of university educated workers in total employment. Trends in the age structure of the labour force do not appear to have played a role in the recent productivity growth slowdown in Canada.

On the other hand, the following factors may have offset the poor productivity performance slightly: intra-industry shifts in labour input; a decline in the proportion of self-employment in total employment; and the recent appreciation in the Canadian dollar relative to the U.S. dollar. However, these factors appear to have been overshadowed by the negative influences on productivity growth.

These conclusions should be considered tentative for two main reasons. First, as noted earlier in the article, Statistics Canada has in recent years revised its productivity growth estimates in an upward direction and to a considerable extent. Although this article employs the most recent data available at the time of publication, future historical revisions could significantly affect productivity estimates for the 2000-2004 period. Thus, our analysis and conclusions are subject to change if significant data revisions take place. Second, our conclusions on the causes of the post-2000 labour productivity growth slowdown in Canada would be more robust if a longer time series were available. The four year 2000-04 period is very short from a historical perspective.

Lessons from the United States on the Potential Importance of Certain Productivity Drivers

In the U.S. business sector, labour productivity growth actually increased by 1.2 percentage points per year from 2.6 per cent in 1996-2000 to 3.8 per cent in 2000-04. Almost all major industries contributed to this productivity growth acceleration, although the largest contribution appears to have been from the service sector as a whole, and the professional and business services, information services, and finance, insurance and real estate industries specifically.

The truly remarkable feature of this impressive U.S. labour productivity growth performance in the context of Canada's recent productivity slump is that most of the productivity drivers discussed in this article as potentially explaining Canada's poor growth have actually evolved in a very similar way in the United States over the same period. There is a general

agreement among U.S. economists that technological change related to ICT and associated organizational innovations were mainly responsible for the increased trend labour productivity growth in the U.S. business sector after 1995, especially in service industries, and that these forces are likely behind the second pick-up in productivity growth after 2000.

Indeed, data compiled by Jorgenson, Ho and Stiroh[22] show that TFP growth in the non-ICT producing sector more than doubled between 1995-2000 and 2000-03, accounting for about 60 per cent of the overall labour productivity growth acceleration between these two periods. This suggests that these ICT-using industries were experiencing substantial efficiency gains in the latter period unrelated to their capital-labour mix, which is consistent with the presence of new high-productivity technologies and the more effective use of these technologies. It may therefore be the case that Canada's poor productivity performance since 2000 is related to a substantial shortfall in the growth of the ICT capital stock relative to what is necessary in order to catch up to the level of technology employed by U.S. industries, as well as perhaps a less effective use of existing technology than is potentially possible.

Conclusion

Economists have been surprised by the poor labour productivity performance of the Canadian business sector since 2000, particularly in 2003 and 2004 when output per hour growth essentially evaporated. This situation lies in stark contrast to the very strong productivity growth in the United States. This article has attempted to shed light on these puzzling developments. A definitive explanation for the recent interruption in productivity growth in Canada has proven elusive. But it would be premature to interpret recent developments as a downward shift in trend productivity growth.

The slower productivity growth in Canada in 2000-2004 relative to 1996-2000 can be partly explained in an accounting sense by the fall-off in the growth of the ICT-producing sector. This high-productivity sector enjoyed a boom in the second half of the 1990s which contributed greatly to overall productivity growth during this period. This source of productivity growth diminished with the collapse of productivity in the ICT-producing sector after 2000. Given the importance of machinery and equipment, and particularly ICT, for productivity advance, the slower rate of M&E investment and capital stock growth after 2000 also likely contributed to the productivity growth slowdown.

Economic growth in Canada has not been particularly strong since 2000, so part of the explanation of weak productivity growth may be cyclical. Stronger economic activity would have stimulated productivity growth through the spreading of overhead costs, longer production runs, and learning by doing. Higher rates of capacity utilization would have raised labour costs and contributed to faster substitution of capital for labour, giving a fillip to labour productivity. Other explanatory factors for the productivity slowdown include the petering out of the productivity boost given the business sector from the large increases in the outward orientation of the Canadian economy and in R&D intensity in the 1990s, as well as the rapid growth in commodity prices since 2000, which reduced productivity in natural resource industries by making it profitable to exploit more marginal reserves.

The key question facing productivity analysts is whether the post-2000 slowdown in labour productivity growth in Canada can be considered a temporary fall-off from the strong pro-

22 See Jorgenson, Ho, and Stiroh (2004) for an analysis of sources of productivity growth in the United States in the 1959-73, 1973-95 and 1995-2003 periods. Their data set has been used by the authors of this article to calculate the sources of productivity growth in the 1995-2000 and 2000-2003 sub-periods.

ductivity growth recorded in the 1996-2000 period that will be reversed, or rather whether it can be considered a return to the trend labour productivity growth of the 1973-1996 period after the non-sustainable productivity surge in the late 1990s that was driven by a unique confluence of special factors. The answer to this question has serious implications for the economic destiny of the country. If labour productivity growth continues at the 0.9 per cent average annual rate of the 2000-04 period, future growth in living standards of Canadians will be torpid. But if labour productivity growth reverts to its 1996-2000 average annual pace of 2.8 per cent, Canadians will enjoy substantial increases in living standards. A middle scenario of productivity growth at around 2 per cent is of course also possible, and indeed may be more likely than the other two scenarios.

It is also important to once again note that Statistics Canada's official productivity estimates are subject to revision. Thus some of the recent weakness in productivity growth may be a statistical artifact or mirage.

In the last decade, Canada has suffered no major macroeconomic shock (excluding exchange rate shocks) and undergone no policy development or reorientation that would have had significant and long-lasting ramifications for productivity growth. Indeed, it can be argued that both the macroeconomic and microeconomic policy environments, characterized by stable inflation, falling debt/GDP ratios, budget surpluses, corporate tax cuts and increased federal funding for post-secondary education have become more, not less, productivity friendly. In addition, the pick-up in U.S. productivity growth after 2000, which appears to be related to the faster pace of technological change, augurs well for a return to stronger productivity growth in this country, as developments in Canada tend to lag those south of the border.

On the other hand, the dangers of complacency are very real, as a failure on the part of Canadian firms to actively adopt the newest technologies and best practices may cause aggregate labour productivity growth to revert to its unimpressive 1973-1996 trend of 1.3 per cent. In this sense, future trends in living standards in Canada are largely in the hands of Canada's private sector, as there is little governments can do to force businesses to pursue productivity improvement when this is not consistent with profitability objectives. Nevertheless, Canadian governments can facilitate productivity-enhancing investments by fostering a highly competitive business climate.

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Appendix Table 1

Industry Contributions to Business Sector Output per Hour Growth in Canada

Average Annual Growth (per cent)

	1997-2000	2000-2004	diff.	2000-2002	2002-2004	diff.
Business Sector	2.80	0.92	-1.88	1.79	0.06	-1.74
Agriculture, Forestry, Fishing and Hunting	7.66	2.34	-5.33	-0.54	5.30	5.84
Mining and Oil and Gas Extraction*	4.81	-3.42	-8.23	-0.49	-6.26	-5.77
Utilities*	0.40	-3.74	-4.13	-0.88	-6.51	-5.62
Construction	2.51	-0.89	-3.40	0.89	-2.63	-3.52
Manufacturing	5.06	1.57	-3.49	1.11	2.02	0.91
Wholesale Trade	4.72	3.55	-1.17	3.83	3.27	-0.57
Retail Trade	4.00	1.85	-2.15	3.10	0.63	-2.47
Transportation and Warehousing	2.01	1.69	-0.32	1.94	1.45	-0.48
Information and Cultural Services	0.50	2.32	1.82	7.58	-2.69	-10.27
FIRE	0.69	1.27	0.58	4.29	-1.67	-5.96
Professional, Scientific and Technical Services	3.29	2.39	-0.90	3.89	0.90	-2.99
Administrative and Support Services	-0.59	-2.20	-1.62	-1.58	-2.82	-1.25
Arts, Entertainment and Recreation*	-2.69	-2.06	0.63	-0.69	-3.42	-2.73
Accommodation and Food Services	0.82	0.38	-0.44	1.39	-0.63	-2.02
Other Services (except Public Administration)	1.78	0.85	-0.94	2.23	-0.51	-2.74
Relative Contributions to Business Sector Average Annual Growth (per cent)						
Business Sector	100	100	100	100	100	100
Agriculture, Forestry, Fishing and Hunting	8.9	7.3	9.6	-0.9	266.3	-9.4
Mining and Oil and Gas Extraction*	9.5	-29.4	28.6	-2.2	-843.5	24.8
Utilities*	0.6	-13.9	7.7	-1.7	-413.8	11.5
Construction	6.3	-6.2	12.4	3.2	-328.0	13.8
Manufacturing	42.1	41.5	42.3	15.2	822.4	-10.7
Wholesale Trade	12.1	25.6	5.4	14.2	394.9	2.0
Retail Trade	9.9	13.4	8.1	11.5	77.4	9.4
Transportation and Warehousing	4.5	10.5	1.5	6.2	153.8	1.4
Information and Cultural Services	0.8	10.5	-4.0	17.7	-208.3	24.9
FIRE	3.7	19.4	-4.0	33.7	-437.6	48.8
Professional, Scientific and Technical Services	5.8	14.7	1.4	12.3	94.1	9.7
Administrative and Support Services	-0.5	-6.3	2.3	-2.3	-142.6	2.2
Arts, Entertainment and Recreation*	-0.9	-2.0	-0.3	-0.4	-57.6	1.5
Accommodation and Food Services	0.9	1.2	0.8	2.4	-35.1	3.6
Other Services (except Public Administration)	3.7	5.1	3.0	6.9	-52.9	8.8
Reallocation of Hours Worked and Residual Effect	-7.2	8.6	-14.9	-15.7	810.6	-42.2

Sources: Statistics Canada, Canadian Productivity Accounts (CANSIM Table 383-0012, quarterly data converted to annual averages). Consistent with data released on June 9, 2005. Output shares based on GDP data from the Input-Output accounts (CANSIM Tables 379-0023 and -0024. Hours data for some industries from the Canadian Productivity Accounts (CANSIM Table 383-0010). GDP data for some industries from the GDP by Industry accounts (CANSIM Table 379-0017). Data downloaded on June 9, 2005.

* Statistics Canada does not publish official productivity indexes for these three industries. Output per hour series for these industries have been estimated based on GDP and hours data as described above. For GDP, the trend in output in the business sector component of these industries has been approximated by the trend in total output in these industries.

Notes: Imputed rents to owner occupied dwellings are not included in the business sector, consistent with the official definition. Growth rates are compound (geometric) average annual rates. All underlying output series are based on a Fisher chained index formula for years until 2001 and a Laspeyres fixed-weighted formula thereafter. The residual effect captures both the effect of the reallocation of hours worked across industries and the effect of non-additivity due to the use of geometric growth rates and Fisher chained indexes. The reallocation of hours worked refers to the movement of work towards or away from industries with an above average productivity level. Business sector productivity growth is higher when industries with above average productivity levels experience increasing hours shares and vice versa. Absolute contributions of industry productivity growth (not shown) are calculated by multiplying the output per hour growth rate of each industry by its share of business sector output in the first year of the growth rate. Output shares have been approximated with current dollar data from the Input-Output accounts available up to 2001 only, with the share in 2001 used as a proxy for that in 2002 due to the unavailability of 2002 data. Relative contributions are calculated as the corresponding absolute contributions divided by the business sector growth rate. FIRE stands for finance, insurance and real estate, and this industry also includes rental and leasing activities as well as management of companies. The Other Services aggregate includes the private activities of the education and health and social assistance industries, as well as other unclassified private service activities. Even though the labour productivity growth acceleration in Canada is generally agreed to have begun after 1996 rather than after 1997, growth rates and contributions for 1997-2000 are shown because 1997 is the earliest year for which official labour productivity estimates by industry are available. While the relative contributions do sum to 100, the above decomposition should be considered as approximate only due to the many effects captured by the residual contribution.

Appendix Table 2

Provincial Contributions to Total Economy Output per Hour Growth in Canada

Average Annual Growth (per cent)

	1997-2000	2000-2004	diff.	2000-2002	2002-2004	diff.
Canada, Business Sector (Official Series)	2.80	0.92	-1.88	1.79	0.06	-1.74
Canada, Total Economy	2.31	1.04	-1.27	1.88	0.22	-1.66
Newfoundland	2.00	5.13	3.13	6.93	3.36	-3.58
Prince Edward Island	-0.16	0.51	0.67	1.11	-0.09	-1.20
Nova Scotia	2.14	1.82	-0.32	3.18	0.48	-2.70
New Brunswick	1.43	1.91	0.49	2.45	1.39	-1.06
Quebec	1.70	1.26	-0.44	1.80	0.73	-1.08
Ontario	2.64	0.79	-1.85	1.78	-0.19	-1.97
Manitoba	2.21	1.08	-1.13	1.01	1.16	0.15
Saskatchewan	2.46	1.66	-0.80	0.88	2.45	1.57
Alberta	1.96	0.06	-1.90	0.22	-0.10	-0.31
British Columbia	1.60	1.01	-0.60	2.45	-0.42	-2.87
Yukon Territories	-1.37	0.72	2.09	2.62	-1.15	-3.76
Northwest Territories Including Nunavut	6.13	2.62	-3.50	1.20	4.07	2.87
Absolute Contributions to Canada Total Economy Average Annual Growth (percentage points)						
Canada, Total Economy	2.31	1.04	-1.27	1.88	0.22	-1.66
Newfoundland	0.02	0.06	0.04	0.08	0.05	-0.04
Prince Edward Island	-0.00	0.00	0.00	0.00	-0.00	-0.00
Nova Scotia	0.05	0.04	-0.01	0.07	0.01	-0.06
New Brunswick	0.03	0.04	0.01	0.05	0.03	-0.02
Quebec	0.36	0.27	-0.10	0.38	0.15	-0.23
Ontario	1.08	0.33	-0.74	0.75	-0.08	-0.83
Manitoba	0.07	0.03	-0.04	0.03	0.04	0.00
Saskatchewan	0.08	0.05	-0.03	0.03	0.07	0.04
Alberta	0.24	0.01	-0.23	0.03	-0.01	-0.04
British Columbia	0.21	0.12	-0.08	0.30	-0.05	-0.35
Yukon Territories	-0.00	0.00	0.00	0.00	-0.00	-0.00
Northwest Territories Including Nunavut	0.02	0.01	-0.01	0.00	0.01	0.01
Reallocation and Residual Effect	0.15	0.08	-0.07	0.15	0.00	-0.15
Relative Contributions to Canada Total Economy Average Annual Growth (per cent)						
Canada, Total Economy	100	100	100	100	100	100
Newfoundland	1.03	5.93	-3.00	4.46	21.03	2.30
Prince Edward Island	-0.02	0.15	-0.16	0.18	-0.13	0.22
Nova Scotia	2.14	3.93	0.66	3.81	5.14	3.64
New Brunswick	1.18	3.41	-0.65	2.42	12.01	1.17
Quebec	15.73	25.56	7.63	20.28	70.87	13.70
Ontario	46.57	31.77	58.75	39.86	-37.68	49.95
Manitoba	3.22	3.34	3.12	1.73	16.86	-0.24
Saskatchewan	3.52	4.88	2.40	1.44	32.30	-2.58
Alberta	10.29	0.68	18.20	1.36	-5.18	2.21
British Columbia	9.00	11.84	6.66	16.02	-23.43	21.15
Yukon Territories	-0.07	0.08	-0.20	0.15	-0.57	0.25
Northwest Territories Including Nunavut	0.81	0.79	0.82	0.20	6.88	-0.67
Reallocation and Residual Effect	6.62	7.65	5.77	8.09	1.90	8.90

Sources: GDP data from CANSIM Table 384-0002 in Fisher chained 1997 dollars; and hours from the Canadian Productivity Accounts, CANSIM Table 383-0010. April 27, 2005.

Notes: Growth rates are compound average annual rates. The reallocation and residual effect refers both to the increase/decrease in productivity growth due to the movement of work towards/away from provinces with an above average productivity level and to the effects of non-additivity due to the use of compound growth rates and chained dollar GDP data. While the relative contributions sum exactly to 100 (since the absolute contribution of the reallocation and residual effect is calculated simply as the difference between the sum of provincial contributions and the Canadian growth rate), the overall decomposition is therefore approximate only. Absolute contributions of industry productivity growth are calculated by multiplying the output per hour growth rate of each industry by its share of Canadian output in the first year of the growth rate.