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**The Stylized Facts About Slower Productivity
Growth in Canada**

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The Stylized Facts about Slower Productivity Growth in Canada

Abstract

Productivity growth in the Canadian economy has been considerably slower in the post-2000 period than in the pre-2000 period, with important implications for the growth in the living standards of Canadians. Output per hour in the business sector advanced at a 0.9 per cent average annual rate from 2000 to 2016 compared to 1.6 per cent from 1981 to 2000. The objective of this paper is to highlight the stylized factors of this important development. The paper first examines trends in both labour productivity and total factor productivity (TFP) at the aggregate level, including how Canada fared internationally. This section also discusses growth accounting estimates of changes in the sources of labour productivity growth. The second section presents labour and total factor productivity estimates for 15 industries, highlighting which industries experienced the largest slowdown in absolute terms and the industry contributions to the slowdown. This section also discusses the contributions of within- industry productivity growth and re-allocation effects for aggregate productivity growth. The third section presents a provincial perspective on the post-2000 productivity slowdown. The fourth discusses productivity performance within the post-2000 period, finding that while labour productivity growth was similar in the 2000-2008 and 2008-2016 sub-periods, the nature of this growth has quite different in terms of the sources of growth.

The Stylized Facts about Slower Productivity Growth in Canada

I. Introduction

Productivity growth in the Canadian economy has been considerably slower in the post-2000 period than in the pre-2000 period, with important implications for the growth in the living standards of Canadians. Output per hour in the business sector advanced at a 0.9 per cent average annual rate from 2000 to 2016 compared to 1.6 per cent from 1981 to 2000. In order to understand the reasons for this slower productivity growth, it is first essential to know the nature of this slowdown. Certain hypotheses to explain the slowdown may not be consistent with the stylized facts of the slowdown. The objective of this paper is to highlight these stylized factors related to this important development from a number of perspectives, including the timing of the slowdown, the slowdown in international perspective, the sources of the slowdown from a growth accounting perspective and in terms of within-sector and re-a-allocation effects, and the industry and provincial dimensions to the slowdown.

The paper consists of five main parts. The first section examines trends in both labour productivity and total factor productivity (TFP) at the aggregate level, including how Canada fared internationally. This section also discusses growth accounting estimates of changes in the sources of labour productivity growth. The second section presents labour and total factor productivity estimates for 15 industries, highlighting which industries experienced the largest slowdown in absolute terms and the industry contributions to the slowdown. This section also discusses the contributions of within- industry productivity growth and re-allocation effects for aggregate productivity growth. The third section presents a provincial perspective on the post-2000 productivity slowdown. The fourth discusses productivity performance within the post-2000 period, finding that while labour productivity growth was similar in the 2000-2008 and 2008-2016 sub-periods, the nature of this growth has quite different in terms of the sources of growth. The fifth and final section summarizes the findings

The data for this paper come from official Statistics Canada estimates found in Canadian Socio-Economic Management Information System (CANSIM). We use annual sectoral data from Table 383-0021 at the national level from 1961 to 2016 and Table 383-0026 at the provincial level from 1997 to 2016. Sectors or industries (the two terms are used as synonyms) are defined by the North American Industry Classification System (NAICS) at the S-level of industry aggregation. Table 1 lists the 15 industries and provides their NAICS codes. Labour productivity in these tables is real value-added gross domestic product (GDP) per hours worked. Total factor productivity is real value-added GDP per unit of combined labour and capital inputs.

Exhibit 1: List of NAICS Industries, their Short Forms and the 2-digit NAICS Code

	Industries	NAICS Code
1.	Agriculture, forestry, fishing and hunting	11
2.	Mining and oil and gas extraction	21
3.	Utilities	22
4.	Construction	23
5.	Manufacturing	31-33
6.	Wholesale trade	41
7.	Retail trade	44-45
8.	Transportation and warehousing	48-49
9.	Information and cultural industries	51
10(a).	Finance, insurance, real estate, rental and leasing and management of companies and enterprises ⁽¹⁾	52-53, 55 ⁽²⁾
10(b).	Finance, insurance, real estate, rental and leasing ⁽¹⁾	52-53 ⁽²⁾
11.	Professional, scientific and technical services	54
12.	Administrative and support, waste management and remediation services	56
13.	Arts, entertainment and recreation	71
14.	Accommodation and food services	72
15.	Other private services ⁽³⁾	61, 62, 81

Note:

(1): Table 383-0021 (national level) uses 10(b) while table 383-0026 (provincial level) uses 10(a) instead.

(2): The industry excludes imputed rents.

(3): Other private services include educational services (61), health care and social assistance (62) and other services (except public services) (81).

One drawback of the official estimates is that the length of annual provincial time-series is limited. While there are 56 annual observations at the national level, there are only 20 annual observations for provincial data. This difference in sample size restricted our exploration of stylized factors to the post-1997 period when provincial data starts.

II. Productivity Trends at the Aggregate Level

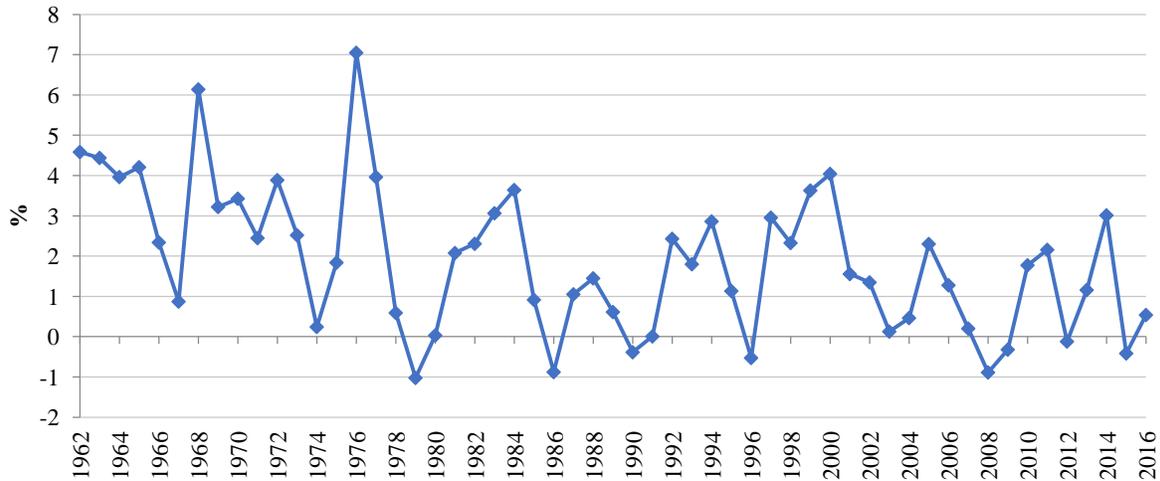
This section discusses labour productivity growth and total factor productivity growth in Canada. We first examine labour productivity in the business sector from 1961 to 2016 by comparing compound annual growth rates in various sub-periods and date structural breaks statistically, and then study total factor productivity in the business sector in the same manner.

A. Labour Productivity in the Business Sector

Chart 1 shows the annual growth in business sector labour productivity in Canada from 1961 to 2016 while Chart 2 provides a five-year moving average of the time series. Productivity growth is very cyclical in the short term because of lags in the adjustment of labour input to fluctuations in output. Productivity can soar in years of strong growth such as 1976 and 1999 and turn negative in years of recession .such as 2008 and 2009.

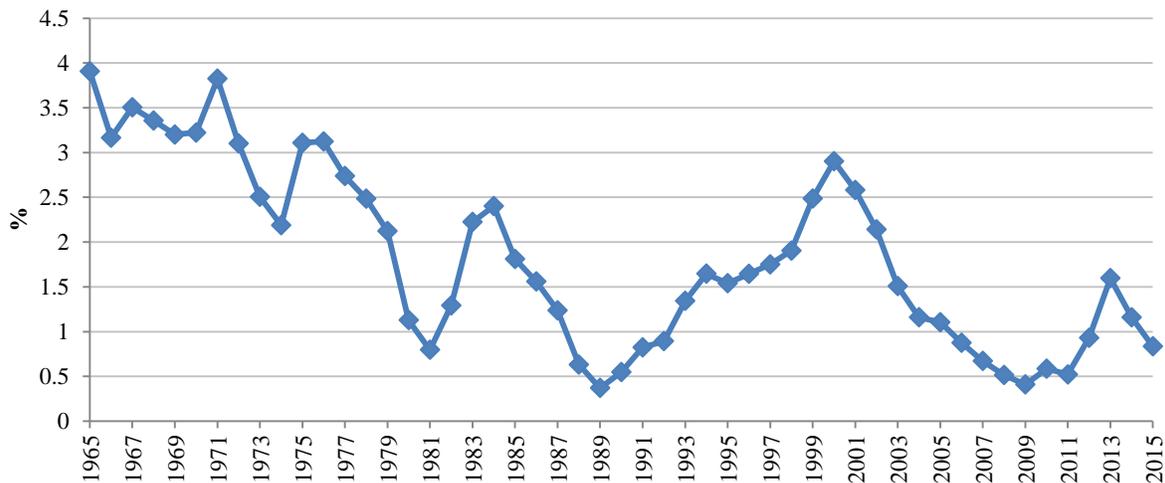
The five-year moving average series smoothes these annual variations and provides a better indication of trend productivity growth. One sees a sharp decline in trend in the 1970s, which was partially reversed in the early 1980s before again falling precipitously in the second fall of the 1980s, only to be reversed in the 1990s, peaking in 2000 before again falling in the 2000s.

Chart 1: Business Sector Labour Productivity Growth in Canada, 1961 - 2016



Source: CANSIM table 383-0021.

Chart 2: 5-Year Moving Average of Business Sector Labour Productivity Growth in Canada, 1961 – 2016

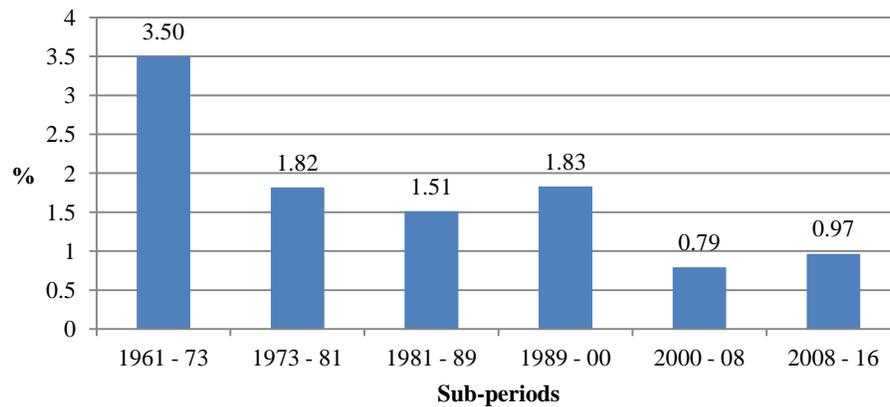


Source: CANSIM table 383-0021.

Superimposed on these five-year moving averages is the long-term two-step downward trend in labour productivity, which is shown in Chart 3 and 4 for six cyclically neutral periods, defined on a output peak to peak basis. In the first cyclically neutral period output per hour advanced at a 3.5 per cent average annual rate. The first productivity slowdown occurred after 1973 and lasted for three business cycles (1973-81, 1981-1989, and 1989-2000) when labour productivity averaged 1.6 per cent. The second productivity slowdown occurred after 2000 when labour productivity averaged 0.9 per cent in the two business cycles, although the cycle since 2008 is not yet complete. It is important to note that the magnitude of the first labour productivity growth slowdown after 1973 at 1.7 percentage points was approximately double that of the second slowdown after 2000 at 0.8 points.

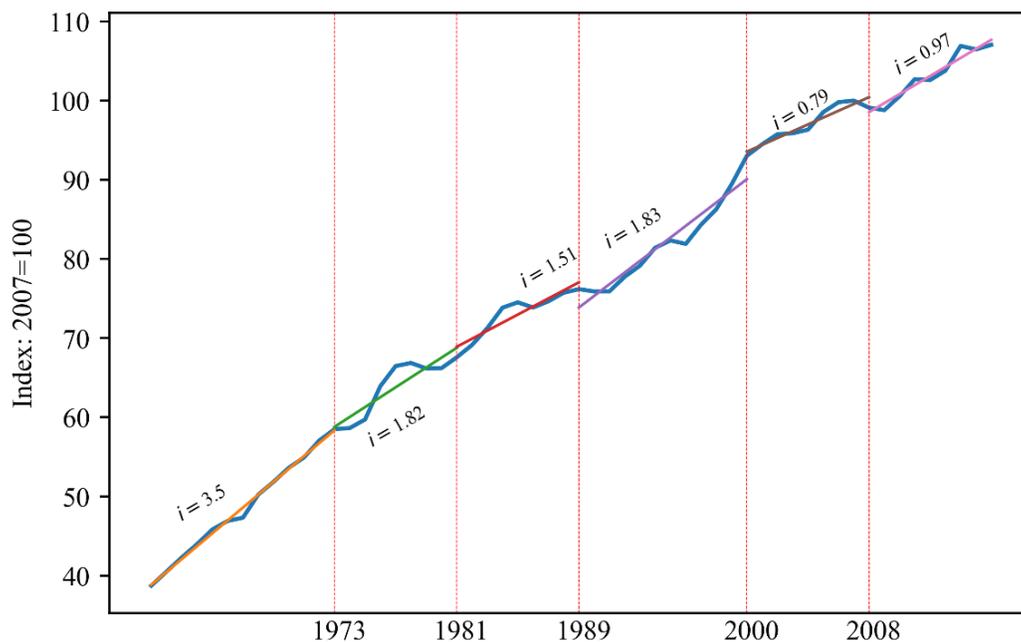
Alternative dating of productivity trends confirms the two-step downward trend in labour productivity growth based on cyclical-neutral output peak to peak period. Table 2 contains compound annual growth rates between labour productivity peaks, as well as 10-year periods and 5-year periods growth rate from 1961 to 2016. The early half of 1960s had the highest labour productivity growth (4.30 per cent from 1961 to 1965), followed by continuous declines until the end of 1980s. In 1990s, labour productivity growth grew again from 1.51 per cent between 1981 and 1989 to 1.83 per cent between 1989 and 2000. It declined again in 2000 to 0.79 per cent but rose after 2008 to 0.97 per cent.

Chart 3: Business Sector Labour Productivity Compound Annual Growth Rates in Selected Sub-periods, 1961 to 2016



Source: CANSIM table 383-0021

Chart 4: Trends in Labour Productivity between Output Peaks in the Business Sector in Canada, 1961 - 2016



Note: Vertical dotted lines indicate labour productivity peaks. Trendlines span between output peaks (1973, 1981, 1989, 2000 and 2008). i above each trendline indicates the compound annual growth rate in percentage points between the output peaks.

Source: CANSIM Table 383-0021

Table 1: Business Sector Labour Productivity Compound Annual Growth Rates in Canada (in percent), 1961 – 2016

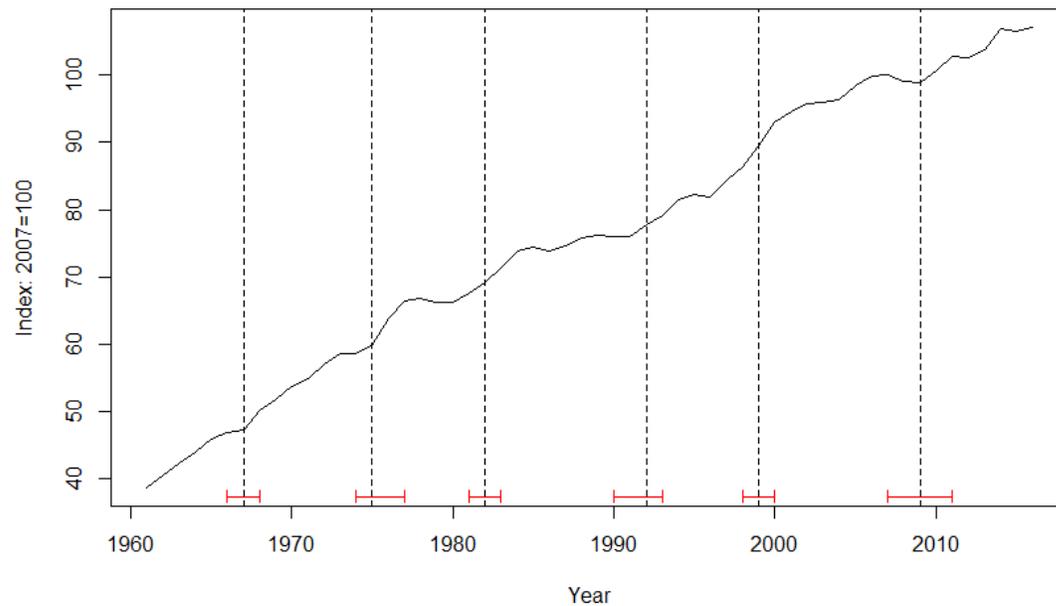
LP Peaks	Growth	Output Peaks	Growth	10-year Periods	Growth	5-year Period	Growth
1961 – 1978	3.26	1961 – 1973	3.50	1961 – 1970	3.68	1961 – 1965	4.30
1978 – 1985	1.56	1973 – 1981	1.82	1970 – 1980	2.13	1965 – 1970	3.19
1985 – 1989	0.56	1981 – 1989	1.51	1980 – 1990	1.38	1970 – 1975	2.18
1989 – 1995	1.30	1989 – 2000	1.83	1990 – 2000	2.06	1975 – 1980	2.08
1995 – 2007	1.63	2000 – 2008	0.79	2000 – 2010	0.78	1980 – 1985	2.40
2007 – 2011	0.67	2008 – 2016	0.97	2010 – 2016	1.05	1985 – 1990	0.37
2011 – 2014	1.34					1990 – 1995	1.64
2014 – 2016	0.06					1995 – 2000	2.47
						2000 – 2005	1.16
						2005 – 2010	0.40
						2010 – 2016	1.05

Note: LP stands for labour productivity.

Source: CANSIM Table 383-0021

Statistical Analysis

The above inspection indicates that labour productivity in Canada experienced at least two major structural breaks, the first around 1973 and the second around 2000. However, we do not know in which year labour productivity in Canada changed structurally. Therefore, we use the method by Bai and Perron (2003) to date such breaks.¹ Chart 5 shows the years when structural break took place as vertical dotted lines and the 95 per cent confidence intervals for each break year as an interval at the bottom of each vertical line. This statistical result is consistent with our inspection that business sector labour productivity in Canada slowed down around in 1970s, and early 2000s.

Chart 5: Break Dates of Labour Productivity Indices in Canada with 95% Confidence Intervals

¹ Section III in the appendix describes how we statistically test and date structural breaks.

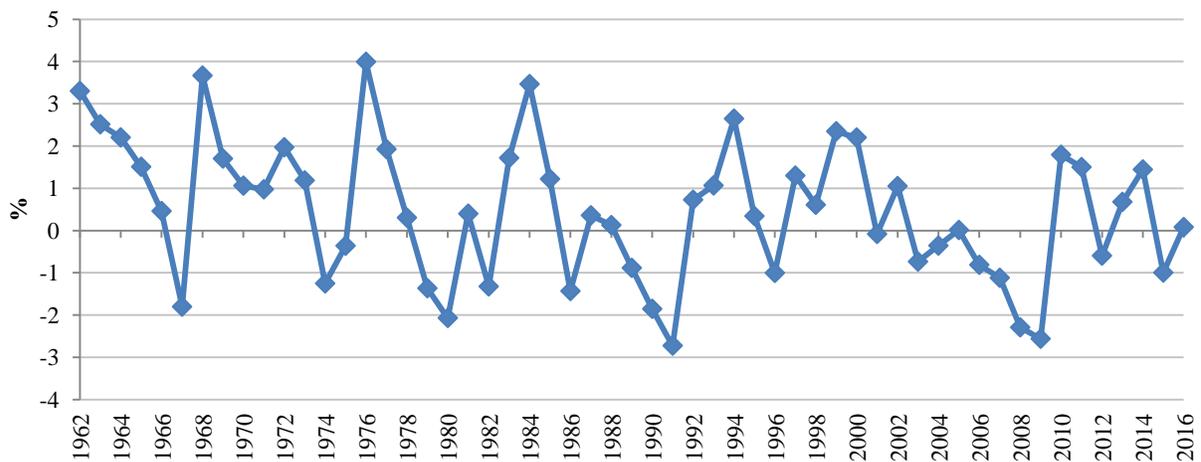
Note: Each vertical dotted line indicates one break date. Break dates are 1967, 1975, 1982, 1992, 1999 and 2009. Each interval at the bottom of a vertical dotted line crossing the vertical dotted lines is the 95% confidence interval of the corresponding break point. The 95% confidence intervals are [1966, 1968], [1974, 1977], [1981, 1983], [1990, 1993], [1998, 2000] and [2007, 2011].

B. Total Factor Productivity in the Business Sector

Chart 6 shows the annual growth in business sector total factor productivity in Canada from 1961 to 2016 while Chart 7 provided a five-year moving average of the time series. Like labour productivity, TFP growth is also cyclical, rising in expansions and falling in recessions..

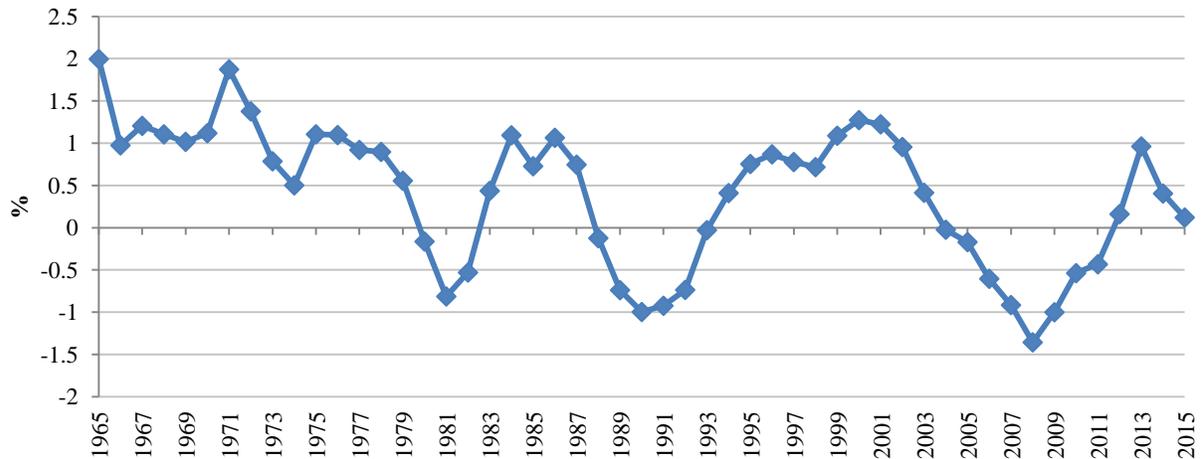
Again, the five-year moving average series smooths these annual variations and provides a better indication of trend productivity growth. The pattern is very similar to that of labour productivity, with a sharp decline in trend in the 1970a, which was partially reversed in the early 1980s before again falling precipitously in the second fall of the 1980s, only to be reversed in the 1990s, peaking in 2000 before again falling in the 2000s.

Chart 6: Business Sector Total Factor Productivity Growth in Canada, 1962 - 2016



Source: CANSIM table 383-0021

Chart 7: 5-Year Moving Average of Business Sector Total Factor Productivity Growth in Canada, 1965 - 2016

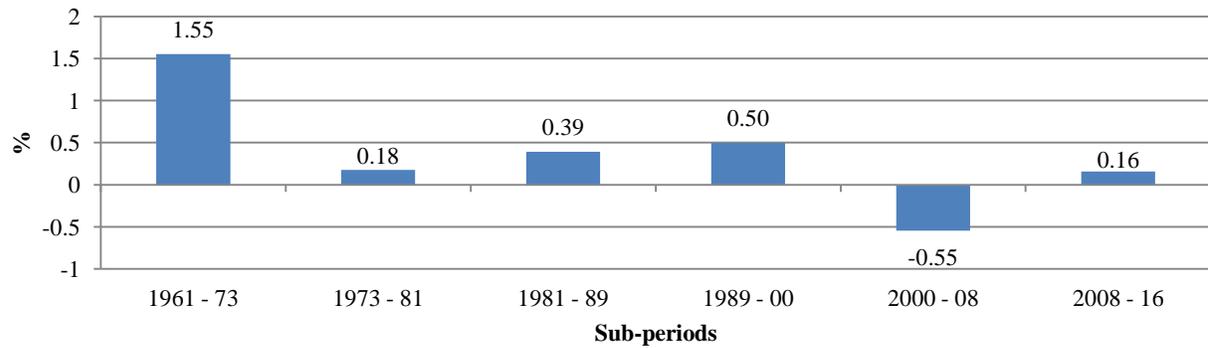


Source: CANSIM table 383-0021.

Superimposed on these five-year moving averages is the long-term two-step downward trend in TFP, which is shown in Chart 8 and 9 for six cyclically neutral periods, defined on a output peak to output peak basis. In the first cyclically neutral period TFP advanced at a 1.6 per cent average annual rate. The first productivity slowdown occurred after 1973 and lasted for three business cycles (1973-81, 1981-1989, and 1989-2000) when TFP over the three cycles average 0.3 per cent per year. The second TFP slowdown occurred after 2000 when TFP fell 0.2 per cent per year. It is again important to note that the magnitude of the first TFP growth slowdown after 1973 at 1.2 percentage points was approximately double that of the second slowdown after 2000 at 0.5 points.

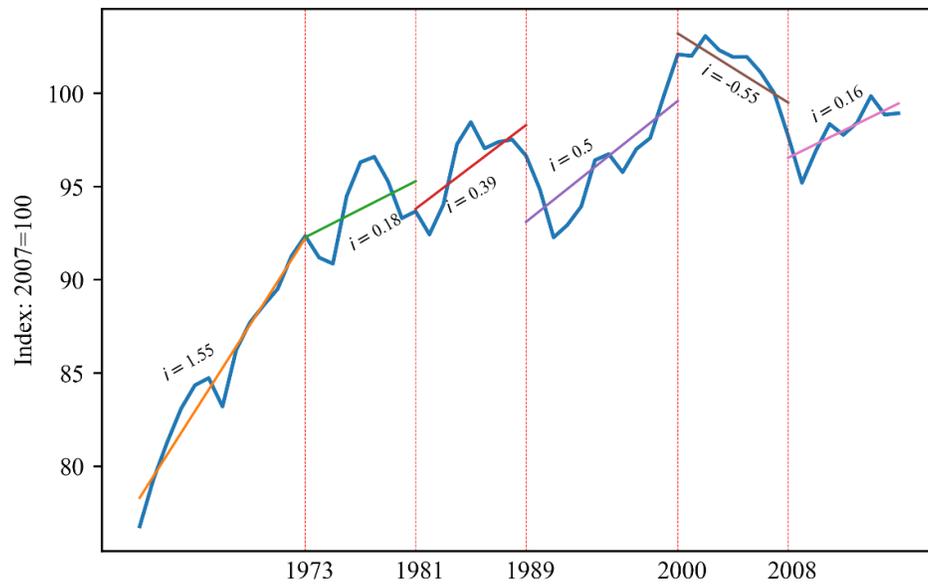
Alternative dating of productivity trends confirms the two-step downward trend in TFP growth based on cyclically-neutral output peak to peak period. Table 2 contains compound annual growth rates between TFP peaks, as well as 10-year periods and 5-year periods growth rates from 1961 to 2016. The early half of 1960s had the highest TFP growth followed by continuous declines until the end of 1980s. The second half of the 1990s saw strong TFP growth associated with the ICT boom.

Chart 8: Total Factor Productivity Growth in the Business Sector in Canada, 1961 - 2016



Source: CANSIM table 383-0021.

Chart 9: Trends in Total Factor Productivity between Output Peaks in the Business Sector in Canada, 1961 - 2016



Note: Vertical dotted lines indicate output peaks. Trendlines span between output peaks. i above each trendline indicates the compound annual growth rate in percentage points between the output peaks.

Source: CANSIM Table 383-0021

Table 2: Business Sector Total Factor Productivity Compound Annual Growth Rates in Canada (in percent), 1961 – 2016

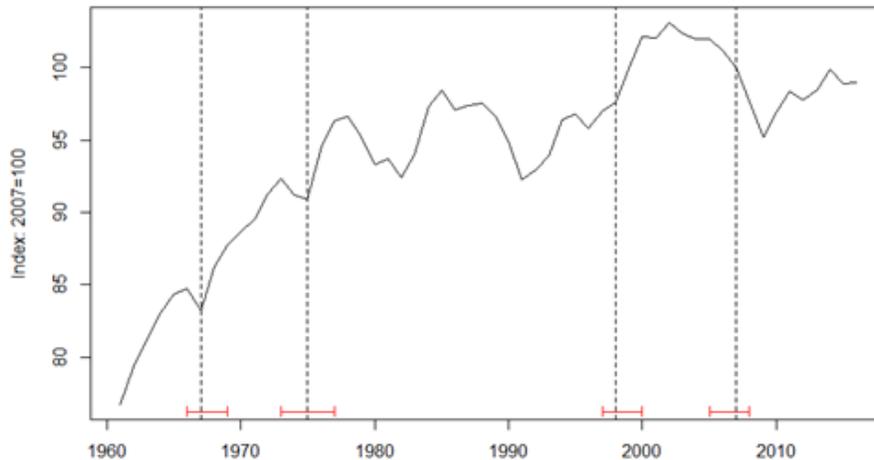
TFP Peaks	Growth	Output Peaks	Growth	10-year Periods	Growth	5-year Periods	Growth
1961 – 1966	1.99	1961 – 1973	1.55	1961 – 1970	1.61	1961 – 1965	2.39
1966 – 1973	1.24	1973 – 1981	0.18	1970 – 1980	0.51	1965 – 1970	1.00
1973 – 1978	0.90	1981 – 1989	0.39	1980 – 1990	0.16	1970 – 1975	0.49
1978 – 1985	0.27	1989 – 2000	0.50	1990 – 2000	0.73	1975 – 1980	0.53
1985 – 1995	-0.18	2000 – 2008	-0.55	2000 – 2010	-0.52	1980 – 1985	1.08
1995 – 2000	1.08	2008 – 2016	0.16	2010 – 2016	0.35	1985 – 1990	-0.74
2000 – 2011	-0.34					1990 – 1995	0.39
2011 – 2016	0.12					1995 – 2000	1.08
						2000 – 2005	-0.03
						2005 – 2010	-1.01
						2010 – 2016	0.35

Note: TFP stands for total factor productivity.

Source: CANSIM table 383-0021.

Statistical Analysis

Like labour productivity, we statistically date structural breaks of total factor productivity in Canada. Chart 4 shows that total factor productivity in Canada changed structurally in 1967, 1975, 1998 and 2007, and the 95 per cent confidence interval for each break year. These break years confirms our inspection that total factor productivity slowed down in the mid-1970s and in early 2000s.

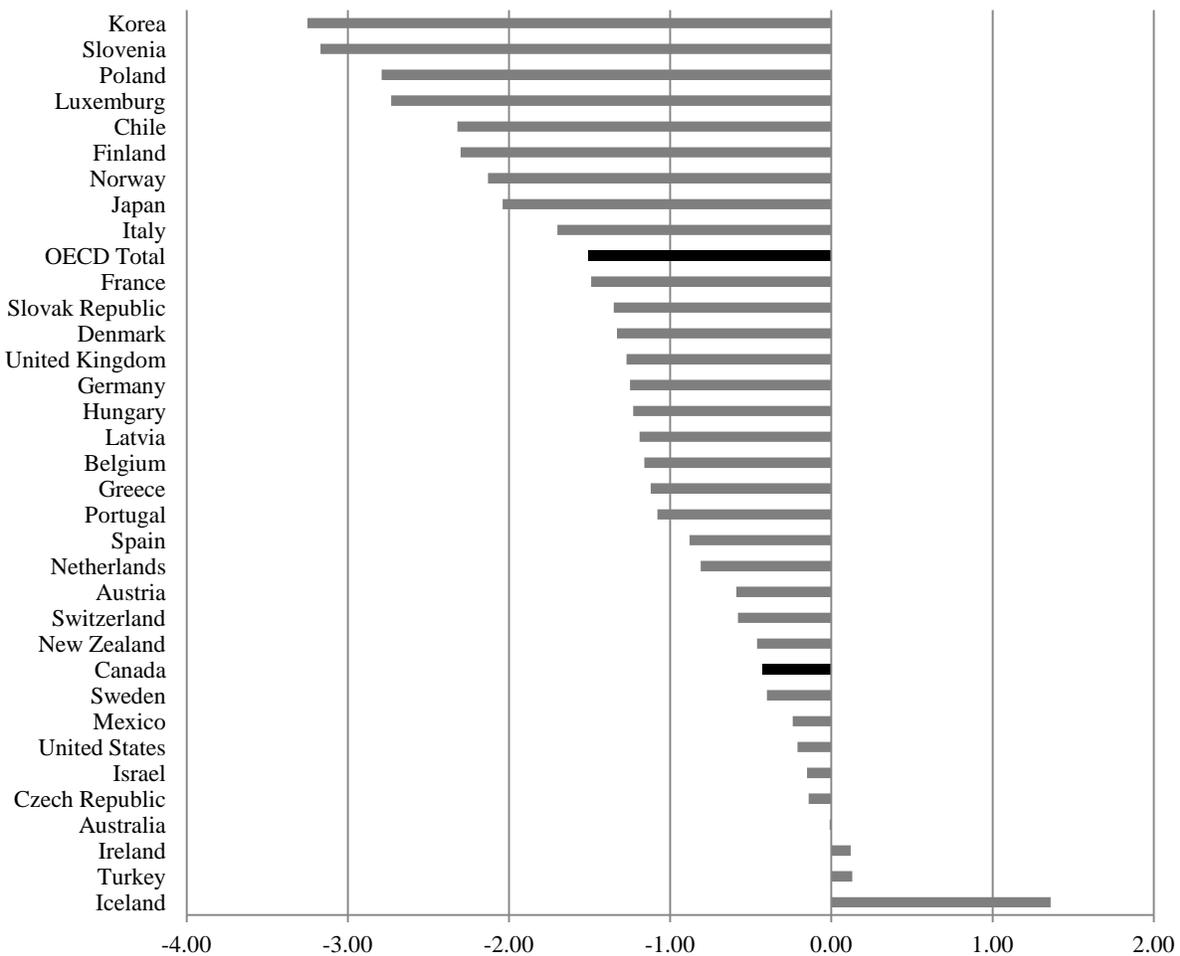
Chart 10: Break Dates of Total Factor Productivity Indices in Canada with 95% Confidence Intervals

Note: Each vertical dotted line indicates one break date. Break dates are 1967, 1975, 1998 and 2007. Each interval at the bottom of a vertical dotted line crossing the vertical dotted lines is the 95% confidence interval of the corresponding break point. The 95% confidence intervals are [1966, 1969], [1973, 1977], [1997, 2000] and [2005, 2008].

C. Canada's Aggregate Productivity Performance from an International Perspective

Slower productivity growth since 2000 is not unique to Canada. Indeed, Chart 11 shows that 30 out of 33 OECD countries experienced slower total economy GDP per hour growth in the 2000-2016 period relative to 1981-2000. The only exceptions were Ireland, Turkey and Iceland.

Chart 11: Change in annual compound growth rates in GDP per hour, between 1981-2000 and 2000-2016, per cent



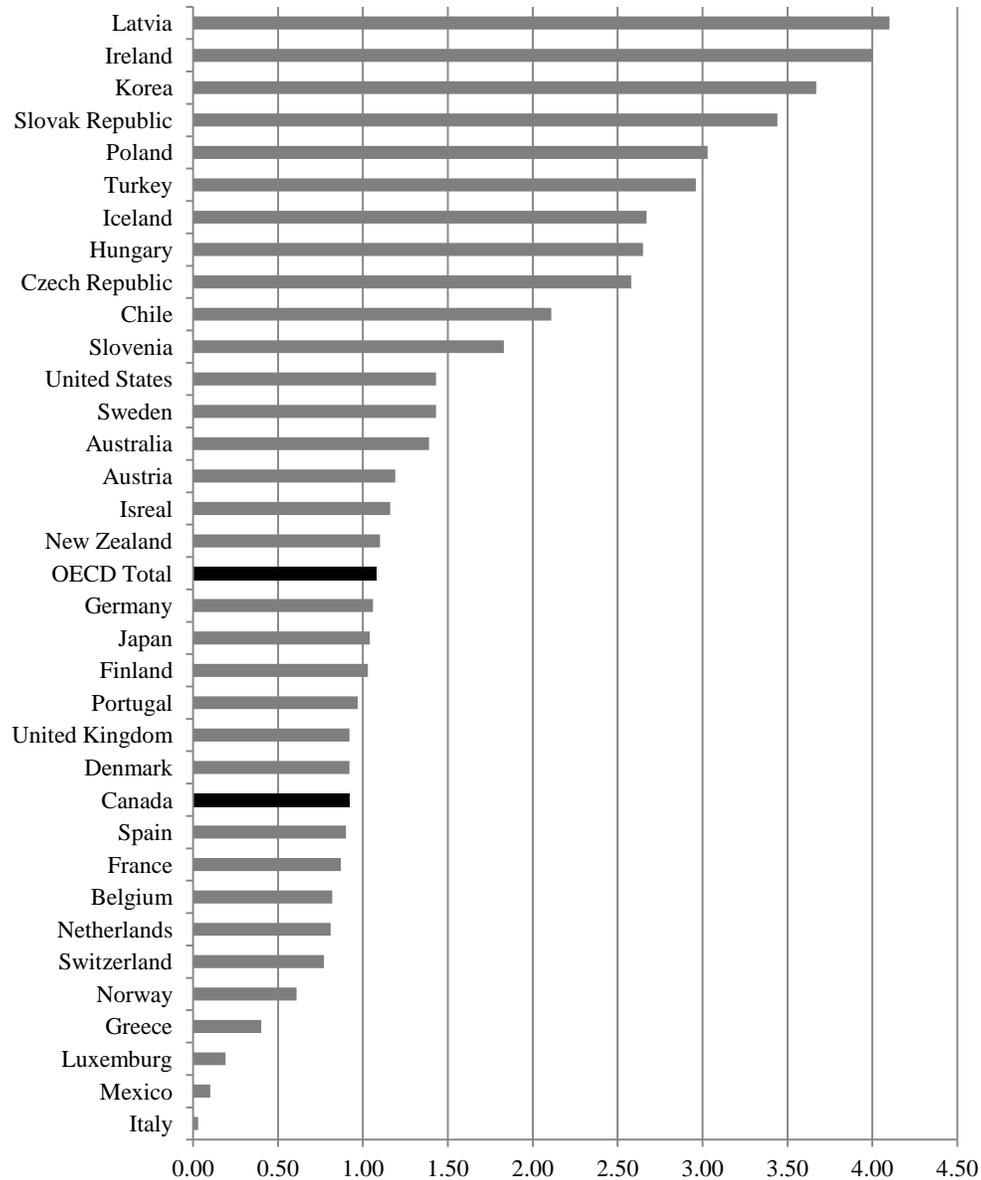
Note: Austria: 1995-2000; Czech Republic: 1993-2000; Greece: 1983-2000; Hungary: 1991-2000; Mexico: 1991-2000; Poland: 1993-2000; Slovak Republic: 1995-2000; Chile: 1986-2000; Latvia: 1995-2000; Slovenia: 1995-2000. Source: OECD. http://stats.oecd.org/Index.aspx?DataSetCode=PDB_GR

In terms of the magnitude of the slowdown Canada at 0.5 percentage points was the sixth smallest among the 30 countries that experienced a slowdown,² and well below the OECD average of 1.7 percentage points. This reflects in part Canada's very weak relative

² This figure is for the total economy, which explains why it differs from the 0.7 point slowdown for the business sector between 1981-2000 and 2000-2016 reported earlier

productivity performance in the 1981-2000 period when Canada ranked 30th out of 33 OECD countries for GDP per hour growth (Chart 12).

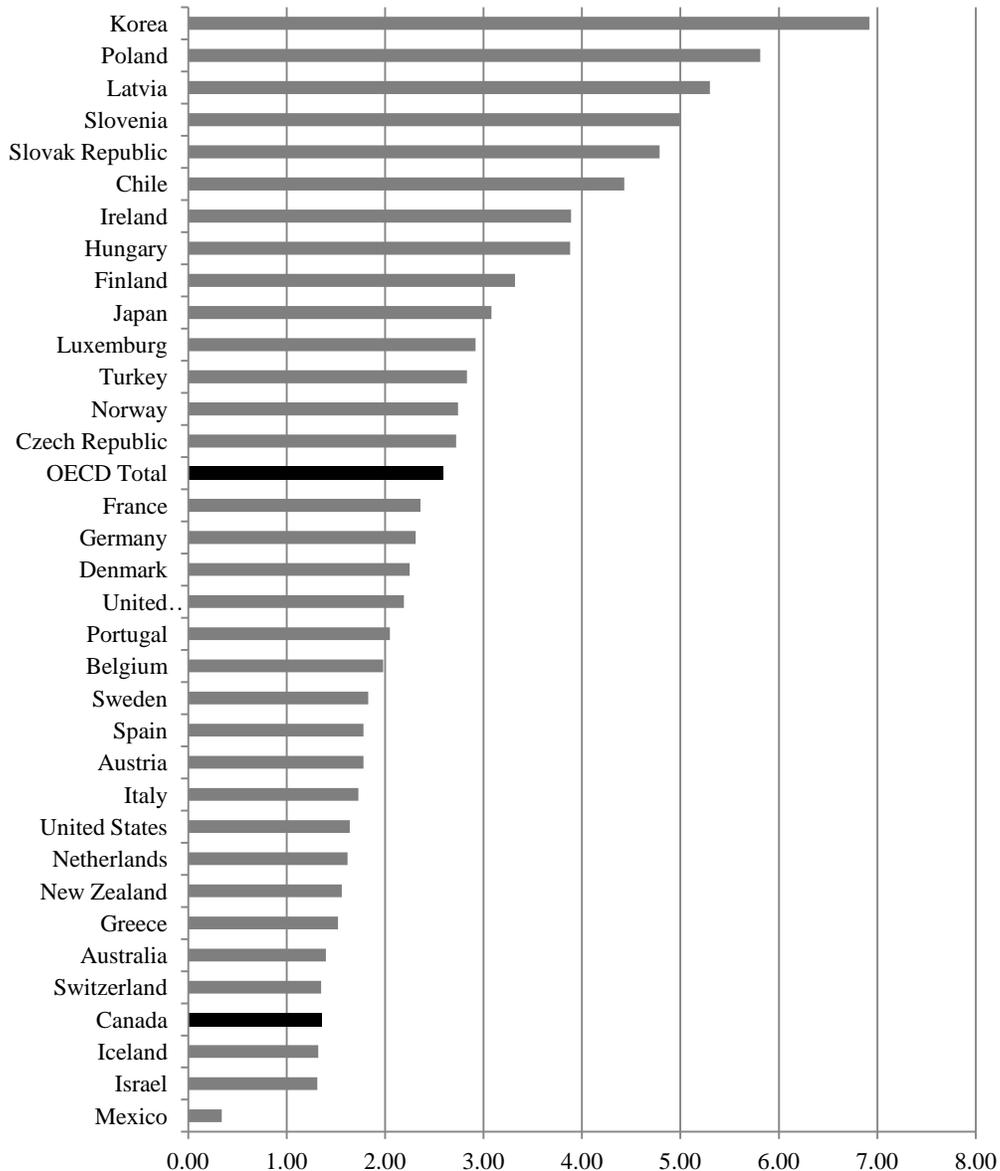
Chart 12: GDP per hour, annual compound growth rate, 2000-2016, per cent



Source: OECD. http://stats.oecd.org/Index.aspx?DataSetCode=PDB_GR

Indeed, in the 1981-2000 period Canada's ranked 24th out of 33 countries in terms of labour productivity growth (Chart 13), better than in the post-2000 period.

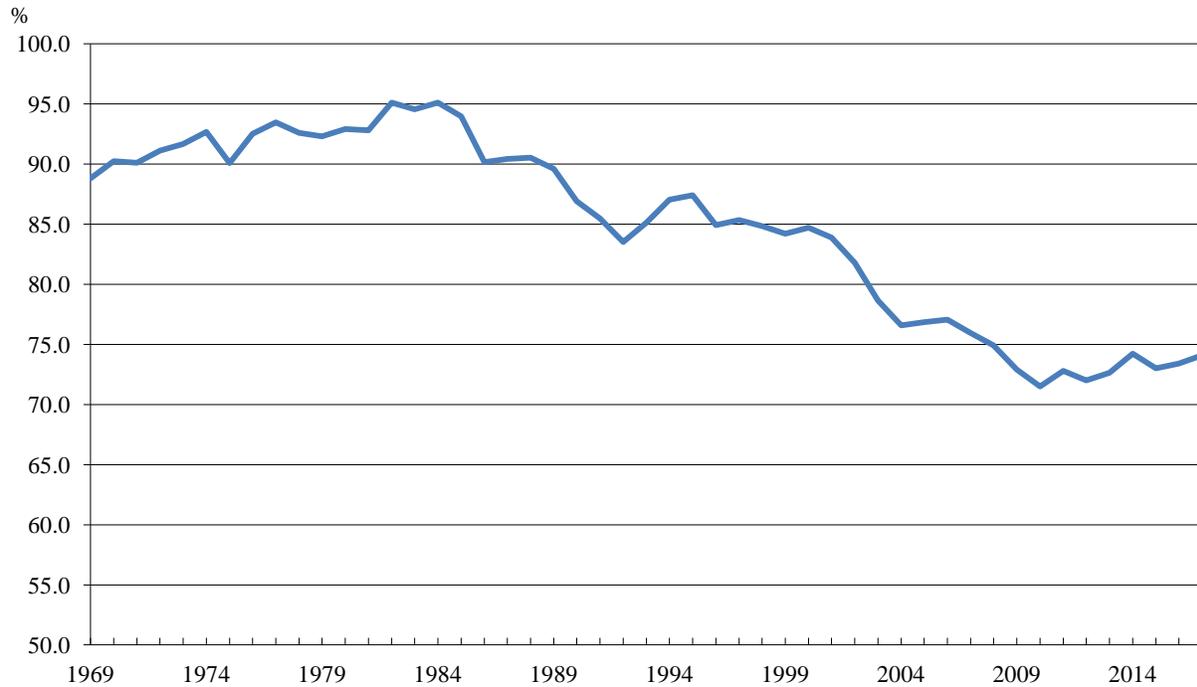
Chart 13: GDP per hour, Annual Compound Growth Rate, 1981-2000, per cent



Note: Austria: 1995-2000; Czech Republic: 1993-2000; Greece: 1983-2000; Hungary: 1991-2000; Mexico: 1991-2000; Poland: 1993-2000; Slovak Republic: 1995-2000; Chile: 1986-2000; Latvia: 1995-2000; Slovenia: 1995-2000. Source: OECD. http://stats.oecd.org/Index.aspx?DataSetCode=PDB_GR

Chart 14 shows the implications of Canada's poor productivity performance in terms of our aggregate productivity level relative to that of the United States. With slower productivity growth than the United States since the early 1980s, Canada has experienced a significant widening of its labour productivity gap from 95 per cent of the US level in the early 1980s (a 5 percentage point gap) to 72 per cent in 2010 (a 28 point gap). Since 2010 productivity growth has actually been slightly faster in Canada so the gap has closed somewhat and stood at 26 points in 2017.

Chart 14: Relative Labour Productivity Levels (GDP per hour) in the Business Sector in Canada, 1969-2017
(Canada as % of the United States)

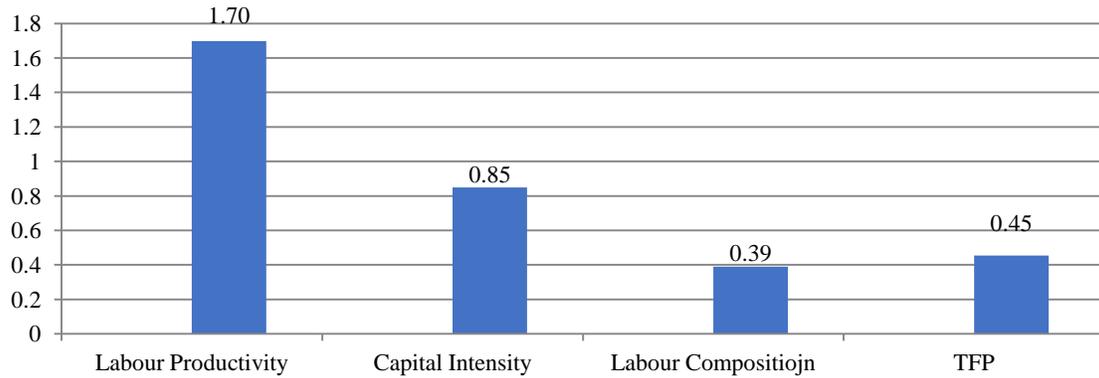


Source: CSLS estimates.

D. Growth Accounting Perspective on the Aggregate Productivity Slowdown

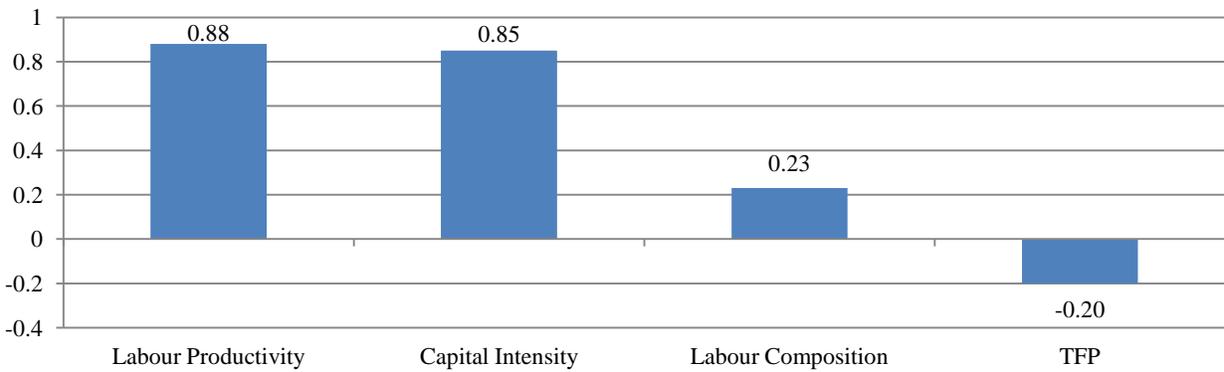
The standard methodology used by economists to analysis the sources of economic growth is growth accounting, which disaggregates labour productivity growth into contributions from capital intensity, labour quality or composition, and total factor productivity growth. Estimates produced by Statistics Canada are found in Chart 15 for the 1981-2000 period, Chart 16 for the 2000-2016 period, and Chart 17 for the change between period.

Chart 15: Percentage Point Contributions of Capital Intensity, Labour Composition, and MFP to Labour Productivity Growth, Business Sector, Canada, 1981 - 2000



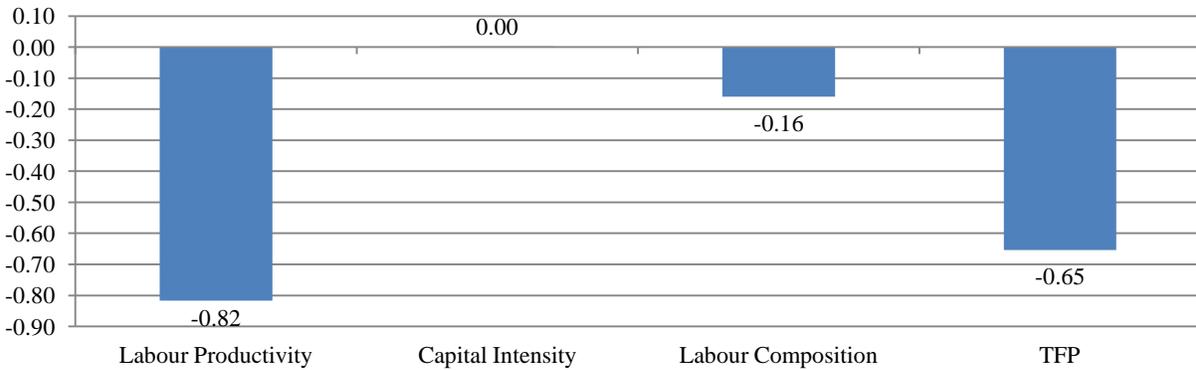
Source: CANSIM table 383-0021.

Chart 16: Percentage Point Contributions of Capital Intensity, Labour Composition, and MFP to Labour Productivity Growth, Business Sector, Canada, 2000 - 2016



Source: CANSIM table 383-0021.

Chart 17: Differences in Percentage Point Contributions of Capital Intensity, Labour Composition, and MFP to Labour Productivity Growth, Business Sector, Canada between 1981 - 2000 and 2000 - 2016



Source: CANSIM table 383-0021.

The major finding is that four fifths (0.65 points out of 0.82 points) of the labour productivity slowdown between the 1981-2000 and 2000-2016 periods was due to the fall in TFP growth, which fell from 0.45 per cent per year to -0.20 per cent. The remaining fifth came from a smaller contribution from labour composition (a fall from 0.39 percentage points to 0.23 points). No contribution to the labour productivity slowdown came from capital intensity which was 0.85 points in both periods.

Unfortunately, TFP is a black box or “measure of our ignorance” so this finding tells little about the causes of the productivity slowdown, only that it appears not to be associated with weaker capital intensity and only weakly linked to human capital growth. Factors affecting TFP include capacity utilization, economics of scale and scope, and measurement problems as well as the pace of underlying technical progress not embodied in new capital equipment.

E. Impact of Sector Re-allocations on Aggregate Productivity Growth

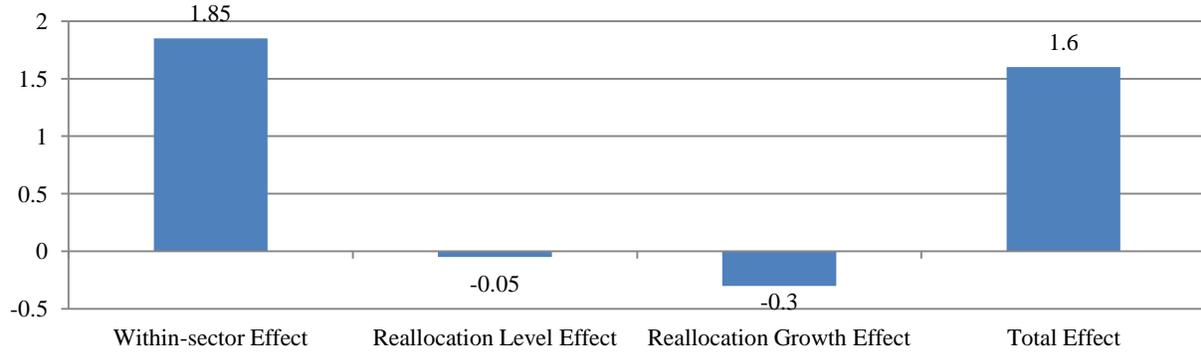
Aggregate productivity is determined by productivity growth within sectors and the reallocation of inputs among industries with differences in both productivity levels and growth rates. The Centre for the Study of Living Standards has developed a methodology to decompose aggregate productivity growth into these two components, with the latter component in turn disaggregated into productivity level and growth rate effects (de Avillez, 2012) The calculations are made on an industry basis so contributions by industry to aggregate productivity growth can also be obtained as well as the relative importance of within- sector productivity growth and reallocation effects at the aggregate level. The re-allocation effect is the sum of, the level and growth re-allocation effects.

Chart 18 provides estimates of the decomposition of aggregate labour productivity into the within-sector effects and the reallocation effects for the 1981-2000 period, Chart 19 for the 2000-2016 period, and Chart 20 for the change between period. The bottom line is that reallocation effects appear to have made dampened somewhat the post-2000 fall in labour productivity growth.

In the 1981-2000 period re-allocation effects subtracted -0.35 points from business sector labour productivity growth as actual productivity growth 1.6 per cent was less than within-sector growth of 1.85 per cent.

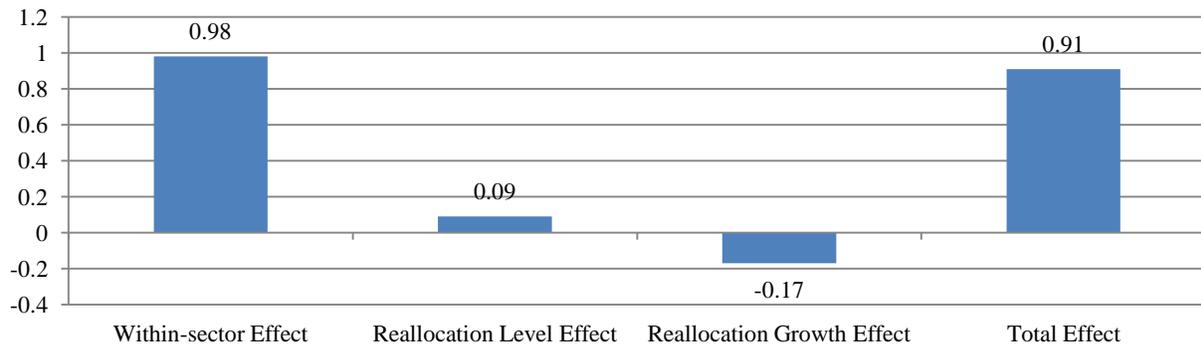
In the 2000-2016 period re-allocation effects only reduced productivity growth by 0.08 points as the within-sector productivity growth at 0.98 per cent was only slightly higher than actual productivity growth (0.91 per cent). The difference in re-allocation effects between periods of 0.27 reduced the slowdown in productivity growth to 0.69 points from the within-sector effect slowdown of 0.87 points.

Chart 18: CSLS Labour Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, 1981-2000



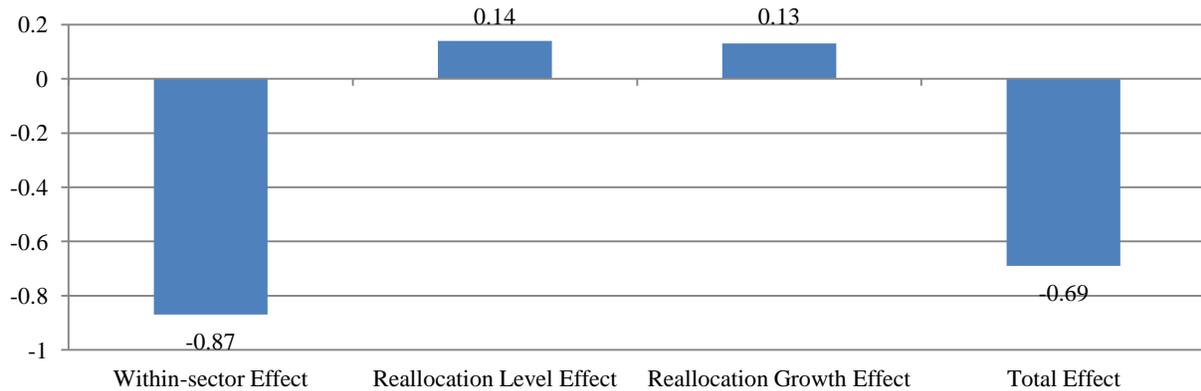
Source: CANSIM table 382-0021.

Chart 19: CSLS Labour Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, 2000 – 2016



Source: CANSIM table 382-0021.

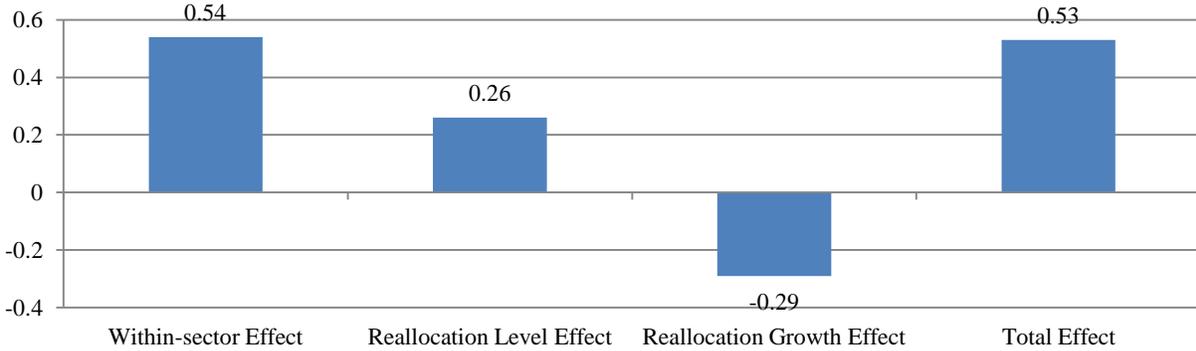
Chart 20: Difference in CSLS Labour Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, between 1981 - 2016 and 2000-2016



Source: CANSIM table 382-0021.

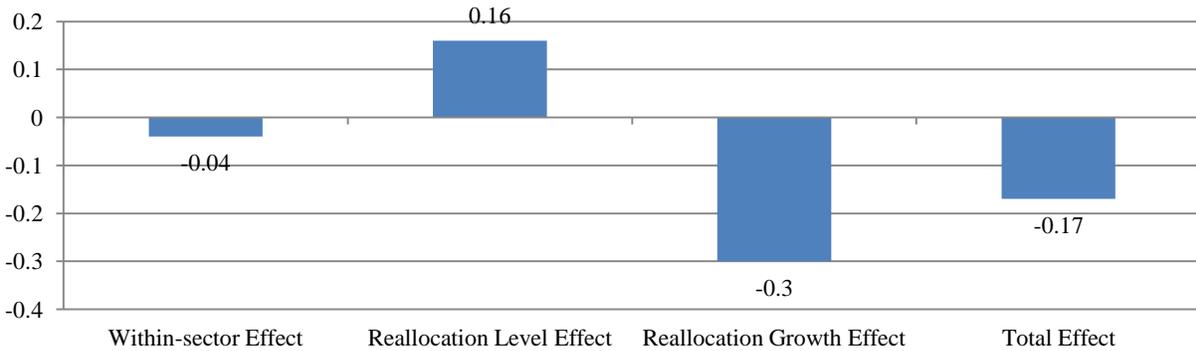
Chart 21 provides estimates of the decomposition of TFP into the within-sector effects and the reallocation effects for the 1981-2000 period, Chart 22 for the 2000-2016 period, and Chart 23 for the change between period. The bottom line is that reallocation effects appear to have increased the post-2000 decline in TFPy growth.

Chart 21: CSLS Total Factor Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, 1981-2000



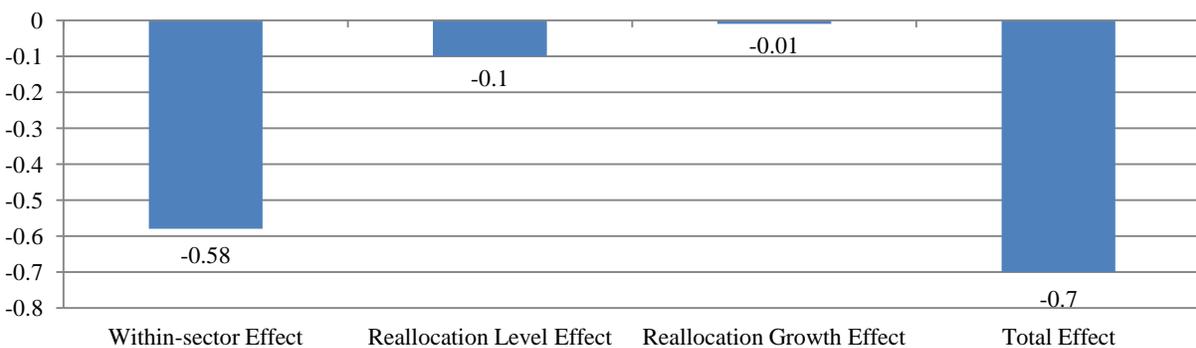
Source: CANSIM table 382-0021.

Chart 22: CSLS Total Factor Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, 2000 – 2016



Source: CANSIM table 382-0021.

Chart 23: Difference in CSLS Total Factor Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, between 1981 - 2016 and 2000-2016



Source: CANSIM table 382-0021.

In the 1981-2000 period re-allocation effects subtracted -0.03 points from business sector TFP growth as actual productivity growth 0.53 per cent was less than within-sector growth of 0.54 per cent.

In the 2000-2016 period re-allocation effects reduced productivity growth by 0.14 points as the within-sector productivity growth at -0.04 per cent was better than actual productivity growth of -0.17 per cent. The difference in re-allocation effects between periods of 0.11 increased the slowdown in productivity growth to 0.70 points from the with-in sector effect slowdown of 0.58 points.

III. Productivity Growth at the Sectoral Level

A. Labour Productivity by Industry

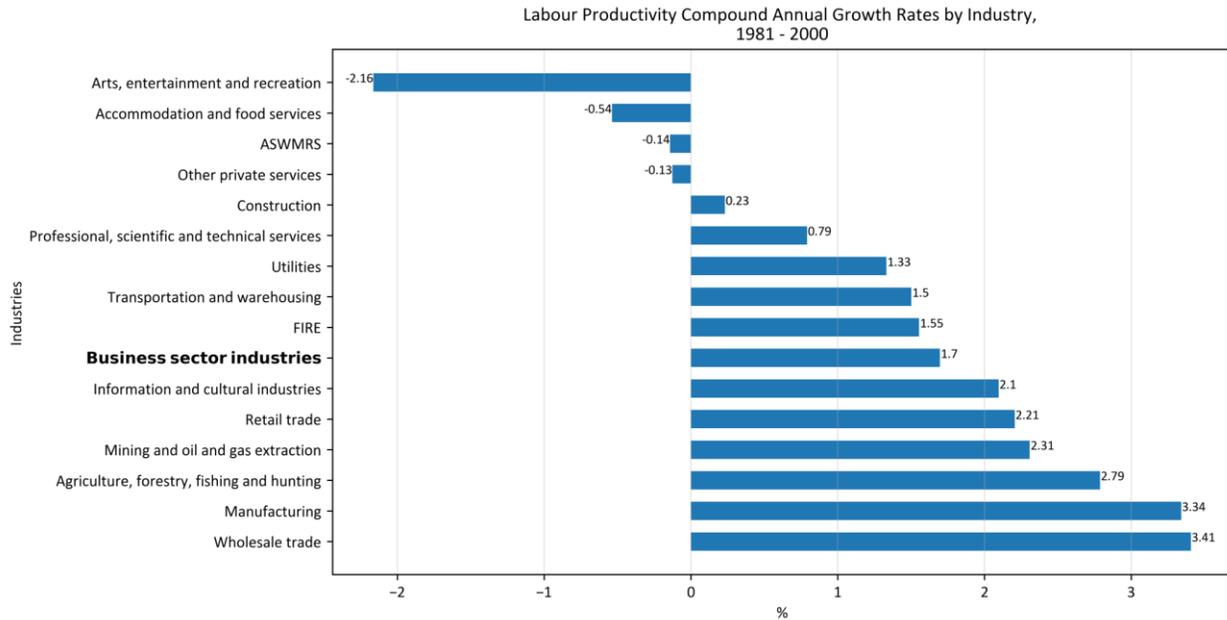
i. Growth Rates

To understand the post-2000 productivity slowdown one must identify which sectors experienced slower productivity growth and the contributions of these sectors to the overall slowdown. Chart 24 shows compound annual growth rates for output per hour for 15 two-digit NAICS industries for the 1981-2000 period, Chart 25 gives the figures for the 2000-2016 period, and Chart 26 the differences between periods. Appendix Chart 1 provides in graphic form a labour productivity index for the 1961-2016 period, with trends the 1961-2000 and 2000-2008 and 2008-2016 sub-period for the 15 industries. Appendix Table 2 provides the compound growth rates for the 15 industries for 1961-2016 and a number of sub-periods.

Slower productivity growth has not been pervasive across all industries. Indeed, only eight of 15 industries experienced slower labour productivity growth in 2000-2016 period relative to 1981-2000, and seven industries enjoying faster labour productivity growth.

The largest decline in mining and oil and gas production (3.4 percentage points per year) , followed by manufacturing (2.2 points). Productivity growth picked up after 2000 in a number of service industries, especially arts, entertainment, and recreation (2.5 points).

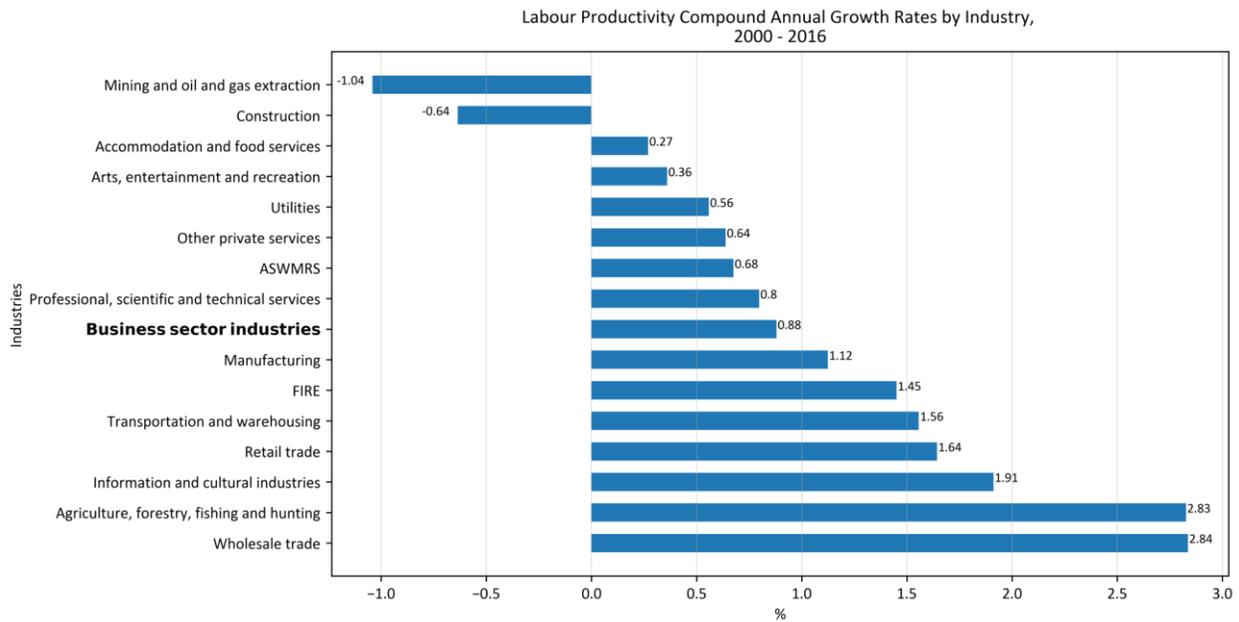
Chart 24: Labour productivity Compound Annual Growth Rates by Industry, 1981 – 2000



Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

Source: CANSIM table 383-0021.

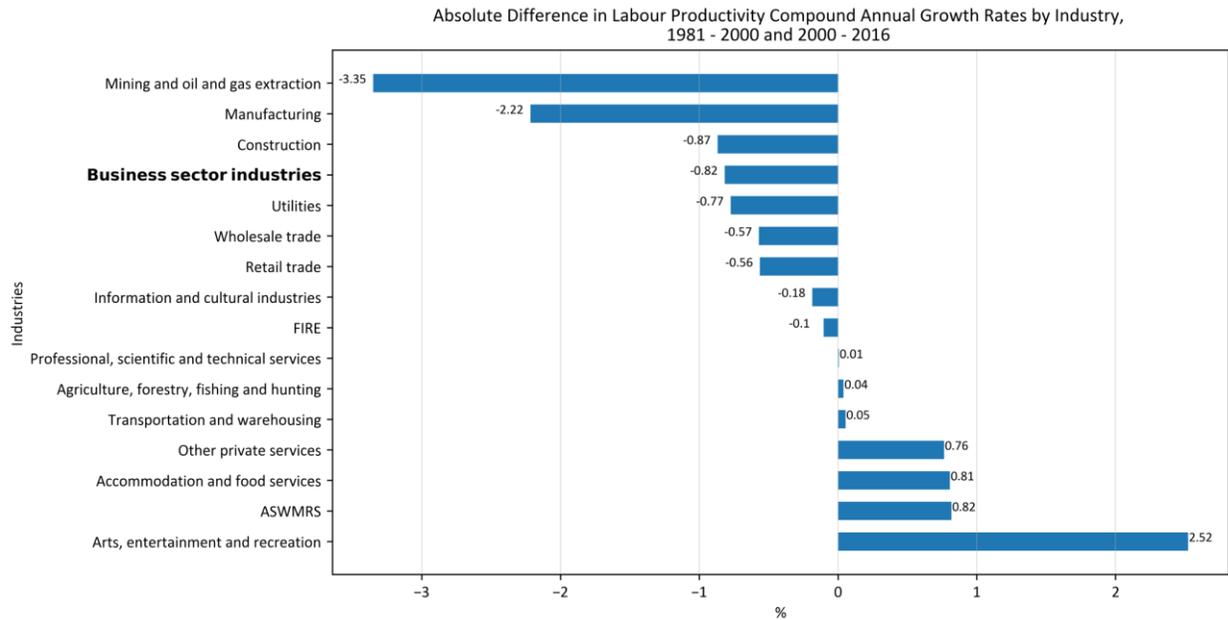
Chart 25: Labour productivity Compound Annual Growth Rates by Industry, 2000 – 2016



Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

Source: CANSIM table 383-0021.

Chart 26: Absolute Difference in Labour Productivity Compound Annual Growth Rates by Industry, 1981 – 2000 and 2000 – 2016



Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

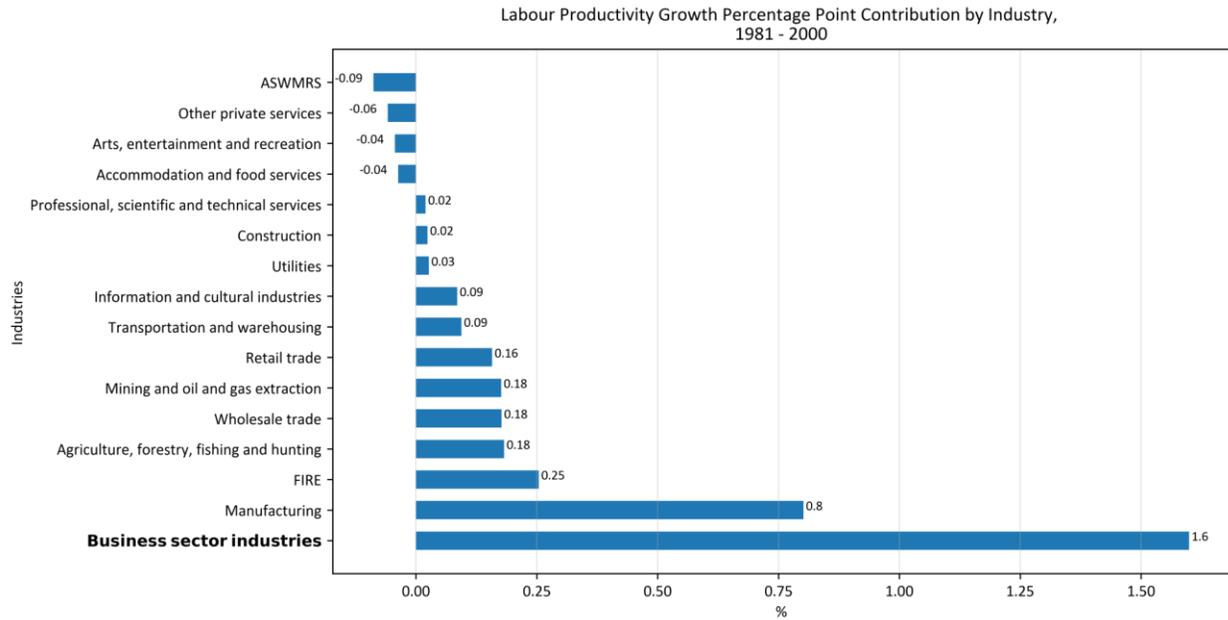
Source: CANSIM table 383-0021.

It is interesting to note that the number of sectors experiencing negative labour productivity growth was actually less after 2000 than before. In the 1981-2000 period four service industries saw an absolute decline in their productivity level: arts, entertainment and recreation; accommodation and food; administrative and support, waste management and remediation services (ASWMRS), and other private services. In contrast to the 2000-2016 period only two industries, both in the good sector, experienced absolute declines: mining and oil and gas extraction and construction. The improved performance of a number of service sector industries is a positive development for overall productivity growth and suggests that the productivity slowdown was a phenomenon largely concentrated in the goods sector.

ii. Contributions by Industry

The contributions by industry to the productivity slowdown are determined by both the absolute size of an industry's productivity growth slowdown and the importance of the industry in total input and output, and reallocation effects. Chart 27 shows the contributions to business sector productivity growth for the 15 industries in the 1981-2000 period, Chart 28 for the 2000-2008 period, and Chart 29 for the change between periods. Appendix Table 2 gives the industry contributions for a number of sub-periods, with total contribution disaggregated into a within-sector component and a re-allocation component, the latter consisting of levels effects and growth effects (de Avillez, 2012).

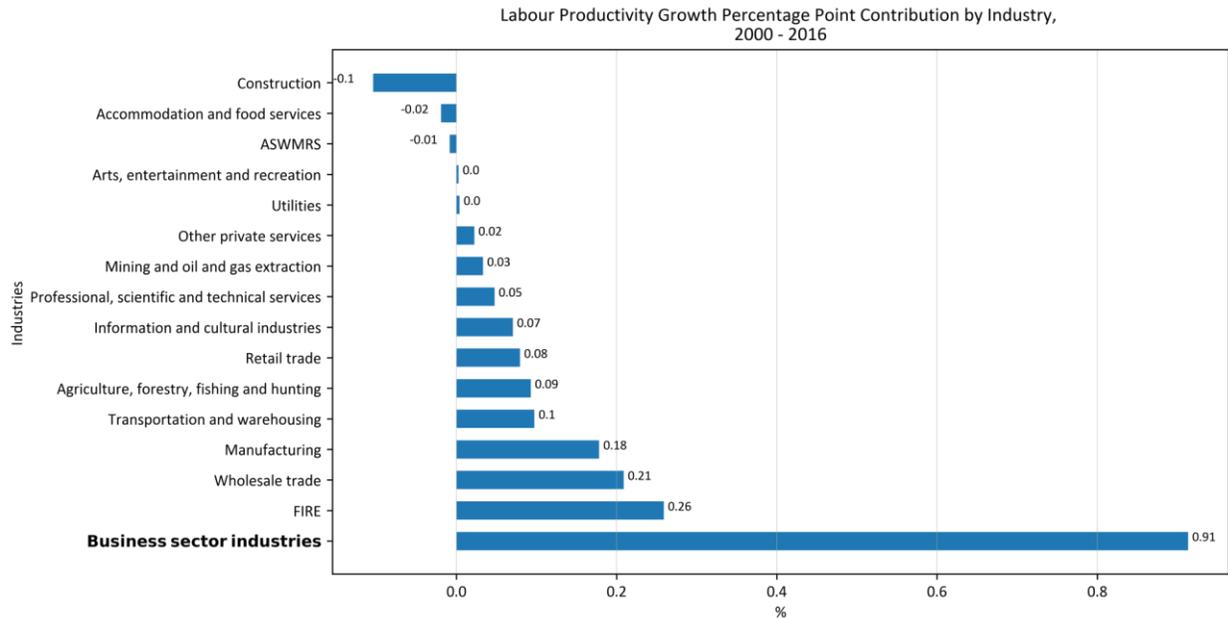
Chart 27: Labour Productivity Growth Percentage Point Contribution by Industry, 1981 – 2000



Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

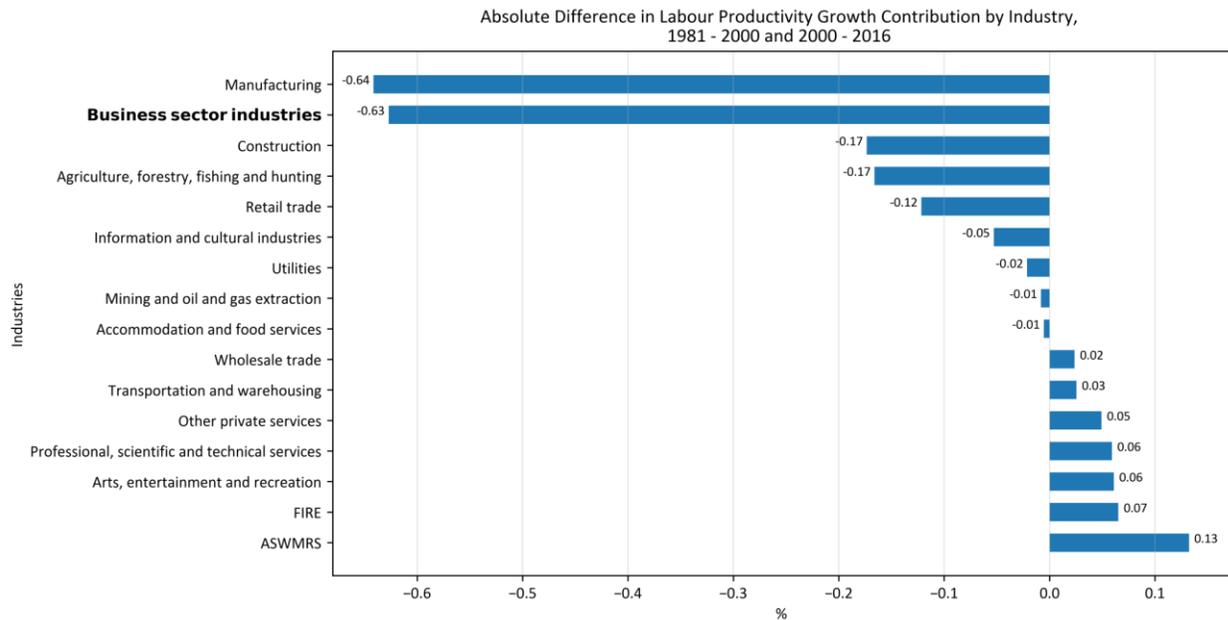
Source: CANSIM table 383-0021.

Chart 28: Labour Productivity Growth Percentage Point Contribution by Industry, 2000 – 2016



Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

Source: CANSIM table 383-0021.

Chart 29: Absolute Difference in Labour Productivity Growth Contribution by Industry, 1981 – 2000 and 2000 – 2016

Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

Source: CANSIM table 383-0021.

The sector that made by far the largest contribution to business sector labour productivity growth in the 1981-2000 period was manufacturing at 0.8 points per year, one half of the overall productivity growth rate of 1.6 per cent. In the 2000-2016 period The largest industry contribution was made by FIRE at 0.26 points, followed by wholesale trade at 0.21 points. Manufacturing was third at 0.18 points.

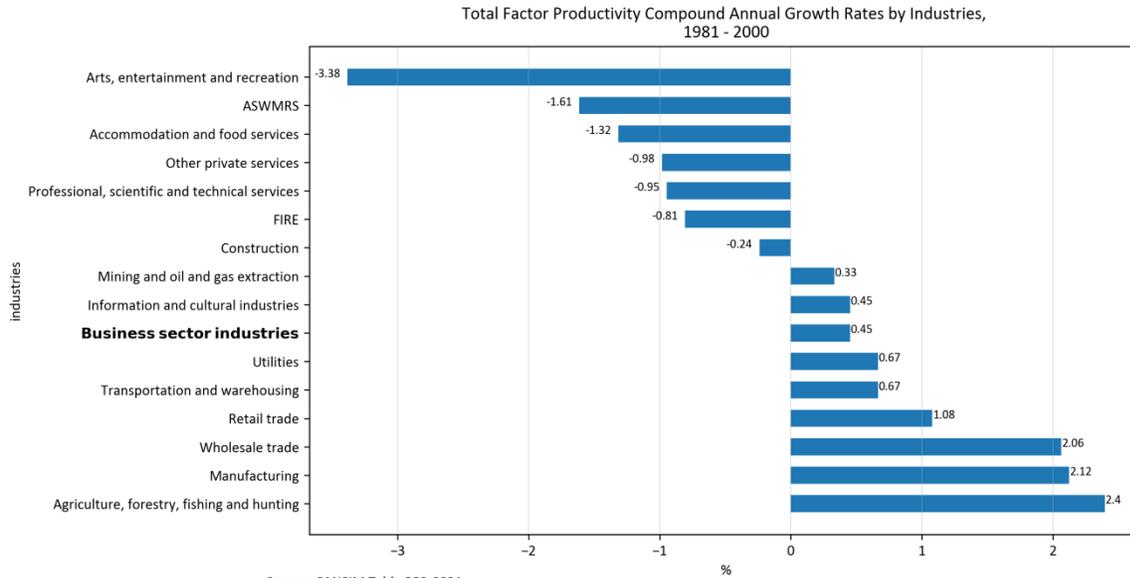
Because of the drop in the contribution to labour productivity growth from manufacturing (0.64 points), this sector accounted for all the labour productivity slowdown of 0.63 points. Additional contributions to the slowdown came from construction, agriculture, and retail trade offset by negative contribution (higher productivity growth after 2000) in ASWMRS and other service industries.

B. Trends in TFP by Industry

i. Growth Rates

Chart 30 shows compound annual growth rates for TFP for 15 two-digit NAICS industries for the 1981-2000 period, Chart 31 gives the figures for the 2000-2016 period, and Chart 32 the differences between periods. Appendix Chart 2 provides in graphic form a TFP index for the 1961-2016 period, with trends the 1961-2000 and 2000-2008 and 2008-2016 sub-period for the 15 industries. Appendix Table 32 provides the compound TFP growth rates for the 15 industries for 1961-2016 and a number of sub-periods.

Chart 30: Total Factor Productivity Compound Annual Growth Rates by Industry, 1981 – 2000

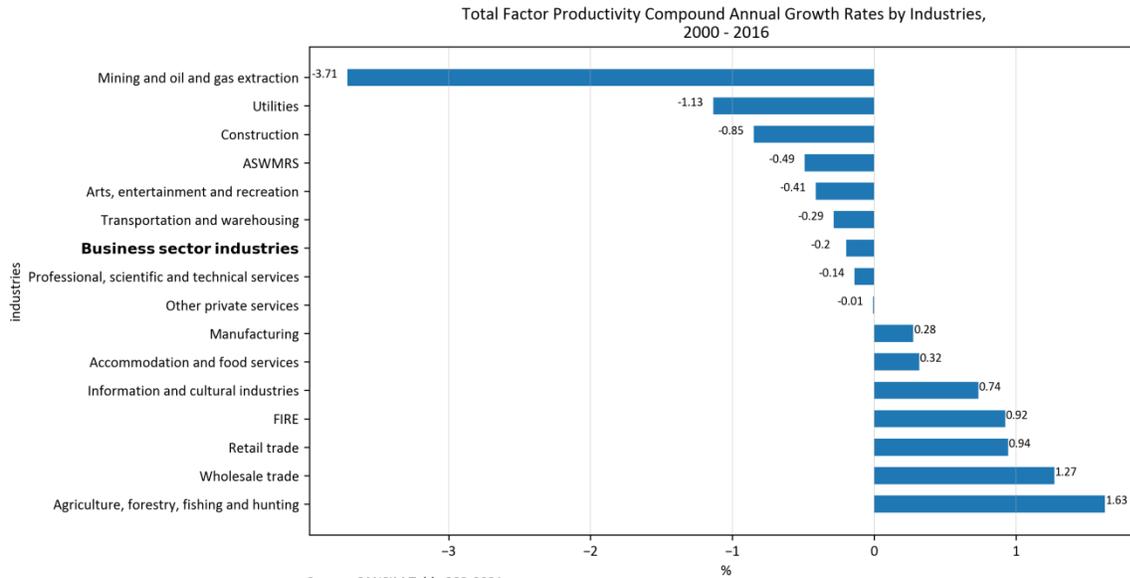


Source: CANSIM Table 383-0021
 Note: FIRE stands for Finance, insurance, real estate, rental and leasing.
 ASWMRS stands for Administrative and support, waste management and remediation services.

Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

Source: CANSIM table 383-0021.

Chart 31: Total Factor Productivity Compound Annual Growth Rates by Industry, 2000 – 2016

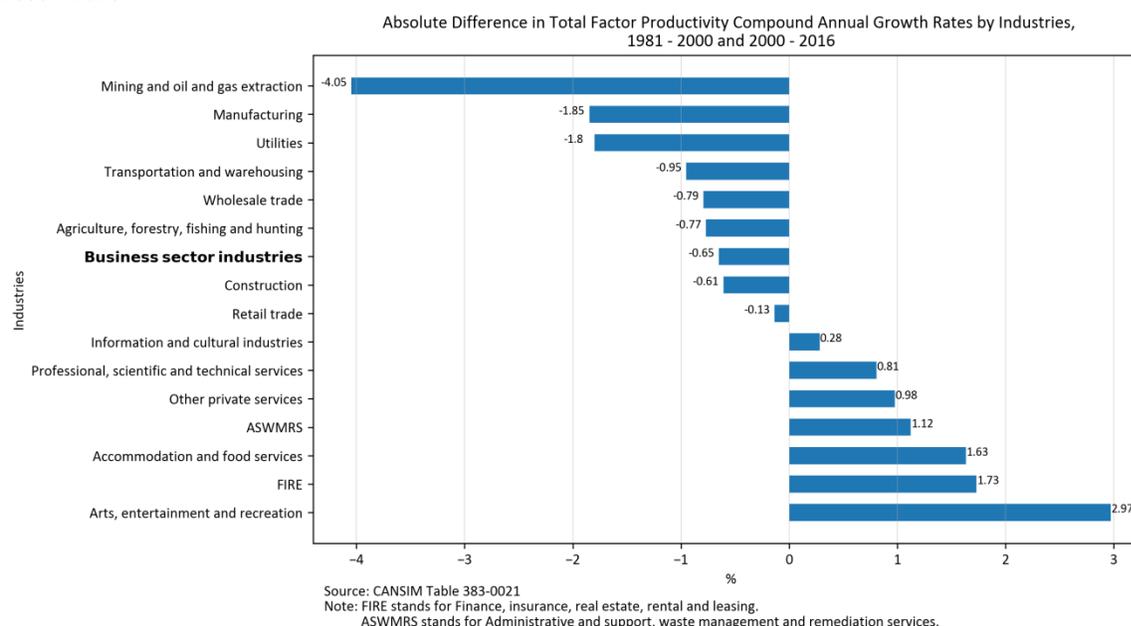


Source: CANSIM Table 383-0021
 Note: FIRE stands for Finance, insurance, real estate, rental and leasing.
 ASWMRS stands for Administrative and support, waste management and remediation services.

Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

Source: CANSIM table 383-0021.

Chart 32: Absolute Difference in Total Factor Productivity Compound Annual Growth by Industry, 1981 – 2000 and 2000 – 2016



Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

Source: CANSIM table 383-0021.

As was the case for labour productivity, slower TFP growth has not been pervasive across all industries. Indeed, only eight of 15 industries experienced slower TFP growth in 2000-2016 period relative to 1981-2000, and seven industries enjoying faster TFP growth.

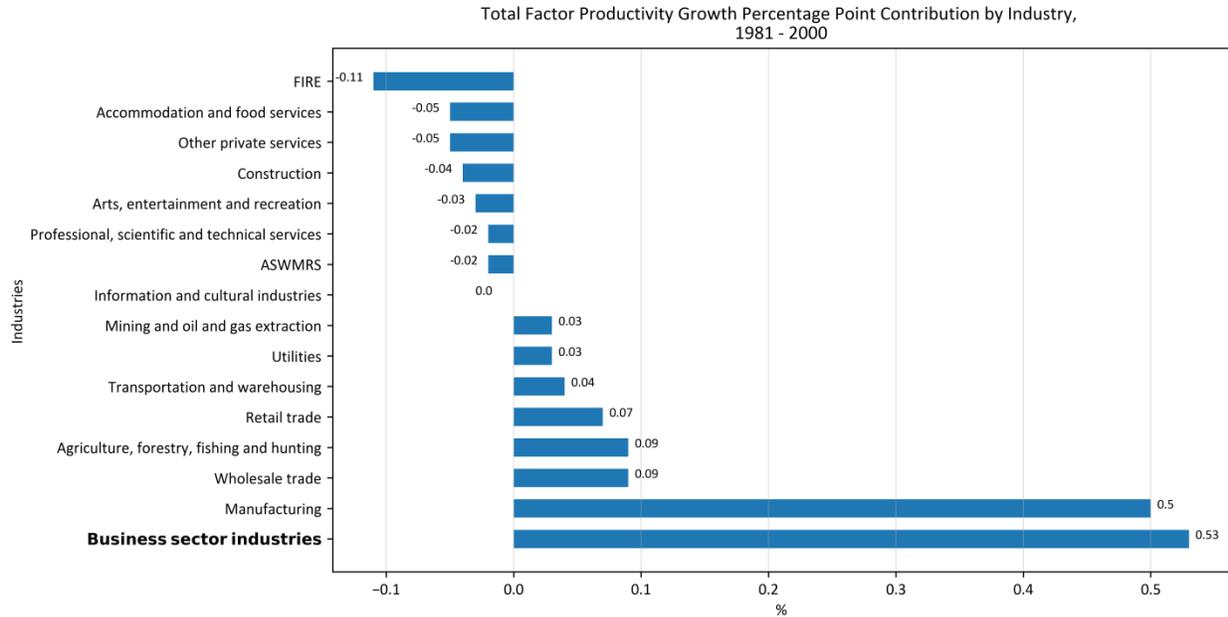
The largest decline of TFP in mining and oil and gas extraction (4.1 percentage points per year), followed by manufacturing (1.9 points). This pattern was very similar to that experienced by labour productivity. TFP growth picked up after 2000 in seven service industries, especially arts, entertainment, and recreation (3.0 points), FIRE (1.7 points), and accommodation and food services (1.6 points).

It is interesting to note that the types of industries experiencing negative TFP growth switched after 2000. In the 1981-2000 the six industries with the largest decline on TFP were in the service sector. After 2000 the three industries with the large falls in TFP were in the goods sector: mining and oil gas extraction, utilities and construction. As with labour productivity, the improved performance of a number of service sector industries is a positive development for overall productivity growth and suggests that the TFP growth slowdown was a phenomenon largely concentrated in the goods sector.

ii. Contributions by Industry

Chart 33 shows the contributions to business sector TFP growth for the 15 industries in the 1981-2000 period, Chart 34 for the 2000-2008 period, and Chart 35 for the change between periods. Appendix Table 4 gives the industry contributions to TFP growth for a number of sub-periods, with total contribution disaggregated into a within-sector component and a re-allocation component, the latter consisting of levels effects and growth effects.

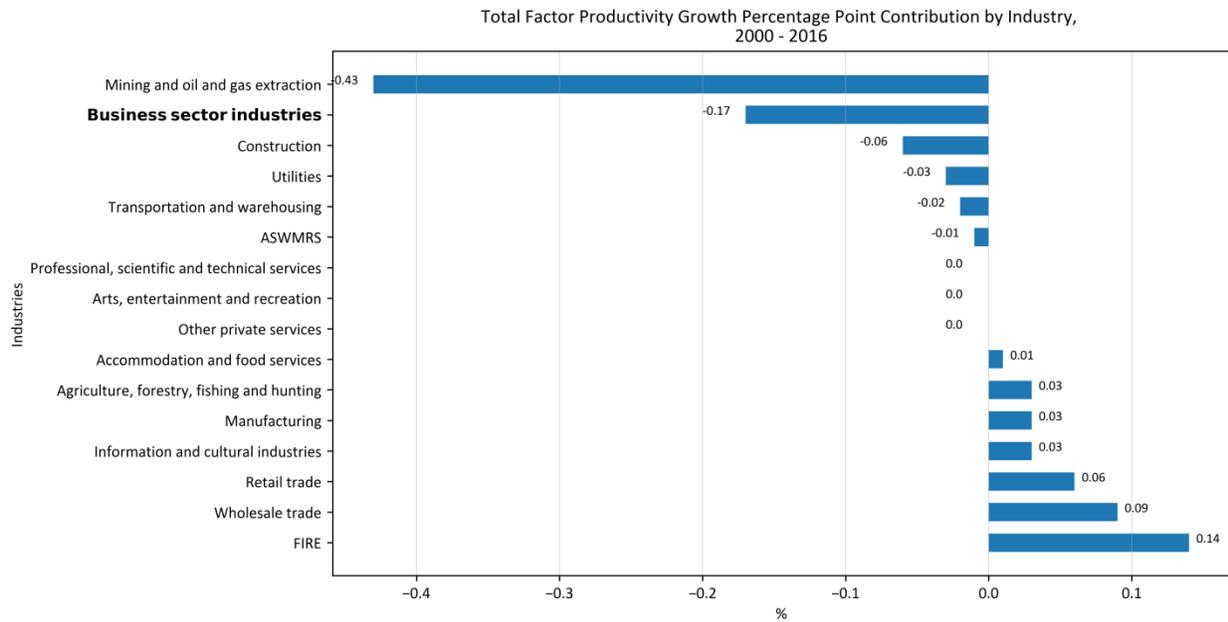
Chart 33: Total Factor Productivity Growth Percentage Point Contribution by Industry, 1981 – 2000



Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

Source: CANSIM table 383-0021.

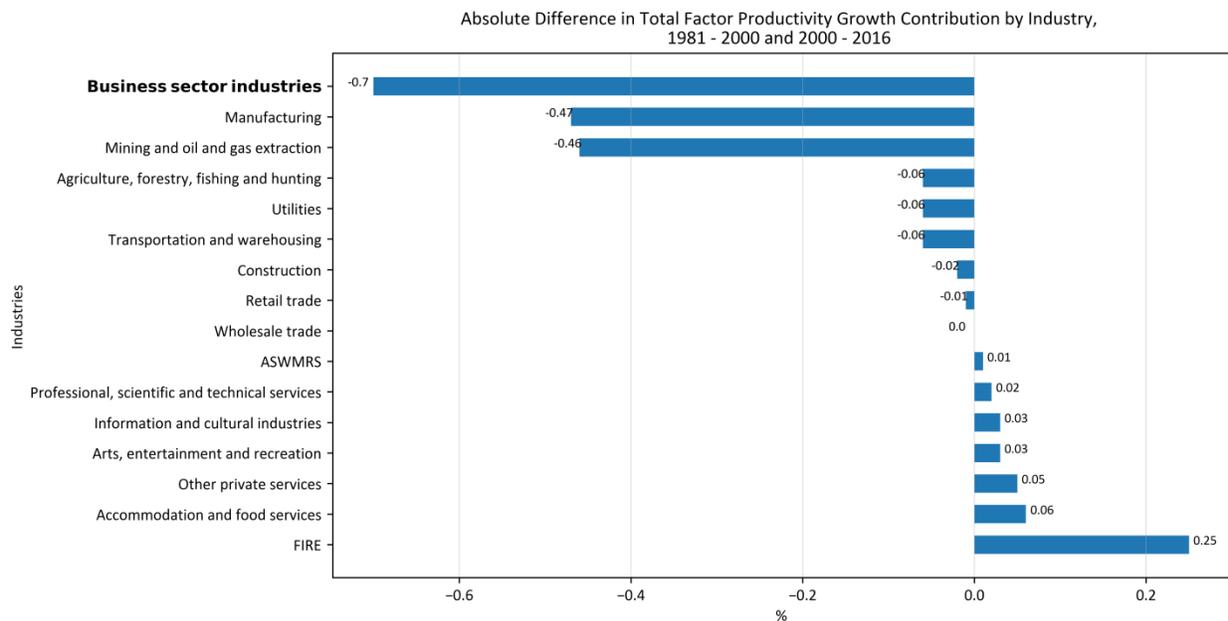
Chart 34: Total Factor Productivity Percentage Point Contribution by Industry, 2000 – 2016



Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

Source: CANSIM table 383-0021.

Chart 35: Absolute Difference in Total Factor Productivity Growth Contribution by Industry, 1981 – 2000 and 2000 – 2016



Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

Source: CANSIM table 383-0021.

The sector that made by far the largest contribution to business sector TFP growth in the 1981-2000 period was manufacturing at 0.50 points per year, nearly equal to the overall productivity growth rate of 0.53 per cent. Six service industries made negative contributions to TFP growth in this period.

In the 2000-2016 period the largest industry contribution to TFP growth was made by FIRE at 0.14 points, followed by wholesale trade at 0.09 points. Manufacturing was fourth at only 0.03 points. On the other hand, mining, and oil and gas extraction contributed -0.43 points to TFP, more than double actual TFP growth of 0.17 points.

Two industries equally contributed to the TFP slowdown of 0.7 points, manufacturing contributing 0.47 points and mining and oil and gas extraction 0.46 points. FIRE on the other hand offset the slowdown by 0.25 points.

The industry contributions to TFP growth in the 1981-2000 and 2000-2016 periods and the change between periods mirror the industry contributions to labour productivity growth.

IV. Productivity Trends by Province

A. Labour Productivity

Unlike developments at the industry level where only roughly half of industries (8 out of 15) experienced slower productivity growth after 2000, eight of ten provinces had a slowdown in labour productivity growth, although because of data limitations the dating of the pre-2000 period differs (1997-2000 in the case of the provinces since official productivity estimates by province are not available before 1997). Table 3 summarizes labour productivity growth by province in various sub-periods between 1997 and 2016. Chart 38 shows that between the 1997-2000 and 2000-2016 periods, only two provinces, Prince Edward Island and British Columbia, enjoyed more rapid business sector output per hour growth. The largest fall-off in labour productivity growth was in Newfoundland and Labrador at 3.8 points, followed by Ontario at 2.5 points.

Table 3: Business Sector Labour Productivity Compound Annual Growth Rates in Canada (in percent), 1997 – 2016

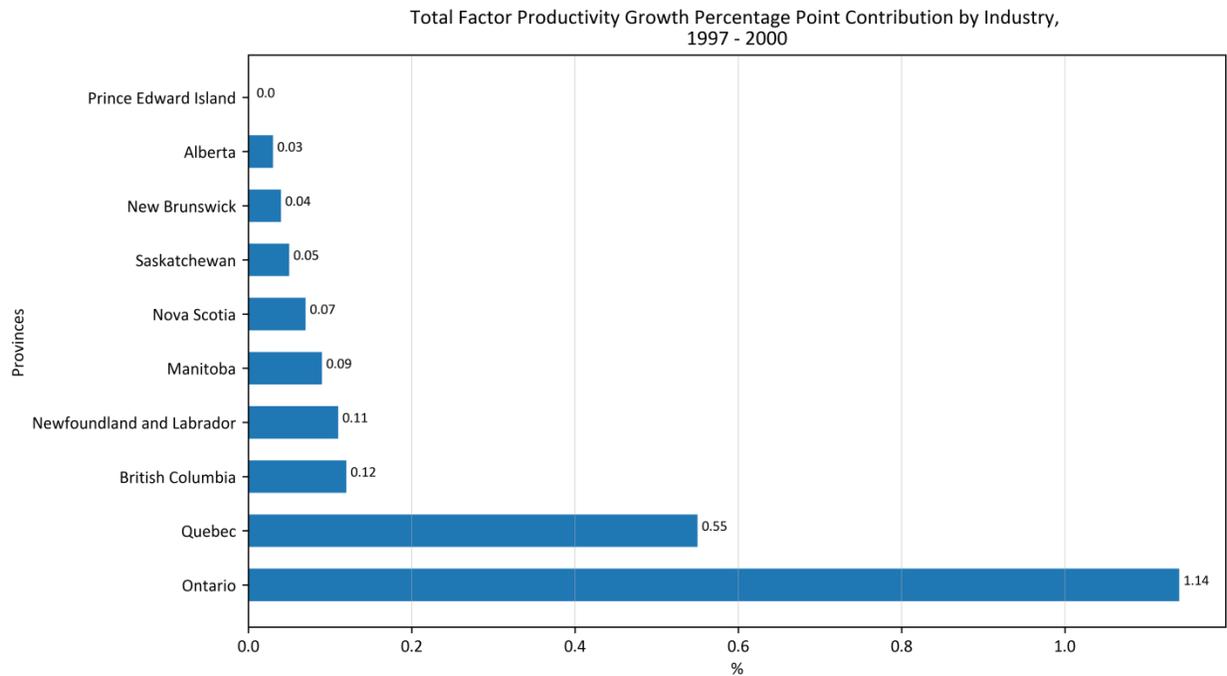
	1997 - 2016	1997 - 2000	2000 - 2016	2000 - 2008	2008 - 2016
Canada	1.26	3.33	0.88	0.79	0.97
Alberta	0.44	0.91	0.36	-0.22	0.94
British Columbia	1.17	1.10	1.18	0.71	1.65
Manitoba	1.79	2.55	1.64	1.61	1.67
New Brunswick	1.00	2.46	0.73	1.28	0.18
Newfoundland	1.50	4.71	0.91	4.01	-2.09
Nova Scotia	0.77	2.84	0.39	0.48	0.29
Ontario	1.06	3.17	0.67	0.45	0.90

Prince Edward Island	1.10	0.20	1.27	1.48	1.06
Quebec	0.83	2.86	0.46	0.51	0.41
Saskatchewan	1.13	2.56	0.86	1.04	0.69

Note: Newfound means Newfoundland and Labrador.
Source: CANSIM tables 383-0021 and 383-0026.

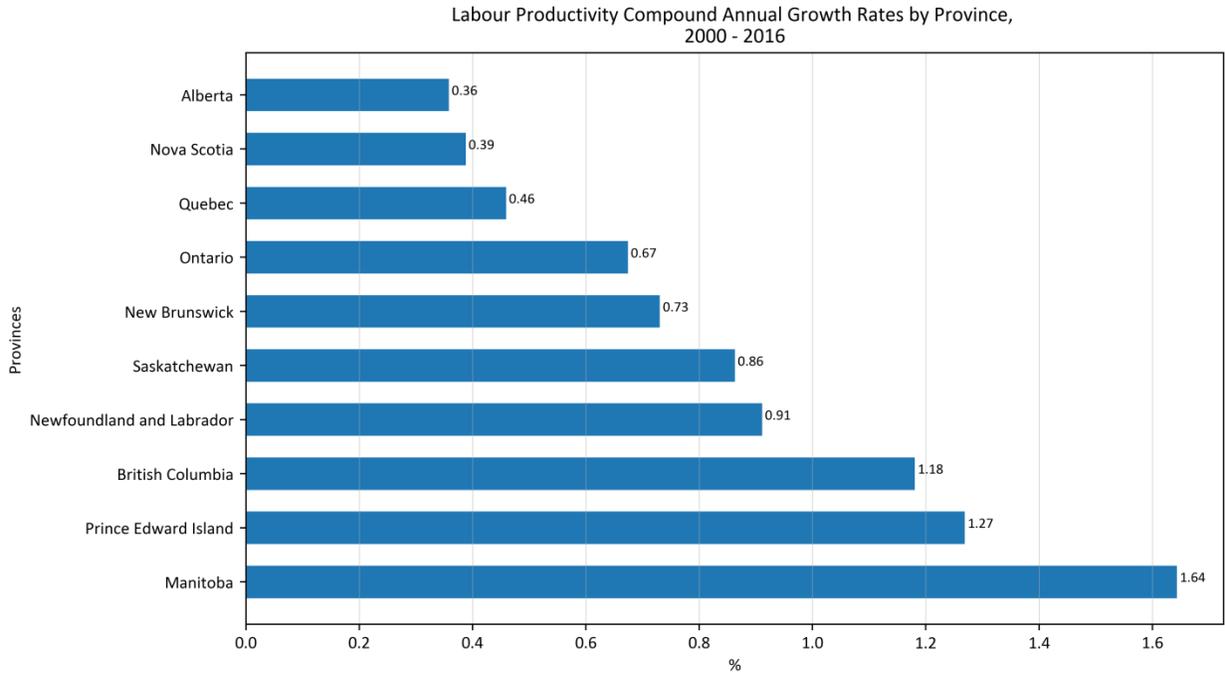
As Chart 36 shows, in the 1997-2000 period, Newfoundland and Labrador enjoyed the faster labour productivity growth at 4.7 per year, thanks to the rapid development of the offshore oil industry during this period. Ontario had the second fastest labour productivity growth (3.2 per cent). In contrast, all provinces had positive labour productivity growth, with Prince Edward Island and Alberta the weakest at 0.2 per cent and 0.9 per cent respectively. In the 2000-2016 period (Chart 37) Manitoba enjoyed the fastest labour productivity growth at 1.6 per cent per year while Alberta had the weakest at 0.4 per cent.

Chart 36: Labour Productivity Compound Annual Growth Rates by Province, 1997 – 2000



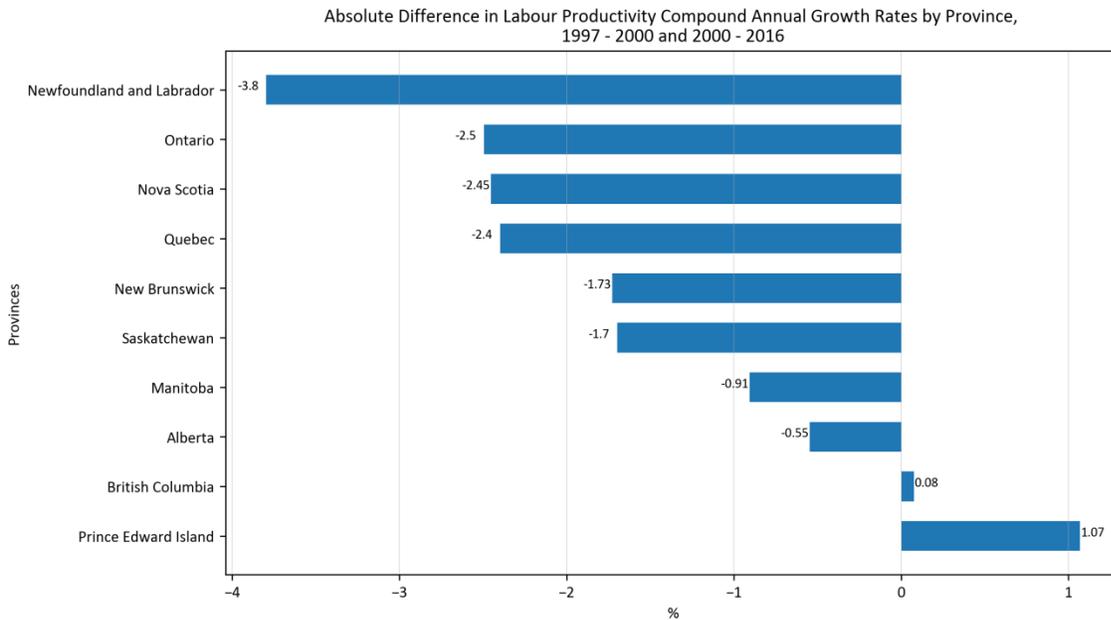
Source: CANSIM table 383-0026.

Chart 37: Labour Productivity Compound Annual Growth Rates by Province, 2000 - 2016



Source: CANSIM table 383-0026.

Chart 38: Absolute Difference in Labour Productivity Compound Annual Growth by Province, 1997 – 2000 and 2000 – 2016

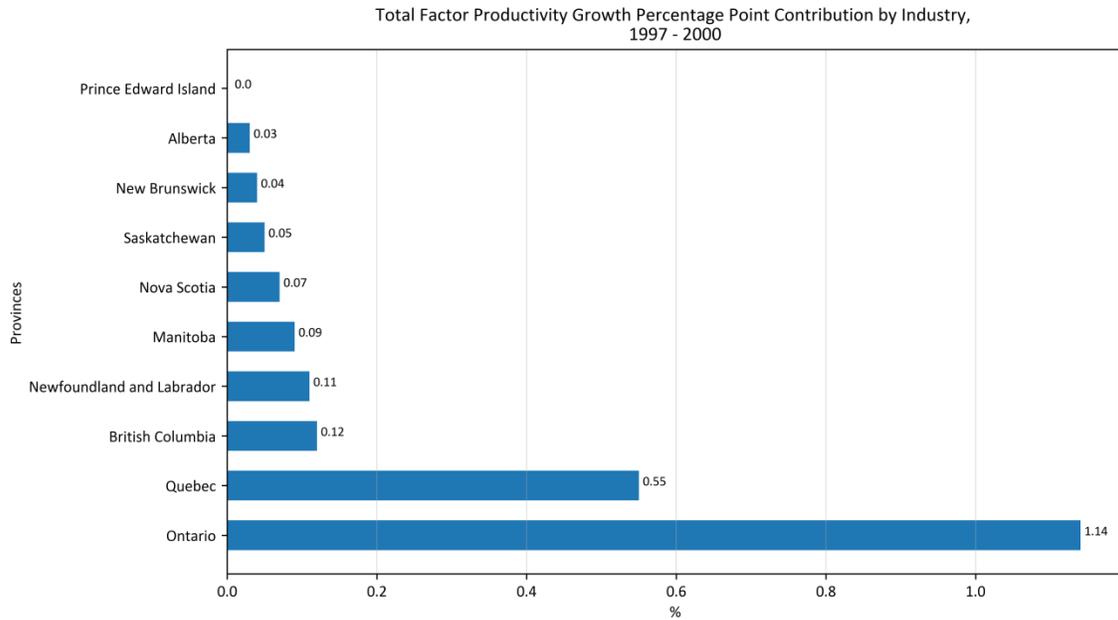


Source: CANSIM table 383-0026.

Because of its size, it is no surprise that Ontario made the largest contribution to national labour productivity growth, 1.1 percentage point in 1997-2000 and 0.3 points in 2000-2016

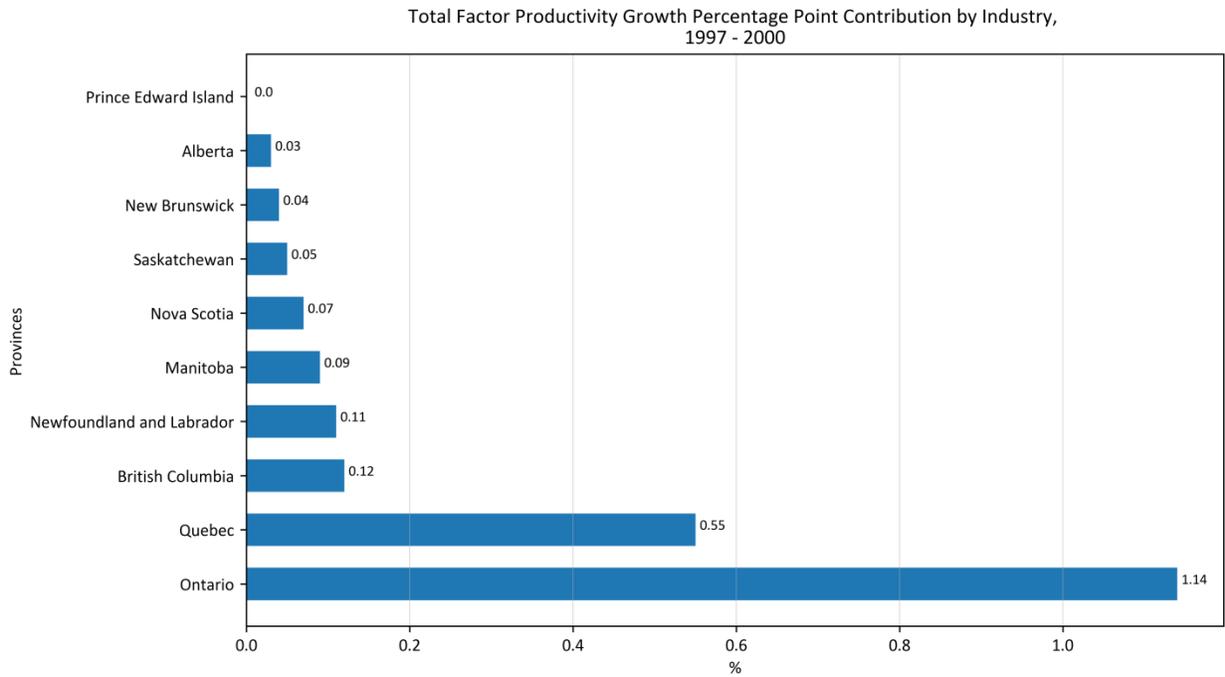
(Charts 39 and 40). It also was responsible for most of the fall-off: 0.9 points of the overall decline of 1.6 points, as shown in Chart 41. Quebec was second at 0.5 points.

Chart 39: Labour Productivity Growth Percentage Point Contribution by Province, 1997 – 2000

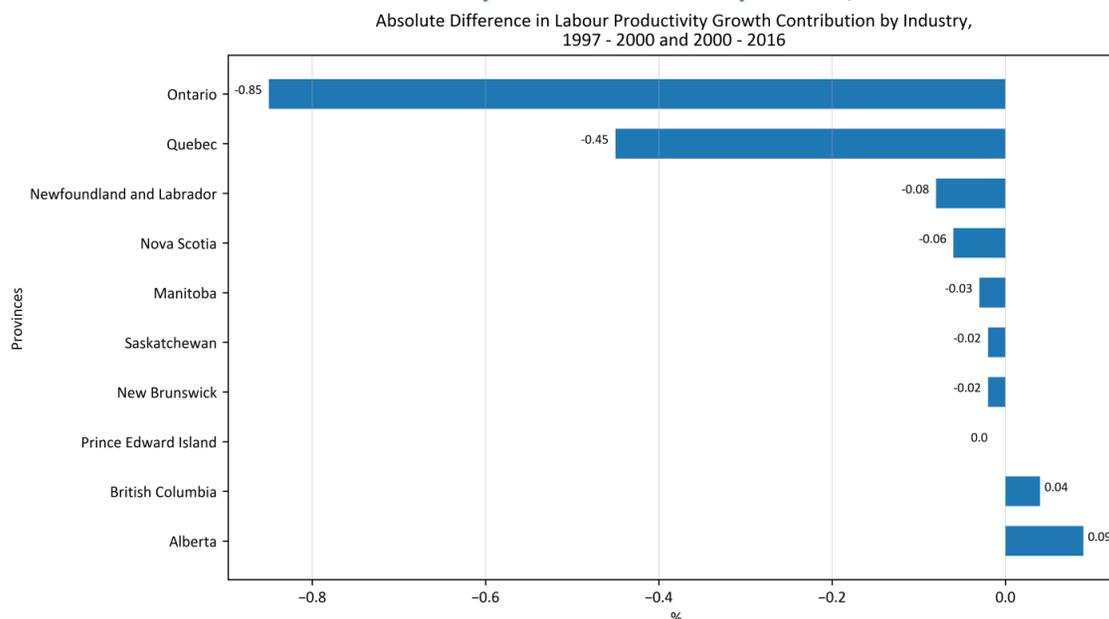


Source: CANSIM table 383-0026.

Chart 40: Labour Productivity Growth Percentage Point Contribution by Province, 2000 – 2016



Source: CANSIM table 383-0026.

Chart 41: Absolute Difference in Labour Productivity Growth Contribution by Province, 1997 – 2000 and 2000 – 2016

Source: CANSIM table 383-0026.

B. Total Factor Productivity

Trends in TFP at the provincial level were similar to those for labour productivity (Charts 42 - 44). Table 4 summarizes total factor productivity growth by province in various sub-periods from 1997 to 2016. The largest slowdown in TFP growth between the 1997-2000 and 2000-2016 periods occurred in Newfoundland and Labrador (5.4 points), followed by Ontario (2.4 points). In the 1997-2000 period Newfoundland enjoyed the most rapid TFP growth (4.3 per cent per year), followed by Ontario (2.5 per cent). Alberta had the worst performance (-1.8 per cent). In 2000-2016, Prince Edward Island and Manitoba has the fastest labour productivity growth, both at 0.5 per cent per year. Saskatchewan and Alberta had the worst performance at -1.7 per cent and -1.6 per cent respectively.

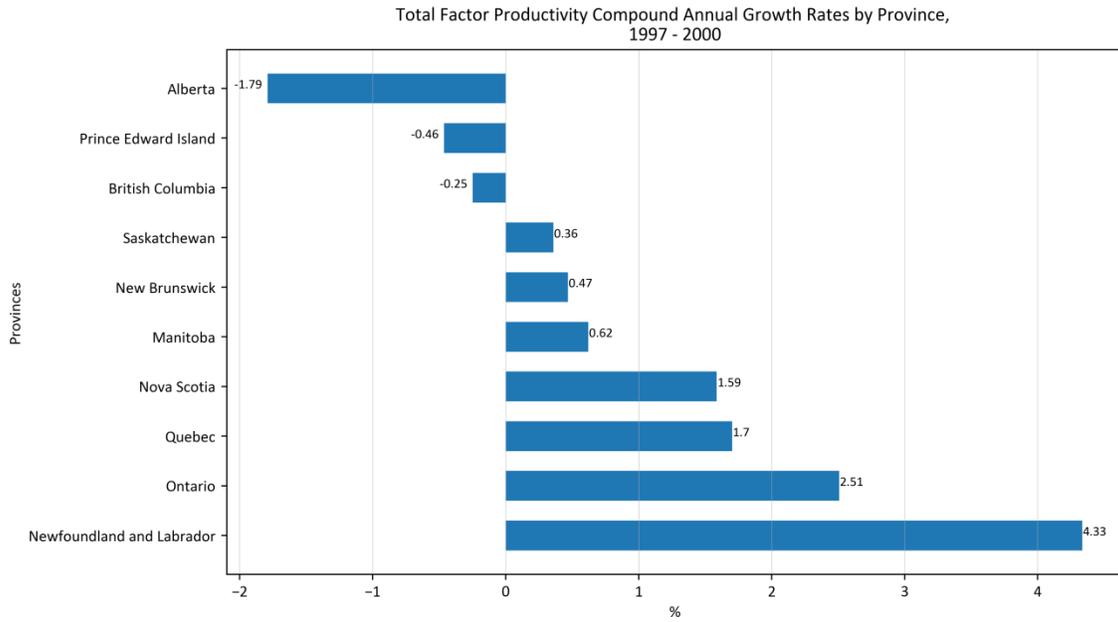
Table 4: Business Sector Total Factor Productivity Compound Annual Growth Rates in Canada (in percent), 1997 – 2016

	1997 - 2016	1997 - 2000	2000 - 2016	2000 - 2008	2008 - 2016
Canada	0.10	1.71	-0.20	-0.55	0.16
Alberta	-1.65	-1.79	-1.63	-2.45	-0.80
British Columbia	0.19	-0.25	0.27	-0.26	0.80
Manitoba	0.49	0.62	0.46	0.66	0.26
New Brunswick	-0.14	0.47	-0.26	-0.17	-0.34
Newfoundland	-0.27	4.33	-1.11	2.89	-4.94
Nova Scotia	-0.07	1.59	-0.37	-0.29	-0.46
Ontario	0.45	2.51	0.07	-0.57	0.71
Prince Edward Island	0.37	-0.46	0.52	0.29	0.75
Quebec	0.14	1.70	-0.14	-0.30	0.01
Saskatchewan	-1.37	0.36	-1.69	-0.66	-2.72

Note: Newfoundland means Newfoundland and Labrador.

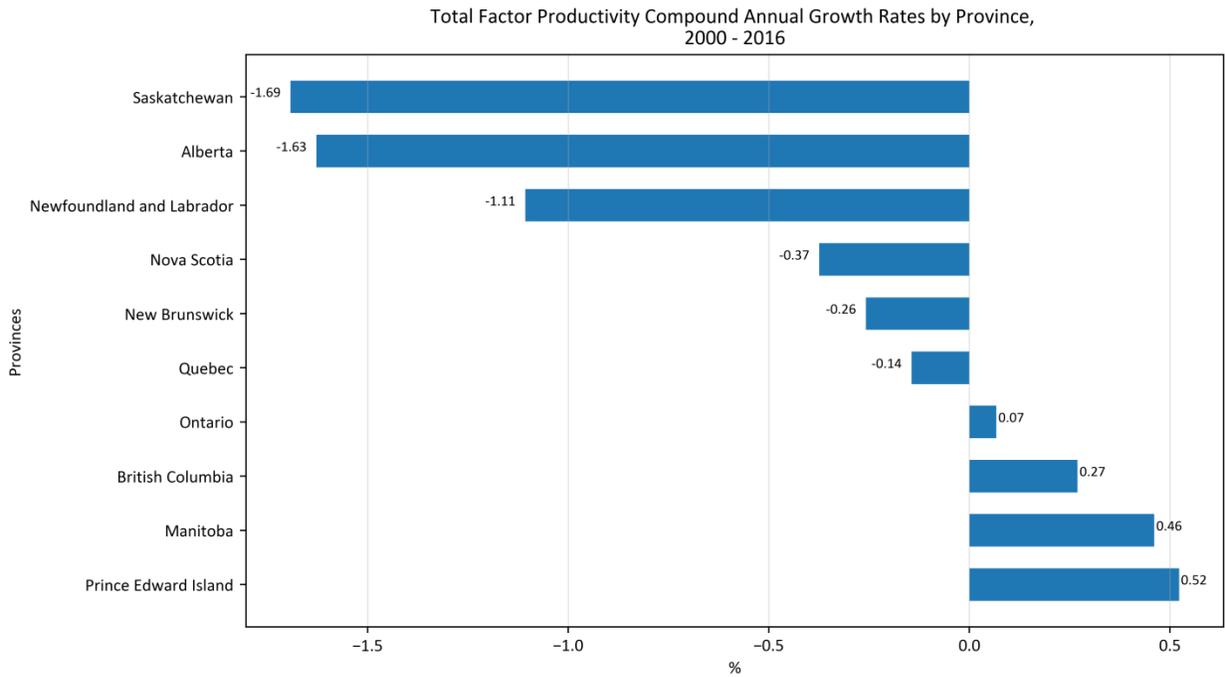
Source: CANSIM tables 383-0021 and 383-0026.

Chart 42: Total Factor Productivity Compound Annual Growth Rates by Province, 1997 – 2000



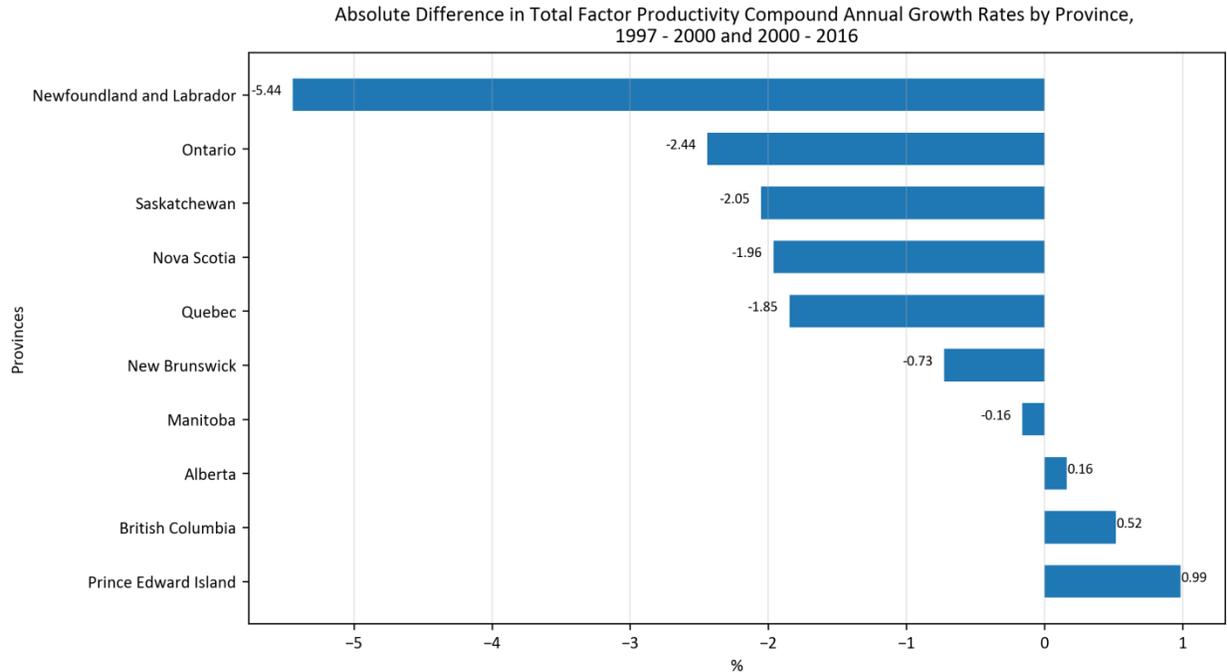
Source: CANSIM table 383-0026.

Chart 43: Total Factor Productivity Compound Annual Growth Rates by Province, 2000 – 2016



Source: CANSIM table 383-0026.

Chart 44: Absolute Difference in Total Factor Productivity Compound Annual Growth by Province, 1997 – 2000 and 2000 – 2016



Source: CANSIM table 383-0026.

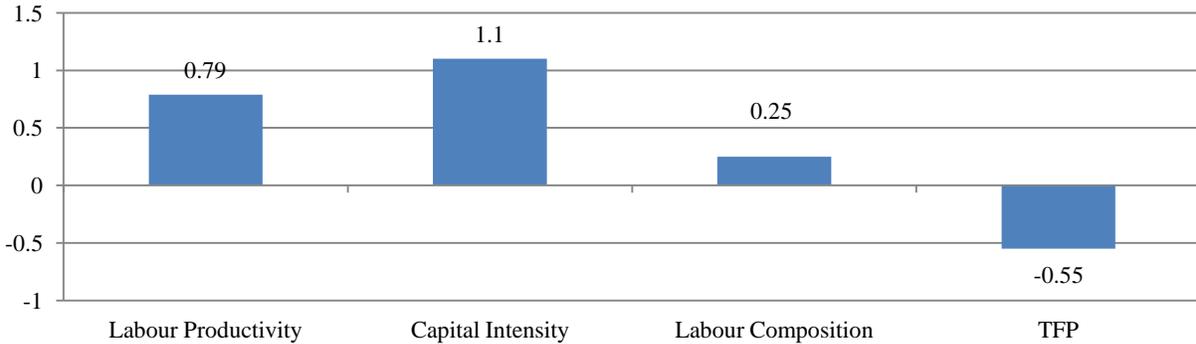
V. Productivity Developments within the Post-2000 Period

Since 2000, labour productivity growth appears to have been quite similar in the 2000-2008 and 2008-2016 sub-periods at 0.8 per cent per year in 2000-2008 and 1.0 per cent in 2008-2016. But this similarity masks underlying differences between periods in the sources of labour productivity growth, the impact of re-allocation effects, and the number of industries experiencing stronger productivity growth.

A. Labour Productivity

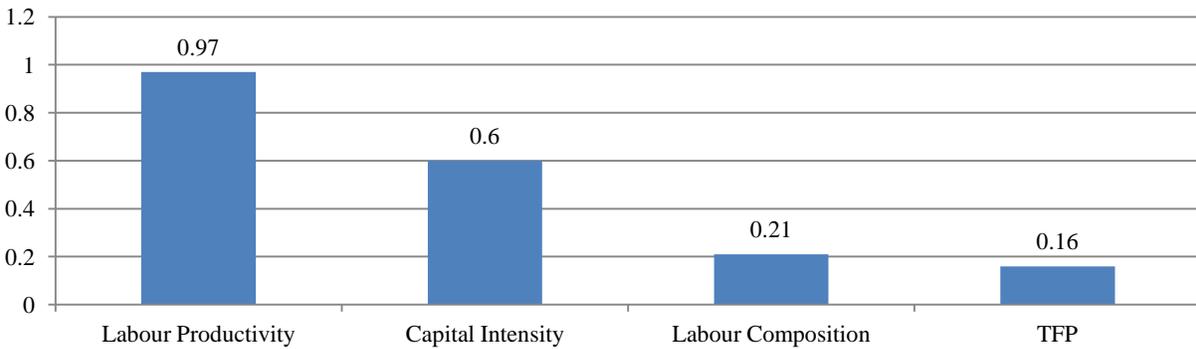
Chart 45- 47 show the contributions of the three sources of labour productivity growth in Canada for the 2000-2008 and 2008-2016 periods as well as the change between periods. The contribution of capital intensity fell 0.5 points between periods from 1.1 points in 2000-2008 to 0.6 points in 2008-2016. In contrast, the contribution of TFP increased 0.7 points from -0.6 points in 2000-2008 to 0.2 points in 2008-2016. The contribution of labour composition was stable at around 0.2 points. In other words, TFP growth, one of whose drivers is technological change picked up after 2008, even though capital accumulation faltered. This latter development is likely linked to the Great Recession.

Chart 45: Percentage Point Contributions of Capital Intensity, Labour Composition, and TFP to Labour Productivity Growth, Business Sector, Canada, 2000 - 2008



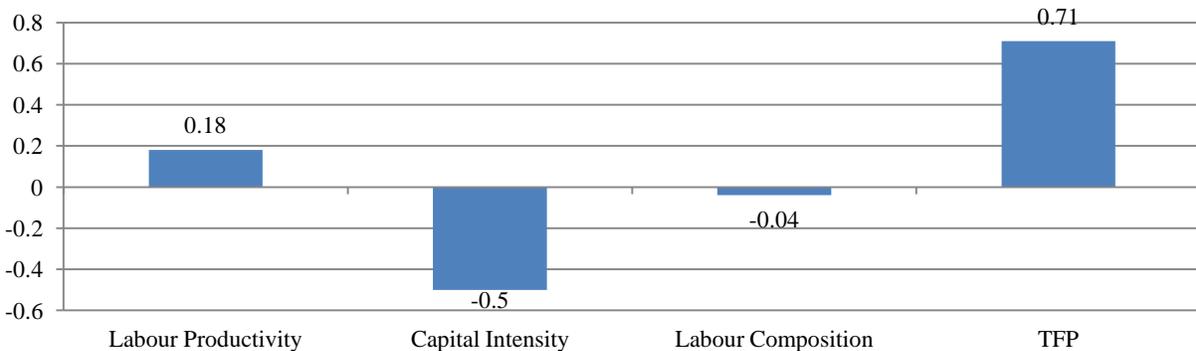
Source: CANSIM table 383-0021.

Chart 46: Percentage Point Contributions of Capital Intensity, Labour Composition, and TFP to Labour Productivity Growth, Business Sector, Canada, 2008 - 2016



Source: CANSIM table 383-0021.

Chart 47: Difference in Percentage Point Contributions of Capital Intensity, Labour Composition, and TFP to Labour Productivity Growth, Business Sector, Canada, between 2000 - 2008 and 2008 - 2016



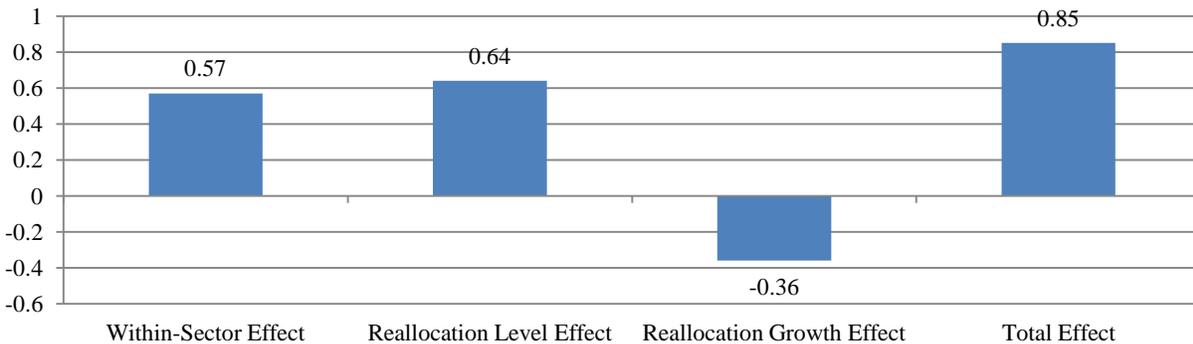
Source: CANSIM table 383-0021.

Chart 48-50 shows the contributions of within-sector effects and re-allocations effects to business sector labour productivity growth in Canada in the 2000-2008 and 2008-2016 sub-periods and the change between periods. The patterns of productivity growth in the two periods were very different even though overall productivity growth was similar. In 2000-2008 there was

a positive re-allocation effect (the sum of the level and growth effects) of 0.3 percentage points while in 2008-2018 there was a negative re-allocation effect of 0.5 points. This resulted in a swing between periods of 0.8 points, a very large number.

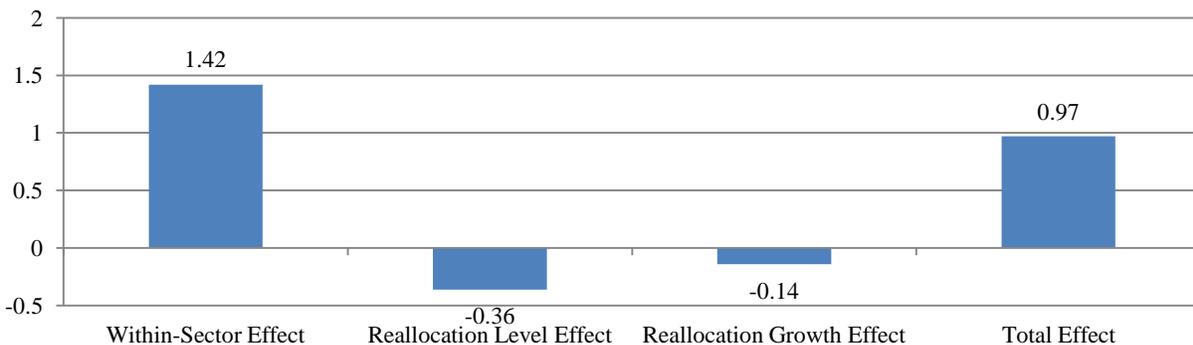
Offsetting this development was the contribution of within-sector productivity growth with the contribution to total productivity growth from this component increasing 0.8 points from 0.6 points in 2000-2008 to 1.4 points in 2008-2016. This pick-up in within-sector productivity growth at the level of the business sector is manifested by the productivity performance at the industry level, with nine of 15 industries enjoying faster productivity growth in the 2008-2016 period relative to the 2000-2008 period (Table 5). Since re-allocation effects tend to be offsetting over the long run this pick-up in within-sector productivity growth bodes well for future productivity developments.

Chart 48: Labour Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, 2000-2008



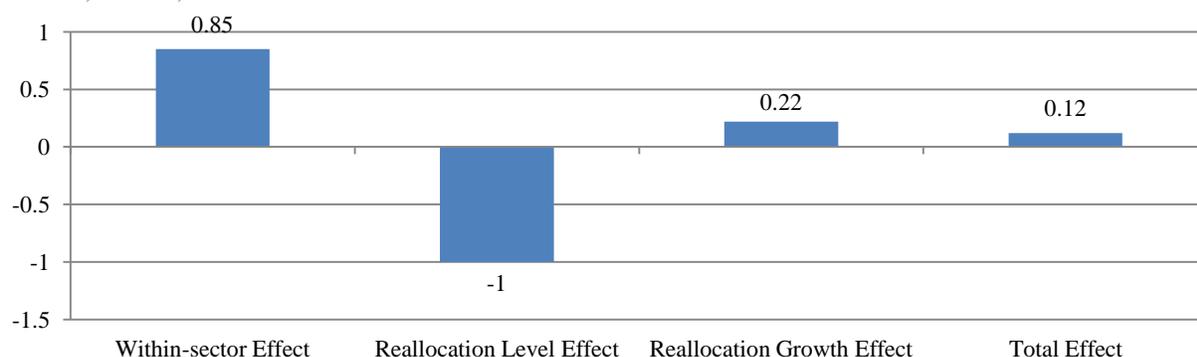
Source: CANSIM table 383-0021.

Chart 49: Labour Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, 2008-2016



Source: CANSIM table 383-0021.

Chart 50: Difference in Labour Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, between 2000 - 2008 and 2008-2016



Source: CANSIM table 383-0021.

Table 5: Number of 2-digit NAICS Industries with Increasing and Decreasing Labour Productivity, 1961 – 2016

Labour productivity				
Sub-periods	Increasing	Decreasing	Accelerating	Decelerating
2000 – 2008	11	4		
2008 – 2016	12	3	9	6
Total Factor Productivity				
Sub-periods	Increasing	Decreasing	Accelerating	Decelerating
2000 – 2008	6	9		
2008 – 2016	9	6	9	6

Source: CANSIM table 383-0021.

Some insight into these re-allocation effects can be obtained from Table 6. The labour productivity level in the mining and oil and gas sector in 2008 was 513 per cent of that of the business sector in 2008, although down from 848 per cent in 2000 due to falling productivity. The labour input share in mining and oil and gas extraction rose from 1.4 per cent of total labour input in 2000 to 2.1 per cent in 2008. This movement of resources to a very high productivity activity boosted aggregate productivity growth despite the negative productivity growth in the sector. This positive-re-allocation effect reversed after 2008 when the labour input share in mining and oil and gas extraction fell to 1.8 per cent by 2016.

Table 6: Absolute Labour Productivity, Hours Worked and Input Shares of Mining and Oil and Gas Extraction and Manufacturing, 2000 – 2016

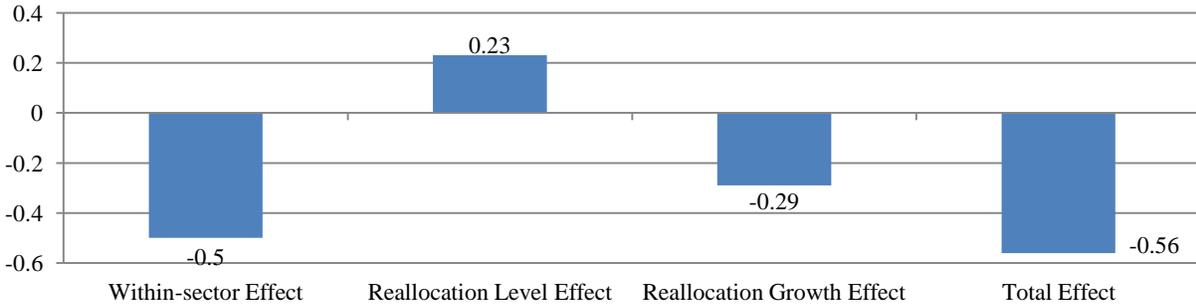
Years	Average Labour Productivity	Mining and oil and gas extraction			Manufacturing		
		Labour Productivity	Hours Worked (Million Hours)	Input Share	Labour Productivity	Hours Worked (Million Hours)	Input Share
2000	43.2	366.4	298.8	1.4	48.3	4086.9	18.7
2001	44.0	340.3	321.6	1.5	47.5	3985.0	18.3
2002	44.7	370.3	307.0	1.4	48.7	3927.8	17.8
2003	44.8	354.9	329.8	1.5	48.3	3924.3	17.5
2004	45.0	333.0	356.6	1.5	48.6	3979.7	17.2
2005	46.0	286.3	417.9	1.8	50.4	3898.8	16.8
2006	46.6	255.2	479.3	2.0	51.8	3739.5	15.9
2007	46.7	255.0	482.7	2.0	51.6	3639.5	15.2
2008	46.3	237.5	507.6	2.1	52.3	3395.7	14.1
2009	46.1	237.1	454.8	2.0	50.4	3042.9	13.3
2010	47.0	245.3	482.3	2.1	52.0	3090.6	13.2
2011	48.0	236.2	535.8	2.3	53.6	3098.3	13.0
2012	47.9	216.0	574.6	2.4	54.3	3106.3	12.8
2013	48.4	235.8	553.9	2.2	54.0	3110.9	12.6
2014	49.9	255.4	553.2	2.2	56.1	3086.5	12.4
2015	49.7	283.7	486.6	1.9	57.0	3039.5	12.1
2016	50.0	309.9	442.5	1.8	57.7	3021.6	12.0

Source: CANSIM table 383-0021.

B. Total Factor Productivity

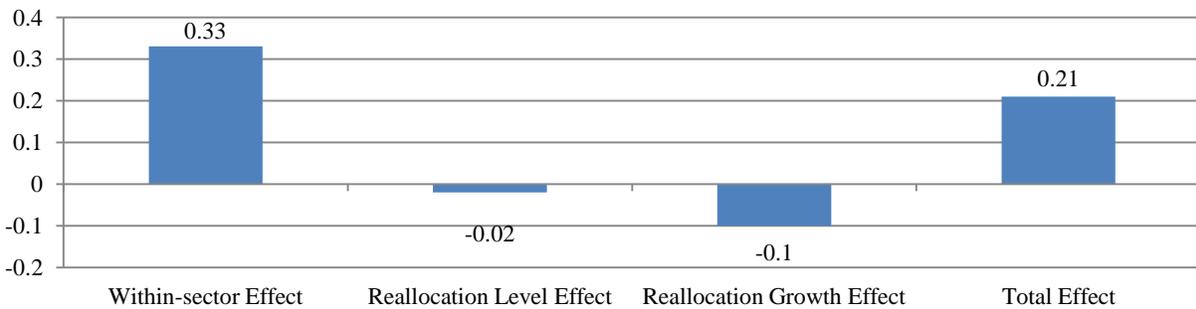
Chart 51-53 shows the contributions of within-sector effects and re-allocations effects to business sector TFP growth in Canada in the 2000-2008 and 2008-2016 sub-periods and the change between periods. The contributions of the re-allocation components in the two periods differ from that of labour productivity. While there was a major fall in the re-allocation effects for labour productivity between 2000-2008 and 2008-2016, this was not the case for TFP where the re-allocation effect was -0.1 point in both periods. This difference is explained by the capital intensive nature of the mining and oil and gas extraction, which make labour productivity differences with the business sector much greater than TFP level differences. Since there are much smaller sectoral differences in TFP, movement of capital and labour between sectors produces much smaller re-allocative gains to aggregate productivity. The within-sector contribution to TFP rose 0.8 points from -0.5 points in 2000-2008 to 0.3 points in 2008-2016. Since there was no offsetting negative development in re-allocation effect between periods, this within-sector effect translated directly into a total TFP effects, as TFP increased 0.8 points from -0.6 per cent to 0.2 per cent. This explains why TFP picked up significantly after 2008 and why labour productivity did not.

Chart 51: CSLS Total Factor Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, 2000-2008



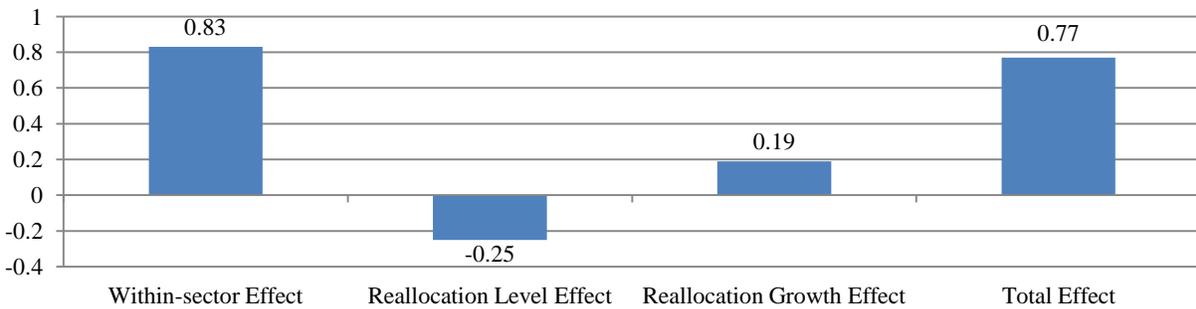
Source: CANSIM table 383-0021.

Chart 52: CSLS Total Factor Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, 2008-2016



Source: CANSIM table 383-0021.

Chart 53: Difference in Total Factor Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, between 2000 - 2008 and 2008-2016



Source: CANSIM table 383-0021.

This pick-up in within-sector TFP growth at the level of the business sector is manifested by the productivity performance at the industry level, with nine of 15 industries enjoying faster TFP growth in the 2008-2016 period relative to the 2000-2008 period (Table 5).

VI. Summary of Findings

- Both inspection and statistical tests show that productivity growth, whether measured in terms of labour productivity or total factor productivity (TFP), appears to have peaked in Canada around 2000. From 2000 to 2016, both business sector labour productivity and TFP growth have been approximately 0.7-0.8 percentage points per year weaker relative to the 1981-2000 period (1.7 per cent versus 0.9 per cent and 0.5 per cent versus -0.2 per cent respectively)
- The post-2000 productivity slowdown is actually the second productivity slowdown of the postwar period as trend productivity growth also fell after 1973. The magnitude of the first productivity slowdown was about twice that of the second slowdown.
- Slower productivity growth is not unique to Canada. Indeed, 30 out of 33 OECD countries experienced slower GDP per hour growth in the 2000-2016 period relative to 1981-2000. In terms of the magnitude of the slowdown Canada at 0.5 percentage points was the sixth smallest among the 30 countries that experienced a slowdown. This reflects in part Canada's very weak relatively productivity performance in the 1981-2000 period (30th out of 33 OECD countries for GDP per hour growth).
- The standard methodology used by economists to analysis the sources of economic growth is growth accounting, which disaggregates labour productivity growth into contributions from capital intensity, labour quality, and total factor productivity growth. Estimates produced by Statistics Canada show that fourth fifths (0.65 points out of 0.82 points) of the labour productivity slowdown between the 1981-2000 and 2000-2016 periods was due to the fall in TFP growth, with one fifth from a smaller contribution from labour composition and no contribution from capital intensity. Unfortunately, TFP is a black box or "measure of our ignorance" so this finding tells little about the causes of the productivity slowdown, only that it appears not to be associated with weaker capital intensity and human capital growth. Factors affecting TFP include capacity utilization, economics of scale and scope, and measurement problems as well as the pace of underlying technical progress not embodied in new capital equipment.
- Slower productivity growth has not been pervasive across all industries. Indeed, only eight of 15 industries experienced slower labour productivity growth in 2000-2016 period relative to 1981-2000, and seven industries enjoying faster labour productivity growth. The largest decline in mining and oil and gas production (3.4 percentage points per year), followed by manufacturing (2.2 points). Productivity growth picked up after 2000 in a number of service industries, especially arts, entertainment, and recreation (2.5 points).

- The contributions by industry to the productivity slowdown are determined by both the absolute size of an industry's productivity growth slowdown and the importance of the industry in total input and output, and reallocation effects. Manufacturing accounted for all the labour productivity slowdown, with additional contributions from construction, agriculture, and retail trade offset by negative contribution (higher productivity growth after 2000) in ASWMRB and other service industries. In terms of the industry contributions to the TFP slowdown manufacturing and mining and oil and gas extraction made equally large contributions of around 0.5 points, with FIRE making a negative contribution of around 0.3 points.
- In general, the productivity performance of goods sector industries has been worse after 2000, while that of service sector industries has improved. The post-2000 productivity slowdown is largely a good sector phenomenon.
- Aggregate productivity growth can be decomposed into contributions from within industry productivity growth and re-allocation effects from movement of inputs between industries with different productivity levels and growth rates. For the 2000-2016 period there was minimal effect of reallocation on aggregate productivity growth as had been the case in 1981-2000, with most all aggregate productivity growth generated within sectors.
- The post-2000 productivity growth slowdown was experienced by eight of ten provinces, although the magnitude of the slowdown varied considerably. Newfoundland and Labrador had the largest decline in absolute terms between 1997-2000 and 2000-2016 (no official provincial estimates are available before 1997) at 3.8 points, followed by Ontario at 2.5 points. Ontario made the largest contribution to the post-2000 labour productivity at 0.9 points, followed by Quebec at 0.5 points.
- Since 2000, productivity growth appears to have been quite similar in the 2000-2008 and 2008-2016 sub-periods at 0.8 per cent per year in 2000-2008 and 1.0 per cent in 2008-2016. But this similarity masks underlying differences between periods in the sources of labour productivity growth, the impact of re-allocation effects, and the number of industries experiences stronger productivity growth. The contribution of capital intensity fell off 0.5 points between the 2000-2008 and 2008-2016 sub-periods, while the contribution of TFP increased 0.7 points. In terms of the relative importance of within-sector productivity growth and re-allocations effects, in 2000-2008 re-allocation effects added 0.3 points to business sector productivity growth while in 2008-2016 these effects subtracted 0.5 points, a major turnaround. Conversely, the contribution of the within-sector productivity growth to business sector productivity growth rose from 0.6 points in 2000-2018 to 1.4 points in 2008-2016. Since within-sector productivity growth is what drives overall productivity growth in the long run, this development augurs well for

future productivity growth. Nine of 15 industries experienced faster labour productivity growth in 2008-2016 relative to 2000-2008, and three industries experienced negative labour productivity down from four in 2000-2008.

- A detailed analysis of the causes of the slower productivity is beyond the scope of this paper and will be subject to future work. However, given the important of R&D as a driver of productivity growth, it is useful at this time to point out that the post-2000 productivity slowdown corresponds with a significant fall in BERD intensity, from 1.2 per cent of GDP in 2000 to 0.7 per cent in 2016. This fall-off is entirely accounted for by the manufacturing sector, which was the sector that made the largest contribution to the productivity slowdown.

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