

# The Stylized Facts about Slower Productivity Growth in Canada

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## 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 in Canada 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 article is to highlight the stylized facts of this important development. It first examines trends in both labour productivity and total factor productivity (TFP) at the aggregate level. It discusses growth accounting estimates of changes in the sources of labour productivity growth. Labour and total factor productivity estimates are provided for 15 industries, highlighting which industries experienced the largest slowdown in absolute terms and the industry contributions to the slowdown. Manufacturing is found to be the industry making the largest contribution to both the labour productivity and TFP slowdowns. Contributions of within-industry productivity growth and re-allocation effects to aggregate productivity growth are also examined.

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 rea-

sons 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 article is to highlight these stylized facts related to this important development from a number of perspectives, including the timing of the slowdown, the slowdown in inter-

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national perspective, the sources of the slowdown from a growth accounting perspective and in terms of within-sector and re-allocation effects, and the industry dimensions to the slowdown.

The article consists of four 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 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 fourth and last section summarizes and concludes.<sup>2</sup>

The data for this article come from Statistics Canada. Indeed, we use annual sectoral data from Table 36-10-

0208-01 at the national level from 1961 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 A1 in the Appendix lists the 15 industries and provided their NAICS codes.<sup>3</sup> Labour productivity in these tables is real value-added gross domestic product (GDP) per hour worked. Total factor productivity is real value-added GDP per unit of combined labour and capital inputs.

## **Productivity Trends at the Aggregate Level**

This section discusses labour productivity growth and total factor productivity growth at the aggregate level 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 then look at total factor productivity in the business sector in the same manner.

## **Labour Productivity in the Business Sector**

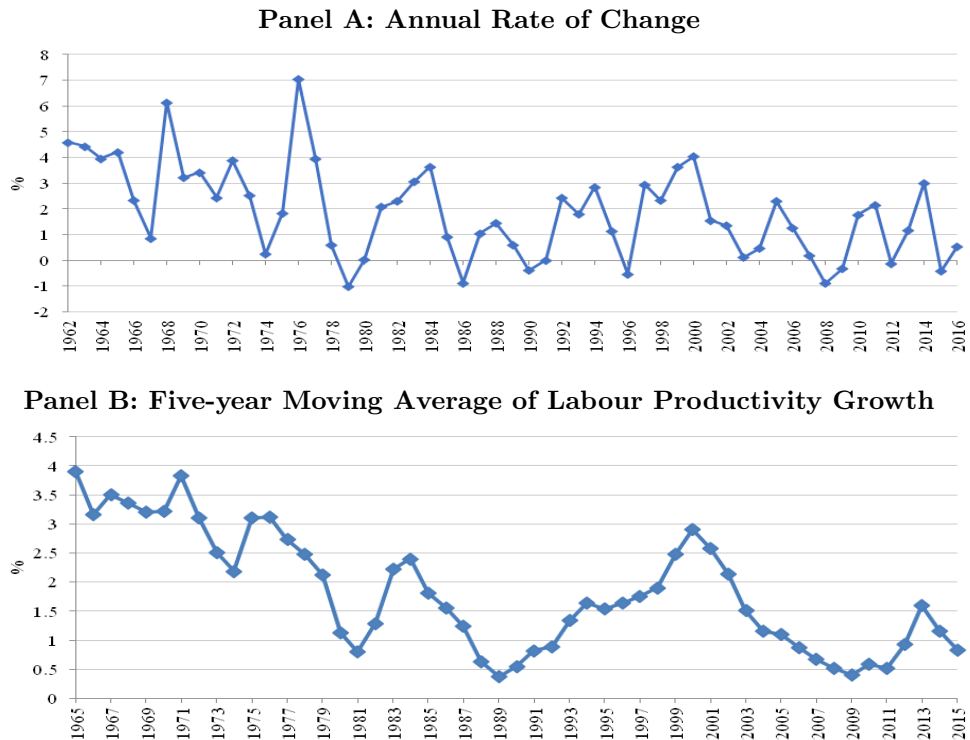
Panel A of Chart 1 shows the annual growth in business sector labour productivity in Canada from 1961 to 2016 while Panel B of Chart 1 provided a five-year moving average of the time series. Pro-

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<sup>2</sup> The paper presented at the 2018 CEA annual meeting included a discussion of productivity trends by province. This material is not included in this article for two reasons. First, to make the article shorter. Second, because of official productivity estimates for the provinces are only available from 1997, the three years pre-2000 productivity slowdown period is considered too short for a definitive comparison of productivity trends by province between the pre-2000 and post-2000 periods. For the provincial analysis, see Sharpe and Tsang (2018).

<sup>3</sup> The tables and charts in the Appendix are found at [www.csls.ca/ipm35/sharpe\\_tsang\\_appendix.pdf](http://www.csls.ca/ipm35/sharpe_tsang_appendix.pdf).

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



Source: Table 36-10-0208-01, Statistics Canada.

ductivity 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.

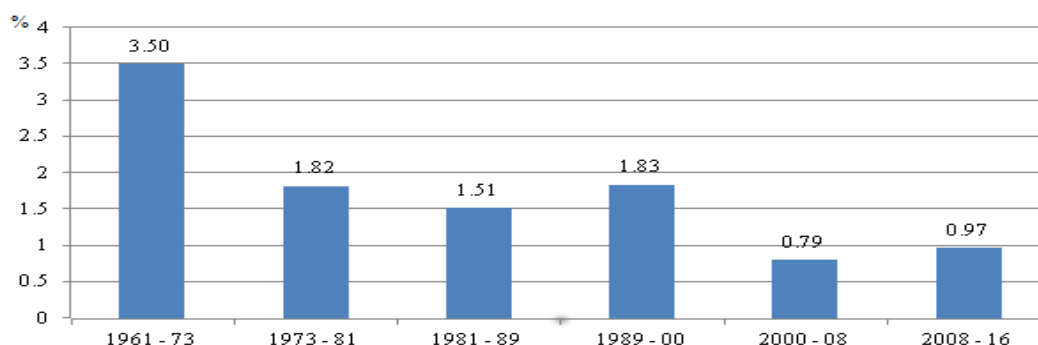
The five-year moving average series smoothes these annual variations and provides a better indication of trend productivity growth. One sees a sharp decline in trend in the 1970s, which was partially reversed in the early 1980s before again falling precipitously in the second fall of the 1980s, only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

Superimposed on these five-year mov-

ing averaged is the long-term two-step downward shift in labour productivity, which is shown in Chart 2 for six cyclically neutral periods, defined on a output peak to output peak basis.<sup>4</sup> 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

<sup>4</sup> See Chart A1 in the Appendix for a graphical presentation of labour productivity growth.

**Chart 2: Business Sector Labour Productivity Cyclically Neutral Periods, 1961-2016 (average annual rate of change)**



Source: Table 36-10-0208-01, Statistics Canada.

**Table 1: Business Sector Labour Productivity in Canada, 1961-2016 (average annual rate of change)**

LP Peaks	Growth	Output Peaks	Growth	10-year Periods	Growth	5-year Periods	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: Table 36-10-0208-01, Statistics Canada.

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 cyclically-neutral output peak to peak periods. Table 1 contains average annual growth rates between labour productivity peaks,<sup>5</sup> as well as 10-year periods and 5-year periods growth rates from 1961 to 2016. The early half of 1960s had the highest labour produc-

tivity growth (4.30 per cent from 1961 to 1965), followed by continuous declines until the end of 1980s. In 1990s, labour productivity growth picked up, especially during the second half of the decade. It declined again after 2000, picking up slightly in the 2010s.

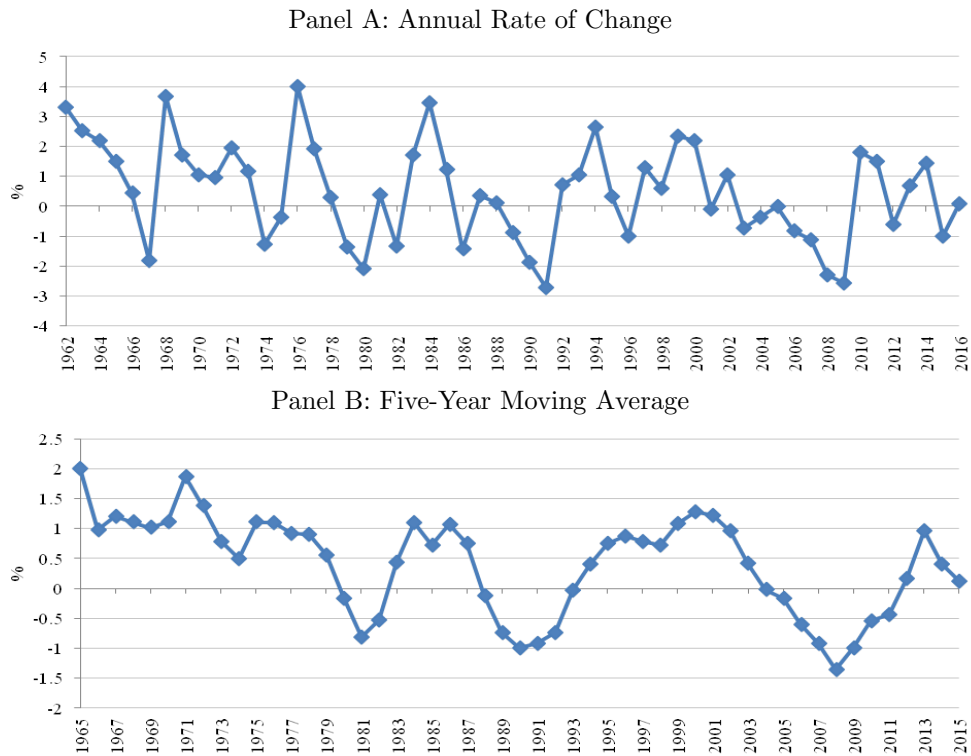
### Total Factor Productivity in the Business Sector

Panel A of Chart 3 shows the annual growth in total factor productivity or multifactor productivity<sup>6</sup> business sector in Canada from 1961 to 2016 while Panel

<sup>5</sup> Productivity peaks are defined in an absolute sense as the year before productivity growth turns negative.

<sup>6</sup> The two terms are used synonymously in this article.

**Chart 3: Business Sector Total Factor Productivity Growth in Canada, 1962-2016**



Source: Table 36-10-0208-01, Statistics Canada.

B 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.

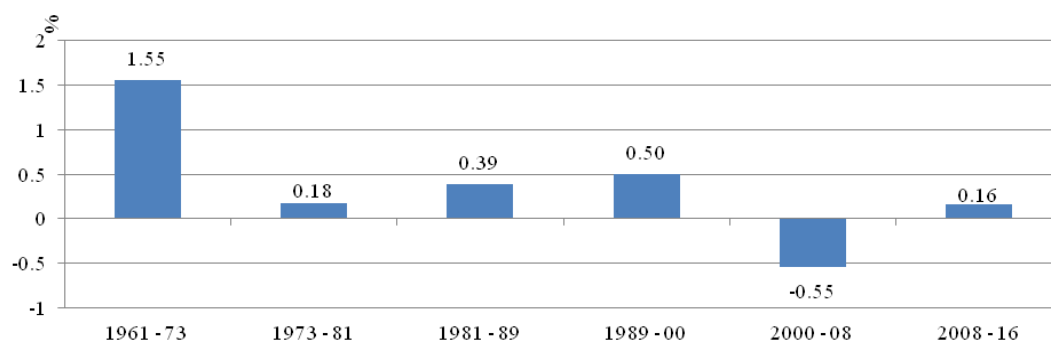
Again, the five-year moving average series smooths these annual variations and provides a better indication of trend productivity growth. The pattern is very similar to that of labour productivity, with a sharp decline in trend in the 1970s, which was partially reversed in the early 1980s before again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

Superimposed on these five year moving averaged is the long-term two-step downward trend in TFP, which is shown

in Chart 4 for six cyclically neutral periods, defined on a output peak to output peak basis.<sup>7</sup> 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 averaged 0.3 per cent per year. The second TFP slowdown occurred after 2000 when TPF growth averaged -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.

<sup>7</sup> See Chart A2 in the Appendix for graphical illustration of TFP growth between output peaks.

**Chart 4: Total Factor Productivity Growth in the Business Sector in Canada, 1961-2016 (average annual rate of change)**



Source: Table 36-10-0208-01, Statistics Canada.

**Table 2: Business Sector Total Factor Productivity in Canada (average annual growth rate, per cent), 1961-2016**

TFP Peaks		Output Peaks		10-year Periods		5-year Periods	
Peaks	Growth	Peaks	Growth	Periods	Growth	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

Source: Table 36-10-0208-01, Statistics Canada.

Alternative dating of productivity trends confirms the two-step downward trend in TFP growth based on cyclical-neutral output peak to peak period. Table 2 contains average 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, followed by negative TFP growth in the 2000s, with some pick-up after 2010.

### Canada's Aggregate Productivity Performance from an International Perspective

Slower productivity growth since 2000 is not unique to Canada. Indeed, Chart 5 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.

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, and well below the OECD average of 1.7 percentage points. This reflects

in part Canada's very weak relative productivity performance in the 1981-2000 period when Canada ranked 30th out of 33 OECD countries for GDP per hour growth (Chart A3 in the Appendix).

Indeed, in the 2000-2016 period Canada's ranked 24<sup>th</sup> out of 33 OECD countries in terms of labour productivity growth (Chart A3 in the Appendix), better than in the pre-2000 period.

Chart 6 above 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 business sector 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 2016.

### **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. Estimates produced by Statistics Canada are found in Panel A of Chart 7 for the 1981-2000 period, Panel B for the 2000-2016 period and Panel C for the change between pe-

riod.

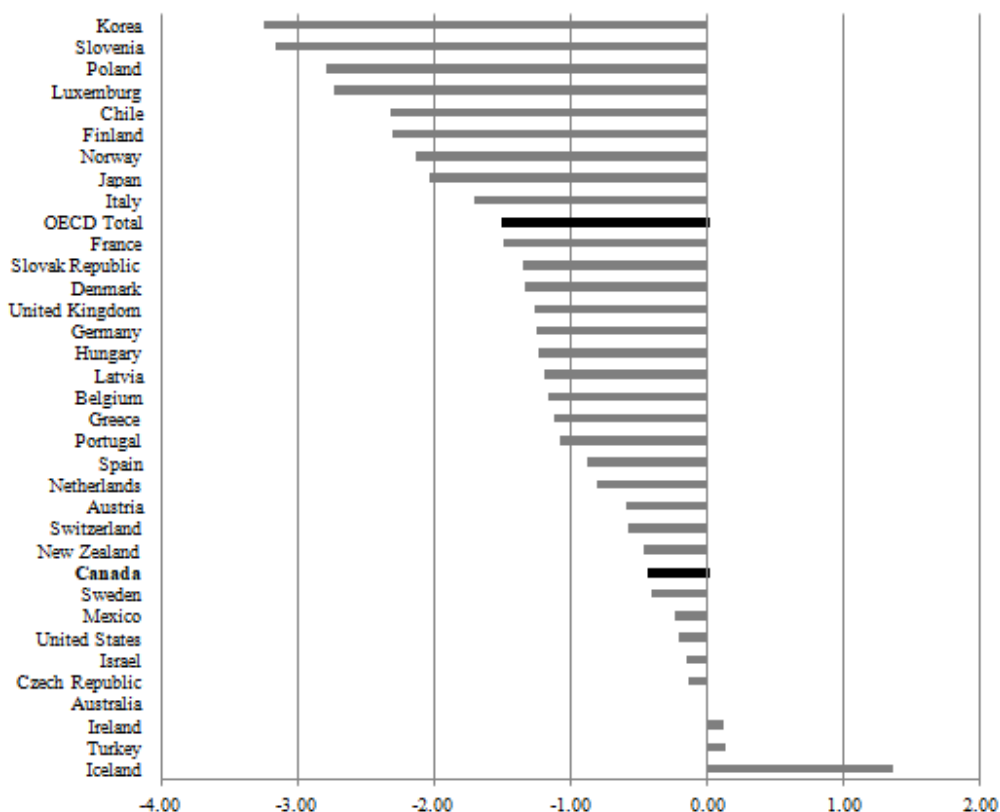
The major finding is that four fifths (0.65 points out of 0.82 points) of the labour productivity slowdown between the 1981-2000 and 2000-2016 periods was due to the fall in TFP growth, which fell from 0.45 per cent per year to -0.20 per cent. The remaining fifth came from a smaller contribution from 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.

### **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

Chart 5: Change in GDP per hour Growth in OECD Countries, between 1981-2000 and 2000-2016 (percentage points per year)



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](http://stats.oecd.org/Index.aspx?DataSetCode=PDB_GR)

made on an industry basis to contribution by industry can also be obtained as well as the relative importance of within-sector productivity growth and reallocation effects, the sum of the level and growth effects.

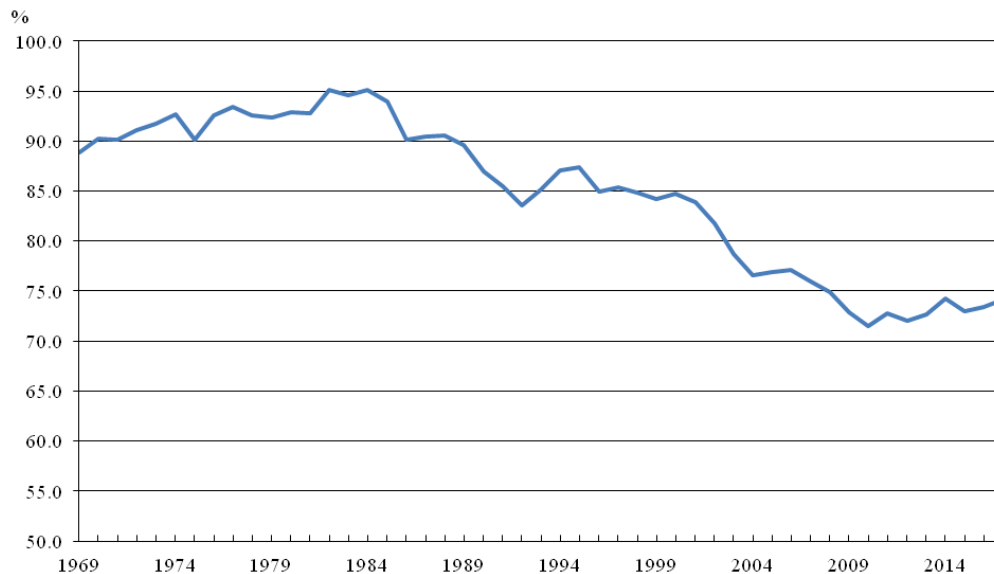
Panel A of Chart 8 provides estimates of the decomposition of aggregate labour productivity into the within-sector effects and the reallocation effects for the 1981-2000 period, Panel B for the 2000-2016 period, and Panel C for the change between period. The bottom line is that reallocation effects appear to have made dampened the post-2000 fall in labour productivity growth.

In the 1981-2000 period re-allocation effects subtracted -0.25 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



**Chart 6: Relative Labour Productivity Levels (GDP per hour) in the Business Sector in Canada, 1969-2016 (Canada as % of the United States)**



Source: CSLS estimates.

points.

Panel A of Chart A5 in the Appendix provides estimates of the decomposition of TFP into the within-sector effects and the reallocation effects for the 1981-2000 period, Panel B for the 2000-2016 period, and Panel C for the change between period. The bottom line is that in contrast to labour productivity, reallocation effects appear to have increased the post-2000 decline in TFP growth.

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.

## Productivity Growth at the Sectoral Level

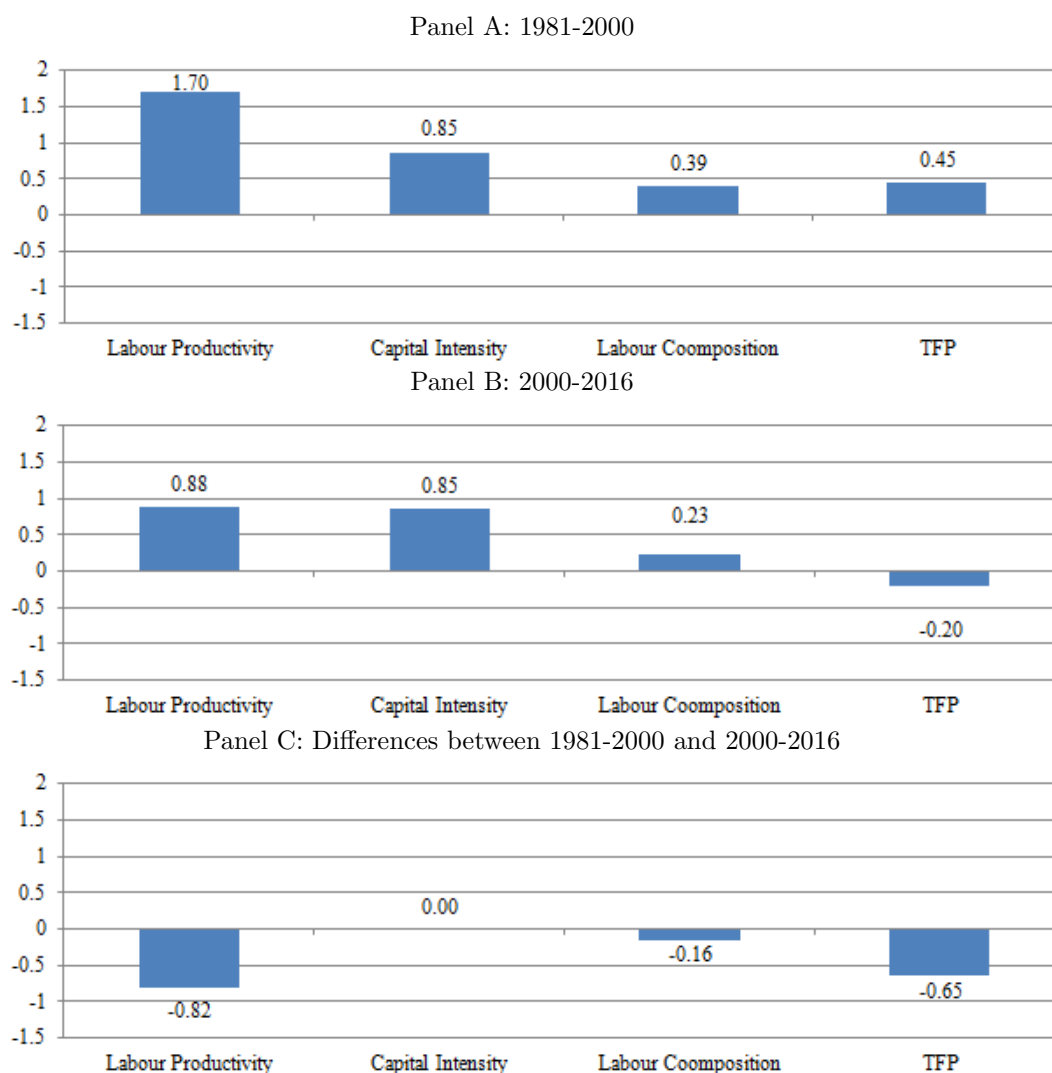
### Labour Productivity by Industry

#### 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. Panel A of Chart 9 shows compound annual growth rates for output per hour for 15 two-digit NAICS industries for the 1981-2000 period, Panel B gives the figures for the 2000-2016 period, and Panel C the differences between periods.

Slower productivity growth has not been pervasive across all industries. In-

**Chart 7: Contributions of Capital Intensity, Labour Composition, and MFP to Labour Productivity Growth, Business Sector, Canada, 1981-2000 and 2000-2016 (percentage points per year)**



Source: Table 36-10-0208-01, Statistics Canada.

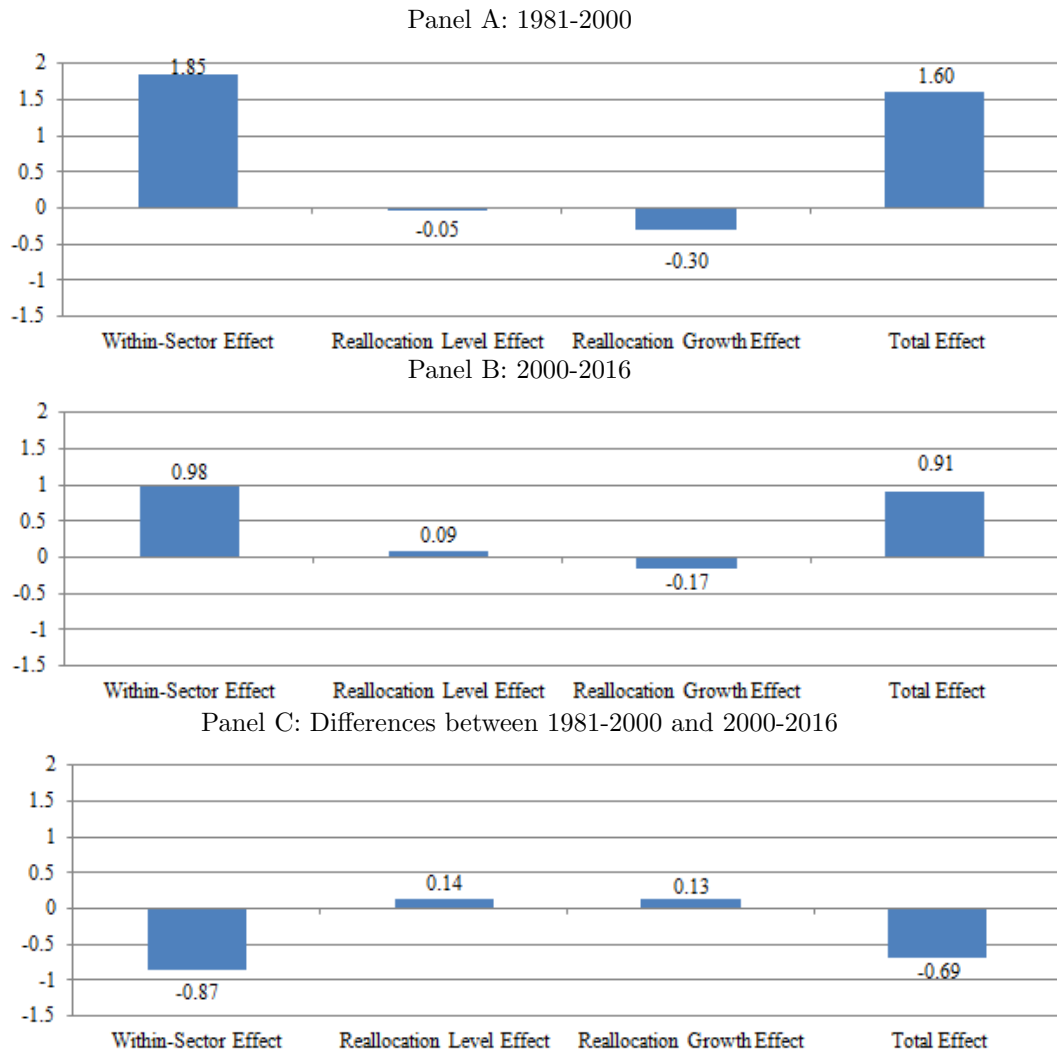
deed, only eight of 15 industries experienced slower labour productivity growth in 2000-2016 period relative to 1981-2000, and seven industries enjoying faster labour productivity growth.

The largest slowdown in labour productivity growth occurred 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, enter-

tainment, and recreation (2.5 points).

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 ser-

**Chart 8: CSLS Labour Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, 1981-2000 and 2000-2016**



Source: Table 36-10-0208-01, Statistics Canada.

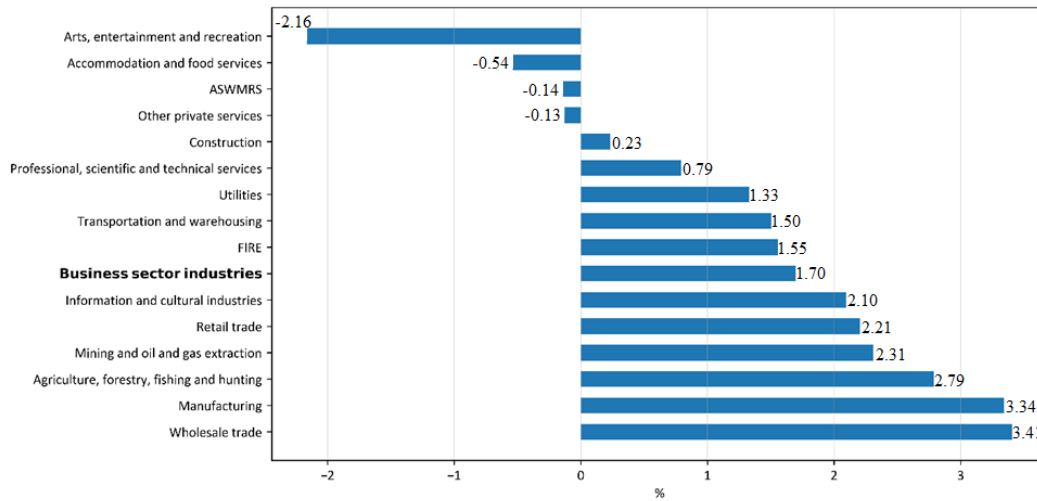
vices. In contrast to the 2000-2016 period only two industries, both in the goods sector, experienced absolute declines: mining and oil and gas extraction and construction. The improved performance of a number of service sector industries is a positive development for overall productivity growth and suggests that the productivity slowdown was a phenomenon largely concentrated in the goods sector.

### Contributions by Industry

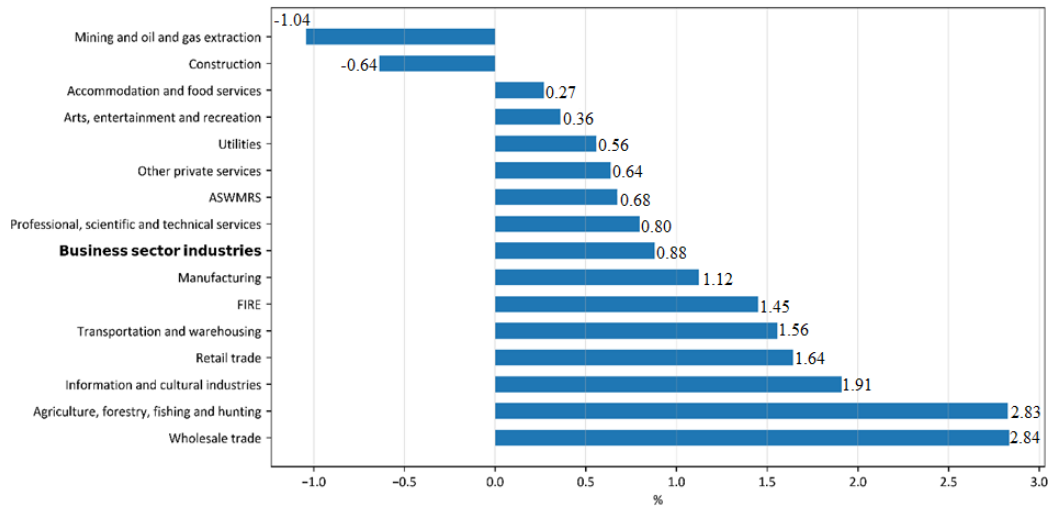
The contributions by industry to the productivity slowdown are determined by both the absolute size of an industry's productivity growth slowdown and the importance of the industry in total input and output, and reallocation effects. Panel A of Chart 10 shows the contributions to business sector labour productivity growth for the 15 industries in the 1981-2000 period, Panel B for the 2000-2008 period, and Panel C for the change between periods.

**Chart 9: Labour Productivity Growth in Canada by Industry, 1981-2000 and 2000-2016 (average annual rate of change)**

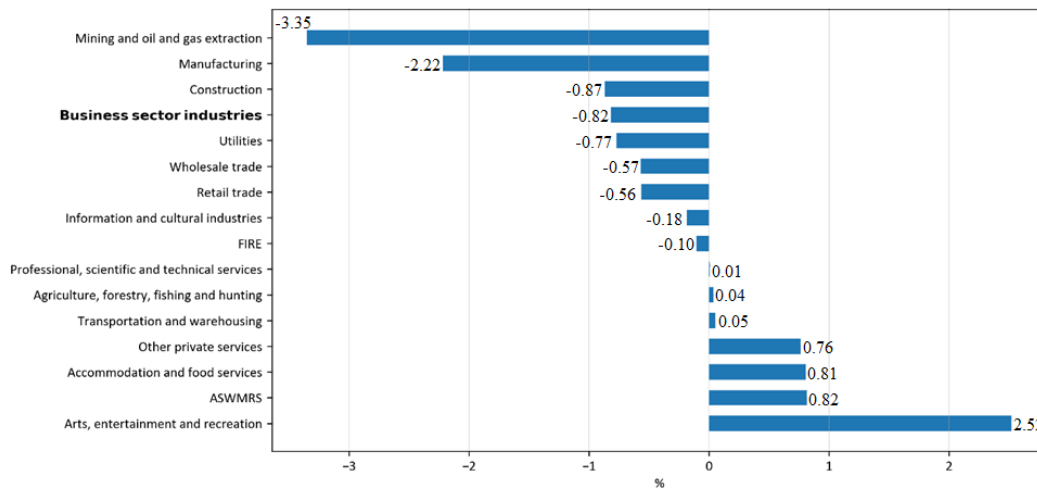
Panel A: 1981-2000



Panel B: 2000-2016



Panel C: Differences between 1981-2000 and 2000-2016 (percentage point change)

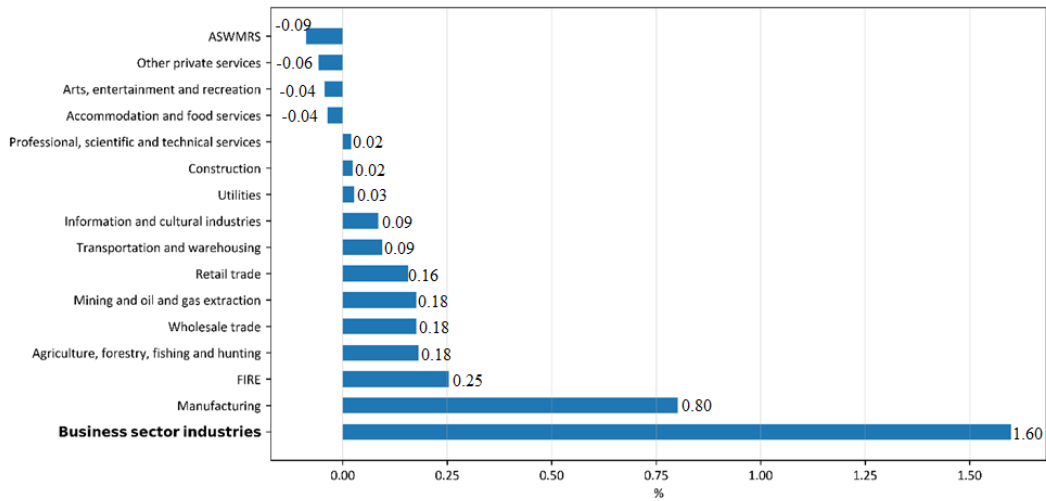


Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.

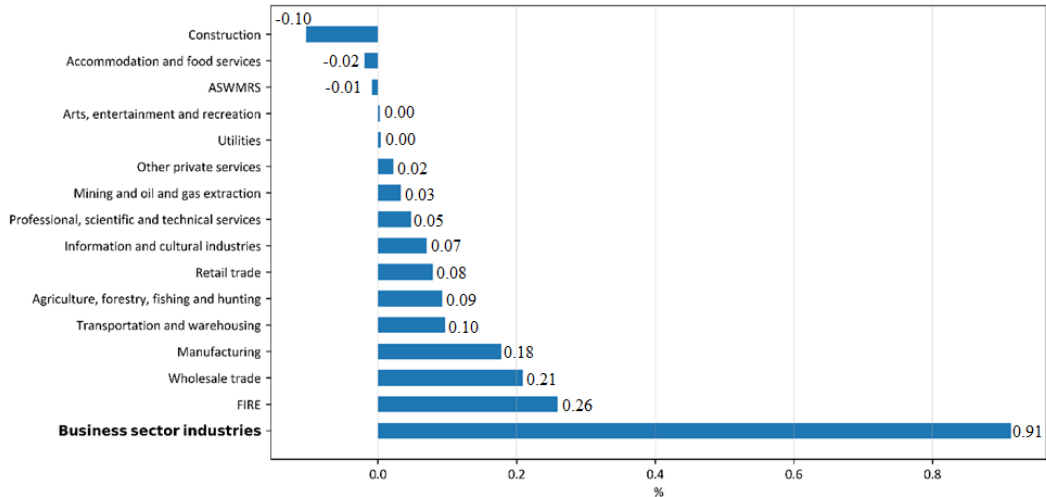
Source: Table 36-10-0208-01, Statistics Canada.

Chart 10: Contribution to Labour Productivity Growth in Canada by Industry, 1981-2000 (percentage point contribution)

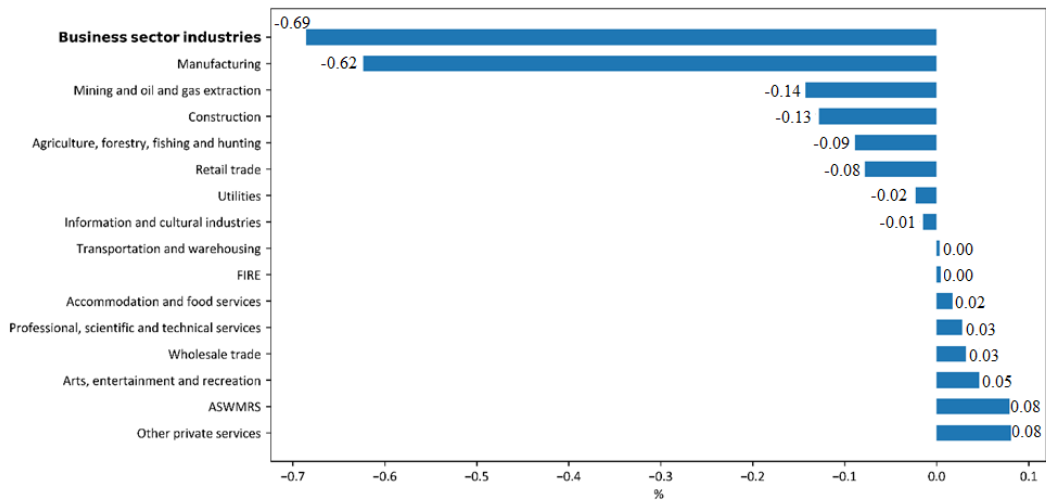
Panel A: 1981-2000



Panel B: 2000-2016



Panel C: Differences between 1981-2000 and 2000-2016 (Percentage Point Change)



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

Source: Table 36-10-0208-01, Statistics Canada.

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 (0.62 points), this sector accounted for almost all (91 per cent) the labour productivity slowdown of 0.69 points. Additional contributions to the slowdown came from mining and oil and gas extraction, construction, agriculture, and retail trade offset by negative contribution (higher productivity growth after 2000) in ASWMRS and other service industries.

## Trends in TFP by Industry

### Growth Rates

Panel A of Chart 11 shows compound annual growth rates for TFP for 15 two-digit NAICS industries for the 1981-2000 period, Panel B gives the figures for the 2000-2016 period, and Panel C the differences between periods.

As was the case for labour productivity, slower TFP growth after 2000 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 labour productivity growth.

It is interesting to note that the profile of industries experiencing negative TFP growth changed 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.

### Contributions by Industry

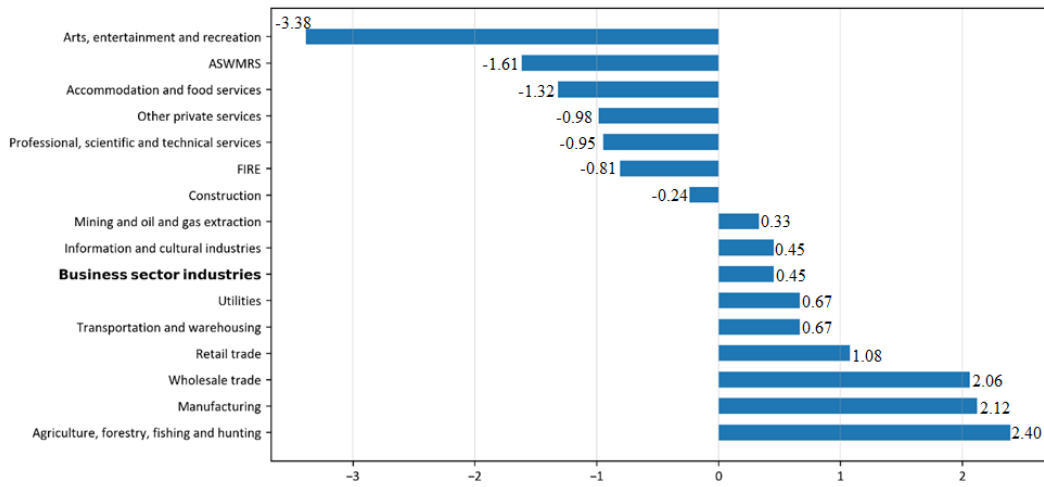
Panel A of Chart A6 in the Appendix shows the contributions to business sector TFP growth for the 15 industries in the 1981-2000 period, Panel B for the 2000-2008 period, and Panel C for the change between periods.

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.

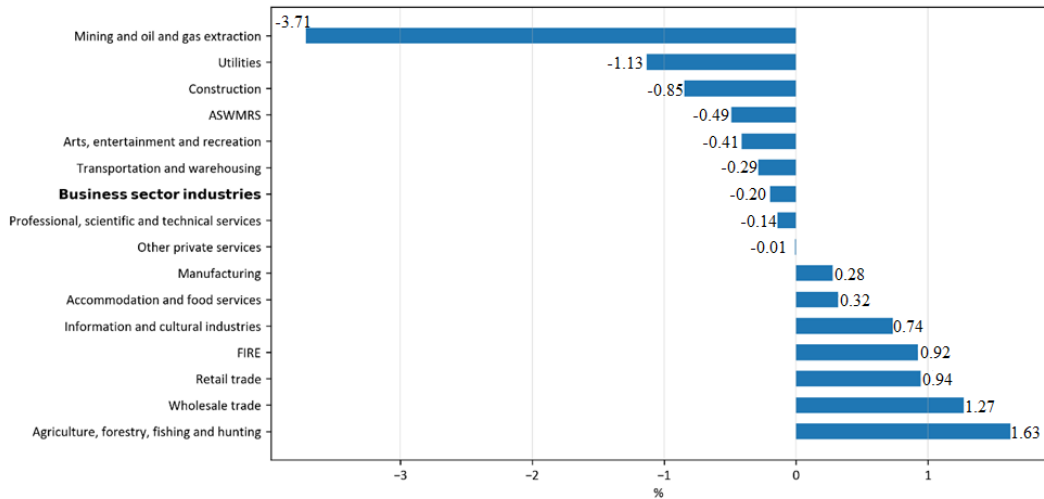
In the 2000-2016 period the largest industry contribution to TFP growth was made by FIRE at 0.14 points, followed by wholesale trade at 0.09 points. Manufacturing was fourth at only 0.03 points. On the other hand, mining, and oil and gas extraction contributed -0.43 points to TFP, more than double actual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

Chart 11: Total Factor Productivity Compound Annual Growth Rates by Industry, 1981-2000 and 2000-2016

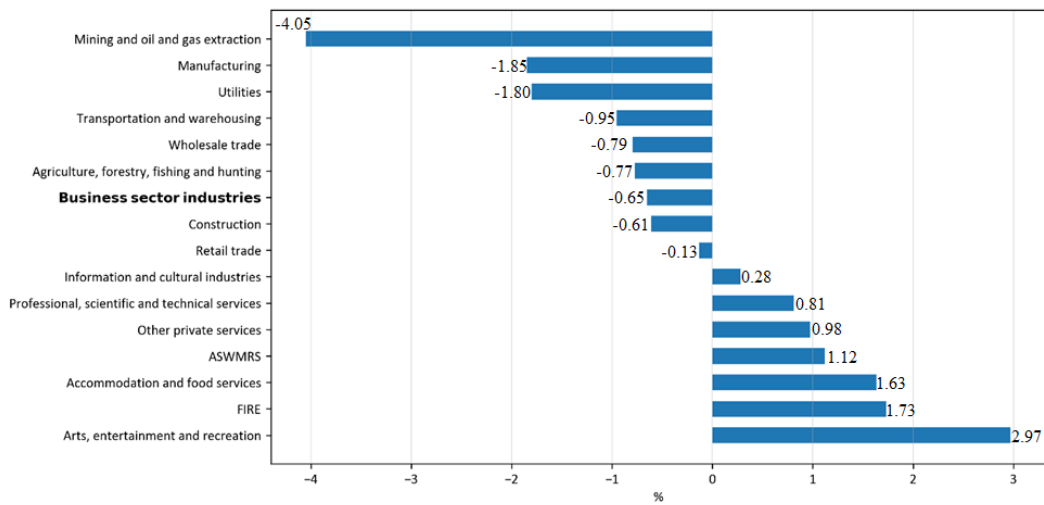
Panel A: 1981-2000



Panel B: 2000-2016

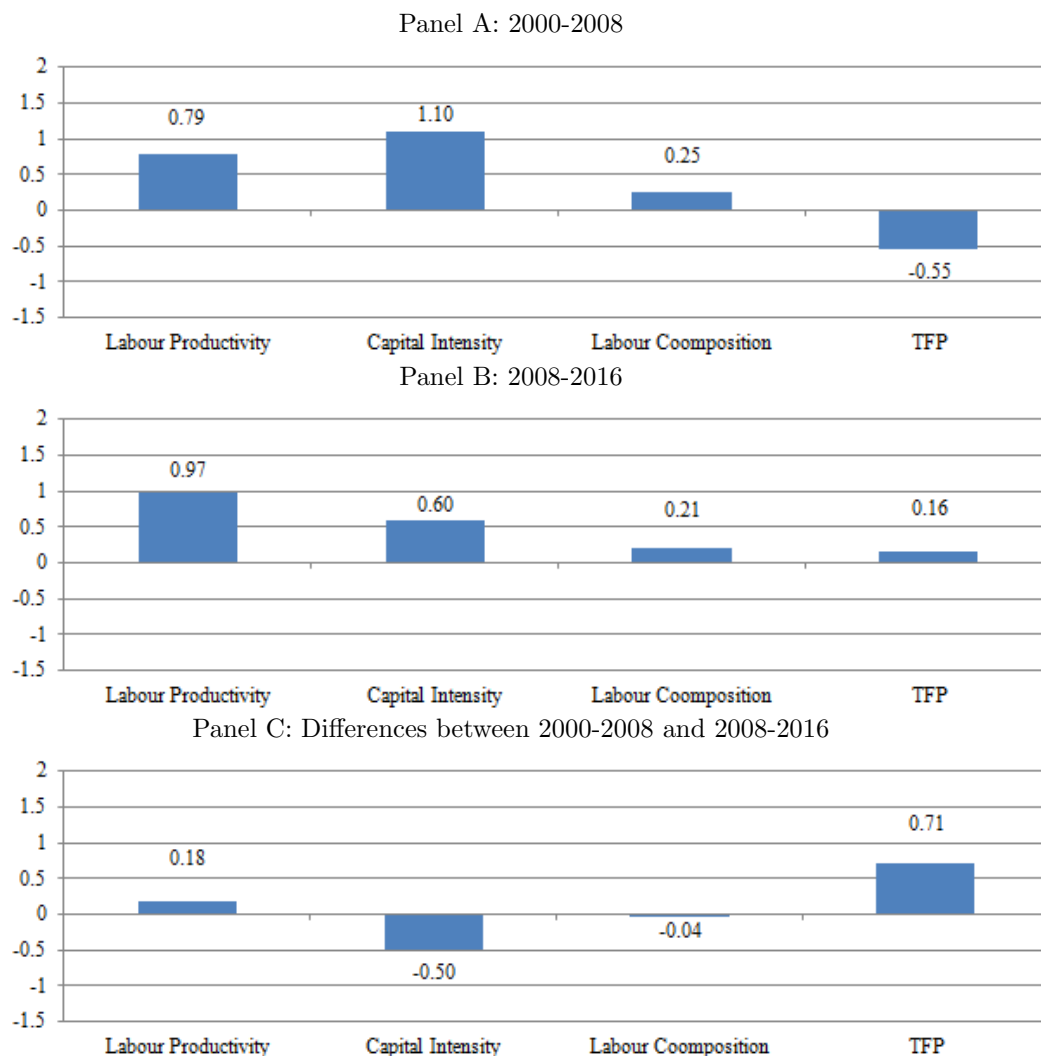


Panel C: Differences between 1981-2000 and 2000-2016 (Percentage Point Change)



Note: FIRE stands for finance, insurance, real estate, rental and leasing. ASWMRS stands for administrative support, waste management and remediation services.  
Source: Table 36-10-0208-01, Statistics Canada.

**Chart 12: Sources of Labour Productivity Growth in Canada, Business Sector, 2000-2008 and 2008-2016 (percentage point contributions)**



Source: Table 36-10-0208-01, Statistics Canada.

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.

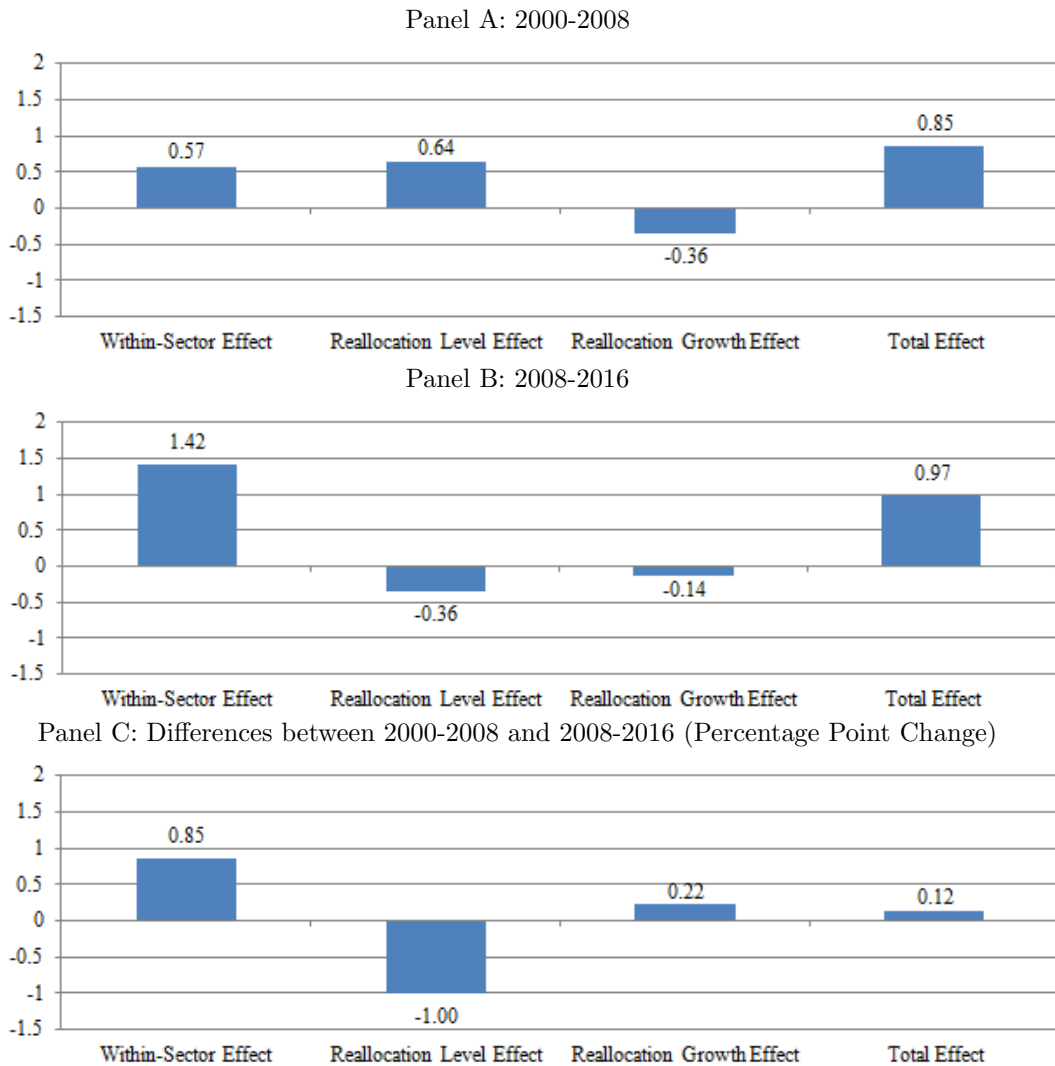
The industry contributions to TFP growth in the 1981-2000 and 2000-2016 periods and the change between periods mirror the industry contributions to labour productivity growth.

## Productivity Developments within the Post-2000 Period

Since 2000, labour productivity growth in Canada appears to have been quite similar in the 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.



**Chart 13: Labour Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, 2000-2008 and 2008-2016**



Source: Table 36-10-0208-01, Statistics Canada.

### Labour Productivity

Chart 12 shows the contributions of the three sources of labour productivity growth in Canada for the 2000-2008 (Panel A) and 2008-2016 (Panel B) periods as well as the change between periods (Panel C). The contribution of capital intensity fell off 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 contribu-

tion 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 13 shows the contributions of within-sector effects and re-allocations effects to business sector labour productivity growth in Canada in 2000-2008 (Panel A) and 2008-2016 (Panel B) sub-periods and the change between periods

**Table 3: Number of 2-digit NAICS Industries with Increasing and Decreasing Labour Productivity, 2000-2008 and 2008-2016**

<b>Labour Productivity</b>				
<b>Sub-periods</b>	<b>Increasing</b>	<b>Decreasing</b>	<b>Accelerating</b>	<b>Decelerating</b>
2000 - 2008	11	4		
2008 - 2016	12	3	9	6
<b>Total Factor Productivity</b>				
<b>Sub-periods</b>	<b>Increasing</b>	<b>Decreasing</b>	<b>Accelerating</b>	<b>Decelerating</b>
2000 - 2008	6	9		
2008 - 2016	9	6	9	6

Source: Table 36-10-0208-01, Statistics Canada.

(Panel C). 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, to total productivity growth, 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 3). 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.

Some insight into these re-allocation effects can be obtained from Table A2 in the Appendix. The labour productiv-

ity 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 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.

### **Total Factor Productivity**

Chart 14 shows the contributions of within-sector effects and re-allocations effects to business sector TFP growth in Canada in the 2000-2008 (Panel A) and 2008-2016 (Panel B) sub-periods and the change between periods (Panel C). 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 ef-

**Chart 14: CSLS Total Factor Productivity Decomposition, Business Sector, Compound Average Annual Growth Rates, Per Cent, Canada, 2000-2008 and 2008-2016**



Source: Table 36-10-0208-01, Statistics Canada.

fect 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.

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 3).

## Summary and Conclusion

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).

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 slower productivity growth. 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).

Growth accounting 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.

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).

Manufacturing accounted for almost all the labour productivity slowdown (91 per cent), with additional contributions from construction, agriculture, and retail trade offset by negative contribution (higher productivity growth after 2000) in a number of 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.

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.

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 labour 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 productiv-

ity 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.

A detailed analysis of the causes of the slower productivity is beyond the scope of this article and will be subject to future work. However, given the importance 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.

## References

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