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A Detailed Analysis of Newfoundland and Labrador's Productivity Performance, 1997-2018

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Executive Summary

Driven by the mining and oil and gas extraction sector, Newfoundland and Labrador's economy experienced impressive growth from 1997 to 2007, with real business sector output advancing at a compound annual rate of 7.7 per cent, more than double the Canadian average (3.4 per cent per year). The situation changed dramatically after 2007 when oil and gas output plummeted. Real business sector GDP in the province declined during the 2007-2018 period at a rate of 1.1 per cent per year while that in Canada rose at 1.5 per cent per year. The productivity performance mirrored that of real output. Business sector labour productivity in the province grew at 6.0 per cent per year during the 1997-2007 period and then fell 1.2 per cent per year during the 2007-2018 period.

The main goal of this report is to describe and explain the trends in productivity in Newfoundland and Labrador. In doing so, the report also describes trends in the variables used in the calculation of productivity, including output, labour input, and capital input. The numbers for Newfoundland and Labrador are compared to those in Canada as a whole, as well as to specific provinces.

The main take-away from the report is the importance of the oil and gas sector to the economy of Newfoundland and Labrador. That sector has been responsible for most of Newfoundland and Labrador's economic growth, and now accounts for the largest share of the province's business sector value added among 2-digit NAICS subsectors, even though it employs only 3.8 per cent of the province's business sector workers in 2018. Due to the size of the mining and oil and gas extraction sector, overall productivity continues to represent a major challenge for the province. However, looking at the business sector excluding mining and oil and gas, productivity growth does fare better. Identifying the main sources and drivers of productivity growth is a necessary first step towards shaping policies that promote growth output and productivity in the province.

Trends in Output

Among two-digit NAICS subsectors of the business sector, the mining and oil and gas extraction sector played an essential role, either positive or negative, in the province's business sector output. Indeed, this sector accounted for 77.7 per cent (6.1 percentage points of 7.8 percentage points) of the business sector real GDP average annual growth from 1998 to 2007 and -1.8 percentage points of -1.0 percentage points of the growth during the 2008-2018 sub-period. In 2015,

this sector also had the largest share of nominal output (25.8 per cent) among all two-digit NAICS subsectors of the business sector. Some key trends from the report follow:

- In terms of business sector real GDP, the province has yet to re-attain its peak of $25,680 million (in chained 2012 dollars) from 2007, when oil and gas output peaked at $16,188 million. In 2018, real business sector GDP in Newfoundland and Labrador's GDP was $22,714 million, up from $12,285 million in 1997, but still 11.6 per cent below the 2007 peak.
- Compared to other provinces, Newfoundland and Labrador ranked first in terms of business sector real GDP growth (3.0 per cent per year) during the 1997-2018 period. This performance is driven by the 1997-2007 period. During that period, real GDP in the province grew at 7.7 per cent per year, more than double that of the national average (3.4 per cent per year) and was higher than in all other provinces. During the 2007-2018 period, the province's real GDP growth ranked lowest among Canadian provinces (-1.1 per cent per year).
- On a sectoral basis, compound annual growth in Newfoundland and Labrador and Canada was slower after 2007 in most subsectors of the business sector. In particular, growth of the mining and oil and gas extraction sector in Newfoundland and Labrador slowed down from 24.7 per cent per year during the 1997-2007 period to -3.4 per cent per year during the 2007-2018 period. One notable exception was the construction sector, which saw its growth rate increase from -0.7 per cent per year in the first sub-period to 7.0 per cent per year. Excluding the mining and oil and gas extraction sector, the province's business sector real GDP grew at 1.8 per cent per year during the 2007-2018 period, in contrast to a decline of 1.1 per cent per year growth of the province's real GDP in the whole business sector.
- In terms of nominal GDP as well, mining and oil and gas extraction in Newfoundland and Labrador had the highest growth among all two-digit NAICS subsectors of the business sector during the 1997-2015 period (14.8 per cent per year). As in the case of real GDP, the mining and oil and gas extraction sector explains much of the trend in nominal GDP. During the 1998-2007 period, the mining and oil and gas extraction sector alone contributed 75.7 per cent of the business sector nominal GDP average annual growth (10.8 percentage points of 14.2 percentage points) in the province. During that period, the growth of mining and oil and gas extraction's nominal GDP was extremely strong (40.2 per cent per year) in Newfoundland and Labrador. During the 2007-2015 period, however, the nominal GDP of the mining and oil and gas extraction sector declined 10.5 per cent per year).
- Because of various development projects in Newfoundland and Labrador such as the Muskrat Falls and the Hebron oil field, nominal GDP of the construction sector during the 2007-2015 period grew 4.6 times faster than in the 1997-2007 period (4.4 per cent per year versus 20.3 per cent per year). This growth only partially offset the decline in the mining and oil and gas extraction sector. Without mining and oil and gas extraction, the

business sector grew at a rate of 7.0 per cent per year during the 2007-2015 period, compared with the business sector average of -0.7 per cent per year.

- During the 2008-2015 period, the mining and oil and gas extraction sector was the only subsector that had negative contribution (-2.8 percentage points) among two-digit NAICS subsectors in the province. On the other hand, the construction sector contributed the most to the business sector nominal GDP growth in the province (1.8 percentage points of 0.8 percentage points), but this sector's contribution only partially offset the negative contribution from mining and oil and gas extraction.

Trends in Labour Input

Despite the significant role of mining and oil and gas extraction on Newfoundland and Labrador's economy, this sector's employment shares in the province were relatively low. Specifically, the mining and oil and gas extraction in the province only accounted for 4.8 per cent of the business sector total hours worked in 2018. Other important observations regarding labour inputs from the report follow:

- During the 1997-2018 period, the number of jobs in Newfoundland and Labrador's business sector grew at a compound annual rate of 1.0 per cent. The growth in the province was particularly fast during the 2009-2013 period (5.4 per cent per year), three times the national average of 1.68 per cent per year. However, in the 2013-2018 period, the number of jobs in Newfoundland and Labrador's business sector declined every year at an annual rate of -2.2 per cent when the growth in Canada was 1.1 per cent. This decline was due to the lower level of mining activity at Vale's nickel processing site and the closure of Wabush Mines
- While 2002 was an exceptional year in terms of real business sector GDP growth (22.4 per cent), because of the beginning of the oil production at the Terra Nova offshore oil platform, the number of jobs in the province barely increased in 2002 (0.5 per cent). The same development occurred in 2007, 2010 and 2011. The low correlation between business sector output and business sector employment in Newfoundland and Labrador was due to the dominance of mining and oil and gas extraction in the province's output combined with its disproportionately low employment shares. For example, in 2007, the mining and oil and gas extraction accounted for 59.2 per cent of the province's business sector nominal GDP but it was only responsible for 3.2 per cent of the business sector employment in the province.
- As for output, the construction sector played an important role in recent trends in labour inputs. In 2018, the employment share of the goods-producing sector in the province rose significantly to 30.6 per cent from 25.4 per cent in 2007. This increase is mainly explained by the increase in the employment shares in the construction sector by a factor of two from 8.5 per cent to 17.7 per cent. This jump in the construction employment in the

province in 2018 was attributable to various public sector infrastructure and commercial projects such as the Muskrat Falls project.

- In terms of weekly hours worked, the average worker in Newfoundland and Labrador consistently worked longer than the average Canadian in a week over the 1997-2018 period. In 2018, a worker in the province worked on average 2.1 hours more than the average Canadian worker in the business sector, working on average 35.45 hours per week instead of the national average of 33.41 hours per week. The difference between hours worked also demonstrated an increasing trend throughout the 1997-2018 period, up from 1.5 hours in 1997 to 2.0 hours in 2018.
- On a sectoral basis, from 1997 to 2018, hours worked in agriculture, forestry, fishing and hunting industries, utilities and manufacturing decreased while hours worked in mining and oil and gas exploration and construction increased. In particular, while the growth in mining and oil and gas extraction was not as strong as before (3.9 per cent in the 1997-2007 sub-period versus 1.9 per cent in the 2007-2018 sub-period), the growth of construction sector in Newfoundland and Labrador increased from -0.07 per cent in the 1997-2007 sub-period to 6.99 per cent in the 2007-2018 sub-period. Such growth in the province was driven by both the public and the private sector, including construction of the Trans Labrador Highway, the Hebron project and the Muskrat Falls project.
- In terms of labour compensation, Newfoundland and Labrador ranked second last in 2015 for business sector labour compensation as a share of business sector nominal GDP. At 50.9 per cent, that indicator was only higher than Saskatchewan's (41.9 per cent), another province where capital-intensive resources industries are very important. The below-average share of Newfoundland and Labrador in 2015 (59.5 per cent in Canada versus 50.9 per cent in the province) was due to the dominance of the capital intensive mining and oil and gas extraction sector in the province's nominal GDP.
- While Canada's labour compensation in the business sector as a share of nominal GDP exhibited a stable trend between 59.7 per cent in 1997 and 59.5 per cent in 2015, the labour compensation share of Newfoundland and Labrador's business sector has been much more volatile, falling from 58 per cent in 1997 to a trough 25.3 per cent in 2008 at the peak of the oil boom before rebounding to 50.9 per cent by 2015.
- It is notable that the large decrease in labour compensation share of nominal GDP from 1997 to 2007 was not due to a below-average growth of labour compensation in itself. Rather, the decline in the province's labour compensation share was due to the very rapid growth in capital compensation, driven (once again) by the capital-intensive mining and oil and gas extraction sector
- In terms of real hourly labour compensation, the business sector in the province experienced an increase from $19.85 (2012 dollars) per hour in 1997 to $22.88 per hour in 2007, and then to $31.55 per hour in 2018. This faster growth in the second sub-period in the province's real labour compensation was due to the rise in output from the labour-

intensive construction sector and the decline in the capital-intensive mining and oil and gas extraction sector in the province.

Trends in Capital Input

The mining and oil and gas extraction sector's role in Newfoundland and Labrador's business sector was also important in capital input. For example, in 1997, this sector alone accounted for more than half (55.7 per cent) of the province's business sector nominal gross capital investment. In 2007, more than 60 per cent (63.6 per cent) of the province's nominal net capital stock came from this sector. During the 2007-2017 sub-period, because of the development of the Muskrat Falls project, utilities gained higher importance than mining and oil and gas extraction with respect to capital input. For example, real gross investment and capital services of utilities in the province grew the fastest during the 2007-2017 sub-period among two-digit NAICS subsectors of the business sector (35.7 per cent per year and 12.5 per cent per year respectively).

- During the 1997-2017 period, real fixed non-residential investment in Newfoundland and Labrador's total economy grew at an annual compound rate of 5.5 per cent per year, from $2,990 million chained 2012 dollars in 1997 to $8,741 million in 2017, after peaking at $11,383 million in 2016. In Canada, real total economy investment grew at a lower rate, at 2.6 per cent per year.
- During the 1997-2007 period, the growth in real investment in the province's total economy was lower than Canada (1.6 per cent per year versus 5.2 per cent per year). This is mostly due to the decline in the province's real investment in engineering construction at a rate of 4.4 per cent per year, contrary to a rise of 5.9 per cent per year at the national level. This corresponds to the completion of construction of offshore oil rigs in the province by 1997. Moreover, the much higher growth of investment in mineral exploration and evaluation than the national average (18.6 per cent per year versus 6.5 per cent per year) reflects that the focus of the mining and oil and gas extraction sector shifted from developing oil field before 1997 to exploring for new oil fields, with the construction of new off-shore oil platforms having started again during the 2007-2017 period.
- During the 2007-2017 period, investment in Newfoundland and Labrador rose significantly (9.6 per cent per year). Such growth was due to the investment growth in engineering construction (16.5 per cent per year) and in non-residential building investment (11.9 per cent per year). As the focus shifted back to the construction of offshore oil rigs, real investment in mineral exploration and evaluation dropped during the 2007-2017 period at an annual compound rate of 6.5 per cent per year.
- Given the predominance of the mining and oil and gas extraction sector in Newfoundland and Labrador and the capital-intensive nature of this sector, it is not surprising that engineering construction had the predominant share of investment in the province's economy.

In 1997, more than a half (54.2 per cent) of investment went to engineering construction which reflects investment in the offshore oil rigs before the first flow of oil in the province. In 2007, as oil price and oil production in the province reached the peak, engineering construction dropped from 54.2 per cent in 1997 to 34.0 per cent while the share of mineral exploration and evaluation increased by 442.3 per cent from 2.1 per cent in 1997 to 11.3 per cent in 2007. In 2017, investment in engineering construction in the province as a share of investment in the province's total economy rose to 66.2 per cent because of the development of the Hebron oil field.

- In terms of capital stock, during the 1997-2017 period. Real capital stock growth in Newfoundland and Labrador outpaced Canada's by a considerable margin (4.1 per cent per year versus 2.7 per cent per year). During the 2007-2017 period, real capital stock growth in Newfoundland and Labrador was more than two times faster than in Canada (6.5 per cent versus 2.5 per cent per year). In the province, net real capital stock growth of (non-residential) building and engineering construction was the highest (7.50 per cent per year and 7.47 per cent per year respectively). This huge growth can be explained by the new Hebron oil field and the Muskrat Falls project in the province.
- Both in Newfoundland and Labrador and Canada the net capital asset of engineering construction always had the largest shares of nominal net capital stock from 1997 to 2017. In 2017, engineering construction represented almost 70 per cent of nominal net capital stock in Newfoundland and Labrador's business sector (69.4 per cent) while it took just more than a half (53.1 per cent) in Canada's business sector. This predominance of engineering assets in Newfoundland and Labrador's business sector capital stock is explained by the fact that a large part of the province's capital stock is in the mining and oil and gas extraction sector and the utilities sector, sectors very intensive in engineering capital. In fact, the share declined in 2011 to 60.0 per cent from 66.9 per cent in 1997, but then gradually climbed to 69.4 per cent in 2017. Canada's capital stock, on the other hand, had a more "balanced" capital stock

Productivity

During the 1997-2007 sub-period, Newfoundland and Labrador was the province that had the highest growth rates in labour productivity, capital productivity, and multi-factor productivity. However, during the 2007-2018 sub-period, the province ranked last in the growth rates of all three productivity measures. The decomposition of labour productivity growth by sector shows that the mining and oil and gas extraction sector contributed the most to the decline.

The report first looks at labour productivity, defined here as real GDP (in chained 2012 dollars) per hour worked. Similar to the discussion on output and inputs, the report stresses the importance of the oil and gas sector in the determination of the aggregate productivity trend. In

fact, Newfoundland and Labrador's labour productivity growth at the aggregate or business sector level is not indicative of the performance at the industry level. In the 1997-2007 sub-period, labour productivity in the mining and oil and gas industry advanced at a 20.0 per cent average annual rate, resulting in the 6.0 per cent annual rise for business sector productivity. In contrast, output per hour in industries excluding the mining and oil and gas averaged only -0.4 per cent per year. The situation was reversed after 2007. Labour productivity in mining and oil and gas fell at a 5.2 per cent per year from 2007 to 2018, resulting in a 1.2 per cent annual decline in business sector productivity. In contrast, output per hour in industries excluding the mining and oil and gas advanced at 1.8 per cent per cent per year. Other interesting trends regarding labour productivity include the following.

- Labour productivity increased at a rate of 2.2 per cent per year in Newfoundland and Labrador's business sector during the 1997-2018 period, above the 1.3 per cent national average (Chart 35). Compared to other provinces, Newfoundland and Labrador ranked the first in terms of compound annual average productivity growth in the 1997-2018 period. Moreover, throughout the 1997-2018 period, the business sector labour productivity levels in Newfoundland and Labrador were higher than the national average
- This overall trend reflected very divergent trends during the 1997-2007 and the 2007-2018 sub-periods. Productivity growth was strong in the first sub-period (6.0 per cent per year), the best among all ten provinces, but negative during the second sub-period (-1.18 per cent per year), the worst provincial performance.
- In 2002, the productivity growth was particularly impressive (24.1 per cent). This substantial increase was caused by the beginning of oil production in the Terra Nova oil field. There was also a marked productivity increase in 2007, due in large part to the return of Terra Nova to full capacity after a six-month halt in operations in 2006 as well as increased production from the White Rose oil field.
- Interestingly, the trend in the labour productivity level in Newfoundland and Labrador relative to the one in Canada is the same as the trend in the province's oil production, rising from 1997 to 2007, the peak year of oil production, and falling from 2007 to 2018. The similarity between the trends in business sector labour productivity in the province, the relative labour productivity level between the province and the national average, and the province's oil production reflects the considerable influence of the oil production on the province's business sector labour productivity during the 1997-2018 period.
- The report also discusses the decomposition of business sector labour productivity growth in Newfoundland and Labrador over the 1997-2017 period using a growth accounting approach. The sources of productivity growth were drastically different in the 1997-2007 and the 2007-2017 sub-periods. During the 1997-2007 sub-period, the province's business sector labour productivity growth was driven by the MFP growth due to the adoption of new technology for offshore oil drilling (5.1 percentage points of 5.9 percentage points). Labour productivity growth fuelled by MFP growth is usually regarded as sustainable growth because technological progress does not face decreasing returns. However, in Newfoundland

and Labrador's case, the MFP growth was not sustainable because of the depletion of the province's oil fields operating at the time. Therefore, contributions from MFP to the business sector labour productivity growth turned negative during the 2007-2017 sub-period. Instead, over this sub-period, capital intensity made a significant contribution to the province's business sector productivity growth. Unfortunately, labour productivity growth from this source is usually temporary because capital accumulation will eventually face decreasing returns.

The report then analyzes contributions to labour productivity by sector, decomposing it in three components. The first is the within-sector effect, capturing changes in labour productivity happening within the sector. The second is the reallocation level effect, capturing changes in labour productivity when more input is used in sectors with higher productivity levels. The third is the reallocation growth effect, capturing changes in labour productivity when more input is used in sectors with faster-growing labour productivity.

According to CSLS calculations, Newfoundland and Labrador's mining and oil and gas extraction sector was responsible for 60.1 per cent (1.5 percentage points of 2.4 percentage points) of the province's business sector labour productivity average annual growth during the 1998-2018 period. Contribution from this sector alone is larger than the double of the sum of all sub-sectors of the service sector (1.5 percentage points versus 0.7 percentage points). It was followed by manufacturing (0.23 percentage points); agriculture, forestry, fishing and hunting (0.21 percentage points); and retail trade (0.20 percentage points).

During the 1998-2007 sub-period, the mining and oil and gas extraction was the largest contributor among sub-sectors of the business sector, and alone contributed 5.3 percentage points, 4.3 percentage points of which are from this sector's within-sector effect. Excluding the mining and oil and gas extraction sector, other sub-sectors of the business sector altogether contributed 1.0 percentage points. Therefore, the business sector labour productivity growth in Newfoundland and Labrador during the 1998-2007 sub-period was driven by the mining and oil and gas extraction sector.

During the 2008-2018 sub-period, the reallocation level effect was the only positive contributor (1.3 percentage points of -1.0 percentage point) to the business sector labour productivity growth among the three components. Contributions from the within-sector effect and the reallocation growth effect were negative (-1.6 percentage points and -0.8 percentage points respectively). The negativity of the business sector's within-sector effect was due largely to the negative contribution from the mining and oil and gas extraction sector (-2.0 percentage points) because of the reduction in the oil production.

The report then looks at capital productivity, defined as real GDP per unit of services. The pattern for this variable is similar to the one for labour productivity. During the 1997-2007

sub-period, capital productivity in the province grew at 4.8 per cent per year while that of all other provinces and Canada except Ontario (0.1 per cent per year) declined. However, during the 2007-2017 sub-period, Newfoundland and Labrador ranked the last in terms of capital productivity growth (-5.5 per cent per year). Between the 1997-2007 and the 2007-2017 sub-periods, Newfoundland and Labrador experienced the greatest capital productivity slowdown among provinces in Canada (10.2 percentage points). Other interesting trends follow.

- On a sectoral basis, 11 of 15 sub-sectors of the business sector in Newfoundland and Labrador had lower capital productivity than Canada in 2016. In terms of growth, the mining and oil and gas extraction sector had the largest capital productivity growth among sub-sectors of the business sector in Newfoundland and Labrador during the 1997-2017 period (4.9 per cent per year). This strong growth in the mining and oil and gas extraction capital productivity over the whole period reflects an even stronger growth during the 1997-2007 sub-period (20.8 per cent per year) and a large decline during the 2007-2017 sub-period (-8.9 per cent per year).
- The case of mining and oil and gas extraction is again interesting. The mining and oil and gas extraction capital productivity in the province grew from 11.6 per cent of the sector's capital productivity in Canada in 1997 to 99.1 per cent in 2007, and then fell to 49.4 per cent in 2016. The mining and oil and gas extraction capital productivity in 1997 was lower than the national average because a large amount of capital accumulated but the oil production only begun at the end of November 1997, leading to a low level of capital productivity in compared with Canada. As production increased, the mining and oil and gas extraction capital productivity level rose and became closer to the national average

The final productivity analysis in the report is about multifactor productivity (MFP). MFP captures the effect of several different factors, such as disembodied technological growth, capital utilization, returns to scale. MFP also incorporates errors due to mismeasurement of inputs and outputs. Interesting observations on MFP are as follows.

- Similar to labour productivity growth, MFP growth in Newfoundland and Labrador ranked first among provinces during the 1997-2007 and last during the 2007-2017 period. Specifically, during the 1997-2007 period, the province's MFP growth was almost five times as high as the province with the second highest growth (5.1 per cent per year in Newfoundland and Labrador versus 1.1 per cent per year in Manitoba). During the 2007-2017 period, Newfoundland and Labrador had the largest MFP decline (3.7 per cent per year) among provinces.
- Because the province's decline in MFP was large during the 2007-2017 period, the province's MFP growth during the 1997-2017 period only ranked 4th among all provinces.
- On a sectoral basis, given the dominance of the mining and oil and gas extraction sector in the province's economy in terms of real output and labour productivity, we see that the sector's MFP growth is indicative of the province's MFP growth in the goods sector and the business sector. During the 1997-2007 period, the province' mining and oil and gas

extraction MFP grew at an impressive annual rate of 20.6 per cent (compared to the -4.5 per cent national average) while the province's business sector MFP growth rate was almost 15 times as high as that in Canada (5.1 per cent per year versus 0.3 per cent per year). The adoption of new technology with the offshore oil field was responsible for the impressive MFP growth in the province's mining and oil and gas extraction sector during the 1997-2007 period.

- During the 2007-2017 period, the MFP of the province's business sector declined at an annual rate of 3.7 per cent as the province's mining and oil and gas extraction MFP decline at 8.6 per cent per year. The decline in the province's mining and oil and gas extraction MFP was almost six times as large as that in Canada (8.6 per cent per year versus 1.5 per cent per year). One of the reasons was the depletion of oil reserves in the province.

Explaining the Productivity Performance

In order to develop policies to improve productivity performance, it is important to identify the drivers of productivity growth. The report identifies three key factors determining labour productivity growth, in line with the simple growth accounting model. The first is investment in human resources, capturing the quality of the labour input. The second is investment in capital goods, determining the size of the capital stock. The third is often referred to as the pace of technological progress (or innovation), but in fact encompasses all factors not captured by the previous two measures. It is very roughly proxied by the rate of multifactor productivity growth.

The report then identifies a number of specific issues related to these three drivers, such as schooling, training and skills, R&D spending, and investment in different types of capital goods. Some interesting trends are as follows.

- Newfoundland and Labrador ranks low in terms of the average years of schooling of the working age population, the labour force and the employed compared with other provinces in 2018. Looking at the highest level of educational attainment in Newfoundland and Labrador and Canada, we observe that the province had significantly lower shares of the population with university degree than Canada, although it had a higher share of the population with other post-secondary certificates or diplomas.
- The province also fared poorly in measures of adult literacy, numeracy, and problem-solving skills. Measures from the OECD's Program for the International Assessment of Adult Competencies (PIAAC) indicate that Newfoundland and Labrador was below the national average in all three domains in 2012.
- This difference was also reflected in scores from the Program for International Student Assessment (PISA). Scores of Newfoundland and Labrador in all three domains were

lower than the national averages in all years. In 2015,[1] out of the 10 provinces, the province ranked 7th in reading, 9th in mathematics and 7th in science.

- Newfoundland and Labrador is characterized by the second lowest proportion of individuals participating in job-related training. On a more positive note, when workers do participate in job-related training, Newfoundland and Labrador employers are among the most generous when it is time to financially support the training of their employees.
- A key component of a competent and skilled labour force is a well-trained and qualified skilled trades workforce. The number of apprenticeship registrations in Newfoundland and Labrador experienced an unusual progression during the 1997-2003 period, climbing from 3,531 registrations in 1997 to 10,641 in 2007. It went back down in later years, settling at 7,188 registrations in 2017. Over this period, apprenticeship completions increased at a higher rate in Newfoundland and Labrador (5.1 per cent per year) than in Canada as a whole (4.3 per cent). However, the completion rate was still low in 2017 in the province.
- In terms of inter-provincial migration, the amount of outgoing net interprovincial migration diminished since 1997 in the province because of the oil production. It reached a peak of 1,877 persons in 2008, before declining again, reaching -3,656 persons in 2017. From a Canadian point of view, inter-provincial migration increases output through the geographical composition effect. However, from the perspective of a policy planner in Newfoundland and Labrador looking at actual and future productivity, the fact that most of those who out-migrated from Newfoundland and Labrador are persons of age 15 to 29 and well-educated residents is an important problem.
- The analysis reveals that while it is implausible that Newfoundland and Labrador is experiencing generalized labour shortages, it is possible that labour shortages exist for certain types of skills specifically.
- In terms of investment intensity, fixed non-residential investment intensity in Newfoundland and Labrador's total economy grew at a faster pace than the national average (4.7 per cent annually during the 1997-2017 period, compared to 1.4 per cent). Growth in that indicator was especially strong for engineering construction during the 2007-2017 period. The strong growth in the province's engineering construction investment intensity during the 2007-2017 period and the province's high investment intensity of the asset in 2017 is not a surprise because engineering construction is the principal type of asset used in the mining and oil and gas extraction sector and utilities that had various development projects in the province.
- We also observe that Newfoundland and Labrador's investment intensity growth during the 1997-2017 period was higher than Canada's in machinery and equipment assets (2.1 per cent per year versus 1.1 per cent per year) as well as in intellectual property products

[1] As of April 11th, 2019, the series of estimated PISA scores in Canada and the provinces end in 2015.

assets (3.5 per cent per year versus 1.1 per cent per year), two types of assets that economists believe to be strongly correlated with productivity growth.

- The difference in investment intensity among sub-sectors in Newfoundland and Labrador was massive. In particular, in 2017, the utilities sector ($713.43 chained 2012 dollars per hour worked) had investment intensity level almost 16 times as high as that of the third highest sector (manufacturing, $44.81 chained 2012 dollars per hour worked) because of the Muskrat Falls project. In addition, the investment intensity level of the mining and oil and gas extraction sector ($220.86 chained 2012 dollars per hour worked) in 2017 was almost five times as high as that of the manufacturing sector. This large difference in investment intensity levels matches with the predominance of the mining and oil and gas extraction sector in the province's economy with respect to output.
- Because of the development of the Hebron oil field and the Muskrat Falls project, investment intensity in the province's mining and oil and gas extraction and utilities switched from decline during the 1997-2017 sub-period (-4.9 per cent per year and -1.4 per cent per year respectively) to growth during the 2007-2017 sub-period (5.6 per cent per year and 38.1 per cent per year respectively).
- In terms of capital stock intensity, the province had a higher capital intensity level in total investment, engineering construction and intellectual property products than the national average throughout the 1997-2017 period. This is explained by the domination in the province's output and capital stock of the capital-intensive mining and oil and gas extraction sector. Moreover, the capital intensity level of engineering construction and hence that of total investment took off in 2012 owing to increases in investment in various mining and oil and gas extraction projects.
- On a sectoral basis, all two-digit NAICS subsectors of the business sector in Newfoundland and Labrador except construction had higher capital stock intensity growth rates than Canada during the 2007-2017 sub-period. In fact, it is surprising to see that Newfoundland and Labrador's construction was the only sector that experienced a decline in capital stock intensity during the 1997-2017 period. Specifically, it decreased from $8.43 per hour worked in 1997 to $7.27 per hour worked in 2017 (both in chained 2012 dollars). This reduction in capital intensity level was due to a significant increase in hours worked, as capital stock grew at a slower rate (3.39 per cent per year versus 4.16 per cent per year) during the 1997-2017 period.
- In terms of innovation, in 2016, R&D intensity in Newfoundland and Labrador was at 1.1 per cent, well below the national average at 1.7 per cent. Compared to the other provinces, Newfoundland and Labrador ranked 7th in terms of R&D intensity. The province fared better in terms of R&D spending growth, although that variable does not take into account the size of the regions. On a more positive note, Newfoundland and Labrador is catching up to the national average in recent years.
- Looking at innovation through the lens of who is performing it, we see that the business sector played a more important role in total R&D spending in Canada than in

Newfoundland and Labrador. In the province, the higher education sector was always the most important between 1997 and 2016. In Canada, on the other hand, the business sector consistently had the highest share, followed by the higher education sector and the government sector.

The analysis of Newfoundland and Labrador's key economic variables shows that the mining and oil and gas extraction sector had a significant impact, either positive or negative, on the province's economy from 1997 to 2018. In particular, this sector was an excellent indicator of the province's overall business sector performance of most economic variables and productivity measures except employment because of this sector's considerable size in real output.

Although Newfoundland and Labrador had growth in R&D expenditure and investment and capital intensity higher than the national average, there are still some serious human capital questions that must be resolved. Indeed, the population in the province is not well-prepared for making full use of the gains from R&D, investment and capital intensity compared with the population in other provinces. Specifically, the province's youth and adult literacy is still significantly lower than the national average and other provinces. Together with the lower educational attainment in the province, the under-performance of these human capital indicators signifies skill shortages in the province. In addition, the province’s aging population, its shrinking working-age population and increasing youth out-migration, especially among the population of age 15 to 29, further worsened the human capital issue by offsetting the province's recent success in raising the apprenticeship training completion rate from 5.6 per cent in 1997 to 7.9 per cent in 2017. Therefore, the province is facing a number of human capital challenges that can hinder its productivity in the short run and the long run.

List of Charts, Tables and Exhibits

Charts

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A Detailed Analysis of Newfoundland and Labrador's Productivity Performance, 1997-2018[2]

Introduction

Driven by the mining and oil and gas extraction sector, Newfoundland and Labrador's economy experienced impressive growth from 1997 to 2007, with real business sector output advancing at a compound annual rate of 7.7 per cent, more than double the Canadian average (3.4 per cent per year). The situation changed dramatically after 2007 when oil and gas output plummeted. Real business sector GDP in the province declined during the 2007-2018 period at a rate of 1.1 per cent per year while that in Canada rose at 1.5 per cent per year. The productivity performance mirrored that of real output. Business sector labour productivity in the province grew at 6.0 per cent per year during the 1997-2007 period and then fell 1.2 per cent per year during the 2007-2018 period.

Questions remain, however, about the breadth of those changes. One sector – mining and oil and gas extraction – has been responsible for most of Newfoundland and Labrador's economic growth, and now accounts for the largest share of the province's business sector value added among 2-digit NAICS subsectors, even though it employs only 3.8 per cent of the province's business sector workers in 2018. From this perspective, productivity continues to represent a major challenge for the province. Identifying the main sources and drivers of productivity growth is a necessary first step towards shaping policies that promote growth output and productivity in the province.

Statistics Canada estimates of labour productivity by province are available from 1997. Consequently 1997 is the first year for the time period discussed in this report. Since estimates for 2018 were the most recent available at the time of the writing of the report, that year is the end date.[3] Real output in the oil and gas sector peaked in 2007 to that year is used to break the 1997-2017 period into two sub-periods, 1997-2007 and 2007-2018.

This report is organized as follows. The first section discusses definitions, concepts and data sources used in this report. The second section contains an overview of Newfoundland and

[2] This report was written by Andrew Sharpe, Founder and Executive Director of the Centre for the Study of Living Standards (CSLS) and John Tsang, an Economist at the CSLS at the time the report was written, with input from Simon Lapointe, an Economist at the CSLS. The authors would like to thank Doug May from Memorial University for comments, and the Collaboration for Applied Research in Economics (CARE) initiative for funding.

[3] While variables of real value-added and labour input are available from Statistics Canada from 1997 to 2018 at the national and the provincial level, variables associated with expenditure-based gross domestic products and capital are only available from 1997 to 2017 at the national and the provincial level. Therefore, analysis pertinent to the latter only spans from 1997 to 2017.

Labrador's economy and analyzes the evolution of output and input (labour and capital) from 1997 to 2018. The third section examines labour, capital and multifactor productivity in the province. The fourth section identifies and discusses factors that affect productivity in general, highlighting their possible effect in driving the province's productivity growth.

I. Definition, Concepts and Data Sources

This part of the report is divided into two sections. In the first section, we review some of the key issues related to productivity analysis. In the second, we briefly discuss the data sources used in the report.

A. Understanding Productivity[4]

Productivity can be broadly defined as a measure of how much output is produced per unit of input used. Despite this simple definition, several different productivity measures arise from the use of distinct concepts of output and input, with each of these measures serving different purposes. In this section, we explain important topics related to productivity analysis, define the main concepts used throughout the report, and discuss the reasons why productivity measurement is relevant in economic analysis.

i. Why Measure Productivity?

The OECD (2001) highlights five objectives of productivity measurement:

- Measuring *technical change* – In economics, a production technique can be understood as a particular way of combining inputs (labour, capital, intermediate inputs, etc.) and transforming them into output. Technical change can be either disembodied (e.g. new organizational techniques) or embodied (e.g. better quality capital goods). Economists often try to capture the effects of technical change in the economy or in an industry by using some measure of multifactor productivity (MFP). It is important to keep in mind, however, that the relationship between technical change and MFP is *not* straightforward. First, not all the effects of technical change are captured by MFP. If inputs are quality adjusted, for instance, MFP will not capture embodied technical change, only disembodied technical change. Second, MFP captures a variety of effects such as measurement error, economies of scale and capacity utilization, not only technical change – thus, it is a mistake to attribute the entirety of MFP growth to technical change.

- Measuring *efficiency improvements* – From an engineering perspective, a production process is efficient if, for a given technology, it uses the least amount of inputs to

[4] This subsection draws on Grand'Maison and Sharpe (2013).

produce one unit of output (or alternatively, if it produces the maximum amount of output for a given quantity of inputs). From an economist's perspective, however, allocative efficiency should also be taken into account. The OECD (2001:11) notes that: "(…) when productivity measurement concerns the industry level, efficiency gains can either be due to improved efficiency in individual establishments that make up the industry or to a shift of production towards more efficient establishments"

- Measuring *real cost savings* – Closely related to the two objectives discussed above, understanding productivity matters because it allows firms to produce a given amount of output using less input, which implies, *ceteris paribus*, lower costs. In other words, productivity improvements generate real cost savings.

- Measuring *improvements in living standards* – Productivity is linked to living standards via two fronts: 1) Value added labour productivity has a direct link to GDP per capita, which is a commonly used measure of living standards; 2) Long-term value added MFP growth, combined with capital intensity and labour input growth, can be used to evaluate the evolution of an economy's potential output.

- *Benchmarking* production processes – At the firm level, productivity measures can be used to identify distortions and inefficiencies across production units. Such measures are often expressed in physical units, e.g. an auto assembly firm could compare the productivity of two (similar) factories by looking at the number of cars produced per day by each of the factories.

ii. Gross Output Productivity vs. Value Added Productivity

Since productivity is a ratio of output to input(s) used in the production process, different productivity measures can be constructed using: 1) different measures of output; 2) different measures of inputs. In this subsection, we discuss the two most used measures of output: gross output and value added. The next subsection focuses on the choice of one or more inputs when constructing a productivity measure.

Gross output consists of all goods and services produced by an economy, sector, industry or establishment during a certain period of time. Value-added (or GDP at basic prices), on the other hand, measures the contribution of primary inputs (labour and capital) to the production process. While gross output refers to an actual physical quantity, there is no physical representation of value added.

When dealing with the economy as a whole, the value-added approach is the natural choice, because it avoids double counting of intermediate inputs in the aggregate output. In

practice, the value-added approach is also the standard choice of most sectoral productivity analysis. Trueblood and Ruttan (1992) argue, however, that when investigating the productivity performance of a particular sector, the focus should be on the total input-output relationship in order to evaluate the overall gains in both primary and intermediate input use. This is particularly true in the case of sectors that experienced significant shifts in the use of inputs through time, such as the primary agriculture sector, where intermediate inputs (feed, fertilizers, pesticides, etc.) play a much more prominent role nowadays than they did in the past.

iii. Partial Productivity Measures vs. Multifactor Productivity

Economists distinguish between partial and multifactor productivity (MFP) measures. Partial productivity measures are a ratio between output and a single input, such as labour, capital, land, energy or intermediate goods. Labour productivity, for example, is commonly defined as the ratio between output and hours worked in a certain activity, while capital productivity is the ratio of output to capital stock (or capital services).

MFP, in turn, is the ratio between output and *combined* inputs used in the production process, e.g. value-added MFP is calculated as the ratio of an index of value added to a *combined index of* labour and capital inputs. Therefore, MFP growth is a residual, reflecting output growth that is not accounted for by measured input growth. MFP growth can be explained by a number of very different factors, such as improvements in technology and organization, capacity utilization, increasing returns to scale, etc. It also embeds errors due to the mismeasurement of inputs. While absolute measures of labour productivity are commonly used and deliver insightful information on the production process, absolute levels of MFP have no intrinsic meaning since they aggregate different inputs under one measure (i.e. hours worked and capital stock). Therefore, we can only analyze MFP in relative terms or in terms of growth rates.

iv. Productivity Growth Rates vs. Productivity Levels

Productivity can be expressed either in growth rates or in levels. The economics literature largely focuses on productivity *growth rates*, which refer to changes in *real* variables (as opposed to *nominal* variables), e.g. value-added labour productivity growth represents the increase of real GDP per hour worked over time; gross output MFP growth measures the increase of real gross output per unit of aggregate labour, capital, and intermediate inputs.

In this report, however, we are also interested in making *level* comparisons between Newfoundland and Labrador and Canada (or other provinces). Productivity level comparisons are often done in current dollars (i.e., using nominal output), as these estimates capture changes in relative prices, whereas estimates in *constant dollars* do not. However, when real output is

calculated using *chained dollars*,[5] changes in relative prices are also incorporated into the estimate, and goods and services which experienced relative price increases receive higher weights than goods and services that experienced price decreases. Productivity level discussions in this report focus on real levels instead of nominal levels for two reasons: 1) Consistency, i.e. since growth rates are calculated based on real output, having real productivity levels produces a consistent set of estimates; 2) The real output measures used in the report are based on chained dollars, and thus the impact of shifts in relative prices is captured. Nominal productivity levels are also discussed whenever they might provide additional insights relatively to productivity growth and living standards. Regardless of whether nominal or real GDP figures are used for interprovincial productivity level comparisons, it is important to note that these comparisons should be used with caution, due not only to differences in industry composition between provinces, but also due to the lack of industry purchasing power parities (PPPs) estimates at the provincial level.

v. Interpreting Productivity Measures

Productivity is a multi-dimensional concept, and different productivity measures capture different aspects of reality. Gross output MFP, for instance, can capture efficiency improvements much better than other productivity measures because it captures the effects of substitution between inputs. Value added labour productivity, on the other hand, is a better tool for understanding improvements in overall living standards. Exhibit 1 discusses how the main productivity measures used in the literature should be interpreted, their purposes, advantages, and limitations.

Exhibit 1: Interpreting Productivity Measures

	Gross Output	Value Added
Labour Productivity	*Purpose*: Can be useful in the analysis of labour requirements by industry. *Interpretation*: Describes how much (physical) output is produced per unit of labour used. Changes in gross output labour productivity can be decomposed into four sources (*proximate* causes of growth): 1) changes in labour quality; 2) changes in capital intensity; 3) changes in intermediate input intensity; 4) gross output MFP growth. *Advantages*: Easy to measure (only requires price indexes for gross output, not intermediate inputs) and understand.	*Purpose*: 1) Can help in the analysis of micro-macro links, e.g. understanding industry contributions to aggregate labour productivity and economic growth; 2) At the total economy level, can be used to analyze improvements in living standards; 3) Used as a reference statistic in wage bargaining. *Interpretation*: Describes how much value added is generated per unit of labour used. Changes in value added labour productivity can be decomposed into three main sources (*proximate* causes of growth): 1) changes in labour quality; 2) changes in capital intensity; 3) value added MFP growth. *Advantages*: Easy to measure and understand.

[5]Constant dollar and chained dollar measures are calculated using fixed-base quantity indexes and chained quantity indexes, respectively. As the name implies, a fixed-base index has a fixed base period, for weighting aggregate purposes, which is used as a basis of comparison with all the other periods. A chained index, on the other hand, has no fixed base period, but rather has different weights for each period. For a detailed discussion on this issue, see Appendix A in Sharpe and de Avillez (2010).

	Limitations: As a partial productivity measure, it does not control for changes in the use of other inputs, and thus reflects the influence of several different factors. *Attention:* Gross output labour productivity is *not* a good measure of technical change.	*Limitations*: As a partial productivity measure, it does not control for changes in the use of other inputs, and thus reflects the influence of several different factors. *Attention:* Value added labour productivity is *not* a good measure of technical change.
Capital Productivity		*Purpose*: "Changes in capital productivity indicate the extent to which output growth can be achieved with lower welfare costs in the form of foregone consumption" (OECD, 2001:17). *Interpretation*: Describes how much value added is generated per unit of capital used. *Advantages*: Easy to understand. *Limitations*: As a partial productivity measure, it does not control for changes in the use of other inputs, and thus reflects the influence of several different factors. *Attention:* Value added capital productivity should *not* be confused with the rate of return on capital.
Multifactor Productivity	*Purpose*: Can help in the analysis of industry-level disembodied technical change. *Interpretation*: Describes how productively capital, labour, and intermediate inputs are combined in order to generate (physical) output. When inputs are quality-adjusted, it captures disembodied technical change reasonably well. It should be clear, however, that it also incorporates other factors that have nothing to do with disembodied technical change, such as economies of scale, changes in capacity utilization, measurement errors, etc. *Advantages*: Industry-level gross output MFP growth can be combined using Domar weights in order to obtain an economy-wideor sectoral estimate of value added MFP growth (for details, see OECD, 2001). *Limitations*: Significant data requirements (input-output tables consistent with national accounts data).	*Purpose*: 1) Can help in the analysis of micro-macro links, e.g. understanding industry contributions to aggregate value added MFP growth; 2) At the total economy level, can be used to analyze improvements in living standards (can help track the evolution of an economy's potential output). *Interpretation*: Describes how productively capital and labour inputs are combined in order to generate value added. At the industry level, it can be seen as "an indicator of an industry's capacity to contribute to economy-wide growth of income per unit of primary input" (OECD, 2001:16). *Advantages*: Easily aggregated across industries. *Limitations*: Not a good measure of technical change.

Source: Adapted from OECD (2001:14-18)

B. Data Sources

The main data source for this report comes from the Canadian Productivity Accounts (CPA). We draw annual data from Tables 36-10-0208-01, 36-10-0211-01 and 36-10-0480-01 (formerly CANSIM Tables 383-0021, 383-0026 and 383-0033 respectively) in the CPA. Other data sources include the Stock and Consumption of Fixed Non-residential Capital Account, Quarterly Demographic Estimates and the OECD Skills Survey.

Output in the CPA is measured as value-added at basic prices.[6] The data encompass the 1997-2018 period. The year of 1997 was the initial year of the CPA's provincial data, which happens to be the beginning of the oil production in Newfoundland and Labrador. Data from the CPA are broken down into two-digit NAICS sectors (Exhibit 2)[7] and four-digit NAICS sectors at the national level and the provincial level. These two-digit NAICS sectors are constituent subsectors of the business sector and do not include the government sector and owner-occupied dwellings (i.e., imputed rental income). This report is also accompanied by a database that contains data used in an accessible format.

Exhibit 2: Two-digit NAICS Sectors

Sector Code	Description
11	Agriculture, Forestry, Fishing and Hunting
21	Mining, and Oil and Gas Extraction
22	Utilities
23	Construction
31-33	Manufacturing
41	Wholesale Trade
44-45	Retail Trade
48-49	Transportation and Warehousing
51	Information and Cultural Industries
52	Finance and Insurance
53	Real Estate, Rental and Leasing
54	Professional, Scientific, and Technical Services
55	Management of Companies and Enterprises
56	Administrative and Support, Waste Management and Remediation Services (ASWMRS)
71	Arts, Entertainment, and Recreation
72	Accommodation and Food Services
61, 62, 81	Other Private Services *

*: Other Private Services combines Educational Services (61), Health care and social assistance (62) and Other services (except public administration) (81).

Source: Statistics Canada.

II. An Overview of Newfoundland and Labrador's Economy

Before analyzing the evolution of productivity trends in Newfoundland and Labrador, it is important to explore the variables used to construct these productivity measures. This exploratory analysis helps us identify significant trends that could individually affect actual and future trends in productivity and highlights key facts about the economy of Newfoundland and Labrador at the macro level. This exploratory analysis can also provide an initial perspective of the

[6] According to Statistics Canada, gross domestic product at basic price refers to gross domestic product at market prices minus taxes less subsidies on products. Gross domestic product at basic prices is also equal to the traditional value at factor cost plus taxes less subsidies on the factors of production (labour and capital).

[7] The analysis of capital services, capital productivity and multifactor productivity combines finance and insurance and holding companies (52) and real estate, rental and leasing (53) into a single sector as the finance, insurance, real estate, rental and leasing (FIRE) because Statistics Canada only provide this aggregation in its online database.

province's structure of the economy. Therefore, in this part of the report, we first examine trends in real output from 1997 to 2018[8] and nominal output from 1997 to 2015 and then discuss trends in labour input from 1997 to 2018 and capital input from 1997 to 2017. This section ends with a brief discussion of the mining and oil and gas extraction sector because of this sector's important role in Newfoundland and Labrador's economy.

After 2007, there were significant changes in various economic variables in Newfoundland and Labrador. Specifically, comparing the 1997-2007 and the 2007-2018 sub-periods, we observe that the province's growth in business sector output and employment slowed while the province's business sector capital input grew faster after 2007. For example, the province's real business sector GDP growth slowed from an annual compound growth rate of 7.7 per cent to -1.1 per cent and the province's total hours worked in the province's business sector also fell from 1.3 per cent per year to 0.3 per cent per year. On the other hand, the province's business sector capital services growth accelerated from 2.8 per cent per year to 5.0 per cent per year between the 1997-2007 and the 2007-2017 sub-period.

Among two-digit NAICS subsectors of the business sector, the mining and oil and gas extraction sector played an essential role, either positive or negative, in the province's business sector output. Indeed, this sector accounted for 77.7 per cent (6.1 percentage points of 7.8 percentage points) of the business sector real GDP average annual growth from 1998 to 2007 and -1.8 percentage points of -1.0 percentage points of the growth during the 2008-2018 sub-period. In 2015, this sector also had the largest shares of nominal output (25.8 per cent) among all two-digit NAICS subsectors of the business sector.

The mining and oil and gas extraction sector's role in Newfoundland and Labrador's business sector was also important in capital input. For example, in 1997, this sector alone accounted for more than half (55.7 per cent) of the province's business sector nominal gross capital investment. In 2007, more than 60 per cent (63.6 per cent) of the province's nominal net capital stock came from this sector. During the 2007-2017 sub-period, because of the development of the Muskrat Falls project, utilities gained higher importance than mining and oil and gas extraction with respect to capital input. For example, real gross investment and capital services of utilities in the province grew the fastest during the 2007-2017 sub-period among two-digit NAICS subsectors of the business sector (35.7 per cent per year and 12.5 per cent per year respectively). This evolution of the province's capital input was consistent with that of the expenditure-based output. In particular, contribution from investment to real total economy average annual output growth increased by a factor of 8.4 between the 1997-2007 and the 2007-2017 sub-periods (1.0

[8]According to footnote 18 of Table 36-10-0208-01 (formerly CANSIM Table 383-0021), the CPA uses the input-output table to compute data on nominal GDP. Since the input-output tables currently end in 2015, this year is the most recent year for nominal GDP series.

percentage point of 5.5 percentage points, 18.5 per cent versus 1.3 percentage points of 0.8 percentage points, 154.9 per cent).

Despite the significant, either positive or negative, effects of mining and oil and gas extraction on Newfoundland and Labrador's economy, this sector's employment shares in the province were relatively low. Specifically, the mining and oil and gas extraction in the province only accounted for 4.8 per cent of the business sector total hours worked in 2018. In addition, the province's growth of mining and oil and gas extraction nominal labour compensation was higher than the business sector average (5.7 per cent per year versus 5.1 per cent per year) during the 2007-2018 sub-period.

A. Gross Domestic Product

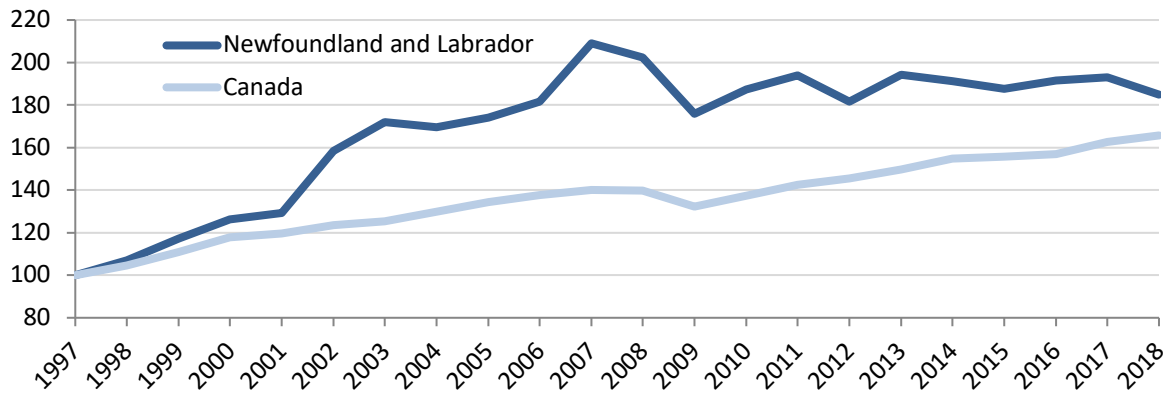
This section analyzes the recent evolution of business sector real output from 1997 to 2018, GDP deflator from 1997 to 2015 and nominal GDP from 1997 to 2015.[9] It also highlights major changes in the sectoral decomposition of Newfoundland and Labrador's economy.

i. Real GDP

In 2018, real business sector GDP in Newfoundland and Labrador's GDP was $22,714 million (chained 2012 dollars), up from $12,285 million (chained 2012 dollars) in 1997. Real GDP peaked at $25,680 million (chained 2012 dollars) in 2007, the year's real mining and oil and gas output also peaked at $16,188 million (chained 2012 dollars) in 2007. By 2018 the province's business sector real GDP was still 11.6 per cent below this peak.

[9] Statistics Canada provides data on real gross domestic product at basic prices (value-added) by sector at the national and the provincial level from 1997 to 2018. However, the time series of nominal gross domestic product at basic prices (value-added) by sector only spans from 1997 to 2015. Therefore, our analysis on real gross domestic product focuses on the 1997-2018 period but that on nominal gross domestic product and the gross domestic product deflator spans from 1997 to 2015.

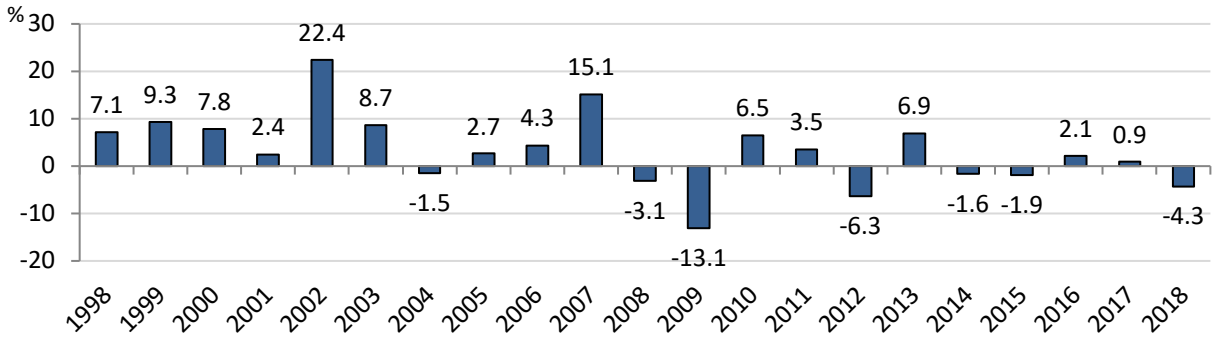
Chart 1: Real GDP, Business Sector, Newfoundland and Labrador and Canada, 1997-2018 (1997=100)



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

Chart 1 illustrates how real business sector GDP increased at a much faster rate in Newfoundland and Labrador than in Canada, particularly between 2001 and 2007, when Newfoundland and Labrador's real GDP grew at an annual compound rate of 8.3 per cent per year versus 2.7 per cent per year for the national average. Moreover, the oil production reduction and the oil price decline due to the financial crisis had a more significant effect on Newfoundland and Labrador's business sector than on Canada in 2009.[10] Indeed, the real GDP in Newfoundland and Labrador dropped by 13.1 per cent in 2009 (Chart 2) while the decline in Canada was 5.4 per cent.

Chart 2: Real GDP Growth, Business Sector, Newfoundland and Labrador, 1998-2018



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

The business sector real GDP growth in Newfoundland and Labrador was extraordinary in 2002 and 2007 (Chart 2) because of the increase in (international and interprovincial) exports.

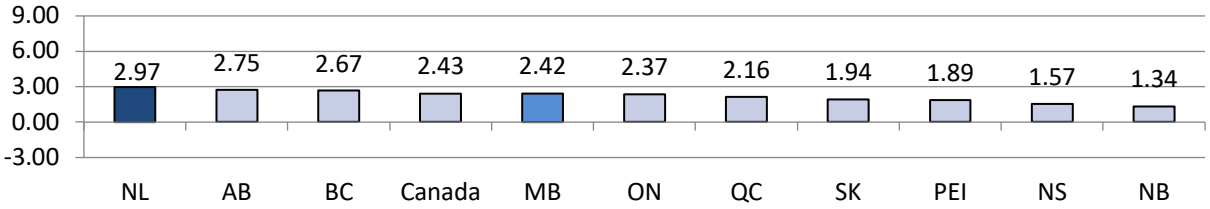
[10] The oil price decreased from an annual average of US$96.94 per barrel in 2008 to US$61.74 per barrel in 2009 (see Chart 32 for more details). Oil production in Newfoundland and Labrador fell from 125.2 million barrels in 2008 to 97.7 million barrels in 2009 (see Chart 29 for details).

From the expenditure perspective, in the total economy,[11] the province's real exports had annual increases of 33.9 per cent in 2002 and 13.4 per cent in 2007, which contributed 17.7 percentage points of 16.2 percentage points and 9.3 percentage points of 11.2 percentage points to real GDP growth respectively (
Chart 5).[12] Most of these increases were from oil exports (Department of Finance, Newfoundland and Labrador, 2002 and 2007). In particular, the province's oil exports (in cubic metres) increased by 216.9 per cent in 2002 and 32.6 per cent in 2007.[13]

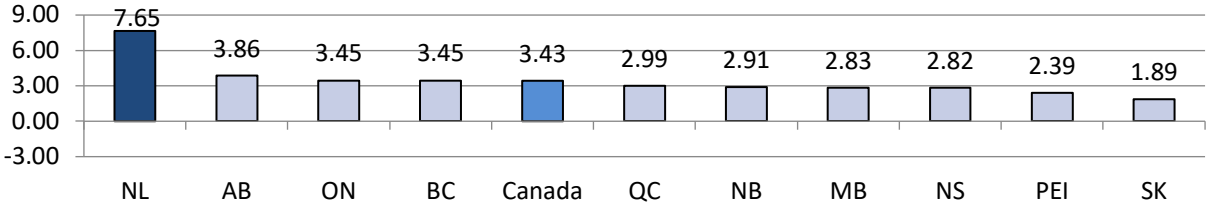
Changes in real exports also resulted in the province's annual decline in the business sector real GDP in 2009 (13.1 per cent) and 2012 (6.3 per cent). Specifically, the province's real exports in the total economy dropped by 19.3 per cent from 2008 to 2009 and 8.6 per cent from 2011 to 2012 while the province's oil exports (in cubic metres) dropped by 22.5 per cent and 57.3 per cent respectively.

Chart 3: Compound Annual Growth of Real GDP in Canada and the Provinces, Business Sector, 1997 – 2018

Panel A: 1997 – 2018

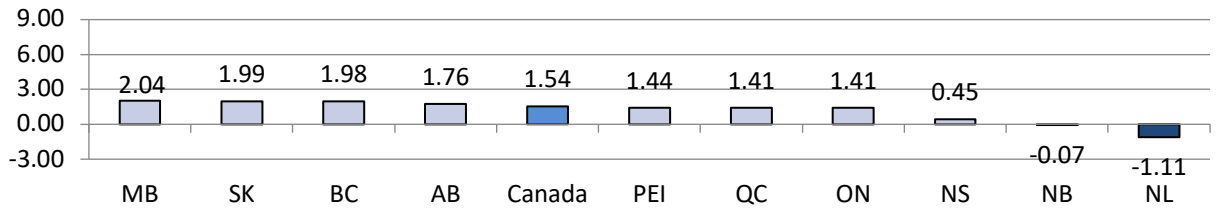


Panel B: 1997 – 2007



Panel C: 2007 – 2018

[11] Statistics Canada does not provide expenditure-based real GDP of the business sector at the national or the provincial level. Therefore, we use the total economy expenditure-based real GDP instead.
[12] More details on the expenditure-based real GDP will be discussed later after examining sectoral real GDP.
[13] The last subsection of this section has a more detailed discussion about the mining and oil and gas extraction sector in Newfoundland and Labrador.



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

Compared to other provinces, Newfoundland and Labrador ranked first in terms of business sector real GDP growth (3.0 per cent per year) during the 1997-2018 period (Chart 3). During the 1997-2007 period, the real GDP in the province grew at 7.7 per cent per year, which was more than double that of the national average (3.4 per cent per year) and was higher than all other provinces. During the 2007-2018 period, the province's real GDP growth ranked lowest among Canadian provinces (-1.1 per cent per year).

Compound annual growth in most subsectors of the business sector in Newfoundland and Labrador and Canada was slower after 2007 (Table 1). During the 2007-2018 period, 11 of 16 sectors in the province and 13 of 16 sectors in Canada grew more slowly than the 1997-2007 period. In particular, growth of the mining and oil and gas extraction sector in Newfoundland and Labrador slowed down from 24.7 per cent per year during the 1997-2007 period to -3.4 per cent per year during the 2007-2018 period, while the growth rate of the construction sector in the province grew from -0.7 per cent per year to 7.0 per cent per year. Excluding the mining and oil and gas extraction sector, the province's business sector real GDP grew at 1.8 per cent per year during the 2007-2018 period, contrary to a decline of 1.1 per cent per year growth of the province's real GDP in the whole business sector.

Table 1: Real Business Sector GDP Compound Annual Growth by Two-Digit NAICS Sectors, Newfoundland and Labrador and Canada, 1997-2018

	Newfoundland and Labrador		
	1997-2018	**1997-2007**	**2007 - 2018**
Business sector	**2.97**	**7.65**	**-1.11**
Agriculture, forestry, fishing and hunting	-1.53	1.45	-4.16
Mining and oil and gas extraction	9.10	24.73	-3.41
Utilities	1.72	1.79	1.65
Construction	3.26	-0.73	7.02
Manufacturing	1.83	2.35	1.36
Goods-producing Sector	**4.20**	**11.76**	**-2.23**
Wholesale trade	3.17	3.95	2.46
Retail trade	3.11	4.67	1.71
Transportation and warehousing	1.33	0.38	2.21
Information and cultural industries	2.61	4.39	1.01

Finance and insurance, and holding companies	0.87	0.79	0.93
Real estate, rental and leasing	1.84	1.64	2.03
Professional, scientific and technical services	2.52	4.17	1.03
Administrative and Support, Waste Management and Remediation and Services	3.13	7.80	-0.93
Arts, entertainment and recreation	0.05	-0.52	0.57
Accommodation and food services	2.48	2.53	2.44
Other private services	2.36	3.05	1.73
Service-producing Sector	**2.21**	**2.99**	**1.52**
Business sector without mining and oil and gas	**1.45**	**1.12**	**1.75**
	Canada		
	1997-2018	**1997-2007**	**2007 - 2018**
Business sector	**2.43**	**3.43**	**1.54**
Agriculture, forestry, fishing and hunting	1.24	0.02	2.36
Mining and oil and gas extraction	1.82	1.76	1.88
Utilities	1.20	1.30	1.11
Construction	3.12	4.51	1.87
Manufacturing	0.80	1.80	-0.10
Goods-producing Sector	**1.64**	**2.26**	**1.07**
Wholesale trade	3.63	5.37	2.08
Retail trade	3.45	5.21	1.88
Transportation and warehousing	2.60	2.88	2.34
Information and cultural industries	3.44	6.19	1.01
Finance and insurance, and holding companies	3.09	4.19	2.10
Real estate, rental and leasing	2.83	3.96	1.82
Professional, scientific and technical services	3.62	5.42	2.01
Administrative and Support, Waste Management and Remediation and Services	2.87	5.06	0.92
Arts, entertainment and recreation	1.02	1.16	0.90
Accommodation and food services	2.36	2.24	2.47
Other private services	2.13	2.84	1.48
Service-producing Sector	**3.01**	**4.30**	**1.86**
Business sector without mining and oil and gas	**2.48**	**3.54**	**1.52**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA) and the Gross Domestic Product by Industry - Provincial and Territorial (Annual), Statistics Canada (Tables 36-10-0480-01 and 36-10-0400-01).

Table 2: Percentage Point Contribution from Two-digit NAICS Sectors to Business Sector Average Annual Growth Rate in Real GDP, Newfoundland and Labrador, 1997 – 2018

	Newfoundland and Labrador			
	1997-2018	**1997-2007**	**2008-2018**	**Differences**

	(contribution to average annual growth, percentage points)			(percentage points)
	A	B	C	C - B
Business sector	3.24	7.84	-0.95	-8.79
Agriculture, forestry, fishing and hunting	-0.01	0.09	-0.11	-0.20
Mining and oil and gas extraction	1.96	6.11	-1.81	-7.93
Utilities	0.05	0.07	0.04	-0.03
Construction	0.29	-0.05	0.59	0.64
Manufacturing	0.13	0.22	0.05	-0.17
Goods-producing Sector	**2.42**	**6.45**	**-1.24**	**-7.68**
Wholesale trade	0.09	0.14	0.05	-0.09
Retail trade	0.24	0.37	0.11	-0.26
Transportation and warehousing	0.03	-0.02	0.08	0.11
Information and cultural industries	0.14	0.27	0.03	-0.24
Finance and insurance, and holding companies	0.04	0.04	0.05	0.00
Real estate, rental and leasing	0.06	0.06	0.05	-0.01
Professional, scientific and technical services	0.09	0.17	0.01	-0.16
Administrative and Support, Waste Management and Remediation and Services	0.06	0.13	-0.02	-0.15
Arts, entertainment and recreation	0.00	-0.01	0.00	0.01
Accommodation and food services	0.06	0.08	0.05	-0.03
Other private services	0.00	0.15	-0.14	-0.29
Service-producing Sector	**0.81**	**1.39**	**0.29**	**-1.11**
Business sector without mining and oil and gas	**1.28**	**1.73**	**0.86**	**-0.86**
	Canada			
	1997-2018	**1997-2007**	**2008-2018**	**Differences**
	(contribution to average annual growth, percentage points)			(percentage points)
	D	E	F	F - E
Business sector	2.46	3.44	1.57	-1.87
Agriculture, forestry, fishing and hunting	0.04	0.02	0.05	0.03
Mining and oil and gas extraction	0.13	0.14	0.12	-0.02
Utilities	0.03	0.04	0.03	-0.01
Construction	0.25	0.33	0.18	-0.14
Manufacturing	0.19	0.46	-0.05	-0.51
Goods-producing Sector	**0.64**	**0.98**	**0.33**	**-0.65**
Wholesale trade	0.24	0.37	0.13	-0.24
Retail trade	0.23	0.34	0.12	-0.21
Transportation and warehousing	0.14	0.17	0.12	-0.05
Information and cultural industries	0.14	0.25	0.04	-0.21
Finance and insurance, and holding companies	0.28	0.37	0.19	-0.18
Real estate, rental and leasing	0.17	0.24	0.11	-0.12
Professional, scientific and technical services	0.23	0.34	0.12	-0.22
Administrative and Support, Waste Management and Remediation and Services	0.09	0.16	0.03	-0.13
Arts, entertainment and recreation	0.01	0.01	0.00	-0.01
Accommodation and food services	0.06	0.06	0.06	0.00
Other private services	0.23	0.15	0.30	0.15
Service-producing Sector	**1.82**	**2.46**	**1.24**	**-1.22**
Business sector without mining and oil and gas	**2.34**	**3.31**	**1.45**	**-1.85**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA) and the Gross Domestic Product by Industry - Provincial and Territorial (Annual), Statistics Canada (Tables 36-10-0480-01 and 36-10-0400-01).

A subsector's contribution to the real business sector output growth is determined by the price growth of the subsector and the business sector and its prices growth and the growth rate of the subsector's real output.[14] Specifically, among two-digit NAICS subsectors of the province's business sector, the mining and oil and gas extraction contributed 60.5 per cent of the business sector real GDP growth during the 1997-2018 period (2.0 percentage point of 3.2 percentage points average annual growth) and 77.9 per cent (6.1 percentage points of 7.8 percentage points

[14] Subsection A of the Appendix explains how we compute the contributions to growth in detail.

average annual growth) during the 1997-2007 sub-period. The mining and oil and gas extraction sector was also responsible for -1.8 percentage points of -1.0 percentage points of the province's business sector real GDP average annual growth during the 2008-2018 sub-period. Comparing sectoral contributions to the growth rate differences between the 1997-2007 and the 2008-2018 sub-periods, we can see that the mining and oil and gas extraction sector contributed to almost all of the slowdown among subsectors of the business sector (-7.9 percentage points of -8.8 percentage points).

Detailed Output Trends

Statistics Canada Table 36-10-0480-01[15] provides estimates for real GDP (2012 chained dollars) for Newfoundland and Labrador at the two, three- and four-digit levels (322 industries) for 1997, 2007 and 2018, growth rates for the 1997-2018 period and 1997-2007 and 2007-2018 sub-periods and output shares in 1997, 2007 and 2018. This table allows for a very detailed identification of the growing and declining sectors in the province. Here are some observations.

- The aquaculture sector, although small in absolute terms, has experienced very rapid growth over the past two decades, with real GDP rising from $3.4 million in 1997 to $8.1 million in 2007 to $28.2 million in 2018, a compound growth rate over the 1997-2018 period of 10.5 per cent per year (12.0 per cent in 2007-2018).

- Conventional oil and gas extraction just started in Newfoundland and Labrador in 1997 and real GDP in the sector only totalled $45.0 million that year. It rose close to three hundred fold to $13,138.8 million in 2007 before falling to $8,845.2 million in 2018. Because of the low base, the compound growth was 76.4 per cent per year from 1997 to 2007 and 28.6 per cent over the 1997-2018 period.

- Metal ore mining also exhibited strong growth between 1997 and 2007, up three-fold from $957.5 million in 1997 to $2,773.3 million in 2007, an 11.2 per cent compound annual growth rate. After 2007, real output fell to $1,798.4 million in 2018. The strong growth in metal ore mining (3.1 per cent in 1997-2018) was not due to the long established iron ore sector, which only declined at 0.6 per cent over the 1997-2018 period, but to the appearance of the copper, nickel, lead and zinc ore mining which first started producing in 2005 in Voisey Bay and by 2007 had real GDP of $1,275.2 million (versus $1,294.9 million for iron ore mining). By 2018 production had fallen to $658.5 million.
- Related to the development of the off-shore oil production, support services for oil and gas exhibited very strong growth in the 1997-2007 period, with real GDP up 7.2 per cent per year from $271.0 million to $541.0 million. By 2018, output in this industry had risen to $548.9 million because of the Hebron project.

[15] This information is reproduced in Table 5 in the Data Appendix to this report.

- Despite the strength of the Newfoundland and Labrador economy in the 1997-2007 sub-period, real GDP in construction declined at 0.7 per cent per year. In contrast, the construction sector experienced a boom after 2007 with real output rising from $1,288.3 million in 2007 to $2,717.9 million in 2018, a growth rate of 7.0 per cent per year, offsetting the weak growth or output declines in other sectors. Indeed, had real GDP in the construction sector in 2018 remained at its 2007 level business sector real GDP would have fallen 0.2 per cent per year instead of the actual increase of 0.4 per cent per year. The construction boom was driven primarily by engineering construction, and within engineering construction by electric power engineering construction, which rose from $43.7 million in 2007 to $806.2 million in 2018, a 30.4 per cent compound growth rate. Muskrat Falls likely accounts for most of this increase.

- Following the overall industry growth pattern, real output in manufacturing grew at a decent pace in the 1997-2007 period (2.4 per cent per year), fueled by seafood products (5.8 per cent per year), clothing (7.1 per cent), printing (13.0 per cent), architectural and structural metal products (12.9 per cent), computer and electronic products (30.8 per cent per year), and transport equipment (3.4 per cent). These robust growth rates reflect in many cases the low 1997 output base.

- After 2007, output in manufacturing fell, grew at a slower rate of 1.4 per cent per year during the 2007-2018 period. This development was widely based, although much of it was due to paper manufacturing falling at an 8.8 per cent per year, linked largely to the closing of the paper mill in Grand Falls in 2010, and lower output in the important oil refinery sector, which accounts for around one third of manufacturing output. Two positive developments in manufacturing since 2007 have been rapid output growth in cement and concrete products (13.6 per cent per year), likely associated with the engineering construction boom, and the opening of a non-ferrous metal processing facility in 2015 at the Vale nickel smelter in Argentia, which by 2018 had real GDP of $190.6 million.

- In contrast to the marked slowdown in economic growth after 2007 at the level of the business sector, both wholesale trade and retail trade had similar growth rates in the 1997-2007 and 2007-2018 sub-periods at around 3-4 per cent per year. Motor vehicle wholesalers and dealers enjoyed strong sales growth after 2007, possibly associated with purchases by individuals who commute to highly paid jobs in the Alberta oils sand, and maintain a residence in Newfoundland and Labrador.
- The real GDP in rail transportation surprisingly doubled between 2013 and 2014 in Newfoundland and Labrador (actually as there are no railroads left on the island of Newfoundland, the increased rail transport production must have taken place in Labrador), resulting in real GDP of $57.0 million for the sector in 2018, up from $17.5 million in 2007, a 11.3 per cent per year growth rate.

- Air transportation enjoyed rapid growth in the 2007-2018 period at 4.9 per cent per year, compared to only -1.6 per cent in 1997-2007. The growth of long-distance commuting after 2007 may account for this development.

- The post-2007 construction boom may account for the very rapid growth in real output in rental and leasing services (except automotive equipment) which rose 11.7 per cent per year in 2007-2018, compared to 5.7 per cent per year in 1997-2007.

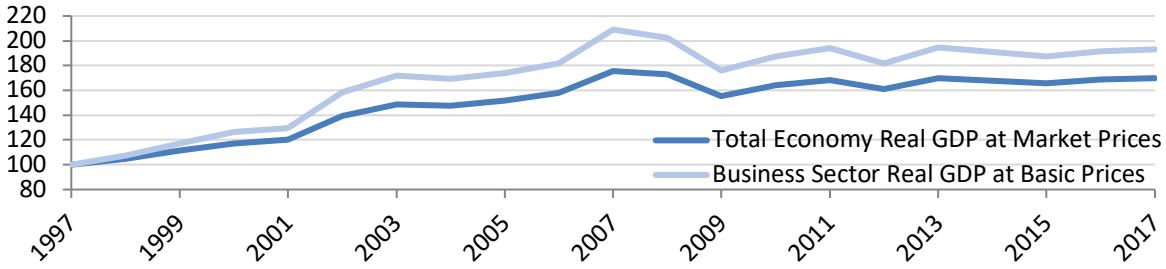
After discussing the sectoral real GDP in Newfoundland and Labrador, we examine the evolution of the expenditure-based real GDP of Newfoundland and Labrador's total economy to understand economic activities in the province.[16] Chart 4 shows that the business sector real GDP (at basic prices) and the total economy real GDP (at market prices)[17] in the province follow the same trend, with the business sector real GDP at basic prices grew at a faster rate than the total economy real GDP at market prices from 1997 to 2017.[18]

[16] The expenditure based (nominal and real) GDP consists of six components: (1) consumption, (2) investment, (3) government spending, (4) exports, (5) imports and (6) statistical discrepancy. Statistics Canada Table 36-10-0222-01 provides data on subcomponents of each of the six components. We group aggregate these subcomponents as follows. Consumption is comprised of Household final consumption expenditure and Non-profit institutions serving households' final consumption expenditure. Investment consists of Business gross fixed capital formation, Non-profit institutions serving households' gross fixed capital formation and Investment in inventories of the business sector. Government expenditure is the sum of General governments final consumption expenditure, General governments gross fixed capital formation and Investment in inventories of the non-business sector. Exports and imports include both international and interprovincial exports and imports.

[17] The difference between GDP at basic prices and GDP at market prices is equal to tax and subsidies on products. Specifically, GDP at basic prices equals to GDP at market prices minus taxes and subsidies on products.

[18] Because the last year available of Statistics Canada's table for expenditure-based GDP is 2017, analysis related to expenditure-based GDP ends in 2017.

Chart 4: Business Sector Real GDP (at Basic Prices) and Total Economy Real GDP (at Market Prices), Newfoundland and Labrador, 1997-2017 (1997=100)



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA) (Table 36-10-0480-01) and the Provincial and Territorial Gross Domestic Product by Income and by Expenditure Accounts (Table 36-10-0222-01), Statistics Canada.

From the expenditure perspective, the main driver of the total economy annual real GDP growth in Newfoundland and Labrador changed during the 1997-2017 period. Specifically, real exports contributed the most (5.1 percentage points of 5.5 percentage points, or 93.0 per cent) to the province's total economy annual real GDP growth during the 1997-2007 sub-period, while investment accounted for 154.9 per cent (1.3 percentage points of 0.8 percentage points) during the 2008-2017 sub-period (Table 3). The decline in real exports was responsible for the real GDP slowdown (-7.0 percentage points of -5.7 percentage points).

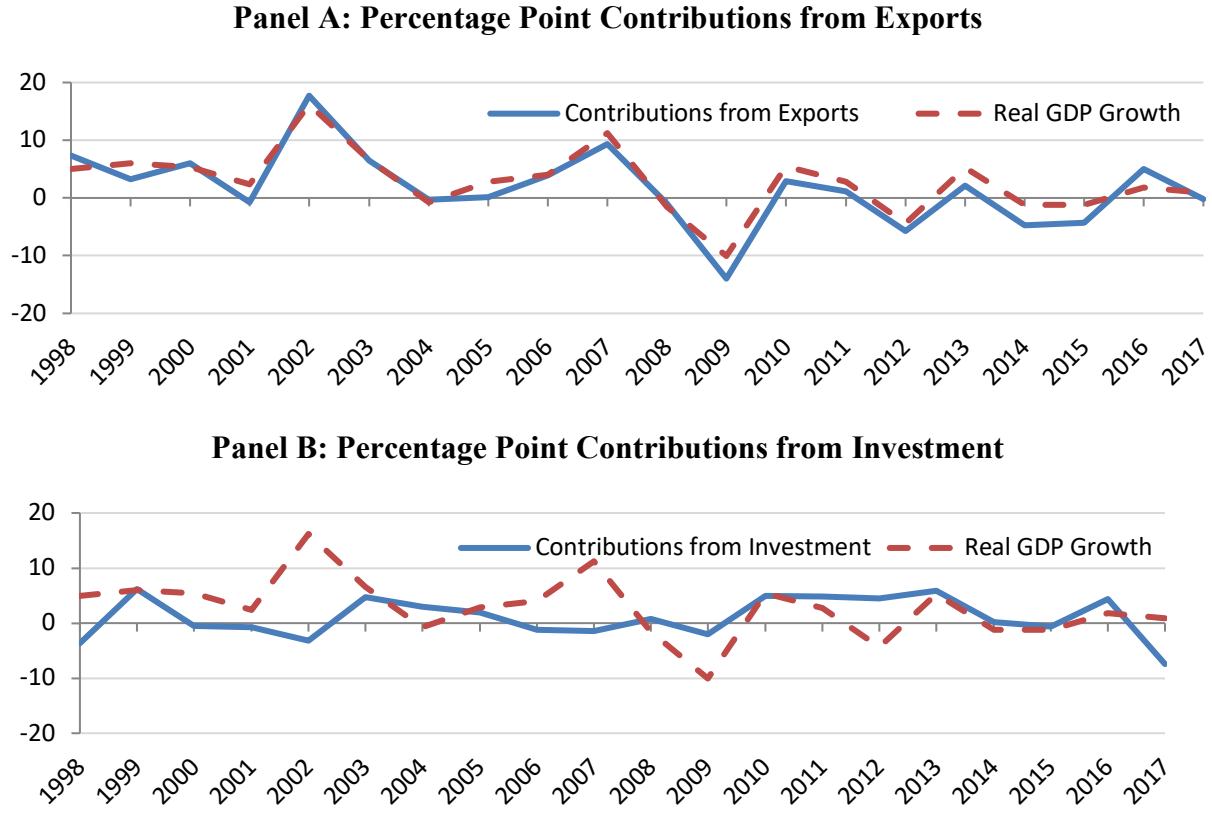
Chart 5 shows the annual percentage point contributions from real exports and real investment to the province's total economy real GDP from 1997 to 2017.

Table 3: Percentage Point Contribution from Components of Expenditures to Average Annual Growth Rate of Real GDP, Total Economy, Newfoundland and Labrador and Canada, 1997-2017

	Newfoundland and Labrador			
	1997-2017	1997-2007	2008-2017	Differences
	(contribution to average annual growth, percentage points)			(percentage points)
	A	B	C	C - B
Gross Domestic Products	2.75	5.45	-0.22	-5.67
Consumption	1.44	1.76	1.08	-0.69
Investment	1.26	1.01	1.54	0.53
Government expenditure	0.50	0.83	0.13	-0.70
Exports	1.76	5.07	-1.88	-6.95
Less: Imports	2.18	3.17	1.09	-2.09
	Canada			
	1997-2017	1997-2007	2008-2017	Differences
	(contribution to average annual growth, percentage points)			(percentage points)
	A	B	C	C - B
Gross Domestic Products	2.48	3.28	1.60	-1.68
Consumption	1.72	2.04	1.37	-0.67
Investment	0.65	1.09	0.17	-0.92
Government expenditure	0.48	0.58	0.37	-0.21
Exports	0.95	1.55	0.29	-1.26
Less: Imports	1.33	1.98	0.61	-1.37

Source: CSLS calculations based on the Provincial and Territorial Gross Domestic Product by Income and by Expenditure Accounts of Statistics Canada (Table 36-10-0222-01).

Chart 5: Percentage Point Contribution from Exports and Investment to Real (Expenditure-based) GDP, Total Economy, Newfoundland and Labrador, 1997-2017



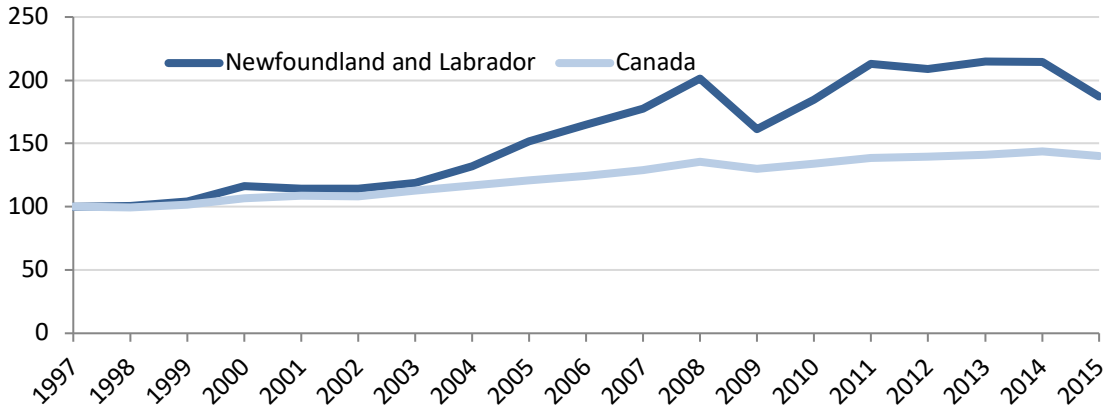
Source: The Provincial and Territorial Gross Domestic Product by Income and by Expenditure Accounts of Statistics Canada (Table 36-10-0222-01).

ii. GDP Deflator

The GDP deflator or the Implicit Price Deflator (IPD), calculated as nominal GDP divided by real GDP, in the Newfoundland and Labrador business sector grew at a much faster pace than the national average during the 1997-2015 period (3.54 per cent per year versus 1.89 per cent per year, respectively).[19] As Chart 6 shows, this is especially true for the 2000-2008 and the 2009-2015 periods, when the deflator in Newfoundland and Labrador increased at three times the pace of Canada as a whole (7.11 per cent vs. 3.06 per cent and 2.50 per cent vs. 1.25 per cent respectively).

[19] The GDP deflator or the Implicit Price Deflator (IPD) measures the price level of the economy based on nominal and real output. However, it includes items that are not usually consumed by a typical consumer such as crude oil and raw minerals. Also, it only measures domestically-produced goods and services. Therefore, inflation computed from the IPD does not reflect the inflation faced by a typical consumer. To measure such inflation, we need to use the consumer price index (CPI) which is based on a typical consumer's consumption basket.

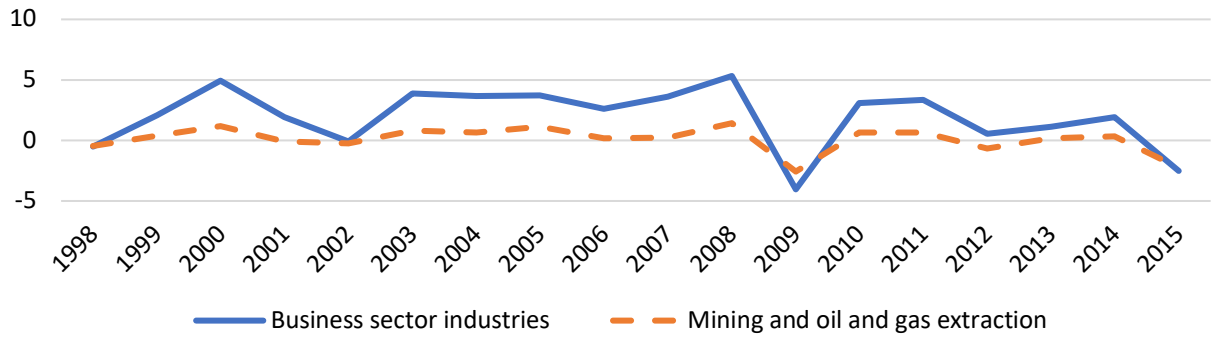
Chart 6: GDP Deflator Growth, Newfoundland and Labrador and Canada, Business Sector, 1997 – 2015 (1997=100)



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

In the previous sub-section, we have seen that the mining and oil and gas extraction sector had significant influence on Newfoundland and Labrador's economy with regard to real output. Therefore, it is not surprising that this sector dominated the movement of the GDP deflator in the province during the 1997-2015 period. As shown in Chart 7, changes in the deflator in the province's business sector closely aligned with the movement of the deflator in the mining and oil and gas extraction sector.[20] Therefore, the mining and oil and gas extraction sector had an essential role in Newfoundland and Labrador's IPD.[21]

Chart 7: Percentage Point Contribution from Mining and Oil and Gas Extraction to Business Sector GDP Deflator Growth, Newfoundland and Labrador, 1998 – 2015



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

Table 4 details the compound annual growth in the GDP deflators for Newfoundland and Labrador and Canada at the two-digit NAICS sector level from 1997 to 2015. During the 1997-

[20] Subsection A of the Appendix provides more details about how to calculate the percentage point contribution from each subsector to the business sector GDP deflator growth.
[21] The Consumer Price Index inflation rate during the 1997-2015 period in Newfoundland and Labrador was 1.88 per cent per year, which is slightly lower than the national average 1.89 per cent per year.

2015 period and the 1997-2007 sub-period, mining and oil and gas extraction had the third highest and the highest growth (4.8 per cent per year and 12.4 per cent per year respectively) among subsectors of the business sector in the province because of the rise in the oil price (Chart 32). During the 2007-2015 period, agriculture, forestry, fishing and hunting had the highest growth in GDP deflator among subsectors of the business sector (7.1 per cent per year) in the province.

Table 4: GDP Deflator Compound Annual Growth by Two-digit NAICS Sectors, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2015

	Newfoundland and Labrador		
	1997-2015	**1997-2007**	**2007-2015**
	(compound annual growth rates, per cent)		
Business sector	**3.54**	**5.92**	**0.65**
Agriculture, forestry, fishing and hunting	3.13	0.07	7.09
Mining and oil and gas extraction	4.77	12.36	-4.00
Utilities	1.17	2.41	-0.34
Construction	5.45	5.20	5.77
Manufacturing	2.94	3.62	2.09
Goods-producing sector	**4.42**	**8.42**	**-0.37**
Wholesale trade	0.36	0.94	-0.37
Retail trade	1.85	2.65	0.85
Transportation and warehousing	2.83	3.22	2.36
Information and cultural industries	-0.14	-0.72	0.58
Finance and insurance, and holding companies	1.97	2.35	1.50
Real estate, rental and leasing	1.47	1.29	1.68
Professional, scientific and technical services	4.79	3.46	6.46
Administrative and Support, Waste Management and Remediation and Services	3.61	4.21	2.86
Arts, entertainment and recreation	3.43	3.48	3.38
Accommodation and food services	3.06	3.30	2.76
Other private services	3.37	3.60	3.10
Service-producing sector	**2.22**	**2.32**	**2.09**
Business sector without mining and oil and gas	**3.61**	**3.91**	**3.23**
	Canada		
	1997-2015	**1997-2007**	**2007-2015**
	(compound annual growth rates, per cent)		
Business sector	**1.89**	**2.56**	**1.07**
Agriculture, forestry, fishing and hunting	1.70	0.63	3.06
Mining and oil and gas extraction	3.99	12.12	-5.35
Utilities	1.70	1.83	1.54

Construction	3.05	3.69	2.26
Manufacturing	1.17	0.77	1.66
Goods-producing sector	**1.97**	**3.37**	**0.25**
Wholesale trade	0.79	0.79	0.79
Retail trade	1.29	1.63	0.85
Transportation and warehousing	1.83	1.81	1.86
Information and cultural industries	0.59	0.43	0.79
Finance and insurance, and holding companies	1.74	2.29	1.06
Real estate, rental and leasing	1.45	1.36	1.57
Professional, scientific and technical services	2.49	2.59	2.36
Administrative and Support, Waste Management and Remediation and Services	3.19	3.64	2.63
Arts, entertainment and recreation	2.83	3.35	2.19
Accommodation and food services	2.27	2.73	1.69
Other private services	2.76	2.71	2.82
Service-producing sector	**1.80**	**1.97**	**1.59**
Business sector without mining and oil and gas	**1.76**	**1.82**	**1.69**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

Table 5: Percentage Point Contribution from Two-digit NAICS Sector to Average Annual GDP Deflator Growth in the Business Sector, Newfoundland and Labrador and Canada, 1998 – 2015

	Newfoundland and Labrador			
	1998-2015	**1998-2007**	**2008-2015**	**Differences**
	(contribution to average annual growth, percentage points)			(percentage points)
	A	B	C	C-B
Business sector	**3.98**	**6.05**	**1.41**	**-4.64**
Agriculture, forestry, fishing and hunting	0.02	0.00	0.05	0.05
Mining and oil and gas extraction	1.07	2.07	-0.18	-2.25
Utilities	0.03	0.05	0.00	-0.06
Construction	0.19	0.15	0.25	0.10
Manufacturing	0.06	0.15	-0.05	-0.19
Goods-producing sector	**1.77**	**2.66**	**0.67**	**-1.98**
Wholesale trade	0.00	0.01	-0.01	-0.02
Retail trade	0.07	0.10	0.02	-0.08
Transportation and warehousing	0.05	0.07	0.03	-0.04
Information and cultural industries	-0.01	-0.03	0.02	0.04
Finance and insurance, and holding companies	0.07	0.09	0.04	-0.05
Real estate, rental and leasing	0.02	0.02	0.02	0.01
Professional, scientific and technical services	0.07	0.06	0.09	0.03
Administrative and Support, Waste Management and Remediation and Services	0.03	0.04	0.02	-0.01
Arts, entertainment and recreation	0.00	0.00	0.00	0.00
Accommodation and food services	0.03	0.04	0.03	-0.01
Other private services	0.07	0.08	0.06	-0.02
Service-producing sector	**0.43**	**0.49**	**0.34**	**-0.15**
Business sector without mining and oil and gas	**2.91**	**3.97**	**1.59**	**-2.39**
	Canada			
	1998-2015	**1998-2007**	**2008-2015**	**Differences**

	(contribution to average annual growth, percentage points)			(percentage points)
	D	E	F	F-E
Business sector	**1.92**	**2.57**	**1.11**	**-1.46**
Agriculture, forestry, fishing and hunting	0.01	0.00	0.02	0.01
Mining and oil and gas extraction	0.08	0.37	-0.29	-0.67
Utilities	0.03	0.03	0.02	-0.01
Construction	0.13	0.14	0.11	-0.03
Manufacturing	0.09	0.09	0.09	0.00
Goods-producing sector	**0.53**	**0.79**	**0.22**	**-0.57**
Wholesale trade	0.03	0.03	0.02	-0.01
Retail trade	0.04	0.06	0.02	-0.03
Transportation and warehousing	0.05	0.05	0.05	0.00
Information and cultural industries	0.01	0.01	0.02	0.01
Finance and insurance, and holding companies	0.09	0.11	0.06	-0.05
Real estate, rental and leasing	0.04	0.04	0.05	0.01
Professional, scientific and technical services	0.08	0.08	0.08	0.00
Administrative and Support, Waste Management and Remediation and Services	0.05	0.06	0.05	-0.01
Arts, entertainment and recreation	0.01	0.02	0.01	-0.01
Accommodation and food services	0.03	0.04	0.02	-0.01
Other private services	0.07	0.07	0.08	0.00
Service-producing sector	**0.53**	**0.58**	**0.47**	**-0.11**
Business sector without mining and oil and gas	**1.84**	**2.20**	**1.40**	**-0.80**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

With respect to the contributions to the business sector growth in GDP deflator among subsectors of the business sector in Newfoundland and Labrador (Table 5), the mining and oil and gas extraction had the largest positive contributions to the average annual GDP deflator growth during the 1998-2015 period and the 1998-2007 sub-period (1.1 percentage points of 4.0 percentage points and 2.1 of 6.1 percentage points respectively) (Table 5). During the 2008-2015 sub-period, the construction sector contributed the most (0.3 of 1.4 percentage points), while the mining and oil and gas extraction sector had the largest negative contribution (-0.2 percentage points). As for the difference between growth rates during the 1998-2007 and the 2008-2015 period, the mining and oil and gas extraction also contributed most (-2.3 percentage points of -4.6 percentage points).

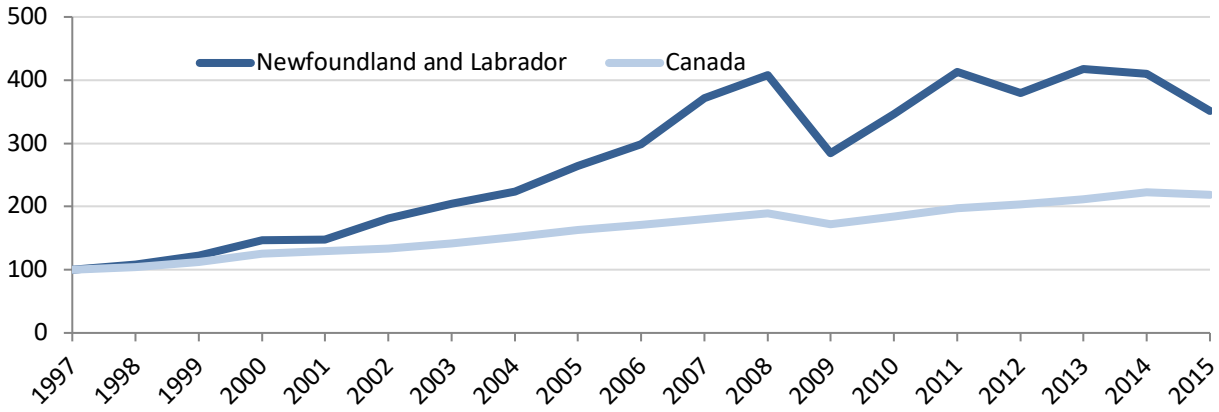
iii. Nominal GDP

In 2015, nominal GDP of the business sector in Newfoundland and Labrador was $20,645 million, up from $5,884 million in 1997.[22] Given such a large increase, it is not surprising that Newfoundland and Labrador's business sector nominal GDP had the highest growth rate (7.2 per cent per year) among all provinces in the 1997-2015 period, followed by Alberta (6.2 per cent per year), while the growth at the national level was 4.4 per cent per year (Panel A of Chart 9). Newfoundland and Labrador's share in national business sector nominal output peaked at 2.0 per cent in 2008, and decreased to 1.5 per cent in 2015 (Chart 10). The high nominal growth in the province during the 1997-2015 period (Chart 8) stemmed from both higher real

[22]The nominal GDP of Newfoundland and Labrador's business sector as a share of the province's total economy has been rising throughout the 1997-2008 period except 2001 from 61.5 per cent in 1997 to 80.4 per cent in 2008. It then tumbled from 80.4 per cent in 2008 to 71.9 per cent in 2009. From 2010 to 2014, the share then fluctuated around 75 per cent in each year. In 2015, the share dropped to 71.4 per cent.

annual compound growth (3.4 per cent versus 2.6 per cent) and higher growth in the implicit price deflator (4.8 per cent versus 2.2 per cent) (Panel A of Chart 11) than the national average.

Chart 8: Nominal GDP, Business Sector, Newfoundland and Labrador and Canada, 1997-2017 (1997=100)

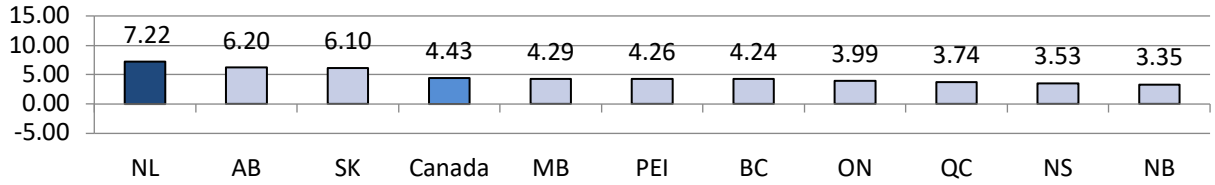


Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

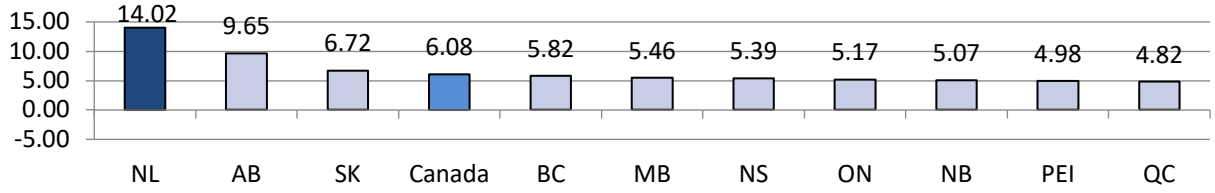
The nominal GDP growth of Newfoundland and Labrador's business sector during the 1997-2015 period was a combination of the strong growth during the 1997-2007 period (14.0 per cent per year) and the below-average growth during the 2007-2015 period (-0.7 per cent per year) (Panel B and C of Chart 9).

Chart 9: Nominal GDP Compound Annual Growth in Canada and the Provinces, Business Sector, 1997 – 2015

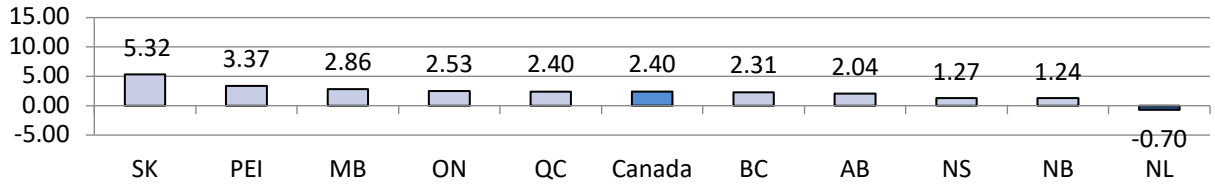
Panel A: 1997 – 2015



Panel B: 1997 - 2007



Panel C: 2007 - 2015

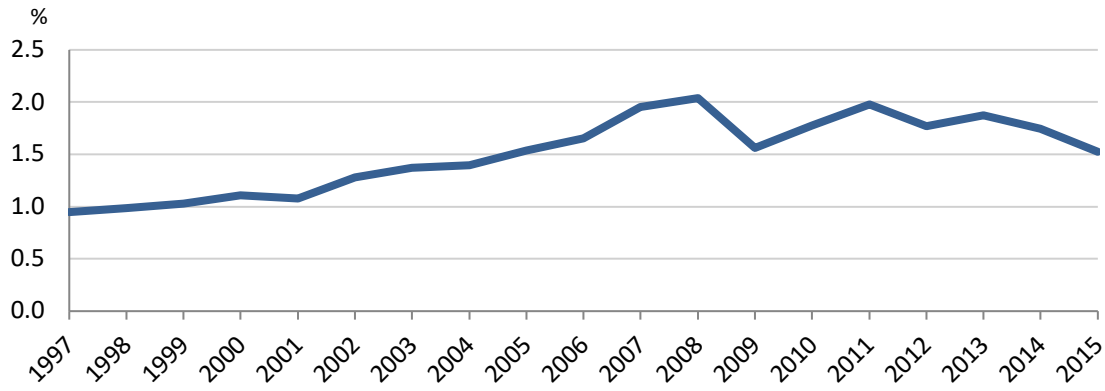


Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

During the 1997-2007 period, business sector nominal GDP growth in Newfoundland and Labrador was the highest amongst provinces and was 2.3 times the growth in Canada (14.0 per cent versus 6.1 per cent). This impressive growth came from both higher real GDP growth (7.7 per cent per year versus 3.4 per cent per year in Canada) and higher growth in implicit price deflator (5.9 per cent per year versus 2.6 per cent per year in Canada) (Panel B of Chart 11).

During the 2007-2015 period, the nominal GDP growth in the province was the lowest among provinces in Canada, which was the only province having had a negative growth (-0.7 per cent per year). This decline in nominal GDP in the province arose from the lower-than-average growth from the implicit price deflator (0.7 per cent per year versus 1.1 per cent per year) and the province's decline in real GDP (-1.4 per cent per year) (Panel C of Chart 11). This real GDP in the province decline arose mainly from the decline in oil production from 134.5 million barrels in 2007 to 62.7 million barrels in 2015.[23]

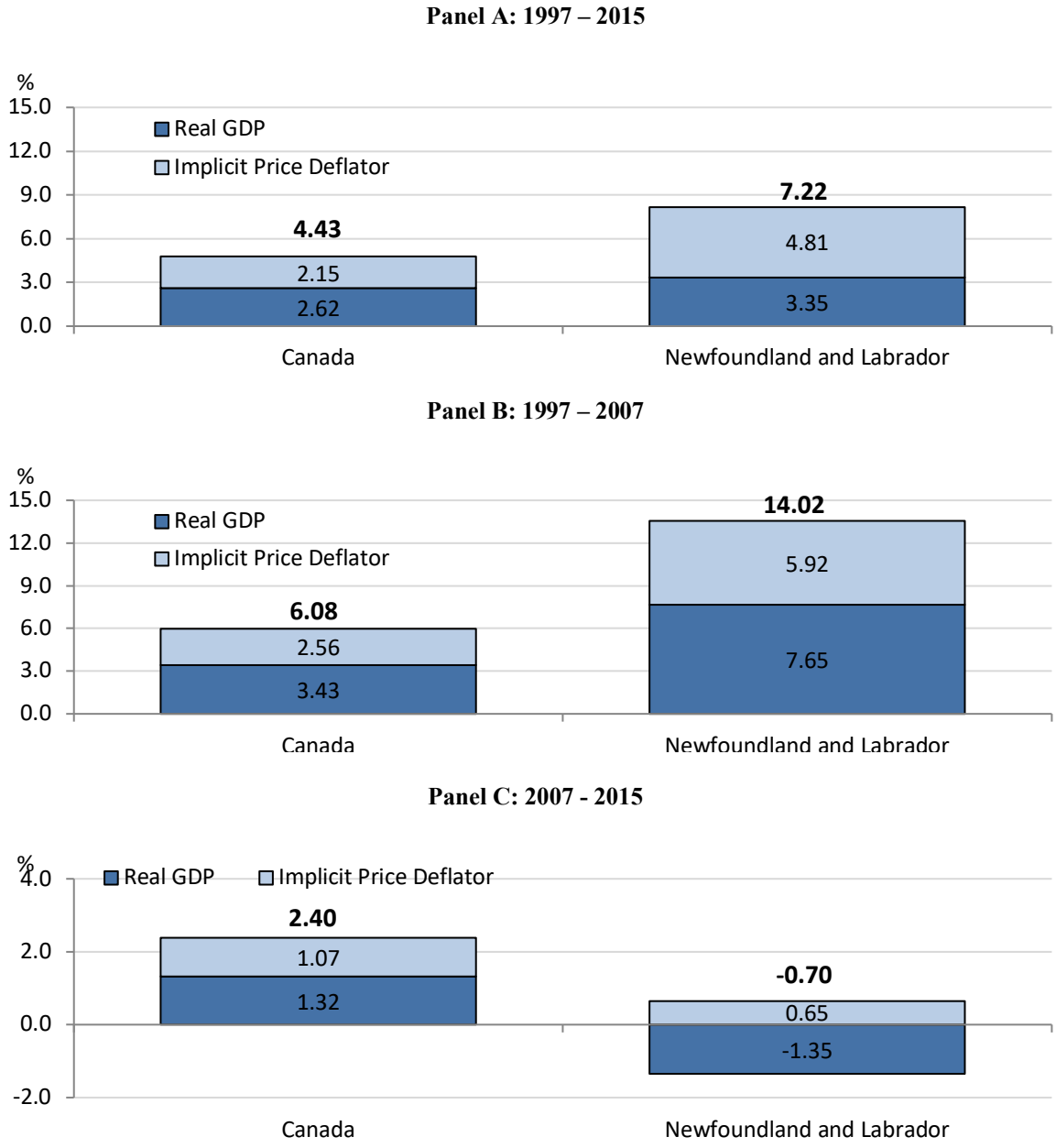
Chart 10: Newfoundland and Labrador's Nominal GDP as a Share of Canada's, Business Sector, 1997 – 2015



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

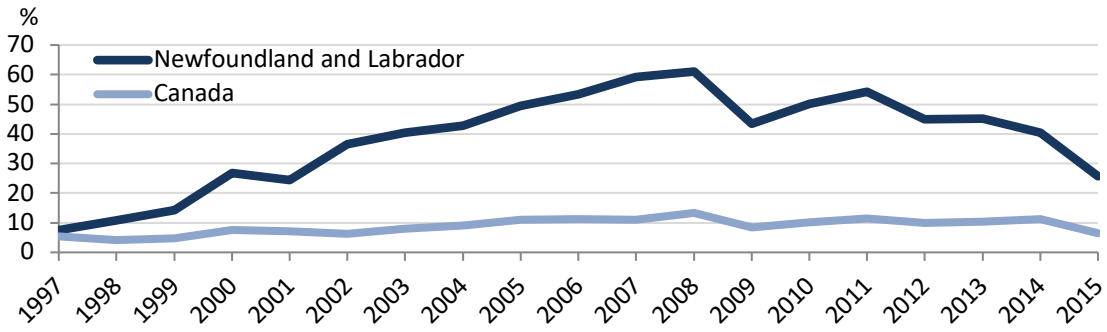
[23] Table 2 provides more details on real GDP growth contribution by sector. Chart 29 contains data on oil production.

Chart 11: Nominal GDP Compound Annual Growth Breakdown in Newfoundland and Labrador and Canada, Business Sector, 1997 – 2015



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

Chart 12: Mining and Oil and Gas Extraction Nominal GDP as a Share of Nominal GDP in the Business Sector, 1997 – 2015



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

Chart 12 shows that the mining and oil and gas extraction sector predominates the business sector nominal GDP in Newfoundland and Labrador from 1997 to 2015. Specifically, mining and oil and gas extraction's share in the province's nominal business sector GDP in 1997 was 7.5 per cent. It increased and peaked in 2008 at 61.1 per cent. From 2008 to 2015, the shares had a downward trend and declined to 25.8 per cent in 2015. No province in Canada is as dominated by one sector in its economy as Newfoundland and Labrador is.[24] At the national level, the share of mining and oil and gas extraction in the business sector nominal GDP also increased, from 5.3 per cent in 1997 and reached the peak at 13.3 per cent in 2008. The share in 2014 decreased slightly to 11.3 per cent and further dropped to 6.5 per cent in 2015.

Table 6: Nominal GDP Shares by Two-digit NAICS Sectors, Newfoundland and Labrador and Canada, 1997, 2007 and 2015

	Newfoundland and Labrador			Canada			NL - Canada		
	1997	2007	2015	1997	2007	2015	1997	2007	2015
Business sector	**100**	**100**	**100**	**100**	**100**	**100**	**-**	**-**	**-**
Agriculture, forestry, fishing and hunting	5.68	1.78	2.86	3.23	1.91	2.44	2.45	-0.13	0.41
Mining and oil and gas extraction	7.51	59.15	25.81	5.30	10.99	6.53	2.21	48.15	19.28
Utilities	5.85	2.38	2.71	3.95	2.98	2.98	1.90	-0.60	-0.27

[24] The share of the mining and oil and gas extraction sector in Alberta, another oil-producing province, in nominal GDP ranged from 18 per cent to 39 per cent in the 1997-2015 period. For Saskatchewan, it ranged from 17 per cent to 37 per cent in the 1997-2015 period.

Construction	10.67	4.43	20.60	7.36	9.12	11.02	3.31	-4.68	9.58
Manufacturing	9.70	4.70	6.42	23.43	16.76	14.66	-13.73	-12.06	-8.24
Goods-producing Sector	**39.41**	**72.44**	**58.39**	**43.26**	**41.76**	**37.63**	**-3.86**	**30.68**	**20.76**
Wholesale trade	5.07	2.21	3.38	7.03	7.11	7.16	-1.96	-4.90	-3.78
Retail trade	9.78	5.40	7.67	6.36	6.89	6.80	3.42	-1.49	0.87
Transportation and warehousing	7.23	2.77	4.47	6.21	5.48	6.09	1.02	-2.70	-1.62
Information and cultural industries	6.26	2.41	3.14	3.94	4.15	4.00	2.33	-1.74	-0.85
Finance and insurance, and holding companies	10.69	3.93	5.11	9.04	9.47	9.96	1.65	-5.54	-4.85
Real estate, rental and leasing	5.73	2.06	3.14	6.23	5.83	6.34	-0.50	-3.76	-3.20
Professional, scientific and technical services	4.02	2.29	4.58	5.64	6.85	8.00	-1.62	-4.56	-3.42
Administrative and Support, Waste Management and Remediation and Services	1.69	1.45	1.89	2.77	3.59	3.97	-1.08	-2.14	-2.08
Arts, entertainment and recreation	0.58	0.21	0.29	1.05	0.90	0.88	-0.47	-0.70	-0.59
Accommodation and food services	3.31	1.58	2.68	2.95	2.67	3.02	0.36	-1.09	-0.33
Other private services	6.24	3.23	5.25	5.52	5.30	6.15	0.72	-2.07	-0.90

Service-producing Sector	**60.59**	**27.56**	**41.61**	**56.74**	**58.24**	**62.37**	**3.86**	**-30.68**	**-20.76**
Business sector without mining and oil and gas	**92.49**	**40.85**	**74.19**	**94.70**	**89.01**	**93.47**	**-2.21**	**-48.15**	**-19.28**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

Table 6 shows the evolution of the predominance of mining and oil and gas extraction in terms of the Newfoundland and Labrador's business sector nominal GDP from 1997 to 2015. In 1997, the year when oil production began in the province, mining and oil and gas extraction only accounted for 7.5 per cent of the province's business sector nominal GDP. This share is roughly higher than the national average of 5.3 per cent. In 2007, as the province's oil production and the oil price reached the peak (Chart 29 and Chart 32), mining and oil and gas extraction's share in the business sector nominal GDP rose to 59.2 per cent, which is about six times as high as the national average (11.0 per cent). In 2015, as the province's oil production and the oil price declined, the mining and oil and gas extraction nominal GDP as a share of the province's business sector nominal GDP dropped to 25.8 per cent. Although the mining and oil and gas extraction sector was still the most predominant sector, the share of construction rose by close to four times from 4.4 per cent in 2007 to 20.6 per cent in 2015. This rise was due to the development of the Hebron project and the Muskrats Fall project.

Box 1: Comparison between the Industrial Structure of Newfoundland and Labrador and Canada

Table 6 also reveals the industrial structure of Newfoundland and Labrador and Canada during the 1997-2015 period. In the province, we observe the predominance of the mining and oil and gas extraction in the economy. This sector accounted for more than a half of the business sector nominal GDP since 2006 (Chart 12). On the contrary, the industrial structure in Canada was more balanced with increasing shares from the service sector.

In 1997, the service sector had the largest share of business sector nominal GDP in the province (60.1 per cent), with finance, insurance and holding companies contributed the most (10.69 per cent). The finance, insurance and holding companies sector also had the highest share among sub-sectors of the business sector in the province, followed construction (10.67 per cent) and retail trade (9.8 per cent). In Canada, manufacturing had the highest share (23.4 per cent), followed by finance, insurance and holding companies (9.0 per cent) and construction (7.4 per cent). Service sectors also had a higher share in Canada than the goods-producing sector (56.7 per cent versus 43.3 per cent).

The share of the mining and oil and gas extraction sector increased in both the province and Canada in 2007. Specifically, the share in Canada doubled from 5.3 per cent in 1997 to 11.0 per cent in 2007. In the province, the share increased significantly from 7.5 per cent in 1997 to 59.2 in 2007. Because the share was more than a half, Newfoundland and Labrador's economy is dependent on the mining and oil and gas extraction sector. This drove the share of the goods-producing sector in the province to 72.4 per cent. On the contrary, the shares of the service sector and the goods-producing sector were much closer in Canada, with the service sector having a higher share (58.2 per cent versus 41.8 per cent).

In 2015, although the mining and oil and gas extraction sector was still predominant in Newfoundland and Labrador's business sector, its share fell from 59.2 per cent in 2007 to 25.8 per cent in 2015. It is notable that the share of the construction sector increased by 4.7 times from 4.4 per cent in 2007 to 20.6 per cent in 2015 because of various development projects such as the Muskrat Falls and the Hebron oil field. We also observe a rise in the share of the construction sector in Canada, but it was much milder (from 9.1 per cent in 2007 to 11.0 per cent in 2015).

Table 7: Nominal Business Sector GDP Compound Annual Growth by Two-digit NAICS Sector, Newfoundland and Labrador and Canada, 1997 – 2015

	Newfoundland and Labrador

	1997-2015	1997-2007	2007-2015
	(compound annual growth rates, per cent)		
Business sector	**7.22**	**14.02**	**-0.70**
Agriculture, forestry, fishing and hunting	3.20	1.52	5.34
Mining and oil and gas extraction	14.83	40.15	-10.48
Utilities	2.73	4.24	0.88
Construction	11.22	4.43	20.32
Manufacturing	4.80	6.06	3.25
Goods-producing Sector	**9.59**	**21.18**	**-3.34**
Wholesale trade	4.83	4.93	4.71
Retail trade	5.79	7.45	3.75
Transportation and warehousing	4.40	3.61	5.40
Information and cultural industries	3.20	3.64	2.65
Finance and insurance, and holding companies	2.92	3.17	2.61
Real estate, rental and leasing	3.70	2.95	4.63
Professional, scientific and technical services	7.99	7.78	8.26
Administrative and Support, Waste Management and Remediation and Services	7.90	12.33	2.61
Arts, entertainment and recreation	3.21	2.94	3.54
Accommodation and food services	5.98	5.91	6.08
Other private services	6.20	6.75	5.51
Service-producing Sector	**5.01**	**5.38**	**4.54**
Business sector without mining and oil and gas	**5.92**	**5.07**	**7.01**
	Canada		
	1997-2015	**1997-2007**	**2007-2015**
	(compound annual growth rates, per cent)		
Business sector	**4.43**	**6.08**	**2.40**
Agriculture, forestry, fishing and hunting	2.82	0.66	5.59
Mining and oil and gas extraction	5.64	14.10	-4.05
Utilities	2.80	3.15	2.38
Construction	6.80	8.37	4.87
Manufacturing	1.74	2.59	0.70
Goods-producing Sector	**3.62**	**5.70**	**1.08**
Wholesale trade	4.53	6.19	2.48
Retail trade	4.82	6.93	2.23
Transportation and warehousing	4.32	4.75	3.78
Information and cultural industries	4.52	6.64	1.93
Finance and insurance, and holding companies	5.00	6.58	3.05
Real estate, rental and leasing	4.53	5.37	3.49

Professional, scientific and technical services	6.47	8.15	4.41
Administrative and Support, Waste Management and Remediation and Services	6.55	8.88	3.71
Arts, entertainment and recreation	3.43	4.55	2.06
Accommodation and food services	4.55	5.04	3.96
Other private services	5.05	5.63	4.33
Service-producing Sector	**4.98**	**6.36**	**3.28**
Business sector without mining and oil and gas	**4.35**	**5.42**	**3.03**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

Mining and oil and gas extraction in Newfoundland and Labrador had the highest growth among all two-digit NAICS subsectors of the business sector during the 1997-2015 period (14.8 per cent per year) (Table 7). The rapid growth of the mining and oil and gas extraction sector resulted in the rapid growth of the goods-producing sector in the province (9.6 per cent per year), which is almost double of the growth in the service sector (5.0 per cent per year). In contrast, in Canada, the service sector had higher growth in nominal GDP than the goods-producing sector (5.0 per cent per year versus 3.6 per cent per year).

During the 1997-2007 period, the growth of mining and oil and gas extraction's nominal GDP was extremely strong (40.2 per cent per year) in Newfoundland and Labrador. As a result, the growth of the goods-producing sector in the province was almost four times that of the service sector (21.2 per cent per year versus 5.4 per cent per year). In Canada, the growth of the mining and oil and gas extraction was also the highest (14.1 per cent per year). However, unlike Newfoundland and Labrador, this did not result in the growth of the goods-producing sector in Canada to higher than the service sector (5.7 per cent per year versus 6.4 per cent per year).

During the 2007-2015 period, although the nominal GDP of the mining and oil and gas extraction sector in both Newfoundland and Labrador and Canada declined, the decline in Canada was much more moderate than that in the province (-4.1 per cent per year versus -10.5 per cent per year). Because of various development projects in Newfoundland and Labrador such as the Muskrat Falls and the Hebron oil field, nominal GDP of the construction sector during the 2007-2015 period grew 4.6 times faster than the 1997-2007 period (4.4 per cent per year versus 20.3 per cent per year), which only partially offset the decline in the mining and oil and gas extraction sector. On the other hand, the service sector grew at a slower rate than the 1997-2007 period in the province (5.4 per cent per year versus 4.5 per cent per year). Without mining and oil and gas extraction, the business sector grew at a rate of 7.0 per cent per year during the 2007-2015 period, compared with the business sector average of -0.7 per cent per year. In Canada, while we also observe a higher growth of the service sector than the goods-producing sector (3.3 per cent per year versus 1.1 per cent per year) during the 2007-2015 period, we do not observe the acceleration of the service sector growth (6.4 per cent per year during the 1997-2007 period versus 3.3 per cent during the 2007-2015 period).

Table 8: Percentage Point Contribution from Two-digit NAICS Sectors to Business Sector Average Annual Growth in Nominal GDP, Newfoundland and Labrador and Canada, 1998 – 2015

	Newfoundland and Labrador			
	1998-2015	1998-2007	2008-2015	Differences
	(contribution to average annual growth, percentage points)			(percentage points)
	A	B	C	C-B
Business sector	**8.26**	**14.23**	**0.80**	**-13.43**
Agriculture, forestry, fishing and hunting	0.12	0.11	0.12	0.01
Mining and oil and gas extraction	4.73	10.77	-2.83	-13.61
Utilities	0.11	0.17	0.04	-0.14
Construction	0.97	0.28	1.83	1.55
Manufacturing	0.32	0.47	0.13	-0.34
Goods-producing Sector	**6.25**	**11.81**	**-0.71**	**-12.53**
Wholesale trade	0.15	0.17	0.13	-0.04
Retail trade	0.43	0.59	0.24	-0.35
Transportation and warehousing	0.15	0.13	0.18	0.06
Information and cultural industries	0.16	0.22	0.07	-0.15
Finance and insurance, and holding companies	0.17	0.21	0.13	-0.08
Real estate, rental and leasing	0.11	0.11	0.11	0.00
Professional, scientific and technical services	0.28	0.30	0.25	-0.05
Administrative and Support, Waste Management and Remediation and Services	0.14	0.21	0.04	-0.17
Arts, entertainment and recreation	0.01	0.00	0.01	0.01
Accommodation and food services	0.14	0.16	0.12	-0.04
Other private services	0.28	0.32	0.22	-0.10
Service-producing Sector	**2.01**	**2.41**	**1.51**	**-0.90**
Business sector without mining and oil and gas	**3.53**	**3.45**	**3.63**	**0.18**
	Canada			
	1998-2015	1998-2007	2008-2015	Differences
	(contribution to average annual growth, percentage points)			(percentage points)
	A	B	C	C-B
Business sector	**4.52**	**6.11**	**2.54**	**-3.56**
Agriculture, forestry, fishing and hunting	0.08	0.04	0.12	0.08
Mining and oil and gas extraction	0.49	1.06	-0.23	-1.30
Utilities	0.09	0.10	0.07	-0.03
Construction	0.57	0.62	0.50	-0.12
Manufacturing	0.40	0.64	0.10	-0.55
Goods-producing Sector	**1.62**	**2.47**	**0.56**	**-1.91**
Wholesale trade	0.32	0.43	0.18	-0.24
Retail trade	0.32	0.45	0.15	-0.30
Transportation and warehousing	0.25	0.28	0.21	-0.06
Information and cultural industries	0.19	0.28	0.08	-0.19
Finance and insurance, and holding companies	0.46	0.59	0.29	-0.30
Real estate, rental and leasing	0.27	0.32	0.21	-0.11
Professional, scientific and technical services	0.43	0.52	0.33	-0.19
Administrative and Support, Waste Management and Remediation and Services	0.22	0.28	0.14	-0.14
Arts, entertainment and recreation	0.03	0.05	0.02	-0.03
Accommodation and food services	0.13	0.14	0.11	-0.03
Other private services	0.28	0.31	0.25	-0.06
Service-producing Sector	**2.90**	**3.64**	**1.99**	**-1.65**
Business sector without mining and oil and gas	**4.03**	**5.04**	**2.77**	**-2.27**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

Table 8 shows the percentage point contribution from each sector to the business sector nominal GDP average annual per cent growth in Newfoundland and Labrador and Canada. During the 1998-2015 period, goods-producing sectors contributed more to the business sector growth than the service sector in Newfoundland and Labrador (6.3 percentage points versus 2.0 percentage points of 8.3 percentage points). The mining and oil and gas extraction sector

contributed the most to the goods-producing sector (4.7 percentage points) while retail trade was the top contributor among subsectors of the service sector (0.4 percentage points of 2.0 percentage points).

During the 1998-2007 period, the mining and oil and gas extraction sector alone contributed 75.7 per cent of the business sector nominal GDP average annual growth (10.8 percentage points of 14.2 percentage points) in the province. Therefore, the goods sector in the province had a much higher contribution than the service sector (11.8 percentage points versus 2.4 percentage points). Among all subsectors of the service sector, retail trade contributed the most (0.6 percentage points).

During the 2008-2015 period, the mining and oil and gas extraction sector was the only subsector that had negative contribution (-2.8 percentage points) among two-digit NAICS subsectors in the province. On the other hand, the construction sector contributed the most to the business sector nominal GDP growth in the province (1.8 percentage points of 0.8 percentage points), but this sector's contribution only partially offset the negative contribution from mining and oil and gas extraction. Because of the negative contributions from mining and oil and gas extraction, the goods sector still contributed negatively to the business sector while the service sector made positive contributions (-0.7 percentage points versus 1.5 percentage points).

Between the 1998-2007 and the 2007-2015 sub-periods, the business sector nominal GDP slowdown in the province was larger than the national average (-13.4 percentage points versus -3.6 percentage points). In particular, in Newfoundland and Labrador, the mining and oil and gas extraction alone accounted for 101.3 per cent of the slowdown (-13.6 percentage points).

Compared with Canada, the goods-producing sector in Newfoundland and Labrador had a more important role in the nominal GDP growth, especially during the 1998-2007 period (83.0 per cent, or 11.8 percentage points of 14.2 percentage points versus 40.4 per cent, or 2.5 of 6.1 percentage points) and the 1998-2015 period (52.2 per cent versus 24.1 per cent). Moreover, contributions to the business sector growth pattern in Canada were not dominated by any one sector, unlike Newfoundland and Labrador.

The above analysis shows the substantial weight of the mining and oil and gas extraction sector in Newfoundland and Labrador's business sector. Specifically, this sector accounted for the largest share of the province's business sector nominal GDP in 2015 (25.8 per cent) and contributed the most to the business sector nominal GDP growth slowdown between the 1998-2007 and the 2008-2015 sub-periods (-13.6 percentage points of -13.4 percentage points). We then examine the evolution of the expenditure-based nominal GDP in Newfoundland and Labrador to understand the flow in the province's total economy.

Table 9: Expenditures as a share of Total Economy Nominal GDP, Newfoundland and Labrador and Canada, 1997-2015

	Newfoundland and Labrador			
	1997	**2007**	**2015**	**Differences**
	(contribution to average annual growth, percentage points)			(percentage points)
	A	**B**	**C**	**C - B**
Gross Domestic Products	100	100	100	-
Consumption	69.14	39.94	52.24	12.30
Investment	25.99	13.23	30.67	17.45
Government expenditure	34.39	23.26	27.35	4.09
Exports	41.22	71.71	50.06	-21.65
Less: Imports	70.13	48.11	60.23	12.12
	Canada			
	1997	**2007**	**2015**	**Differences**
	(contribution to average annual growth, percentage points)			(percentage points)
	A	**B**	**C**	**C - B**
Gross Domestic Products	100	100	100	-
Consumption	56.76	54.68	57.76	3.09
Investment	18.38	20.21	20.05	-0.16
Government expenditure	22.83	23.06	24.78	1.72
Exports	57.13	53.68	50.14	-3.54
Less: Imports	55.23	51.56	52.66	1.10

Source: CSLS calculations based on the Provincial and Territorial Gross Domestic Product by Income and by Expenditure Accounts of Statistics Canada (Table 36-10-0222-01).

From the expenditure perspective, the compositions of Newfoundland and Labrador's nominal GDP changed between 1997 and 2007 and between 2007 and 2015 (Table 9). In 1997, consumption had the highest nominal GDP share in the province (69.1 per cent). As oil production in the province and oil price rose, in 2007, exports accounted for most of the province's nominal GDP (71.7 per cent). Although the share from exports was still significant in 2015 (50.1 per cent), investment as a share of the province's total economy nominal GDP doubled from 13.2 per cent in 2007 to 30.7 per cent in 2015.

Table 10: Expenditure-based Nominal GDP Growth by Expenditure, Total Economy, Newfoundland and Labrador and Canada, 1997-2015

	Newfoundland and Labrador			
	1997-2015	**1997-2007**	**2007-2015**	**Differences**

	(compound annual growth rate, per cent)			(percentage points)
	A	**B**	**C**	**C - B**
Gross Domestic Products	6.10	10.49	0.86	-9.63
Consumption	4.56	4.59	4.51	-0.08
Investment	7.90	3.27	13.98	10.71
Government expenditure	5.06	6.25	3.58	-2.67
Exports	6.74	16.78	-4.61	-21.39
Less: Imports	5.46	6.41	4.28	-2.12
	Canada			
	1997-2015	**1997-2005**	**2007-2015**	**Differences**
	(compound annual growth rate, per cent)			(percentage points)
	A	**B**	**C**	**C - B**
Gross Domestic Products	4.47	5.70	2.95	-2.75
Consumption	4.57	5.31	3.66	-1.64
Investment	4.98	6.71	2.85	-3.86
Government expenditure	4.95	5.81	3.88	-1.92
Exports	3.72	5.04	2.08	-2.96
Less: Imports	4.19	4.98	3.22	-1.75

Source: CSLS calculations based on the Provincial and Territorial Gross Domestic Product by Income and by Expenditure Accounts of Statistics Canada (Table 36-10-0222-01).

The total economy nominal GDP growth during the 1997-2015 period in Newfoundland and Labrador was higher than the national average (6.1 per cent per year versus 4.5 per cent per year) (Table 10). Among all types of expenditures, the province's investment and exports had the most rapid growth. Specifically, the growth in exports was about twice as high as the national average (4.7 per cent per year versus 3.7 per cent per year) and the growth in investment was about 1.5 times as high as the national average (7.9 per cent per year versus 5.0 per cent per year). Growth rates of other expenditures in the province were close to the national averages.

During the 1997-2007 sub-period, the province's total economy nominal GDP grew at 10.5 per cent per year, which is almost twice as high as the national average (10.5 per cent per year versus 5.7 per cent per year). The province's growth in exports was particularly impressive, which was 332.9 per cent of the national average (16.8 per cent per year versus 5.0 per cent per year). This dramatic growth was due to the beginning of the province's oil production in 1997 and the rising oil price from 1997 to 2007.

During the 2007-2015 sub-period, while the province's exports declined at an annual rate of 4.6 per cent, the province's investment grew at 14.0 per cent per year. The decline in exports was not a surprise because of the decline in oil prices and the province's oil production. This drop in exports seemed to have impacted other expenditures except investment, as the growth of these expenditures decelerated. On the other hand, the drastic rise in the province's investment was due to a number of development projects such as the Hebron project and the Muskrats Falls project. As a result, the growth in the province's investment also accelerated by 10.7 percentage points.

Table 11: Percentage Point Contribution from Expenditures to Average Annual Growth in Expenditure-based Nominal GDP, Total Economy, Newfoundland and Labrador and Canada, 1998-2015

	Newfoundland and Labrador			
	1998-2015	1998-2007	2008-2015	Differences
	(contribution to average annual growth, percentage points)			(percentage points)
	A	B	C	C - B
Gross Domestic Products	6.60	10.59	1.61	-8.99
Consumption	2.36	2.63	2.02	-0.61
Investment	1.70	0.69	2.95	2.25
Government expenditure	1.50	1.95	0.93	-1.02
Exports	4.54	9.55	-1.73	-11.27
Less: Imports	3.52	4.29	2.56	-1.73
	Canada			
	1998-2015	1998-2007	2008-2015	Differences
	(contribution to average annual growth, percentage points)			(percentage points)
	A	B	C	C - B
Gross Domestic Products	4.52	5.71	3.02	-2.70
Consumption	2.55	2.94	2.06	-0.88
Investment	0.95	1.23	0.61	-0.62
Government expenditure	1.16	1.32	0.96	-0.36
Exports	2.15	2.99	1.10	-1.89
Less: Imports	2.28	2.74	1.70	-1.04

Source: CSLS calculations based on the Provincial and Territorial Gross Domestic Product by Income and by Expenditure Accounts of Statistics Canada (Table 36-10-0222-01).

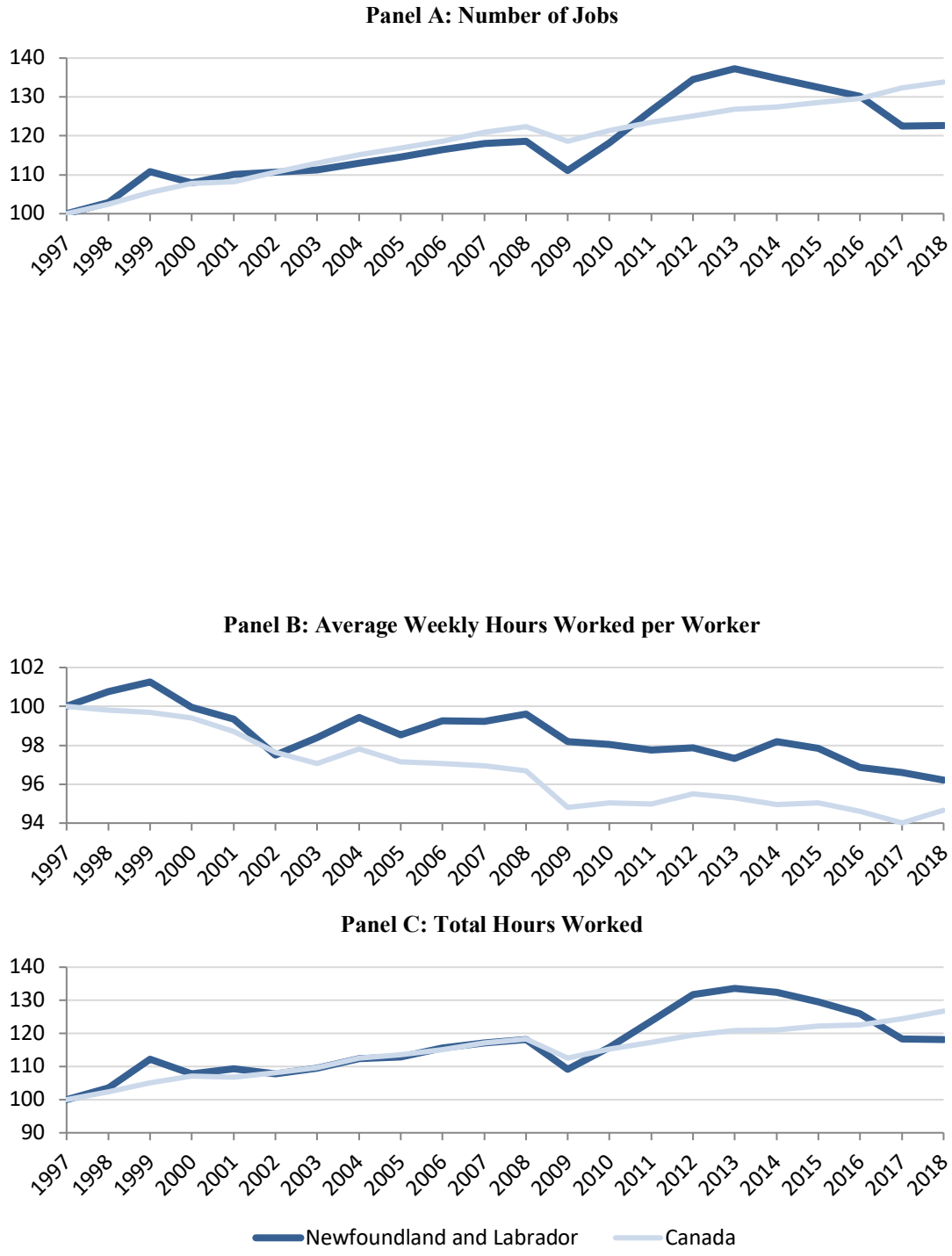
Among all types of expenditures, exports contributed the most to the average annual growth in the province's nominal GDP during the 1998-2015 period (4.5 percentage points of 6.6 percentage points, or 68.8 per cent of the growth) and the 1998-2015 sub-period (9.6 percentage points of 10.6 percentage points, or 90.2 per cent of the growth) (Table 11). The significant contribution from exports during the two periods was due to the province's oil production and the resultant oil exports since 1997 and the rise in oil prices.

During the 2008-2015 sub-period, investment contributed the most to the average annual nominal GDP growth in the total economy (3.0 percentage points of 1.6 percentage points) because of various development projects in the province as mentioned. On the other hand, contributions from the province's exports declined by 11.3 percentage points compared with the 1997-2007 sub-period from 9.6 percentage points to -1.7 percentage points. This decline accounted for 125.4 per cent of the slowdown (11.3 percentage points of 9.0 percentage points) between the 1998-2007 and the 2008-2015 sub-periods.

B. Labour Input

In this section, we analyze labour input trends in Newfoundland and Labrador, and compare them to trends observed at the national level. We focus mainly on the number of hours worked in the business sector and at the two-digit NAICS level, but also on the number of jobs, average weekly hours worked. We end this sub-section with a discussion about compensation of labour inputs.

Chart 13: Labour Input, Business Sector, Newfoundland and Labrador, 1997-2018 (1997=100)



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

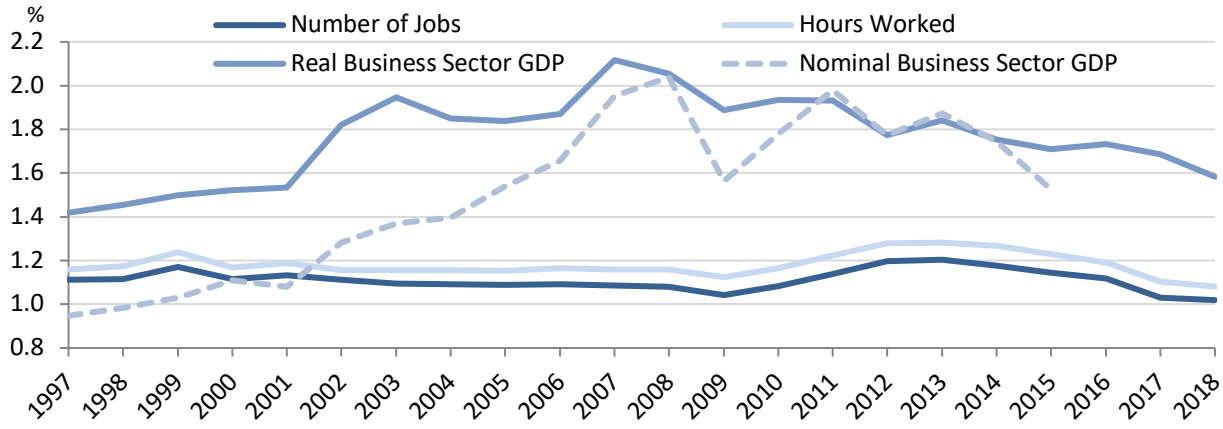
In general, hours worked is a better measure of labour input than number of jobs, because they take changes in the length of the work week and shifts from full-time employment to part-

time employment into account. However, growth rate differences are relatively small (Chart 13). Since employment is an important indicator of well-being, we analyze trends in the number of jobs as follows.

i. Number of Jobs

During the 1997-2018 period, the number of jobs in Newfoundland and Labrador's business sector grew at a compound annual rate of 1.0 per cent (Panel A of Chart 13). The growth in the province was particularly fast during the 2009-2013 period (5.4 per cent per year), three times the national average of 1.68 per cent per year.[25] Such impressive growth was driven by project development and related independent businesses, increasing consumer and public sector spending (Department of Finance, Newfoundland and Labrador, 2012 and 2013). However, in the 2013-2018 period, the number of jobs in Newfoundland and Labrador's business sector declined every year at an annual rate of -2.2 per cent when the growth in Canada was 1.1 per cent. This decline was due to the lower level of mining activity at Vale's nickel processing site and the closure of Wabush Mines (Department of Finance, Newfoundland and Labrador, 2017).[26]

Chart 14: Newfoundland and Labrador's Number of Jobs, Hours Worked, Real GDP and Nominal GDP as a Share of Canada's, Business Sector, 1997 – 2018



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Chart 14 shows that there is no significant correlation between the growth of the real business sector output and employment in Newfoundland and Labrador during the 1997-2018

[25] The number of jobs in the non-business sector in Newfoundland and Labrador grew from 61,800 jobs in 1997 to 71,780 jobs in 2018. The number was quite stable throughout the 1997-2018 period (an average change of 0.74 per cent per year).

[26] Specifically, the total number of jobs in Newfoundland and Labrador's construction sector fell from 33,065 jobs in 2015 to 26,425 jobs in 2018, and the total number of jobs in the mining and oil and gas extraction sector in the province dropped from 7,185 in 2013 to 5,660 in 2018.

period.[27] For instance, in the last subsection, we identified 2002 as an exceptional year in terms of real business sector GDP growth (22.4 per cent) because of the beginning of the oil production at the Terra Nova offshore oil platform. However, the number of jobs in the province barely increased in 2002 (0.5 per cent). The same development occurred in 2007, 2010 and 2011. On the other hand, while the business sector nominal output growth rates in the province were around 20 per cent in these three years, the number of jobs in the province's business sector stayed practically the same. The low correlation between business sector output, either nominal or real, and business sector employment in Newfoundland and Labrador was due to the dominance of mining and oil and gas extraction in the province's output but the disproportionately low employment shares (3.8 per cent in 2018), as shown in Table 13. For example, in 2007, the mining and oil and gas extraction accounted for 59.2 per cent of the province's business sector nominal GDP but it was only responsible for 3.2 per cent of the business sector employment in the province.

As illustrated in Chart 14, the Newfoundland and Labrador shares of business sector national employment were practically the same in 1997 and 2018. Chart 14 also shows hours worked in the province's business sector as a share of Canada's. Both the business sector hours worked and business sector numbers of jobs in the province as a share of Canada follow closely with each other throughout the 1997-2018 period, with the former one consistently higher than the latter one, which reflects higher average hours worked in the province than in Canada.

Table 12 shows shares of the employment in Newfoundland and Labrador as a share of Canada's of the two-digit NAICS subsectors of the business sector in 1997, 2007 and 2018. The shares in all sectors are around one to two per cent, which is consistent with Newfoundland and Labrador's population relative to Canada's.

Table 13 shows the employment shares in the business sector and subsectors of the business sector in Newfoundland and Labrador and Canada in 1997, 2007 and 2018. The service sector had higher employment shares than the goods-producing sector in the province in 1997, 2007 and 2018, although the service sector had lower real output. In 2018, the employment share of the goods-producing sector in the province rose significantly from 25.4 per cent in 2007 to 30.6 per cent because the employment shares in the construction sector increased by a factor of two from 8.5 per cent to 17.7 per cent. This increase in the construction employment in the province in 2018 was attributable to various public sector infrastructure and commercial projects such as the Muskrat Falls project.

[27]The Pearson correlation coefficient between the business sector real output annual growth and the annual growth in the business sector number of jobs in Newfoundland and Labrador throughout the 1998-2017 period was 0.29, which is a weak positive linear correlation. However, the coefficient for Canada was 0.87, a very strong positive linear correlation. This weak relationship in Newfoundland and Labrador is due to the importance on changes in the mining and oil and gas industry for real output and the relatively limited employment in the sector.

Table 12: Employment Levels by Two-digit NAICS Sector, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2018

	Newfoundland and Labrador			Canada		
	1997	**2007**	**2018**	**1997**	**2007**	**2018**
Business sector	**122,125**	**144,225**	**149,745**	**10,980,460**	**13,272,825**	**14,695,255**
Agriculture, forestry, fishing and hunting	7,000	5,115	3,050	541,880	417,940	384,320
Mining and oil and gas extraction	3,190	4,670	5,660	134,445	212,775	236,875
Utilities	2,525	2,575	2,015	87,550	100,785	104,500
Construction	12,495	12,195	26,425	866,470	1,228,625	1,541,895
Manufacturing	10,480	12,125	8,660	1,910,635	1,871,845	1,585,180
Goods-producing Sector	**35,690**	**36,680**	**45,810**	**3,540,980**	**3,831,970**	**3,852,770**
Wholesale trade	6,265	6,315	5,810	725,630	844,155	836,920
Retail trade	23,065	29,915	28,085	1,507,825	1,839,570	2,049,870
Transportation and warehousing	8,020	8,515	9,385	632,150	752,880	854,555
Information and cultural industries	3,330	4,405	2,085	236,570	324,220	337,610
Finance and insurance, and holding companies	9,680	10,255	7,855	817,555	1,010,465	1,069,185
Real estate, rental and leasing	2,095	2,155	2,430	212,590	327,120	370,745
Professional, scientific and technical services	3,975	6,950	7,770	631,225	1,006,790	1,230,070
Administrative and Support, Waste Management and Remediation and Services	4,005	6,775	5,960	548,660	856,505	1,003,790
Arts, entertainment and recreation	1,330	2,200	2,045	188,195	271,500	327,670
Accommodation and food services	11,270	13,090	14,550	929,490	998,025	1,299,170
Other private services	13,400	16,970	17,960	1,009,590	1,209,625	1,462,900
Service-producing Sector	**86,435**	**107,545**	**103,935**	**7,439,480**	**9,440,855**	**10,842,485**
Business sector without mining and oil and gas	**118,935**	**139,555**	**144,085**	**10,846,015**	**13,060,050**	**14,458,380**

	NL / Canada		
	1997	2007	2017
Business sector	1.11	1.09	1.02
Agriculture, forestry, fishing and hunting	1.29	1.22	0.79
Mining and oil and gas extraction	2.37	2.19	2.39
Utilities	2.88	2.55	1.93
Construction	1.44	0.99	1.71
Manufacturing	0.55	0.65	0.55
Goods-producing Sector	1.01	0.96	1.19
Wholesale trade	0.86	0.75	0.69
Retail trade	1.53	1.63	1.37
Transportation and warehousing	1.27	1.13	1.10
Information and cultural industries	1.41	1.36	0.62
Finance and insurance, and holding companies	1.18	1.01	0.73
Real estate, rental and leasing	0.99	0.66	0.66
Professional, scientific and technical services	0.63	0.69	0.63
Administrative and Support, Waste Management and Remediation and Services	0.73	0.79	0.59
Arts, entertainment and recreation	0.71	0.81	0.62
Accommodation and food services	1.21	1.31	1.12
Other private services	1.33	1.40	1.23
Service-producing Sector	1.16	1.14	0.96
Business sector without mining and oil and gas	1.10	1.07	1.00

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Table 13: Employment Shares by Sector in the Business Sector, Newfoundland and Labrador and Canada, 1997, 2007 and 2018

	Newfoundland and Labrador			Canada			NL - Canada Gap		
	1997	2007	2018	1997	2007	2018	1997	2007	2018
	(per cent)								
	A	B	C	D	E	F	G=A-D	H=B-E	I=B-F
Business sector	**100**	**100**	**100**	**100**	**100**	**100**	-	-	-
Agriculture, forestry, fishing and hunting	5.73	3.55	2.04	4.93	3.15	2.62	0.80	0.40	-0.58
Mining and oil and gas extraction	2.61	3.24	3.78	1.22	1.60	1.61	1.39	1.63	2.17

Utilities	2.07	1.79	1.35	0.80	0.76	0.71	1.27	1.03	0.63
Construction	10.23	8.46	17.65	7.89	9.26	10.49	2.34	-0.80	7.15
Manufacturing	8.58	8.41	5.78	17.40	14.10	10.79	-8.82	-5.70	-5.00
Goods-producing Sector	**29.22**	**25.43**	**30.59**	**32.25**	**28.87**	**26.22**	**-3.02**	**-3.44**	**4.37**
Wholesale trade	5.13	4.38	3.88	6.61	6.36	5.70	-1.48	-1.98	-1.82
Retail trade	18.89	20.74	18.76	13.73	13.86	13.95	5.15	6.88	4.81
Transportation and warehousing	6.57	5.90	6.27	5.76	5.67	5.82	0.81	0.23	0.45
Information and cultural industries	2.73	3.05	1.39	2.15	2.44	2.30	0.57	0.61	-0.91
Finance and insurance, and holding companies	7.93	7.11	5.25	7.45	7.61	7.28	0.48	-0.50	-2.03
Real estate, rental and leasing	1.72	1.49	1.62	1.94	2.46	2.52	-0.22	-0.97	-0.90
Professional, scientific and technical services	3.25	4.82	5.19	5.75	7.59	8.37	-2.49	-2.77	-3.18
Administrative and Support, Waste Management and Remediation and Services	3.28	4.70	3.98	5.00	6.45	6.83	-1.72	-1.76	-2.85
Arts, entertainment and recreation	1.09	1.53	1.37	1.71	2.05	2.23	-0.62	-0.52	-0.86
Accommodation and food services	9.23	9.08	9.72	8.46	7.52	8.84	0.76	1.56	0.88
Other private services	10.97	11.77	11.99	9.19	9.11	9.95	1.78	2.65	2.04
Service-producing Sector	**70.78**	**74.57**	**69.41**	**67.75**	**71.13**	**73.78**	**3.02**	**3.44**	**-4.37**

Business sector without mining and oil and gas	**97.39**	**96.76**	**96.22**	**98.78**	**98.40**	**98.39**	**-1.39**	**-1.63**	**-2.17**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Table 14: Employment Compound Annual Growth by Two-digit NAICS Sector, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2018

	Newfoundland and Labrador		
	1997-2018	**1997-2007**	**2007-2018**
	(per cent)		
Business sector	**0.98**	**1.68**	**0.34**
Agriculture, forestry, fishing and hunting	-3.88	-3.09	-4.59
Mining and oil and gas extraction	2.77	3.88	1.76
Utilities	-1.07	0.20	-2.20
Construction	3.63	-0.24	7.28
Manufacturing	-0.90	1.47	-3.01
Goods-producing Sector	**1.20**	**0.27**	**2.04**
Wholesale trade	-0.36	0.08	-0.75
Retail trade	0.94	2.63	-0.57
Transportation and warehousing	0.75	0.60	0.89
Information and cultural industries	-2.20	2.84	-6.57
Finance and insurance, and holding companies	-0.99	0.58	-2.39
Real estate, rental and leasing	0.71	0.28	1.10
Professional, scientific and technical services	3.24	5.75	1.02
Administrative and Support, Waste Management and Remediation and Services	1.91	5.40	-1.16
Arts, entertainment and recreation	2.07	5.16	-0.66
Accommodation and food services	1.22	1.51	0.97
Other private services	1.40	2.39	0.52
Service-producing Sector	**0.88**	**2.21**	**-0.31**
Business sector without mining and oil and gas	**0.92**	**1.61**	**0.29**
	Canada		
	1997-2018	**1997-2007**	**2007-2018**
	(per cent)		
Business sector	**1.40**	**1.91**	**0.93**
Agriculture, forestry, fishing and hunting	-1.62	-2.56	-0.76
Mining and oil and gas extraction	2.73	4.70	0.98
Utilities	0.85	1.42	0.33
Construction	2.78	3.55	2.09
Manufacturing	-0.89	-0.20	-1.50
Goods-producing Sector	**0.40**	**0.79**	**0.05**
Wholesale trade	0.68	1.52	-0.08
Retail trade	1.47	2.01	0.99
Transportation and warehousing	1.45	1.76	1.16
Information and cultural industries	1.71	3.20	0.37
Finance and insurance, and holding companies	1.29	2.14	0.51
Real estate, rental and leasing	2.68	4.40	1.14
Professional, scientific and technical services	3.23	4.78	1.84

Administrative and Support, Waste Management and Remediation and Services	2.92	4.55	1.45
Arts, entertainment and recreation	2.68	3.73	1.72
Accommodation and food services	1.61	0.71	2.43
Other private services	1.78	1.82	1.74
Service-producing Sector	**1.81**	**2.41**	**1.27**
Business sector without mining and oil and gas	**1.38**	**1.87**	**0.93**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Table 14 shows the compound annual growth of employment of each two-digit NAICS subsector of the business sector in Newfoundland and Labrador and Canada from 1997 to 2018. Although the real GDP growth of the mining and oil and gas extraction sector was much higher than the national average during the 1997-2007 period (24.7 per cent per year versus 1.8 per cent per year), the employment growth of this sector in the province was lower than the national average (3.9 per cent per year versus 4.7 per cent per year).

During the 2007-2018 period, despite the decline in the mining and oil and gas extraction real GDP in the province (-3.4 per cent per year), employment of this sector in the province grew at 1.8 per cent per year. In addition, the construction sector had the largest growth in employment among two-digit NAICS subsectors of the business sector in the province during the 2007-2018 period (7.3 per cent per year), which was higher than the national average by a factor 3.5 (2.1 per cent per year versus 7.3 per cent per year). As for the service sector, there was a slight contraction in the province's employment (-0.3 per cent per year) while Canada's employment in the service sector increased at 1.3 per cent per year.

Table 15 shows the percentage point contribution from each two-digit NAICS subsectors to the average annual employment growth in the business sector in Newfoundland and Labrador and Canada. The sum of contributions from all subsectors of the business sector except mining and oil and gas extraction in the province was very close to the business sector average annual growth during the 1998-2018 period, the 1998-2007 and the 2008-2018 sub-periods. This characteristic is consistent with the low share of mining and oil and gas extraction employment in the province's business sector.

Another characteristic is the higher employment growth contributions from the service sector than the goods sector during the 1998-2018 period and the 1998-2007 and the 2008-2018 sub-periods. The service sector's contribution to the province's business sector employment average annual growth was higher than the goods sector during the 1998-2018 period and the 1998-2007 sub-period (0.7 percentage points versus 0.3 percentage points and 1.6 percentage points versus 0.1 percentage points respectively). However, during the 2008-2018 sub-period, the construction sector had the largest positive contribution among subsectors of the business sector (0.9

percentage points of 0.4 percentage points), which was large enough to offset the negative contributions from other goods sectors except mining and oil and gas extraction.

Table 15: Percentage Point Contribution from Two-digit NAICS Sectors to Business Sector Average Annual Growth in Employment, Newfoundland and Labrador and Canada, 1998 – 2018

	Newfoundland and Labrador			
	1998-2018	1998-2007	2008-2018	Differences
	(contribution to average annual growth, percentage points)			(percentage points)
	A	B	C	C-B
Business sector	**1.04**	**1.71**	**0.44**	**-1.27**
Agriculture, forestry, fishing and hunting	-0.13	-0.14	-0.12	0.02
Mining and oil and gas extraction	0.09	0.11	0.07	-0.04
Utilities	-0.01	0.01	-0.03	-0.04
Construction	0.44	-0.03	0.86	0.88
Manufacturing	-0.04	0.14	-0.21	-0.35
Goods-producing Sector	**0.34**	**0.09**	**0.57**	**0.47**
Wholesale trade	-0.01	0.01	-0.02	-0.03
Retail trade	0.20	0.51	-0.08	-0.59
Transportation and warehousing	0.05	0.04	0.05	0.01
Information and cultural industries	-0.04	0.08	-0.14	-0.22
Finance and insurance, and holding companies	-0.05	0.04	-0.13	-0.17
Real estate, rental and leasing	0.01	0.01	0.02	0.01
Professional, scientific and technical services	0.14	0.23	0.05	-0.18
Administrative and Support, Waste Management and Remediation and Services	0.08	0.21	-0.05	-0.26
Arts, entertainment and recreation	0.03	0.07	-0.01	-0.08
Accommodation and food services	0.12	0.14	0.10	-0.04
Other private services	0.17	0.28	0.08	-0.20
Service-producing Sector	**0.70**	**1.61**	**-0.13**	**-1.74**
Business sector without mining and oil and gas	**0.95**	**1.60**	**0.37**	**-1.22**
	Canada			
	1998-2018	1998-2007	2008-2018	Differences
	(contribution to average annual growth, percentage points)			(percentage points)
	A	B	C	C-B
Business sector	**1.40**	**1.92**	**0.94**	**-0.98**
Agriculture, forestry, fishing and hunting	-0.06	-0.11	-0.02	0.08
Mining and oil and gas extraction	0.04	0.06	0.02	-0.04
Utilities	0.01	0.01	0.00	-0.01
Construction	0.25	0.29	0.21	-0.08
Manufacturing	-0.11	-0.02	-0.20	-0.18
Goods-producing Sector	**0.12**	**0.24**	**0.01**	**-0.23**

Wholesale trade	0.04	0.10	-0.01	-0.11
Retail trade	0.20	0.27	0.14	-0.13
Transportation and warehousing	0.08	0.10	0.07	-0.03
Information and cultural industries	0.04	0.08	0.01	-0.07
Finance and insurance, and holding companies	0.10	0.16	0.04	-0.12
Real estate, rental and leasing	0.06	0.09	0.03	-0.07
Professional, scientific and technical services	0.23	0.31	0.15	-0.17
Administrative and Support, Waste Management and Remediation and Services	0.17	0.26	0.10	-0.17
Arts, entertainment and recreation	0.05	0.07	0.04	-0.04
Accommodation and food services	0.13	0.06	0.20	0.14
Other private services	0.17	0.17	0.17	0.00
Service-producing Sector	**1.28**	**1.68**	**0.93**	**-0.75**
Business sector without mining and oil and gas	**1.37**	**1.85**	**0.92**	**-0.93**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Detailed Employment Developments and Implications for Productivity

Statistics Canada Table 36-10-0480-01[28] provides estimates for jobs for Newfoundland and Labrador at the two, three and four digit levels (322 industries) for 1997, 2007 and 2018 and growth rates for the 1997-2018 period and 1997-2007 and 2007-2018 sub-periods, and jobs share in 1997, 2007, and 2018. This table allows for a very detailed identification of the growing and declining sectors in the province. Here are some observations.

- Given the massive output growth in aquaculture noted above ($3.4 million chained 2012 dollars in 1997 to $28.2 million chained 2012 dollars in 2018), the stability of employment in the sector (330 jobs in 1997 versus 325 jobs in 2018) is surprising. This stability resulted in massive productivity growth in the aquaculture sector, 11.1 per cent per year in 1997-2018.

- Fishing (technically fishing, hunting and trapping, but there are few jobs in the second and third economic activities) recorded a strong, steady fall in employment from 3,690 jobs in 1997 to 2,950 in 2007 to 1,665 in 2018 (-3.7 per cent per year during the 1997-2018 period). Yet real output in the sector was relatively stable over the 1997-2018 period (2.0 per cent decline per year), resulting in a significant increase in labour productivity (3.0 per cent per year).

- Employment in support activities for mining rose from 145 in 2007 to 425 in 2018, a 10.3 per cent compound annual growth rate. Yet real output in this sector surprisingly fell from $66.7 million to $41.0 million between 2007 and 2018, a 4.3 per cent average annual rate, resulting in labour productivity falling 13.0 per cent per year. Misclassification of employees involved in mining activities between services and production may account for these seemingly inconsistent developments.

- By far the most important employment development in Newfoundland and Labrador in recent years has been the surge in employment in construction. Despite the booming economy from 1997 to 2007, there was in fact a small fall in construction employment (12,495 in 1997 versus 12,195 in 2007). After 2007 employment in construction took off, reaching 26,425 by 2018, a 7.3 per cent average annual rate of growth. The share of business sector employment accounted for by construction rose from 8.5 per cent in 2007 to 17.6 per cent in 2018. As business sector employment only generated 5,520 (149,745 – 144,225) jobs between 2007 and 2018, all business sector employment growth on a net basis was accounted for by construction. Employment growth in the other sectors was negative overall. Output growth was also strong in construction in 2007-2018, up 7.0 per cent per year. Because it was faster than labour input growth, labour productivity grew at 0.02 per cent per year.

[28] Information from that table is reproduced in Table 27 of the Data Appendix to this report.

- The rapid employment growth in construction between 2007 and 2015 was accounted for almost completely by engineering construction and within engineering construction by oil and gas construction from (1,085 jobs to 10,115 jobs or 32.2 per cent per year) and electric power construction (from 335 to 9,755 or 40.1 per cent per year). Output growth was strong in oil and gas construction (19.5 per cent), but not as strong as labour input growth so labour productivity fell at an 8.7 per cent per year. In contrast, output growth was exceedingly strong in electric power construction at 53.0 per cent per year, so productivity advanced 0.4 per cent per year.

- While the employment of electric power engineering construction continued to grow from 2015 to 2018, the employment of oil and gas engineering construction declined at an annual rate of 30.0 per cent during the 2015-2018 period. The real output also dropped by 19.3 per cent per year during the 2015-2018 period. The decline in employment and real output from 2016 to 2018 reflects the end of the development of the Hebron project, which started oil production in 2017. The labour productivity (real output per hours worked) of the province's oil and gas engineering construction actually increased at an annual rate of 21.2 per cent from 2016 to 2018 as hours worked had a larger decline than real output (37.0 per cent per year versus 23.6 per cent).

- Employment in manufacturing in Newfoundland and Labrador has collapsed over the last 10 years from 12,125 in 2007 to 8,660 in 2018 (a 3.0 per cent average annual rate of decline). Manufacturing's share of total business sector employment fell from 8.4 per cent to 5.8 per cent over the period. Manufacturing's hours worked in the province dropped at 3.7 per cent per year during the 2007-2018 period. However, manufacturing output rose at an annual rate of 1.7 per cent from $814.8 million chained 2012 dollars in 2007 to $945.8 million chained 2012 dollars in 2018. Therefore, labour productivity (output per hour worked) grew at 5.2 per cent per year.

- The decline in employment in fishing was accompanied by a massive fall in employment in seafood products manufacturing, from 3,845 in 2007 to 1,865 in 2018 (-6.4 per cent per year), even though output was stable over this period. This resulted in a 7.4 per cent per year increase in labour productivity in the sector. However, in 2018, fishing's employment declined to 1,665 and output dropped by 5.3 per cent from $212.9 million chained 2012 dollars in 2016 to $157.9 million chained 2012 dollars, resulting in labour productivity decline of 11.2 per cent per year between 2016 and 2018.

- The demise of paper manufacturing in Newfoundland and Labrador is reflected in the fall in employment from 1,600 in 1997 to 1,100 in 2007 to only 300 in 2018, with the closing of the Grand Falls mill.

- There were a small number of sectors that have bucked the downward trend in manufacturing employment since 2007. The establishment of the non-ferrous metal production and processing industry with the Vale operations resulted in 500 jobs in 2018. The ship and boat building enjoyed strong employment growth, with jobs up to 845 in 2014 up from 340 in 2007 but then declined to 75 in 2018. On the other hand, employment fell from 960 in 2007 to 375 in 2018 in petroleum refineries and from 240 in 2007 to 110 in 2018 in computer and electronic product manufacturing.

- After strong growth in the 1997-2007 period (2.2 per cent per year), employment in services producing business had a slight decline during the 2007-2018 period (0.3 per cent per year). In contrast, employment in goods-producing industries took off after 2007 (2.0 per cent per year in 2007-2018 versus 0.3 per cent in 1997-2007) because of construction.

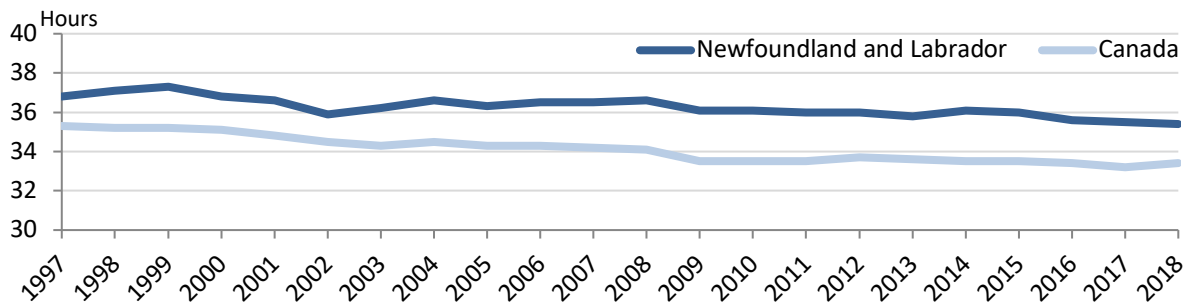
- The fall-off in employment growth in service industries after 2007 was widespread. Service industries that enjoyed strong employment growth in 2007-2018 included educational services (0.4 per cent per year), health care and social assistance (2.9 per cent per year) and accommodation and food services (1.0 per cent per year).

- Within the accommodation and food services industry, food services and drinking places posted employment gains of 1.6 per cent per year between 2007 and 2018, up from 1.5 per cent per year in 1997-2007. In absolute terms the number of jobs in food services and drinking places increased from 9,035 in 1997 to 10,485 in 2007 to 12,475 in 2017, falling from 7.4 per cent to 7.3 per cent and then rose to 8.3 per cent of total business sector employment.

ii. Average Weekly Hours Worked

Weekly hours worked were estimated by combining the data on total hours worked and number of jobs. During the 1997-2018 period, the average worker in Newfoundland and Labrador consistently worked longer than the average Canadian in a week (Chart 15). In 2018, a worker in the province worked on average 2.1 hours more than the average Canadian worker in the business sector, working on average 35.45 hours per week instead of the national average of 33.41 hours per week (Table 16). The difference between hours worked also demonstrated an increasing trend throughout the 1997-2018 period, up from 1.5 hours in 1997 to 2.0 hours in 2018.

Chart 15: Average Weekly Hours Worked per Worker, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2018



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

There are two reasons for higher average weekly hours worked per worker in Newfoundland and Labrador than in Canada. First, the percentage of part-time worker in the province is consistently smaller than the national average. In 2018, according to the Labour Force Survey (LFS), 16.1 per cent of labour force worked part-time in Newfoundland and Labrador while 18.7 per cent worked part-time in Canada. If more workers are working part-time, this will inevitably reduce the average weekly hours worked. Second, the average annual overtime hours of all employees in Newfoundland and Labrador was higher than Canada during the 1997-2017 period except 1997, 1999 and 2005.[29] This phenomenon comes from the increase in the goods-producing sector as a share of the business sector's average weekly hours worked, especially the construction sector (Table 16). Because of longer overtime in the province, average weekly hours worked per worker is higher in the province.

The difference in the length of the working week is especially visible in sectors like construction and utilities, where workers in Newfoundland and Labrador worked 6.8 hours and 3.8 hours more per week than Canada (Table 16) in 2018. Overall, during the 1997-2018 period, the average length of the work week in the business sector declined in both Newfoundland and Labrador and Canada with the drop in Canada more pronounced (0.18 per cent per year in the province and 0.26 per cent per year in Canada).

[29] In 2018, the average weekly overtime hours of all employees in Newfoundland and Labrador was 0.1 hours higher than the national average (1.8 hours – 1.7 hours) (Statistics Canada Table 14-10-0076-01).

Table 16: Average Weekly Hours Worked by Sector, Newfoundland and Labrador and Canada, 1997, 2007 and 2018

	Newfoundland and Labrador		
	1997	2007	2018
		(Hours per Worker)	
Business sector	**36.79**	**36.51**	**35.45**
Agriculture, forestry, fishing and hunting	45.66	43.21	38.70
Mining and oil and gas extraction	44.59	44.75	45.42
Utilities	36.31	38.55	39.74
Construction	44.97	45.76	44.40
Manufacturing	36.32	37.69	34.97
Goods-producing Sector	**41.92**	**42.10**	**42.16**
Wholesale trade	39.33	39.34	35.18
Retail trade	32.64	33.12	30.79
Transportation and warehousing	39.22	39.16	38.63
Information and cultural industries	34.70	34.85	31.65
Finance and insurance, and holding companies	36.17	35.82	33.63
Real estate, rental and leasing	36.05	36.73	34.83
Professional, scientific and technical services	37.99	36.52	36.25
Administrative and Support, Waste Management and Remediation and Services	32.38	36.43	33.93
Arts, entertainment and recreation	30.97	29.71	26.43
Accommodation and food services	33.17	31.71	28.89
Other private services	33.33	33.43	31.85
Service-producing Sector	**34.70**	**34.60**	**32.50**
Business sector without mining and oil and gas	**36.60**	**36.20**	**35.10**
	Canada		
	1997	2007	2018
		(Hours per Worker)	
Business sector	**35.29**	**34.21**	**33.41**
Agriculture, forestry, fishing and hunting	40.68	39.66	37.73
Mining and oil and gas extraction	42.99	42.30	42.38
Utilities	35.96	35.54	35.96
Construction	38.25	38.15	37.65
Manufacturing	38.21	37.30	37.06
Goods-producing Sector	**38.73**	**38.06**	**37.66**
Wholesale trade	38.13	37.25	36.91
Retail trade	31.54	30.00	29.40
Transportation and warehousing	38.96	38.24	37.34
Information and cultural industries	34.69	33.51	33.71
Finance and insurance, and holding companies	35.04	33.71	34.08
Real estate, rental and leasing	34.17	33.74	33.56
Professional, scientific and technical services	36.14	34.67	34.19
Administrative and Support, Waste Management and Remediation and Services	30.25	30.94	30.48
Arts, entertainment and recreation	29.90	27.96	26.78
Accommodation and food services	30.43	29.01	27.63
Other private services	32.71	32.16	30.95
Service-producing Sector	**33.65**	**32.65**	**31.90**
Business sector without mining and oil and gas	**35.19**	**34.08**	**33.27**

	NL - Canada Gap		
	1997	2007	2018
		(Hours per Worker)	
Business sector	**1.50**	**2.30**	**2.04**
Agriculture, forestry, fishing and hunting	4.98	3.55	0.97
Mining and oil and gas extraction	1.60	2.45	3.04
Utilities	0.35	3.01	3.78
Construction	6.72	7.61	6.75
Manufacturing	-1.89	0.39	-2.09
Goods-producing Sector	**3.19**	**4.04**	**4.50**
Wholesale trade	1.20	2.09	-1.73
Retail trade	1.10	3.12	1.39
Transportation and warehousing	0.26	0.92	1.29
Information and cultural industries	0.01	1.34	-2.06
Finance and insurance, and holding companies	1.13	2.11	-0.45
Real estate, rental and leasing	1.88	2.99	1.27
Professional, scientific and technical services	1.85	1.85	2.06
Administrative and Support, Waste Management and Remediation and Services	2.13	5.49	3.45
Arts, entertainment and recreation	1.07	1.75	-0.35
Accommodation and food services	2.74	2.70	1.26
Other private services	0.62	1.27	0.90
Service-producing Sector	**1.05**	**1.95**	**0.60**
Business sector without mining and oil and gas	**1.41**	**2.12**	**1.83**

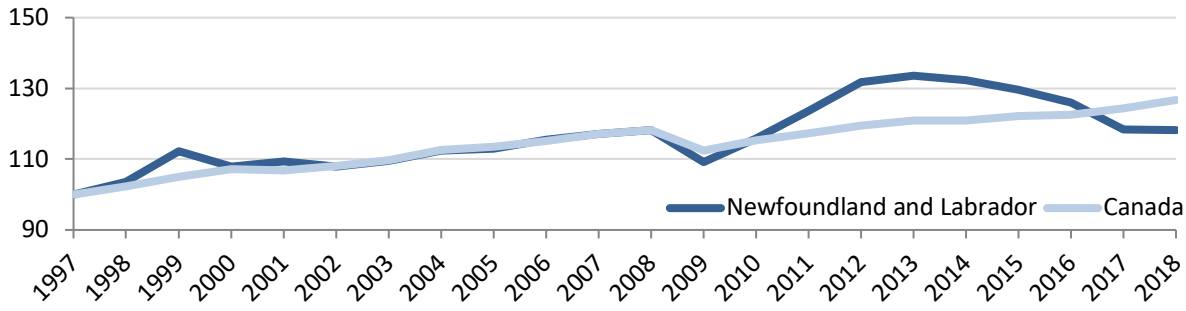
Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

iii. Total Hours Worked

Total hours worked is the main labour input indicator in this report because it is used for calculating labour productivity (defined here as real GDP per total hours worked). During the 1997-2018 period, the number of hours worked in Newfoundland and Labrador grew at a compound annual rate of 0.8 per cent, slower than the national growth of 1.1 per cent per year. The growth of the business sector total hours worked in the province was particularly faster than that of Canada during the 2010-2014 period (Chart 16).

As with the numbers of jobs, growth of hours work in Newfoundland and Labrador's business sector was much higher from 2009 to 2014. The growth rate between 2009 and 2014 was 3.9 per cent per year while the growth rate between 1997 and 2008 was 1.5 per cent per year. Moreover, the financial crisis had a larger effect on Newfoundland and Labrador's hours worked than in Canada, with hours worked decreased by 6.7 per cent in the province from 2008 to 2009 versus 5.1 per cent in Canada.

Chart 16: Total Hours Worked, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2018 (1997=100)



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Table 17 shows the total hours worked in Newfoundland and Labrador and Canada at the two-digit NAICS level in 1997, 2007 and 2018. Sectoral distributions of the province's total hours worked in each of the three years are like that of employment. For instance, the shares of hours worked and employment in the province's service sector in these three years are dominant. However, there are some minor differences between the shares of hours worked in the province and Canada. For example, in 2018, hours worked shares of construction and utilities are higher than national average (22.1 per cent versus 17.7 per cent and 1.51 per cent versus 1.35 per cent respectively). Hours worked shares of arts, entertainment and recreation and accommodation and foods services in 1997, 2007 and 2018 were also lower than employment shares.

Table 17: Hours Worked Shares by Two-digit NAICS Sector, Newfoundland and Labrador and Canada, 1997, 2007 and 2018

	Newfoundland and Labrador			Canada			NL - Canada		
	1997	2007	2018	1997	2007	2018	1997	2007	2018
	(per cent)						(Percentage Point)		
Business sector	**100**	**100**	**100**	**100**	**100**	**100**	-	-	-
Agriculture, forestry, fishing and hunting	7.11	4.20	2.22	5.69	3.65	2.95	1.42	0.55	-0.73
Mining and oil and gas extraction	3.17	3.97	4.84	1.49	1.98	2.04	1.67	1.99	2.80
Utilities	2.04	1.89	1.51	0.81	0.79	0.77	1.23	1.10	0.74
Construction	12.50	10.60	22.10	8.55	10.32	11.82	3.95	0.28	10.28

Manufacturing	8.47	8.68	5.71	18.84	15.37	11.97	-10.37	-6.69	-6.26
Goods-producing Sector	**33.29**	**29.33**	**36.38**	**35.39**	**32.12**	**29.55**	**-2.10**	**-2.79**	**6.83**
Wholesale trade	5.48	4.72	3.85	7.14	6.92	6.29	-1.66	-2.21	-2.44
Retail trade	16.76	18.82	16.29	12.28	12.15	12.27	4.48	6.66	4.02
Transportation and warehousing	7.00	6.33	6.83	6.36	6.34	6.50	0.64	-0.01	0.33
Information and cultural industries	2.57	2.92	1.24	2.12	2.39	2.32	0.45	0.52	-1.07
Finance and insurance, and holding companies	7.79	6.98	4.98	7.39	7.50	7.42	0.40	-0.53	-2.45
Real estate, rental and leasing	1.68	1.50	1.59	1.87	2.43	2.53	-0.19	-0.93	-0.94
Professional, scientific and technical services	3.36	4.82	5.31	5.89	7.69	8.56	-2.53	-2.87	-3.26
Administrative and Support, Waste Management and Remediation and Services	2.89	4.69	3.81	4.28	5.84	6.23	-1.40	-1.15	-2.42
Arts, entertainment and recreation	0.92	1.24	1.02	1.45	1.67	1.79	-0.54	-0.43	-0.77
Accommodation and food services	8.32	7.88	7.92	7.30	6.37	7.31	1.02	1.51	0.61
Other private services	9.94	10.78	10.78	8.52	8.57	9.22	1.42	2.21	1.56
Service-producing Sector	**66.71**	**70.67**	**63.62**	**64.61**	**67.88**	**70.45**	**2.10**	**2.79**	**-6.83**
Business sector without mining and oil and gas	**96.83**	**96.03**	**95.16**	**98.51**	**98.02**	**97.96**	**-1.67**	**-1.99**	**-2.80**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Table 18 shows the total hours work compound annual growth at the two-digit NAICS level in Newfoundland and Labrador and Canada from 1997 to 2018. The hours worked growth of each subsector of the business sector in the province was similar to their corresponding employment growth in each period. However, during the 2007-2018 sub-period, the province had a decline in hours worked in the business sector without mining and oil and gas extraction (-0.01 per cent per year), while the employment had a weak growth (0.29 per cent per year).

Table 18: Hours Worked Compound Annual Growth by Two-digit NAICS Sector, Newfoundland and Labrador and Canada, 1997 – 2018

	Newfoundland and Labrador		
	1997-2018	**1997-2007**	**2007-2018**
	(compound annual growth rate, per cent)		
Business sector	**0.80**	**1.60**	**0.07**
Agriculture, forestry, fishing and hunting	-4.63	-3.62	-5.54
Mining and oil and gas extraction	2.86	3.92	1.90
Utilities	-0.64	0.80	-1.93
Construction	3.57	-0.07	6.99
Manufacturing	-1.08	1.85	-3.67
Goods-producing Sector	**1.22**	**0.32**	**2.05**
Wholesale trade	-0.89	0.08	-1.76
Retail trade	0.66	2.78	-1.23
Transportation and warehousing	0.68	0.59	0.76
Information and cultural industries	-2.63	2.88	-7.39
Finance and insurance, and holding companies	-1.33	0.48	-2.95
Real estate, rental and leasing	0.54	0.47	0.61
Professional, scientific and technical services	3.01	5.33	0.95
Administrative and Support, Waste Management and Remediation and Services	2.14	6.64	-1.80
Arts, entertainment and recreation	1.30	4.72	-1.71
Accommodation and food services	0.56	1.05	0.11
Other private services	1.19	2.42	0.08
Service-producing Sector	**0.57**	**2.19**	**-0.88**
Business sector without mining and oil and gas	**0.71**	**1.51**	**-0.01**
	Canada		
	1997-2018	**1997-2007**	**2007-2018**
	(compound annual growth rate, per cent)		
Business sector	**1.13**	**1.60**	**0.71**
Agriculture, forestry, fishing and hunting	-1.98	-2.81	-1.21
Mining and oil and gas extraction	2.66	4.53	1.00
Utilities	0.85	1.30	0.44
Construction	2.71	3.53	1.96

Manufacturing	-1.03	-0.45	-1.56
Goods-producing Sector	**0.27**	**0.62**	**-0.05**
Wholesale trade	0.53	1.29	-0.16
Retail trade	1.13	1.50	0.80
Transportation and warehousing	1.24	1.57	0.94
Information and cultural industries	1.57	2.85	0.42
Finance and insurance, and holding companies	1.15	1.75	0.62
Real estate, rental and leasing	2.60	4.27	1.10
Professional, scientific and technical services	2.95	4.34	1.71
Administrative and Support, Waste Management and Remediation and Services	2.95	4.79	1.31
Arts, entertainment and recreation	2.14	3.04	1.32
Accommodation and food services	1.14	0.23	1.97
Other private services	1.51	1.65	1.39
Service-producing Sector	**1.55**	**2.10**	**1.05**
Business sector without mining and oil and gas	**1.11**	**1.55**	**0.71**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

From 1997 to 2018, hours worked of subsectors of the goods-producing sectors including agriculture, forestry, fishing and hunting industries, utilities and manufacturing decreased in hours worked while hours worked of other goods-producing sectors such as mining and oil and gas exploration and construction increased. In particular, while the growth in mining and oil and gas extraction was not as strong as before (3.9 per cent in the 1997-2007 sub-period versus 1.9 per cent in the 2007-2018 sub-period), the growth of construction sector in Newfoundland and Labrador increased from -0.07 per cent in the 1997-2007 sub-period to 6.99 per cent in the 2007-2018 sub-period. Such growth in the province was driven by both the public and the private sector, including construction of the Trans Labrador Highway, the Hebron project and the Muskrat Falls project.

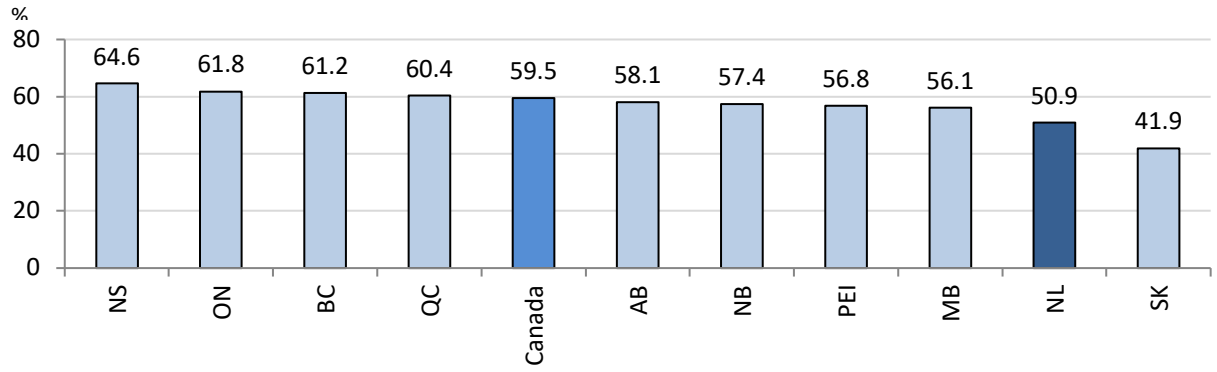
On the other hand, in the service sector, Canada experienced a positive but moderate growth in total hours worked in all services-oriented sectors except a mild decline in the wholesale trade sector during the 2007-2018 period, whereas in Newfoundland and Labrador there was a clear split between sectors which experienced a small but negative growth rate, and other sectors. In particular, in the 2007-2018 period, while most service-oriented sectors experienced negative growth, transportation and warehousing (0.8 per cent per year), real estate, rental and leasing (0.6 per cent per year), professional, scientific and technical services (1.0 per cent per year), accommodation and food services (0.1 per cent per year) and other private services (0.1 per cent per year). The growth rates of all these sectors in the province are lower than the national average (0.9 per cent per year, 1.1 per cent per year, 1.7 per cent per year, 2.0 per cent per year and 1.4 per cent per year respectively).

iv. Labour Compensation

From an income perspective, nominal value-added can be broken down into labour compensation and capital compensation. In this subsection, we discuss the share of labour compensation in Newfoundland and Labrador's business sector GDP, i.e. how much of the province's business sector GDP went to pay its workers during the 1997-2015 period,[30] and how the labour compensation per worker increased during the 1997-2018 period.

In 2015, the business sector labour compensation as a share of business sector nominal GDP in Newfoundland and Labrador ranked second last (50.9 per cent), which is only higher than Saskatchewan (41.9 per cent), another province where capital-intensive resources industries are very important (Chart 17). The below-average share of Newfoundland and Labrador in 2015 (59.5 per cent in Canada versus 50.9 per cent in the province) was due to the dominance of the capital intensive mining and oil and gas extraction sector in the province's nominal GDP.

Chart 17: Labour Compensation as a Share of Nominal GDP in Canada and the Provinces, Business Sector, 2015

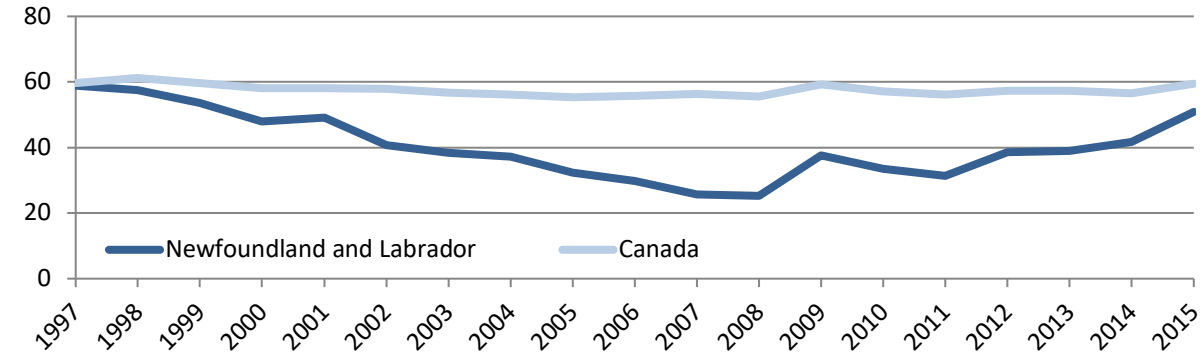


Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

While Canada's labour compensation in the business sector as a share of nominal GDP exhibited a stable trend between 59.7 per cent in 1997 and 59.5 per cent in 2015, the labour compensation share of Newfoundland and Labrador's business sector has been much more volatile, falling from 58 per cent in 1997 to a trough 25.3 per cent in 2008 at the peak of the oil boom before rebounding to 50.9 per cent by 2015.

[30] Although the time series of labour compensation spans from 1997 to 2018 at the national and the provincial level, the nominal GDP (value-added) data are only available from 1997 to 2015. Therefore, the analysis only spans from 1997 to 2015.

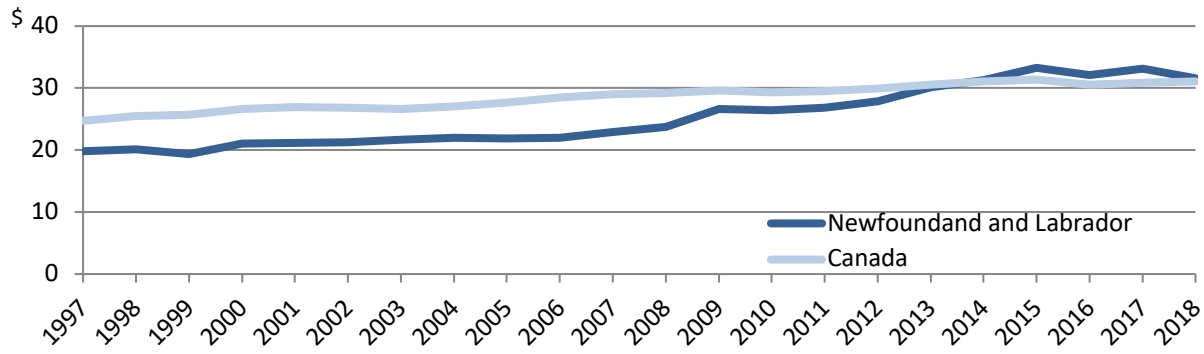
Chart 18: Labour Compensation as a Share of Nominal GDP, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2015



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

It is notable that the large decrease in labour compensation share of nominal GDP from 1997 to 2007 was not due to a below-average growth of labour compensation in itself. During the 1997-2007 period, the business sector total labour compensation in Newfoundland and Labrador and Canada grew at similar rates (5.22 per cent and 5.24 per cent respectively). Rather, the decline in the province's labour compensation share was due to the very rapid growth in capital compensation, driven (once again) by the capital-intensive mining and oil and gas extraction sector, as discussed later in this report.

Chart 19: Real Hourly Labour Compensation, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2018



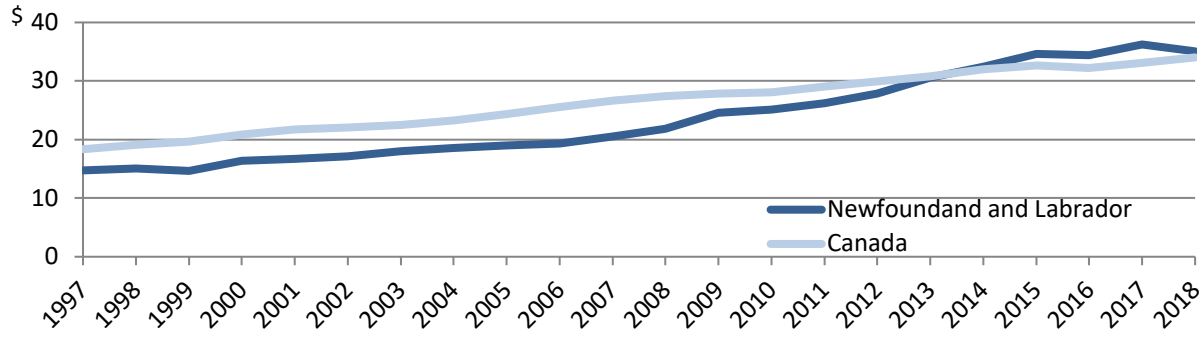
Note: The time-series of the business sector real hourly labour compensation in Newfoundland and Labrador and Canada are computed from deflating the nominal business sector hourly labour compensation in Newfoundland and Labrador and Canada by the Consumer Price Index (CPI) of all items from Statistics Canada table 18-10-0005-01 (formerly CANSIM 326-0021).

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Chart 19 shows the real hourly labour compensation of the business sector in Newfoundland and Labrador and Canada from 1997 to 2018.[31] During these 23 years, the real hourly labour compensation in the business sector in the province rose from $19.85 (2012 dollars) per hour in 1997 to $22.88 (2012 dollars) per hour in 2007 (1.4 per cent per year during the 1997-2007 period), and then grew more slowly to $31.55 (2012 dollars) per hour in 2018 (3.0 per cent per year during the 2007-2018 period). This faster growth in the province's real labour compensation was due to the rise in output from the labour-intensive construction sector and the decline in the capital-intensive mining and oil and gas extraction sector in the province.

On the other hand, the real labour compensation of the business sector in Canada rose from $24.71 (2012 dollars) per hour in 1997 to $29.04 (2012 dollars) per hour in 2007, and then grew more quickly to $31.05 (2012 dollars) per hour in 2018. The year of 2014 was the first year when the real hourly labour compensation of the business sector in Newfoundland and Labrador supersedes that in Canada ($31.10 (2012 dollars) per hour versus $31.25 (2012 dollars) per hour).

Chart 20: Nominal Hourly Labour Compensation, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2018



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

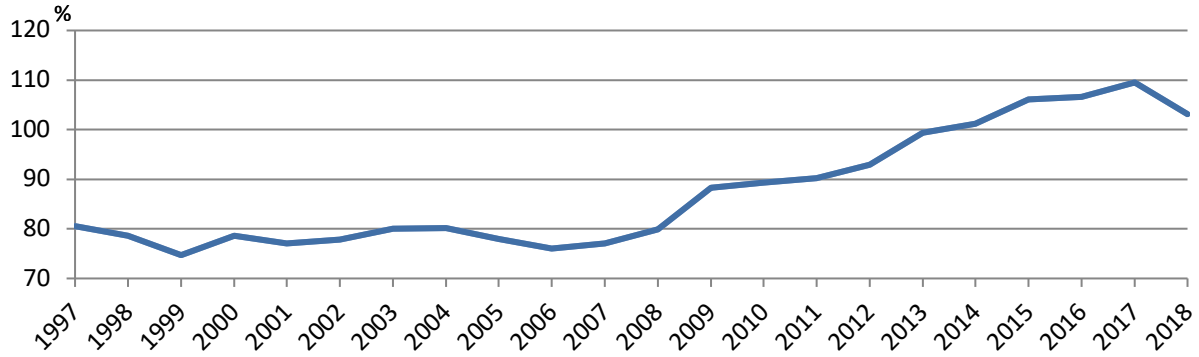
In 2018, nominal hourly labour compensation in Newfoundland and Labrador was $35.11 current dollar per hour, up from $14.78 current dollar per hour in 1997 (Chart 20). This represents a 4.2 per cent increase per year, a growth rate than is much higher than Canada's, at 3.0 per cent per year. It is notable that the difference in hourly labour compensation between Newfoundland and Labrador and Canada narrowed every year from 2006 to 2013. Starting from 2014, hourly labour compensation in Newfoundland and Labrador was higher than the national average.

Wage growth is generally related to the pace of economic activity, with periods of strong economic growth seeing higher wage gains. Ironically, this relationship did not hold in

[31] We obtain the time-series of real hourly labour compensation by deflating the nominal hourly labour compensation by the Consumer Price Index (CPI) of all items from Statistics Canada table 18-10-0005-01.

Newfoundland and Labrador. As noted earlier, real GDP growth was very strong in the 1997-2007 period and negative in the 2007-2018 period. Yet nominal labour compensation growth was increased by a factor of 1.5 after 2007, 5.0 per cent per year versus 3.3 per cent per year.

Chart 21: Nominal Hourly Labour Compensation in Newfoundland and Labrador as a Per Cent of Canada, Business Sector, 1997 – 2018



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

As for hourly nominal labour compensation growth in each sector, during the 1997-2018 period, growth rates of labour compensation in Newfoundland and Labrador's business sector, goods-producing sector and the service sector were higher than Canada (4.2 per cent per year vs. 3.0 per cent per year, 4.3 per cent per year vs. 3.2 per cent per year and 4.0 per cent per year vs. 3.0 per cent per year respectively) (Table 20). During the period, all sectors in the province except for the agriculture, forestry, fishing and hunting sector had higher nominal hourly labour compensation growth than their counterparts at the national level.

During the 1997-2007 sub-period, nominal labour compensation growth in the province was lower than that in Canada in the business sector, the goods-producing sector and the service sector (3.3 per cent per year vs. 3.8 per cent per year, 3.9 per cent per year vs. 4.0 per cent per year, 3.2 per cent per year vs. 3.8 per cent per year). It is notable that all sub-sectors of the goods-producing sector in the province grew more slowly than their Canadian counterparts except manufacturing. On the contrary, 4 of 11 subsectors of the service sector, including transportation and cultural industries, information and cultural industries, real estate, rental and leasing and administrative and support, waste management and remediation and services had stronger growth than Canada.

During the 2007-2018 period, hourly nominal labour compensation of every sub-sector of the province's business sector grew more quickly than Canada. In particular, the growth of the construction sector in the province was faster than Canada's construction sector by a factor 2.4 (5.35/2.26).

Table 19 and Table 21 show the nominal and real labour compensation levels by two-digit NAICS sector of Newfoundland and Labrador and Canada in 1997, 2007 and 2018. Table 22 shows the real labour compensation growth by two-digit NAICS sector in Newfoundland and Labrador and Canada from 1997 to 2018 and demonstrates that the real labour compensation growth and the nominal labour compensation growth follow the same trend.

Table 19: Hourly Nominal Labour Compensation (Current Dollars per Hour Worked) by Two-digit NAICS Sector, Newfoundland and Labrador and Canada, 1997, 2007 and 2018

	Newfoundland and Labrador		
	1997	**2007**	**2018**
Business sector industries	**14.78**	**20.52**	**35.11**
Agriculture, forestry, fishing and hunting	13.90	16.91	26.36
Mining and oil and gas extraction	30.41	42.52	63.75
Utilities	27.10	32.78	62.08
Construction	15.00	21.04	37.32
Manufacturing	16.86	26.29	45.78
Goods-producing Sector	**17.45**	**25.67**	**42.52**
Wholesale trade	16.28	22.22	40.15
Retail trade	10.74	14.18	25.30
Transportation and warehousing	15.68	22.84	33.40
Information and cultural industries	19.95	28.03	51.96
Finance and insurance, and holding companies	21.11	26.06	46.07
Real estate, rental and leasing	12.39	19.00	31.27
Professional, scientific and technical services	18.82	25.84	41.78
ASWMRS	11.69	18.11	28.19
Arts, entertainment and recreation	9.86	12.66	18.71
Accommodation and food services	8.04	12.27	21.40
Other private services	10.97	15.67	28.57
Service-producing Sector	**13.46**	**18.38**	**30.87**
Business sector without mining and oil and gas	**14.27**	**19.61**	**33.65**
	Canada		
Business sector industries	**18.35**	**26.61**	**34.03**
Agriculture, forestry, fishing and hunting	8.44	12.35	18.33
Mining and oil and gas extraction	30.71	46.46	59.13
Utilities	37.32	54.66	73.39
Construction	20.44	28.71	36.70
Manufacturing	22.35	32.00	40.88
Goods-producing Sector	**20.35**	**30.15**	**39.06**
Wholesale trade	20.98	29.71	38.54
Retail trade	12.85	18.82	24.13
Transportation and warehousing	19.03	25.87	32.27
Information and cultural industries	25.23	35.31	45.89
Finance and insurance, and holding companies	24.71	35.29	48.14
Real estate, rental and leasing	18.54	24.13	32.40
Professional, scientific and technical services	23.51	32.56	41.49
ASWMRS	14.26	21.16	26.33
Arts, entertainment and recreation	12.72	18.41	23.90
Accommodation and food services	9.85	15.52	19.98
Other private services	14.75	21.28	26.76
Service-producing Sector	**17.26**	**24.93**	**31.92**
Business sector without mining and oil and gas	**18.17**	**26.20**	**33.51**
	N.L. - Canada Gap		
Business sector industries	**-3.57**	**-6.09**	**1.08**
Agriculture, forestry, fishing and hunting	**5.47**	**4.56**	**8.03**
Mining and oil and gas extraction	**-0.30**	**-3.94**	**4.62**
Utilities	**-10.22**	**-21.88**	**-11.32**
Construction	**-5.44**	**-7.66**	**0.62**
Manufacturing	**-5.49**	**-5.71**	**4.90**
Goods-producing Sector	**-2.90**	**-4.49**	**3.46**
Wholesale trade	**-4.69**	**-7.48**	**1.61**
Retail trade	**-2.11**	**-4.64**	**1.18**
Transportation and warehousing	**-3.35**	**-3.03**	**1.13**
Information and cultural industries	**-5.28**	**-7.27**	**6.07**
Finance and insurance, and holding companies	**-3.61**	**-9.23**	**-2.07**
Real estate, rental and leasing	**-6.15**	**-5.13**	**-1.13**
Professional, scientific and technical services	**-4.69**	**-6.72**	**0.29**
ASWMRS	**-2.57**	**-3.05**	**1.86**
Arts, entertainment and recreation	**-2.86**	**-5.75**	**-5.19**
Accommodation and food services	**-1.80**	**-3.25**	**1.43**
Other private services	**-3.78**	**-5.60**	**1.81**
Service-producing Sector	**-3.80**	**-6.54**	**-1.05**
Business sector without mining and oil and gas	**-3.89**	**-6.59**	**0.15**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Table 20: Hourly Nominal Labour Compensation Compound Annual Growth by Two-digit NAICS Sector, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2018

	Newfoundland and Labrador		
	1997-2018	1997-2007	2007-2018
	(per cent)		
Business sector industries	**4.21**	**3.33**	**5.00**
Agriculture, forestry, fishing and hunting	3.09	1.98	4.12
Mining and oil and gas extraction	3.59	3.41	3.75
Utilities	4.03	1.92	5.98
Construction	4.44	3.44	5.35
Manufacturing	4.87	4.54	5.17
Goods-producing sector	**4.33**	**3.94**	**4.70**
Wholesale trade	4.39	3.16	5.52
Retail trade	4.16	2.81	5.41
Transportation and warehousing	3.67	3.84	3.51
Information and cultural industries	4.66	3.46	5.77
Finance and insurance, and holding companies	3.79	2.13	5.32
Real estate, rental and leasing	4.51	4.37	4.63
Professional, scientific and technical services	3.87	3.22	4.47
ASWMRS	4.28	4.48	4.10
Arts, entertainment and recreation	3.10	2.53	3.62
Accommodation and food services	4.77	4.31	5.19
Other private services	4.66	3.63	5.61
Service-producing sector	**4.03**	**3.17**	**4.83**
Business sector without mining and oil and gas	**4.17**	**3.23**	**5.03**
	Canada		
	1997-2018	**1997-2007**	**2007-2018**
	(per cent)		
Business sector industries	**2.98**	**3.78**	**2.26**
Agriculture, forestry, fishing and hunting	3.76	3.88	3.65
Mining and oil and gas extraction	3.17	4.23	2.22
Utilities	3.27	3.89	2.72
Construction	2.83	3.45	2.26
Manufacturing	2.92	3.65	2.25
Goods-producing sector	**3.15**	**4.01**	**2.38**
Wholesale trade	2.94	3.54	2.40
Retail trade	3.04	3.89	2.29
Transportation and warehousing	2.55	3.12	2.03
Information and cultural industries	2.89	3.42	2.41
Finance and insurance, and holding companies	3.23	3.63	2.86
Real estate, rental and leasing	2.70	2.67	2.72
Professional, scientific and technical services	2.74	3.31	2.23
ASWMRS	2.96	4.03	2.00
Arts, entertainment and recreation	3.05	3.76	2.40
Accommodation and food services	3.43	4.65	2.32
Other private services	2.88	3.73	2.11
Service-producing sector	**2.97**	**3.75**	**2.27**
Business sector without mining and oil and gas	**2.96**	**3.73**	**2.26**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Table 21: Hourly Real Labour Compensation Levels (in 2012 Dollars) by Two-digit NAICS Sector, Newfoundland and Labrador and Canada, Business Sector, 1997, 2007 and 2018

	Newfoundland and Labrador		
	1997	**2007**	**2018**
	(2012 Dollars per Hour Worked)		
Business sector industries	**19.85**	**22.88**	**31.55**
Agriculture, forestry, fishing and hunting	18.66	18.86	23.68
Mining and oil and gas extraction	40.82	47.42	57.28
Utilities	36.38	36.56	55.78
Construction	20.13	23.47	33.53
Manufacturing	22.63	29.32	41.13
Goods-producing sector	**23.42**	**28.62**	**38.20**
Wholesale trade	21.86	24.78	36.07
Retail trade	14.42	15.81	22.74
Transportation and warehousing	21.05	25.48	30.01
Information and cultural industries	26.78	31.26	46.68
Finance and insurance, and holding companies	28.33	29.06	41.40
Real estate, rental and leasing	16.63	21.19	28.10
Professional, scientific and technical services	25.26	28.81	37.54
ASWMRS	15.69	20.20	25.33
Arts, entertainment and recreation	13.24	14.12	16.81
Accommodation and food services	10.80	13.68	19.23
Other private services	14.72	17.48	25.67
Service-producing sector	**18.06**	**20.50**	**27.74**
Business sector without mining and oil and gas	**19.16**	**21.87**	**30.24**
	Canada		
	1997.00	**2007.00**	**2018.00**
	(2012 Dollars per Hour Worked)		
Business sector industries	**24.71**	**29.04**	**31.05**
Agriculture, forestry, fishing and hunting	11.36	13.48	16.72
Mining and oil and gas extraction	41.34	50.71	53.95
Utilities	50.24	59.66	66.96
Construction	27.52	31.33	33.48
Manufacturing	30.09	34.92	37.30
Goods-producing sector	**27.39**	**32.91**	**35.64**
Wholesale trade	28.24	32.42	35.16
Retail trade	17.30	20.54	22.01
Transportation and warehousing	25.61	28.24	29.44
Information and cultural industries	33.96	38.54	41.86
Finance and insurance, and holding companies	33.27	38.52	43.92
Real estate, rental and leasing	24.96	26.34	29.56
Professional, scientific and technical services	31.65	35.54	37.85
ASWMRS	19.20	23.10	24.02
Arts, entertainment and recreation	17.13	20.09	21.81
Accommodation and food services	13.26	16.94	18.22
Other private services	19.86	23.22	24.41
Service-producing sector	**23.23**	**27.21**	**29.12**
Business sector without mining and oil and gas	**24.45**	**28.60**	**30.57**

	NL - Canada Gap		
	1997	2007	2018
Business sector industries	**-4.86**	**-6.16**	**0.50**
Agriculture, forestry, fishing and hunting	7.30	5.38	6.96
Mining and oil and gas extraction	-0.52	-3.29	3.33
Utilities	-13.86	-23.10	-11.18
Construction	-7.39	-7.86	0.05
Manufacturing	-7.46	-5.60	3.83
Goods-producing sector	**-3.98**	**-4.29**	**2.57**
Wholesale trade	-6.38	-7.64	0.91
Retail trade	-2.88	-4.73	0.72
Transportation and warehousing	-4.57	-2.76	0.57
Information and cultural industries	-7.18	-7.27	4.82
Finance and insurance, and holding companies	-4.94	-9.46	-2.52
Real estate, rental and leasing	-8.32	-5.15	-1.47
Professional, scientific and technical services	-6.39	-6.73	-0.31
ASWMRS	-3.51	-2.90	1.31
Arts, entertainment and recreation	-3.89	-5.97	-4.99
Accommodation and food services	-2.46	-3.26	1.01
Other private services	-5.13	-5.74	1.26
Service-producing sector	**-5.17**	**-6.71**	**-1.38**
Business sector without mining and oil and gas	**-5.30**	**-6.73**	**-0.33**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Table 22: Hourly Real Labour Compensation (in 2012 Dollars) Compound Annual Growth by Two-digit NAICS Sector, Newfoundland and Labrador and Canada, Business Sector, 1997 – 2018

	Newfoundland and Labrador		
	1997-2018	1997-2007	2007-2018
		(per cent)	
Business sector industries	**2.23**	**1.43**	**2.96**
Agriculture, forestry, fishing and hunting	1.14	0.11	2.09
Mining and oil and gas extraction	1.63	1.51	1.73
Utilities	2.06	0.05	3.92
Construction	2.46	1.54	3.30
Manufacturing	2.89	2.62	3.13
Goods-producing Sector	**2.36**	**2.03**	**2.66**
Wholesale trade	2.41	1.26	3.47
Retail trade	2.19	0.93	3.36
Transportation and warehousing	1.70	1.93	1.50
Information and cultural industries	2.68	1.56	3.71
Finance and insurance, and holding companies	1.82	0.25	3.27
Real estate, rental and leasing	2.53	2.45	2.60
Professional, scientific and technical services	1.90	1.33	2.43
ASWMRS	2.31	2.56	2.08
Arts, entertainment and recreation	1.15	0.65	1.60
Accommodation and food services	2.79	2.39	3.14
Other private services	2.68	1.73	3.55
Service-producing Sector	**2.06**	**1.27**	**2.79**
Business sector without mining and oil and gas	**2.20**	**1.33**	**2.99**

	Canada		
	(per cent)		
Business sector industries	**1.09**	**1.63**	**0.61**
Agriculture, forestry, fishing and hunting	1.86	1.73	1.98
Mining and oil and gas extraction	1.28	2.06	0.56
Utilities	1.38	1.73	1.05
Construction	0.94	1.31	0.61
Manufacturing	1.03	1.50	0.60
Goods-producing Sector	**1.26**	**1.85**	**0.72**
Wholesale trade	1.05	1.39	0.74
Retail trade	1.15	1.73	0.63
Transportation and warehousing	0.66	0.98	0.38
Information and cultural industries	1.00	1.27	0.76
Finance and insurance, and holding companies	1.33	1.47	1.20
Real estate, rental and leasing	0.81	0.54	1.05
Professional, scientific and technical services	0.86	1.16	0.57
ASWMRS	1.07	1.87	0.35
Arts, entertainment and recreation	1.16	1.61	0.75
Accommodation and food services	1.53	2.48	0.67
Other private services	0.99	1.58	0.45
Service-producing Sector	**1.08**	**1.59**	**0.62**
Business sector without mining and oil and gas	**1.07**	**1.58**	**0.61**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

C. Capital Input

In this subsection, we analyze the trends in the use of capital input in Newfoundland and Labrador and Canada during the 1997-2017 period. Specifically, we focus on the evolution of the capital flow (gross investment) and the capital stock (net capital stock) of fixed, non-residential capital assets. Statistics Canada defined four broad categories of fixed, non-residential capital assets: (1) non-residential buildings, (2) engineering construction, (3) machinery and equipment (M&E), and (4) intellectual property products. Each of these four categories has sub-categories. In particular, we focus on the sub-categories of intellectual property product: (a) mineral exploration and evaluation, (b) research and development and (c) software because they are essential to the province's productivity. While (a) is an indicator of the sustainability of the province's mining and oil and gas extraction productivity, (b) and (c) signify the province's innovation. This report makes use of the geometric end-year net stock concept.

We first analyze the real fixed, non-residential investment in Newfoundland and Labrador and Canada by the four major asset categories and three sub-types of the intellectual property

products in the total economy.[32] Then we examine the real total fixed, non-residential investment in the province and Canada by two-digit NAICS subsector of the business sector and the portion of GDP that capital returns in the business sector. Analysis of capital stock will precede in the same manner.

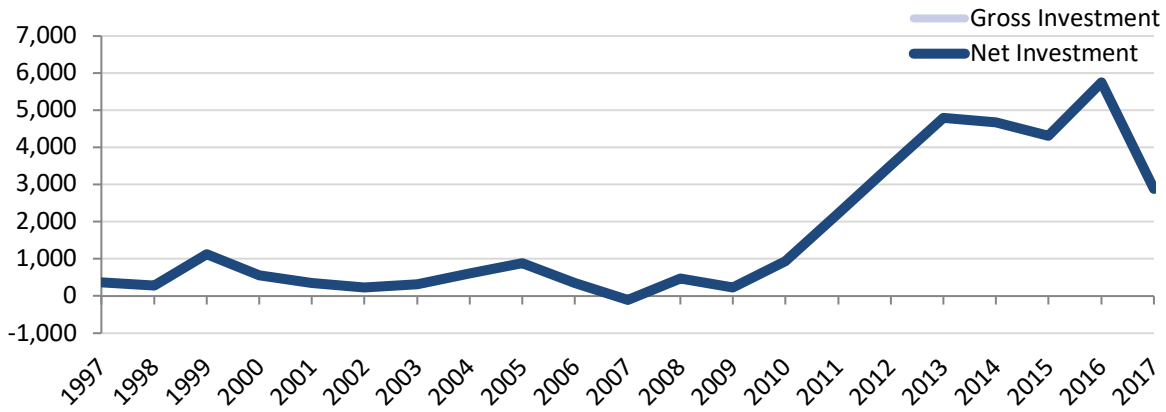
i. Fixed Capital Flows

During the 1997-2017 period, real fixed non-residential investment in Newfoundland and Labrador's total economy grew at an annual compound rate of 5.5 per cent per year, from $2,990 million chained 2012 dollars in 1997, peaked at $11,383 million chained 2012 dollars in 2016, to $8,741 million chained 2012 dollars in 2017. In Canada, real total economy investment grew at a lower rate, at 2.6 per cent per year. As shown in Chart 22, gross real investment and net real investment (defined as gross real investment minus depreciation) in the province skyrocketed since 2007. This significant increase between 2007 and 2017 in Newfoundland and Labrador (9.6 per cent per year) was due to both non-residential building and engineering construction investment in the mining and oil and gas extraction sector and the government's infrastructure strategy.[33] During the same period, growth of real investment in Canada was only 0.1 per cent per year. We can also observe that the province's net investment is positive most of the time from 1997 to 2017, except in 2007.

In terms of real investment growth by major asset categories in the total economy, during the 1997-2017 period, Newfoundland and Labrador outperformed Canada in all four major categories of assets (Table 23). Among these four categories, the province experienced the highest growth in non-residential building engineering construction (8.1 per cent per year) and engineering construction (5.5 per cent per year).

[32] Because data on the sub-categories of assets by two-digit NAICS sector are not available on Statistics Canada's website, analysis pertinent to sub-categories of assets is based on data for the total economy. Subsection A in the Appendix explains how we estimate the business sector aggregate of investment and capital stock from sectoral data.
[33] According to the Newfoundland and Labrador's Department of Finance (2012), capital investment after 2004 can be attributed to the continued development of major project such as Vale's nickel processing facility in Long Harbour and many other projects in the oil, iron ore mining and hydro-electric sector. For example, according to the Department of Finance in Newfoundland and Labrador (2018), the Muskrat Falls project was projected to cost $10.1 million from 2012 to 2020.

Chart 22: Real Investment (Fixed, Non-residential), Business Sector, Newfoundland and Labrador, 1997 – 2017 (Millions, Chained 2012 Dollars)



Source: The Stock and Consumption of Fixed Non-residential Capital Program, Statistics Canada (Table 36-10-0096-01).

During the 1997-2007 period, the growth in real investment in the province's total economy was lower than Canada (1.6 per cent per year versus 5.2 per cent per year). While the province experienced higher growth in investment in non-residential building, machinery and equipment and intellectual property products than Canada, the province's real investment in engineering construction declined at a rate of 4.4 per cent per year, contrary to a rise of 5.9 per cent per year at the national level. This corresponds to the completion of construction of offshore oil rigs in the province by 1997. Moreover, the much higher growth of investment in mineral exploration and evaluation than the national average (18.6 per cent per year versus 6.5 per cent per year) reflects that the focus of the mining and oil and gas extraction sector shifted from developing oil field before 1997 to exploring for new oil fields, with the construction of new off-shore oil platforms having started again during the 2007-2017 period.

During the 2007-2017 period, investment in Newfoundland and Labrador rose significantly (9.6 per cent per year). Such growth was due to the investment growth in engineering construction (16.5 per cent per year), as discussed, and the growth in non-residential building investment (11.9 per cent per year). The growth in the investment, however, was partially offset by the decline in machinery and equipment (0.8 per cent per year) and intellectual property products (-0.7 per cent per year). As the focus shifted back to the construction of offshore oil rigs, real investment in mineral exploration and evaluation dropped during the 2007-2017 period at an annual compound rate of 6.5 per cent per year.

Box 2: Major Investment Projects

Newfoundland and Labrador has been home to impressive investments. According to the Department of Finance of the Government of Newfoundland and Labrador, about $21 billion in major capital

spending is planned or in 2018 going forward. The following are the top three largest projects, which account for 75 per cent of the major capital spending.

- The Lower Churchill Project – Phase I (Muskrat Falls) is worth $10.1 billion dollars, which covers the capital cost from 2012 to 2020. This project entails construction of an 824-mega-watt hydroelectric generating facility at Muskrat Falls on the lower Churchill River and over 1,600 kilometres of associated transmission line and related infrastructure.

- The West White Rose project is worth $3.2 billion dollars. This expenditure covers capital cost from 2013 to 2022 for developing a fixed drilling platform tied back to existing infrastructure at the White Rose field.

- The underground mine development at Voisey's Bay is worth $2.5 billion dollars. The development is expected to start in 2018.

Source: The Economy, 2018, Department of Finance, Government of Newfoundland and Labrador.

Table 23: Real Gross Investment (Fixed, Non-residential) Compound Annual Growth, Total Economy, Newfoundland and Labrador and Canada, 1997 – 2017 (Per Cent)

	Newfoundland and Labrador		
	1997-2017	**1997-2007**	**2007-2017**
Total (Non-residential) Investment	**5.51**	**1.58**	**9.60**
Non-residential Building	6.28	0.95	11.90
Engineering Construction	5.53	-4.44	16.54
Machinery and Equipment	2.90	6.73	-0.79
Intellectual Property Products	4.24	9.43	-0.70
Mineral exploration and evaluation	5.31	18.63	-6.52
Research and development	3.93	4.44	3.41
Software	3.91	3.25	4.57
		Canada	
	1997-2017	**1997-2000**	**2007-2017**
Total (Non-residential) Investment	**2.63**	**5.23**	**0.10**
Non-residential Building	1.04	0.94	1.14

Engineering Construction	3.76	5.73	1.82
Machinery and Equipment	2.30	6.31	-1.57
Intellectual Property Products	2.29	5.86	-1.16
Mineral exploration and evaluation	-2.46	6.53	-10.68
Research and development	2.11	4.05	0.20
Software	4.03	7.72	0.47

Note: Investment growth rates of mineral exploration and evaluation, research and development and software are for the total economy instead of the business sector because the data are not available at the sectoral level.
Source: The Stock and Consumption of Fixed Non-residential Capital Program, Statistics Canada (Table 36-10-0098-01).

Given the predominance of the mining and oil and gas extraction sector in Newfoundland and Labrador and the capital-intensive nature of this sector, it is not surprising that engineering construction had the predominant share of investment in the province's economy (Table 24). In 1997, more than a half (54.2 per cent) of investment went to engineering construction which reflects investment in the offshore oil rigs before the first flow of oil in the province. In 2007, as oil price and oil production in the province reached the peak (see Chart 29 and Chart 32 of engineering construction dropped from 54.2 per cent in 1997 to 34.0 per cent while the share of mineral exploration and evaluation increased by 442.3 per cent from 2.1 per cent in 1997 to 11.3 per cent in 2007. In 2017, investment in engineering construction in the province as a share of investment in the province's total economy rose to 66.2 per cent because of the development of the Hebron oil field.

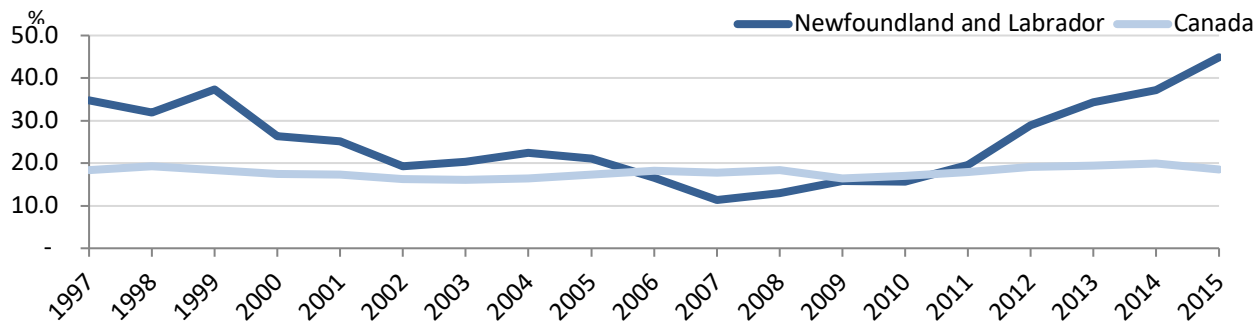
Table 24: Asset Shares of Total Economy Nominal Gross Investment in Newfoundland and Labrador and Canada, 1997, 2007 and 2017

	Newfoundland and Labrador			Canada			NL - Canada		
	1997	2007	2017	1997	2007	2017	1997	2007	2017
	(share of nominal total economy gross investment, per cent)						(percentage point)		
Total (Non-residential) Investment	100	100	100	100	100	100	-	-	-
Non-residential Building	9.99	11.15	13.63	16.31	15.11	16.74	-6.32	-3.96	-3.11
Engineering Construction	54.20	33.97	66.21	22.28	29.82	37.74	31.93	4.14	28.47
Machinery and Equipment	27.39	34.44	12.49	45.25	35.07	28.12	-17.86	-0.63	-15.63
Intellectual Property Products	8.45	20.41	7.67	16.16	20.00	17.40	-7.71	0.41	-9.73
Mineral exploration and evaluation	2.08	11.28	2.39	2.52	3.87	1.28	-0.44	7.41	1.11
Research and development	3.29	5.75	3.17	6.81	8.17	8.07	-3.53	-2.42	-4.90
Software	3.12	3.41	2.11	6.83	7.95	8.05	-3.71	-4.54	-5.94

Source: The Stock and Consumption of Fixed Non-residential Capital Program, Statistics Canada (Table 36-10-0098-01).

The remainder of the discussion about gross capital investment focuses on the business sector and its two-digit NAICS subsectors in Newfoundland and Labrador and Canada. As Chart 23 shows, the province's nominal capital investment as a share of the province's business sector nominal GDP dropped from 34.9 per cent in 1997 to 11.3 per cent in 2007 and then took off to 44.9 per cent in 2015, while the national average was stable throughout the entire period (oscillating between 16.1 per cent and 19.9 per cent). This increasing share from investment reflects the rising importance of investment in the province's business sector GDP after 2007.

Chart 23: Nominal Gross Investment (Fixed, Non-residential) as a Share of Nominal GDP, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2015



Source: The Stock and Consumption of Fixed Non-residential Capital Program and the Canadian Productivity Account, Statistics Canada (Table 36-10-0098-01 and 36-10-0211-01).

Table 25: Sectoral Nominal Gross Investment (Fixed, Non-residential) as a Share of Nominal Gross Investment in the Business Sector, Newfoundland and Labrador and Canada, 1997, 2007 and 2017

	Newfoundland and Labrador			Canada			NL - Canada		
	1997	2007	2017	1997	2007	2017	1997	2007	2017
	(per cent)								
Business sector industries	**100**	**100**	**100**	**100**	**100**	**100**	**-**	**-**	**-**
Agriculture, forestry, fishing and hunting	1.46	1.77	0.42	4.31	2.50	3.15	-2.85	-0.72	-2.73
Mining and oil and gas extraction	55.73	48.65	39.88	19.37	29.37	23.42	36.37	19.28	16.47
Utilities	6.10	5.57	36.62	6.07	9.07	12.87	0.03	-3.50	23.75
Construction	1.46	3.43	1.07	2.41	2.55	3.21	-0.94	0.88	-2.14
Manufacturing	5.76	5.73	8.73	20.09	11.82	10.47	-14.33	-6.09	-1.75
Goods-producing sector	**1.51**	**0.93**	**0.65**	**3.79**	**2.85**	**2.72**	**-2.28**	**-1.92**	**-2.07**
Wholesale trade	3.42	5.00	1.10	3.91	4.78	3.59	-0.49	0.23	-2.49
Retail trade	12.84	9.28	4.17	7.96	8.13	14.68	4.87	1.15	-10.51
Transportation and warehousing	4.98	6.17	1.66	8.22	5.24	7.14	-3.24	0.93	-5.48
Information and cultural industries	3.61	5.37	0.49	10.77	8.91	4.15	-7.16	-3.55	-3.67
Finance and insurance and holding companies	3.61	5.32	0.40	10.48	8.78	3.59	-6.87	-3.45	-3.20

Real estate and rental and leasing	0.39	3.51	2.28	6.36	7.47	6.50	-5.97	-3.96	-4.22
Professional, scientific and technical Services	1.07	2.78	0.78	2.73	2.85	3.19	-1.66	-0.07	-2.41
ASWMRS	0.93	0.40	0.09	0.94	0.82	1.13	-0.01	-0.42	-1.04
Arts, entertainment and recreation	0.05	0.12	1.02	0.81	0.93	1.24	-0.76	-0.81	-0.22
Accommodation and food services	0.49	0.73	0.86	1.12	1.42	1.78	-0.63	-0.69	-0.92
Other private services	0.20	0.56	0.17	1.16	1.31	0.77	-0.96	-0.74	-0.59
Service-producing sector	**31.58**	**39.25**	**13.03**	**54.44**	**50.63**	**47.76**	**-22.87**	**-11.38**	**-34.73**
Business sector without mining and oil and gas	**44.27**	**51.35**	**60.12**	**80.63**	**70.63**	**76.58**	**-36.37**	**-19.28**	**-16.47**

Source: The Stock and Consumption of Fixed Non-residential Capital Program, Statistics Canada (Table 36-10-0096-01).

Most of the nominal gross investment in Newfoundland and Labrador went to the mining and oil and gas extraction sector (

Table 25). In 2017, 39.9 per cent of investment in the province is for mining and oil and gas extraction, followed by utilities (36.6 per cent). The much greater mining and oil and gas share of nominal gross investment in Newfoundland and Labrador compared to Canada (39.9 per cent versus 23.4 per cent in 2017) is not a surprise, given the predominance of the mining and oil and gas extraction sector in the province's economy in terms of output.

Table 26 shows the compound annual growth of real gross fixed, non-residential investment in sub-sectors of the business sector in Newfoundland and Labrador and Canada from 1997 to 2017. The business sector real investment in Newfoundland and Labrador grew at a higher annual rate than the national level during the 1997-2017 period and the 2007-2017 sub-periods (5.9 per cent versus 2.3 per cent, 11.1 per cent versus -0.4 per cent respectively). During the 2007-2017 sub-period, the real investment in the province's goods sector was grew at an annual rate of 14.1 per cent, compared with a 1.2-per cent decline in Canada.

In Newfoundland and Labrador, during the 2007-2017 sub-period, the real investment growth in the province's mining and oil and gas extraction sector and the utilities sector experienced strong growth compared with Canada. In particular, the real investment in the mining and oil and gas extraction sector rose at 8.4 per cent per year (versus -3.1 per cent per year in Canada) because of development projects including the Hebron oil field. Due to the Muskrat Falls project, the real gross utilities investment had a more impressive growth than mining and oil and gas extraction at an annual rate of 34.7 per cent per year, which is almost 12 times as high as the national average of 2.9 per cent per year.

It is also notable that the province's real investment growth of the arts, entertainment and recreation sectors was the largest during the 1997-2017, the 1997-2007 and the 2007-2017 periods because of restoration and renovation of various facilities such as the expansion of the St. John's Convention Centre. However, its contribution to the province's business sector investment is small because the dollar amount of the investment is small, compared to investment in mining and oil and gas extraction and utilities.[34]

[34] Specifically, from 1997 to 2017, the arts, entertainment and recreation sector as a per cent of the mining and oil and gas extraction investment ranges from the minimum 0.06 per cent in 2006 to the maximum 2.6 per cent in 2017.

Table 26: Sectoral Real Gross Investment (Fixed, Non-residential) Compound Annual Growth, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2017

	Newfoundland and Labrador		
	1997-2017	**1997-2007**	**2007-2017**
Business sector industries	**5.87**	**0.92**	**11.06**
Agriculture, forestry, fishing and hunting	-1.47	2.10	-4.91
Mining and oil and gas extraction	3.53	-1.15	8.44
Utilities	15.71	-0.60	34.69
Construction	4.59	10.68	-1.16
Manufacturing	8.35	1.24	15.95
Goods-producing industries	**6.56**	**-0.48**	**14.11**
Wholesale trade	3.04	-1.53	7.83
Retail trade	0.12	4.80	-4.35
Transportation and warehousing	0.57	-1.12	2.30
Information and cultural industries	1.72	5.54	-1.96
Finance and Insurance and Holding Companies	-2.54	7.18	-11.38
Real estate and rental and leasing	17.07	27.38	7.59
Professional, scientific and technical services	7.18	16.65	-1.53
ASWMRS	-3.09	-3.05	-3.13
Arts, entertainment and recreation	24.57	11.61	39.04
Accommodation and food services	8.54	3.87	13.43
Other private services	5.35	11.96	-0.86
Service-producing industries	**2.77**	**4.27**	**1.29**
Business sector without mining and oil and gas	**8.22**	**3.43**	**13.23**
	Canada		
	1997-2017	**1997-2007**	**2007-2017**
Business sector industries	**2.29**	**5.00**	**-0.35**
Agriculture, forestry, fishing and hunting	0.43	-0.62	1.49
Mining and oil and gas extraction	1.69	6.77	-3.14
Utilities	5.67	8.52	2.90
Construction	4.36	6.55	2.22
Manufacturing	-0.96	-0.36	-1.55
Goods-producing industries	**1.43**	**4.21**	**-1.15**
Wholesale trade	1.43	3.40	-0.50
Retail trade	2.02	7.09	-2.80
Transportation and warehousing	5.49	5.26	5.72
Information and cultural industries	3.06	2.65	3.48
Finance and Insurance and Holding Companies	-0.71	5.53	-6.57
Real estate and rental and leasing	3.54	7.89	-0.64
Professional, scientific and technical services	5.53	9.44	1.75
ASWMRS	6.11	8.49	3.78
Arts, entertainment and recreation	5.28	7.70	2.92
Accommodation and food services	4.21	6.33	2.12

Other private services	0.79	6.94	-5.00
Service-producing industries	**3.23**	**5.79**	**0.72**
Business sector without mining and oil and gas	**2.61**	**4.47**	**0.78**

Source: The Stock and Consumption of Fixed Non-residential Capital Program, Statistics Canada (Table 36-10-0096-01).

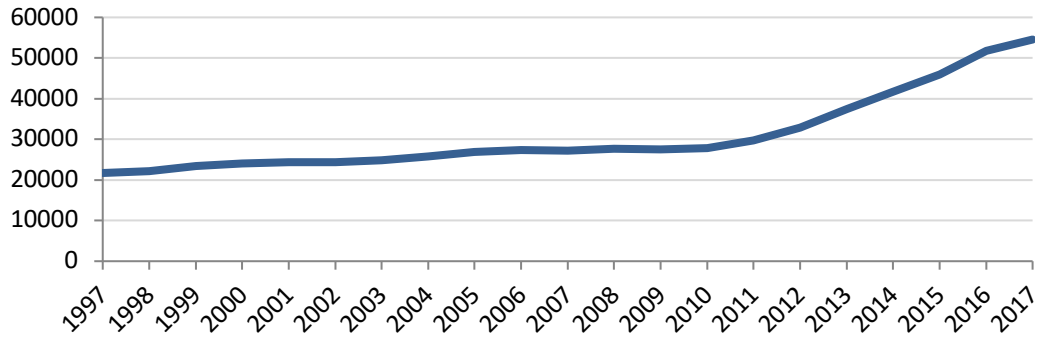
ii. Fixed Capital Stock

Variations in capital stock are determined by net investment expenditures (gross investment expenditures minus capital depreciation). Ultimately, what matters for production is the quantity and quality of the capital stock.

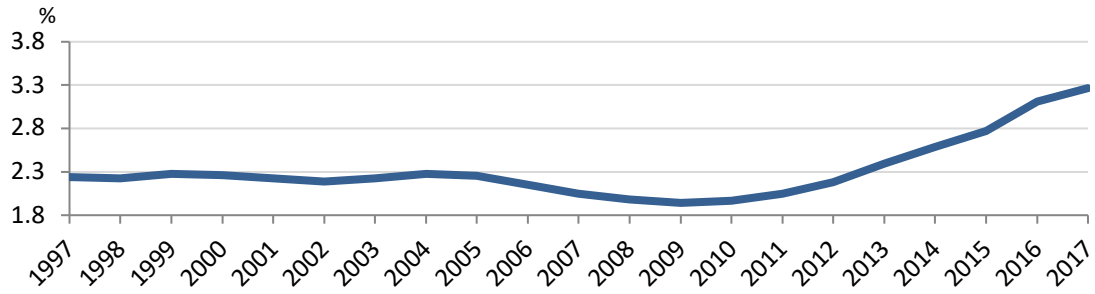
Chart 24 shows the evolution of Newfoundland and Labrador's real net capital stock (fixed, non-residential) in the business sector from 1997 to 2017. Since 2009, the business sector real net capital stock (fixed, non-residential) took off from $27,455 million (chained 2012 dollars) to $54,551 million (chained 2012 dollars) (Panel A of Chart 24). Panel B of Chart 24 shows that in nominal terms the province's capital stock as a share of Canada's fell during the 1997-2009 period from 2.2 per cent to 1.9 per cent and rose during the 2009-2017 period to 3.3 per cent.

Chart 24: Net Capital Stock (Fixed, Non-residential) in Newfoundland and Labrador and Canada, Business Sector, 1997 – 2017

Panel A: Net Capital Stock (Million Chained 2012 Dollars)



Panel B: Nominal Net Capital Stock in Newfoundland and Labrador as a Per Cent of Canada



Source: The Stock and Consumption of Fixed Non-residential Capital Program, Statistics Canada (Table 36-10-0096-01).

Table 27 details some of the key figures related to net real capital stock growth during the 1997-2017 period. Real capital stock growth in Newfoundland and Labrador outpaced Canada's by a considerable margin (4.1 per cent per year versus 2.7 per cent per year). Among the four major asset types, net real capital stock of intellectual property products in the province had the highest growth (4.8 per cent per year), which is 1.5 times as much as the national average (3.1 per cent per year). Among the three sub-categories of intellectual property products, net real capital stock of mineral exploration and evaluation had the highest growth, which is also higher than the national average by a factor of 1.5 (5.23 per cent per year versus 3.33 per cent per year).

During the 2007-2017 period, real capital stock growth in Newfoundland and Labrador was more than two times faster than in Canada (6.5 per cent versus 2.5 per cent per year). In the province, net real capital stock growth of (non-residential) building and engineering construction was the highest (7.50 per cent per year and 7.47 per cent per year respectively). This huge growth can be explained by the new Hebron oil field and the Muskrat Falls project in the province.

Table 27: Net Real Capital Stock (Fixed, Non-residential) Compound Annual Growth by Asset Type, Total Economy, Newfoundland and Labrador and Canada, 1997 – 2017

	Newfoundland and Labrador		
	1997-2017	**1997-2007**	**2007-2017**
Total (Non-residential) Investment	**4.12**	**1.81**	**6.47**
Non-residential Building	4.40	1.39	7.50
Engineering Construction	4.04	0.71	7.47
Machinery and Equipment	3.05	4.40	1.72
Intellectual Property Products	4.81	5.64	3.98
Mineral exploration and evaluation	5.23	6.52	3.96
Research and development	3.46	3.07	3.85
Software	4.16	3.91	4.41
	Canada		
	1997-2017	**1997-2000**	**2007-2017**
Total (Non-residential) Investment	**2.68**	**2.88**	**2.49**
Non-residential Building	1.34	1.25	1.42
Engineering Construction	3.50	2.66	4.36
Machinery and Equipment	2.20	3.95	0.48
Intellectual Property Products	3.13	5.84	0.49
Mineral exploration and evaluation	3.33	6.79	-0.01
Research and development	2.10	3.97	0.26
Software	4.60	7.61	1.67

Source: The Stock and Consumption of Fixed Non-residential Capital Program, Statistics Canada (Table 36-10-0096-01).

At the two-digit NAICS sector level, Table 28 reveals that Newfoundland and Labrador outperformed Canada in terms of real capital stock growth in the business sector, the goods sector, the service sector, the business sector without mining and oil and gas and 8 of 16 subsectors of the business sector during the 1997-2017 period. Six of these subsectors are subsectors of the service sector (6 subsectors) while two of them are from the goods sector (utilities and manufacturing).

The out-performance of Newfoundland and Labrador was due to the huge growth during the 2007-2017 sub-period. During the 1997-2007 sub-period, 7 of 16 subsectors in the province outperformed Canada with respect to the growth. However, during the 2007-2017 sub-period, 12 of 16 subsectors in the province outperformed Canada in terms of real net capital stock growth.

Also, real net capital stock growth of a number of subsectors of the business sector in the province was extraordinary during the 2007-2017 sub-period. In particular, utilities (14.2 per cent per year), manufacturing (15.5 per cent per year) and arts, entertainment and recreation (15.1 per cent per year) experienced annual capital stock growth of more than 10 per cent per year.

Table 28: Real Net Capital Stock (Fixed, Non-residential) Compound Annual Growth by Two-digit NAICS Sector, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2017

	Newfoundland and Labrador		
	1997-2017	**1997-2007**	**2007-2017**
Business sector industries	**4.72**	**2.30**	**7.19**
Agriculture, forestry, fishing and hunting	-1.70	-0.30	-3.09
Mining and oil and gas extraction	4.45	3.27	5.65
Utilities	6.00	-1.63	14.21
Construction	3.39	2.62	4.16
Manufacturing	8.27	1.51	15.48
Goods-producing industries	**4.96**	**2.15**	**7.84**
Wholesale trade	2.12	1.11	3.14
Retail trade	3.48	3.80	3.17
Transportation and warehousing	3.59	1.62	5.60
Information and cultural industries	0.19	3.52	-3.05
Finance and Insurance and Holding Companies	-0.15	5.97	-5.92
Real estate and rental and leasing	1.23	0.50	1.97
Professional, scientific and technical services	9.81	16.47	3.53
ASWMRS	-1.28	-6.98	4.77
Arts, entertainment and recreation	9.68	4.50	15.11
Accommodation and food services	6.37	4.29	8.50
Other private services	9.70	11.15	8.26
Service-producing industries	**3.01**	**3.03**	**2.98**
Business sector without mining and oil and gas	**5.17**	**0.92**	**9.59**
	Canada		

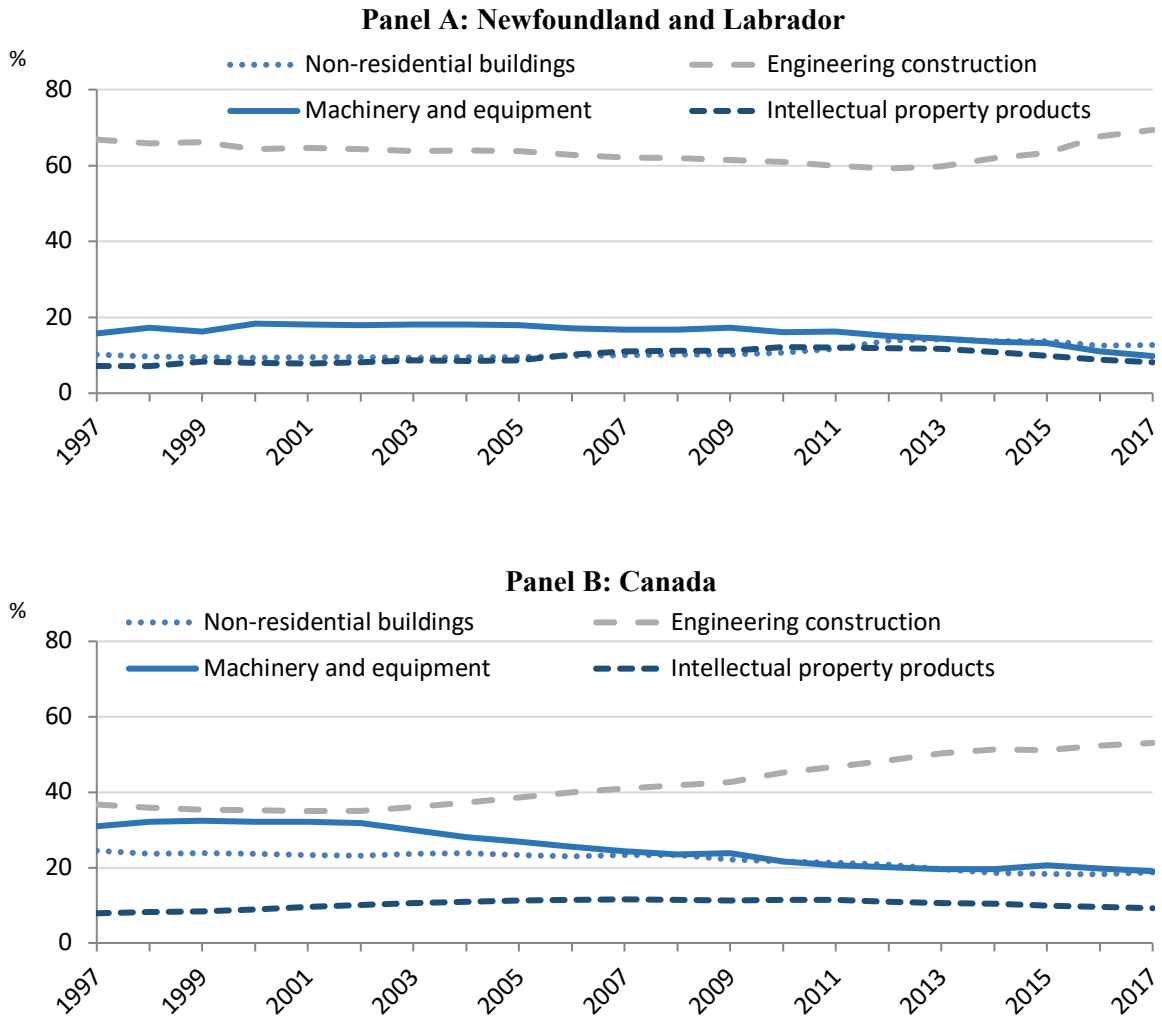
	1997-2017	1997-2007	2007-2017
Business sector industries	**2.68**	**3.09**	**2.27**
Agriculture, forestry, fishing and hunting	0.14	-0.44	0.72
Mining and oil and gas extraction	5.07	6.68	3.49
Utilities	2.09	0.45	3.76
Construction	3.57	4.03	3.11
Manufacturing	-0.78	-0.13	-1.43
Goods-producing industries	**2.72**	**2.78**	**2.67**
Wholesale trade	2.75	3.77	1.75
Retail trade	2.88	5.09	0.73
Transportation and warehousing	3.80	2.91	4.69
Information and cultural industries	2.40	3.93	0.89
Finance and Insurance and Holding Companies	0.69	5.42	-3.84
Real estate and rental and leasing	-0.16	0.75	-1.06
Professional, scientific and technical services	6.74	10.82	2.82
ASWMRS	7.26	7.13	7.39
Arts, entertainment and recreation	3.74	4.48	3.01
Accommodation and food services	2.54	1.63	3.47
Other private services	4.68	7.88	1.57
Service-producing industries	**2.55**	**3.57**	**1.54**
Business sector without mining and oil and gas	**1.79**	**1.95**	**1.63**

Source: The Stock and Consumption of Fixed Non-residential Capital Program, Statistics Canada (Table 36-10-0096-01).

Chart 25 shows that in Newfoundland and Labrador and Canada the net capital asset of engineering construction always had the largest shares of nominal net capital stock from 1997 to 2017. In 2017, engineering construction represented almost 70 per cent of nominal net capital stock in Newfoundland and Labrador's business sector (69.4 per cent) while it took just more than a half (53.1 per cent) in Canada's business sector. This predominance of engineering assets in Newfoundland and Labrador's business sector capital stock can easily be explained by the fact that a large part of the province's capital stock is in the mining and oil and gas extraction sector and the utilities sector, sectors very intensive in engineering capital. In fact, the share declined in 2011 to 60.0 per cent from 66.9 per cent in 1997, but then gradually climbed to 69.4 per cent in 2017.

Canada's capital stock, on the other hand, had a more "balanced" capital stock, though the share of engineering construction was rising more quickly than before since 2009. We can also observe that machinery and equipment in Canada demonstrated a declining trend since 2002. Share of this asset declined from 31.8 per cent in 2000 to 19.0 per cent in 2017. Shares from the other two types of capital stock were rather stable.

Chart 25: Nominal Net Capital Assets as a Share of Nominal Net Capital Stock (Fixed, Non-residential) in Newfoundland and Labrador and Canada, Business Sector, 1997 – 2017



Source: The Stock and Consumption of Fixed Non-residential Capital Program, Statistics Canada (Table 36-10-0096-01).

Table 29: Shares of Net Capital Stock by Sector, Newfoundland and Labrador and Canada, 1997, 2007 and 2016

	Newfoundland and Labrador			Canada			NL - Canada		
	1997	**2007**	**2017**	**1997**	**2007**	**2017**	**1997**	**2007**	**2017**
	(share of business sector nominal investment, per cent)						(percentage point)		
Business sector industries	**100**	**100**	**100**	**100**	**100**	**100**	**-**	**-**	**-**

Agriculture, forestry, fishing and hunting	2.28	1.85	0.68	4.70	3.11	2.72	-2.42	-1.26	-2.04
Mining and oil and gas extraction	56.51	63.57	56.01	19.75	31.65	37.32	36.75	31.92	18.69
Utilities	17.96	12.37	22.45	18.79	14.35	16.99	-0.83	-1.98	5.46
Construction	1.31	1.23	0.92	1.91	1.84	1.97	-0.60	-0.61	-1.05
Manufacturing	5.15	4.55	9.36	16.97	11.80	8.09	-11.81	-7.25	1.27
Goods-producing sector	**83.21**	**83.57**	**89.42**	**62.12**	**62.75**	**67.09**	**21.09**	**20.82**	**22.33**
Wholesale trade	0.78	0.62	0.40	1.85	1.84	1.67	-1.07	-1.22	-1.27
Retail trade	2.00	2.28	1.51	2.80	3.52	2.92	-0.80	-1.23	-1.41
Transportation and warehousing	4.92	4.53	3.93	9.34	9.09	11.34	-4.42	-4.56	-7.40
Information and cultural industries	3.26	2.96	1.02	5.09	4.39	3.59	-1.83	-1.43	-2.57
Finance and insurance and holding companies	1.67	1.96	0.46	5.09	5.22	2.50	-3.42	-3.26	-2.04
Real estate and rental and leasing	2.60	2.06	1.15	9.26	7.58	5.04	-6.66	-5.52	-3.89
Professional, scientific and technical	0.22	0.58	0.38	0.91	1.43	1.40	-0.69	-0.85	-1.02
ASWMRS	0.42	0.13	0.09	0.39	0.45	0.68	0.03	-0.32	-0.59
Arts, entertainment and recreation	0.18	0.22	0.44	0.74	0.87	0.91	-0.56	-0.65	-0.47

Accommodation and food services	0.52	0.63	0.70	1.56	1.52	1.64	-1.04	-0.89	-0.94
Other private services	0.22	0.46	0.49	0.84	1.35	1.21	-0.62	-0.89	-0.72
Service-producing sector	**16.79**	**16.43**	**10.58**	**37.88**	**37.25**	**32.91**	**-21.09**	**-20.82**	**-22.33**
Business sector without mining and oil and gas	**43.49**	**36.43**	**43.99**	**80.25**	**68.35**	**62.68**	**-36.75**	**-31.92**	**-18.69**

Source: The Stock and Consumption of Fixed Non-residential Capital Program, Statistics Canada (Table 36-10-0096-01).

Table 29 shows the sectoral composition of net capital stock in Newfoundland and Labrador and Canada. Throughout the 1997-2017 period, the mining and oil and gas extraction sector had the largest share of net capital stock in the province every year, with the share in each year exceeding 50 per cent. Utilities consistently took the second place every year in the period, fluctuating between 10 to 23 per cent.

iii. Capital Services

The capital stock can be seen as a repository of capital services,[35] which represent the actual input used in the production process. The difference between capital stock and capital services stems from the fact that not all types of capital assets provide services at the same rate. Short-lived assets, such as a car or a computer, must provide all their services in just a few years before they completely depreciate. Office buildings, on the other hand, provide their services over decades. Therefore, over a year, a dollar's worth of a car provides relatively more capital services than a dollar's worth of a building. Thus, capital services growth is driven by: 1) increases in the level of **capital stock**; and 2) shifts in the **capital composition** caused by more investment in assets that provide relatively more services per dollar of capital stock (i.e. short-lived assets).

Table 30: Capital Services Compound Annual Growth in Newfoundland and Labrador and Canada, Business Sector, 1997 – 2017

	Newfoundland and Labrador		
	1997-2017	**1997-2007**	**2007-2017**
	(compound annual growth rates, per cent)		
Business sector industries	**3.84**	**2.75**	**4.95**

[35] Capital services are obtained by chained-Fisher aggregation of capital stocks using the cost of capital to determine weights.

Agriculture, forestry, fishing and hunting	-1.76	-0.42	-3.08
Mining and oil and gas extraction	4.46	3.25	5.69
Utilities	5.65	-0.75	12.47
Construction	4.25	3.68	4.81
Manufacturing	1.94	2.58	1.30
Goods-producing Sector	**4.01**	**2.44**	**5.61**
Wholesale trade	2.50	1.31	3.70
Retail trade	3.38	3.75	3.00
Transportation and warehousing	4.11	2.63	5.62
Information and cultural industries	0.48	4.73	-3.59
FIRE	2.86	4.20	1.54
Professional, scientific and technical services	10.39	18.24	3.07
ASWMRS	-2.18	-8.26	4.32
Arts, entertainment and recreation	9.38	4.31	14.70
Accommodation and food services	6.50	4.63	8.40
Other private services	6.26	5.81	6.72
Service-producing Sector	**3.34**	**3.86**	**2.82**
Business sector without mining and oil and gas extraction	**3.02**	**2.90**	**3.15**
	Canada		
	1997-2017	**1997-2007**	**2007-2017**
	(compound annual growth rates, per cent)		
Business sector industries	**3.30**	**4.50**	**2.11**
Agriculture, forestry, fishing and hunting	0.93	0.42	1.43
Mining and oil and gas extraction	5.47	7.11	3.86
Utilities	2.50	1.21	3.80
Construction	4.43	5.21	3.65
Manufacturing	0.36	1.44	-0.71
Goods-producing Sector	**2.93**	**3.54**	**2.32**
Wholesale trade	3.83	5.12	2.56
Retail trade	3.21	5.38	1.08
Transportation and warehousing	4.33	4.23	4.42
Information and cultural industries	3.10	5.15	1.09
FIRE	2.71	5.14	0.32
Professional, scientific and technical services	9.25	12.98	5.65
ASWMRS	7.65	10.95	4.45
Arts, entertainment and recreation	5.17	7.42	2.97
Accommodation and food services	1.45	1.59	1.31
Other private services	3.66	5.87	1.50
Service-producing Sector	**3.64**	**5.39**	**1.92**
Business sector without mining and oil and gas extraction	**3.24**	**4.43**	**2.07**

Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Table 36-10-0208-01).

Table 30 shows that capital services in Newfoundland and Labrador's business sector grew at a compound annual rate of 3.8 per cent from 1997 to 2017 and that in Canada was 3.3 per cent. The higher growth of the province's capital services than the national average during the 1997-2017 period was due to the rise in capital services during the 2007-2017 sub-periods. In particular, the business sector growth in the province was higher than the national average by a factor of 2.3 (5.0 per cent per year versus 2.1 per cent per year) during the 2007-2017 sub-period. During the 2007-2017 sub-period, only 4 of 16 sub-sectors of the business sector in the province had lower capital services growth than the national average (agriculture, forestry, fishing and hunting; information and cultural industries; finance, insurance, real estate and rental and leasing; professional, scientific and technical services and administrative and support, waste management and remediation services).

Table 31: Industry Share of Capital Services, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2017

	Newfoundland and Labrador			Canada			NL - Canada		
	1997	2007	2017	1997	2007	2017	1997	2007	2017
	(share of Business sector nominal investment, per cent)								
Business sector industries	**100**	**100**	**100**	**100**	**100**	**100**	**-**	**-**	**-**
Agriculture, forestry, fishing and hunting	3.07	2.24	1.01	3.80	2.55	2.39	-0.73	-0.31	-1.37
Mining and oil and gas extraction	68.51	71.92	77.19	13.48	17.23	20.42	55.03	54.69	56.77
Utilities	3.26	2.31	4.61	5.88	4.27	5.03	-2.61	-1.96	-0.42
Construction	0.81	0.89	0.88	1.60	1.71	1.99	-0.79	-0.83	-1.11
Manufacturing	0.83	0.82	0.57	20.90	15.52	11.72	-20.07	-14.70	-11.15
Goods-producing sector	**80.26**	**77.93**	**82.97**	**44.74**	**40.77**	**41.61**	**35.52**	**37.15**	**41.36**
Wholesale trade	1.99	1.73	1.54	6.99	7.42	7.74	-5.00	-5.68	-6.21
Retail trade	2.56	2.82	2.34	4.30	4.67	4.22	-1.74	-1.85	-1.88
Transportation and warehousing	4.71	4.65	4.96	10.60	10.33	12.92	-5.89	-5.67	-7.96
Information and cultural industries	2.99	3.62	1.55	6.02	6.41	5.79	-3.03	-2.79	-4.24
FIRE	6.02	6.92	4.98	22.60	24.03	20.13	-16.59	-17.11	-15.16
Professional, scientific and technical Services	0.20	0.81	0.68	0.80	1.74	2.45	-0.60	-0.93	-1.77
ASWMRS	0.48	0.15	0.14	0.62	1.12	1.41	-0.14	-0.97	-1.26
Arts, entertainment and recreation	0.09	0.11	0.27	0.44	0.58	0.63	-0.34	-0.47	-0.36
Accommodation and food services	0.53	0.64	0.88	1.16	0.87	0.80	-0.62	-0.23	0.08
Other private services	0.44	0.59	0.70	2.03	2.31	2.17	-1.59	-1.72	-1.48
Service-producing sector	**19.81**	**22.06**	**17.98**	**54.58**	**59.39**	**58.27**	**-34.76**	**-37.33**	**-40.29**
Business sector without mining and oil and gas extraction	**27.78**	**28.20**	**23.72**	**79.99**	**79.45**	**79.09**	**-52.21**	**-51.25**	**-55.38**

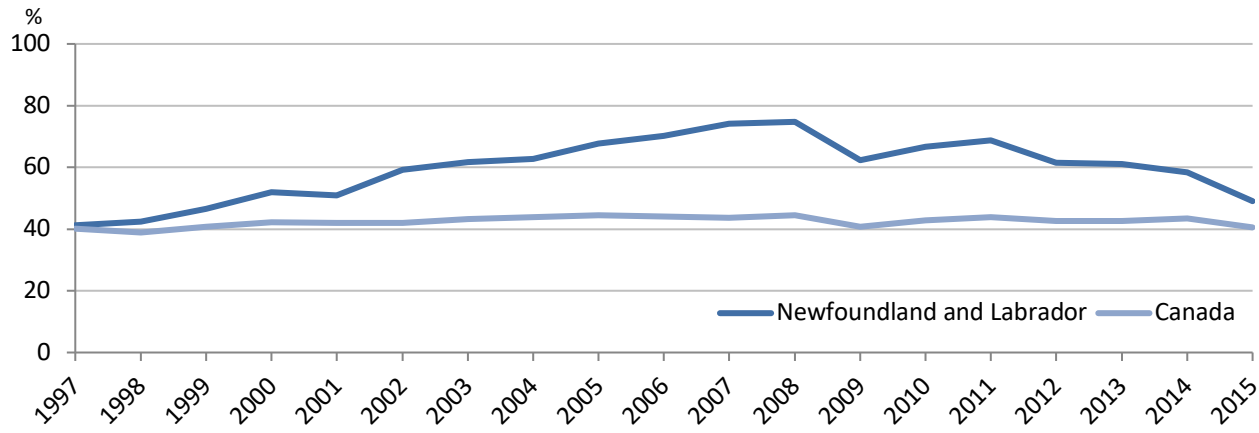
Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

In 2017, the capital services from the mining and oil and gas extraction sector represented 82.5 per cent of Newfoundland and Labrador's capital service (Table 31). In Canada, this sector also had the highest share of capital services at 28.8 per cent.

iv. Capital Compensation

Capital compensation is the share of nominal GDP that goes to capital.[36] During the 1997-2015 period, the share of capital compensation in Newfoundland and Labrador's business sector nominal GDP saw a large increase from 44.4 per cent in 1997 to 49.1 per cent in 2017 (Chart 26), with the peak of 74.9 per cent in 2008. Despite the fluctuation of Newfoundland and Labrador's capital compensation after 2008, Canada's capital compensation has been quite stable throughout the 1997-2015 period (ranging from the lowest 38.2 per cent in 1998 to the highest 44.3 per cent in 2005). Newfoundland and Labrador's biggest sector in terms of nominal output, mining and oil and gas extraction industries, experienced an abrupt increase in its capital compensation share of output during the 1997-2007 period (from 51.3 per cent in 1997 to 96.4 per cent in 2007) (Chart 27). Since then, capital compensation of the sector has declined from 96.4 per cent in 2008 to 81.6 per cent in 2015). The reduction in capital compensation as a share of nominal GDP was due to reduced profit during the financial crisis and an increase in labour compensation after 2012.

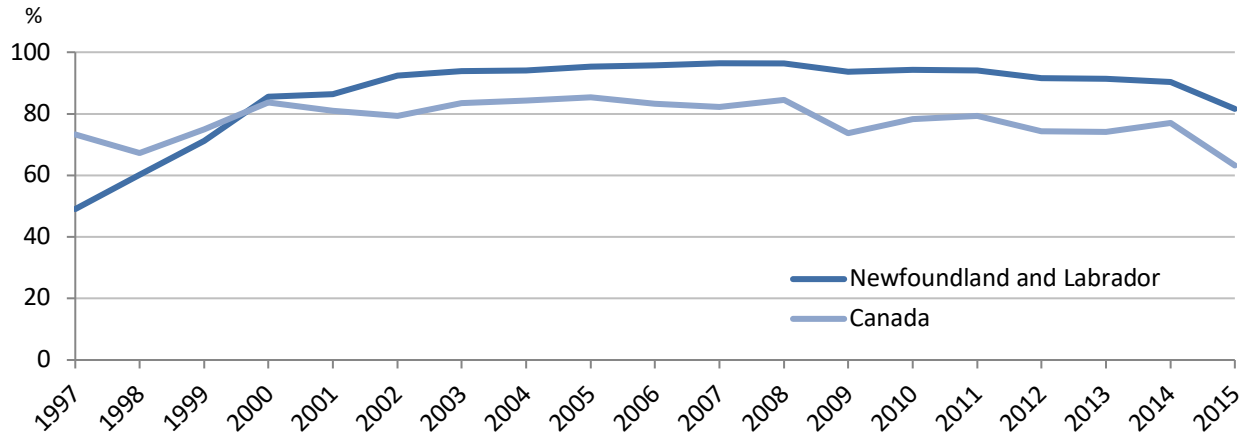
Chart 26: Capital Compensation as a Share of Nominal GDP, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2015



Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

[36] We calculate capital compensation by subtracting nominal GDP from labour compensation. Because the nominal GDP time series at the provincial level from Statistics Canada spans from 1997 to 2015, capital compensation also spans from 1997 to 2015.

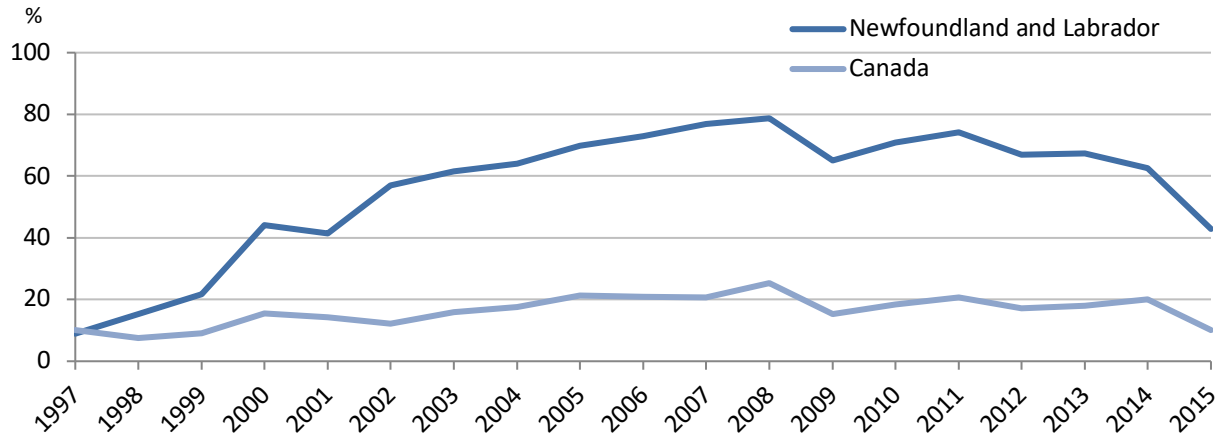
Chart 27: Mining and Oil and Gas Extraction Capital Compensation as a Share of This Sector's Nominal GDP, Newfoundland and Labrador and Canada, 1997 – 2015



Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

The province's mining and oil and gas extraction share of the business sector capital compensation had higher growth than Canada from 1998 to 2015 because of the predominance of this capital-intensive sector in the province's economy (Chart 28). In particular, difference between the shares of the province and that of Canada diverged from 1997 to 2007 when the province's oil production was rising. After reaching the peak oil production in 2008 (78.7 per cent), the share of the province declined to 42.9 per cent in 2015.

Chart 28: Mining and Oil and Gas Extraction Capital Compensation as a Share of Business Sector Capital Compensation, Newfoundland and Labrador and Canada, 1997 – 2015



Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

D. Mining and Oil and Gas Extraction in Newfoundland and Labrador

This section summarizes the development of the mining and oil and gas extraction sector in Newfoundland and Labrador since the beginning of oil production in the province in 1997. It first

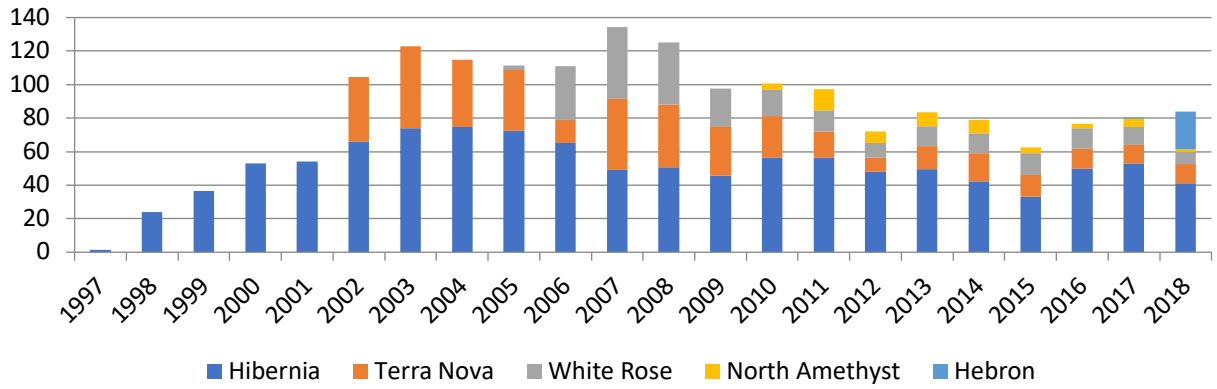
describes the development of oil production in the province, and then highlights the role of the mining sector in the province.

i. The Oil Boom in Newfoundland and Labrador

Since oil first flowed at Hibernia in 1997, Newfoundland and Labrador's economy has changed completely. The mining and oil and gas extraction sector contributed 60.5 per cent (2.0 percentage points of 3.2 percentage points) of the business sector real GDP average annual growth during the 1997-2018 period and 26.9 per cent (1.1 percentage points of 4.0 percentage points) of the business sector nominal GDP average annual growth during the 1997-2015 period (Table 2 and Table 8).

Newfoundland and Labrador now has five off-shore oil fields (parentheses contain the start year of offshore oil production): (1) Hibernia (1997), (2) Terra Nova (2002), (3) White Rose (2005), (4) North Amethyst (2010) and (5) Hebron (2017). Hibernia is the province's largest off-shore oil project in terms of the estimated recoverable reserves. Specifically, Hibernia contains estimated recoverable reserves of 1.4 billion barrels of oil and 1.9 billion of standard cubic feet of gas, followed by Hebron, Terra Nova, North Amethyst and White Rose respectively.

Chart 29: Breakdown of Offshore Oil Production by Oil Field, Million Barrels, Newfoundland and Labrador, 1997 – 2018



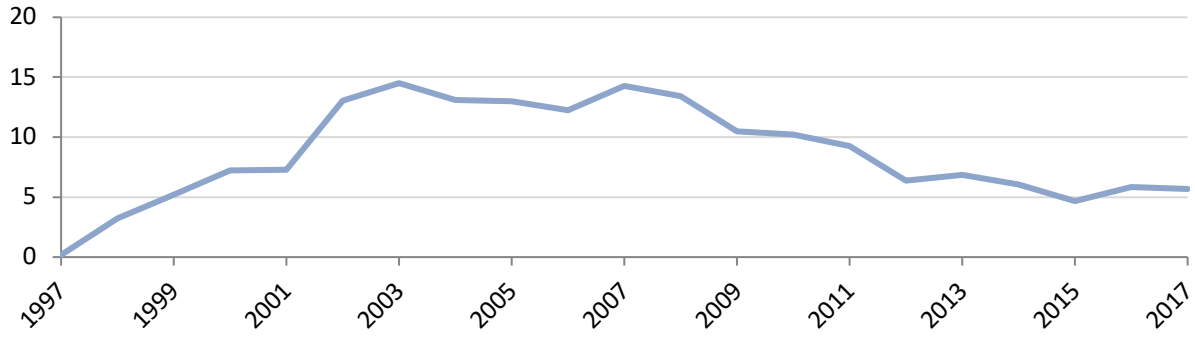
Source: Offshore Petroleum Broad, Newfoundland and Labrador.

Oil production in Newfoundland and Labrador began with an upsurge that turned into a downward trend since the 2007 peak (Chart 29).[37] The annual growth of the mining and oil and gas extraction real GDP and the annual growth in the province's oil production had a very strong

[37] Specifically, the Pearson correlation coefficient between the annual growth of the mining and oil and gas extraction real GDP and the annual growth in the province's oil production (in barrel) from 1999 to 2017 is 0.98, which signifies a very strong positive linear relationship.

positive relationship. The province's oil production as a share of Canada followed the same trend (Chart 30).

Chart 30: Oil Production (in Barrels) in Newfoundland and Labrador as a Share of Canada's, 1997 – 2017, Per Cent

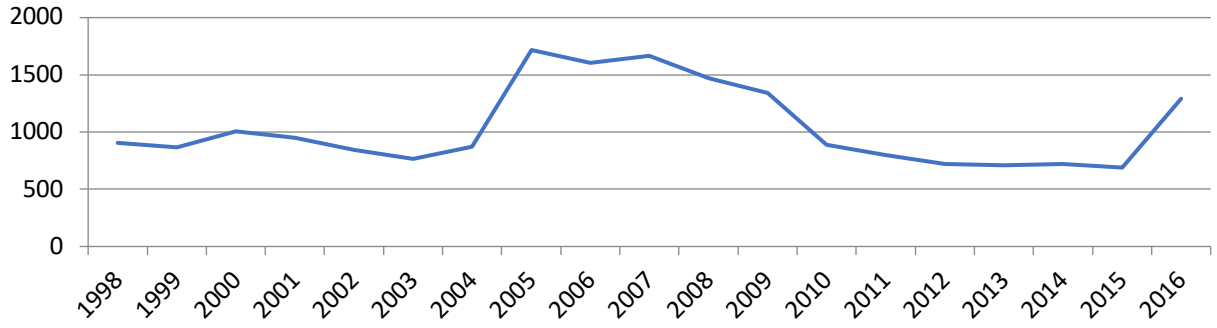


Source: CSLS calculations based on the Crude Oil and Natural Gas (MCONG), Statistics Canada.

The province's depletion of the established oil reserves and changes in the oil price and accounted for the downward trend in the province's oil production. First, the production declined because of the depletion of the province's established crude oil reserves. Specifically, the closing stock dropped from 1,665.5 million barrels in 2007 to 689.4 million barrels in 2015 (Chart 31).[38] On the other hand, the oil price fell significantly from US$111.26 per barrel in 2011 to US$54.12 per barrel in 2017 (Chart 32). These two factors together caused the province's reduction in oil production. Indeed, given the falling oil price and a fixed amount of lifetime oil reserves in the province, it is more profitable for the province, in the long run, to lower the oil production at the moment and delay the production until the oil price would become higher. The depletion of the established oil reserves from 2005 to 2015 further reduced the province's oil production[39] to allow for a higher volume of more profitable production in the future.

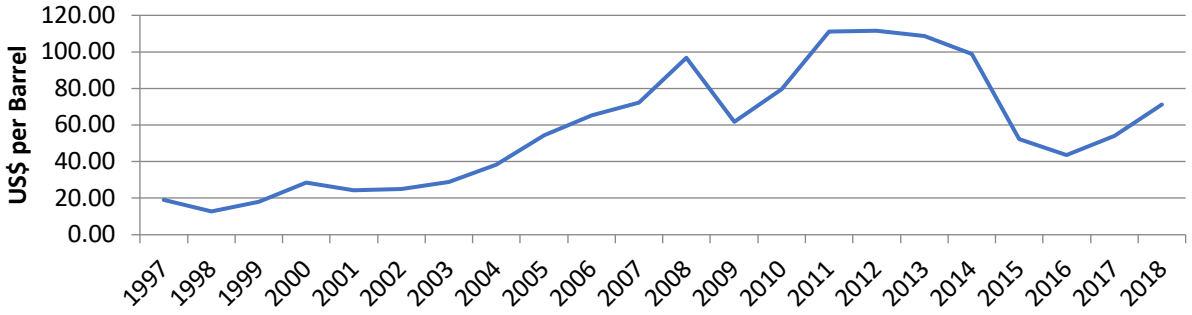
Chart 31: Closing Stock of the Established Crude Oil Reserves, Newfoundland and Labrador, 1998-2016 (Million Barrels)

[38] The upsurge of the province's established crude oil closing stock from 2004 to 2005 and from 2015 to 2016 was due to the beginning of the production of the oil reserves in White Rose and Hebron respectively.
[39] If Newfoundland and Labrador produce crude oil at the 2016 level (80.6 million barrels), it would take 16 years (1292.6 million barrels / 80.6 million barrels per year) for the province to exhaust its established crude oil reserves.



Source: CSLS calculations based on the Canadian System of Environmental and Resource Accounts - Natural Resource Asset Accounts, Statistics Canada (Table 38-10-0007-01).

Chart 32: Brent Crude Oil Prices, Annual Average U.S. Dollars per Barrel, 1997 – 2018



Source: U.S. Energy Information Administration.

Chart 33 shows the predominant mining and oil and gas extraction shares of the province's exports from 1997 to 2015.[40] From 1997 to 2015, nominal exports of mining and oil and gas extraction related products as a share of nominal exports in the province demonstrated a rising trend from 17.5 per cent in 1997, peaked at 66.3 per cent in 2011, to 46.3 per cent in 2015.

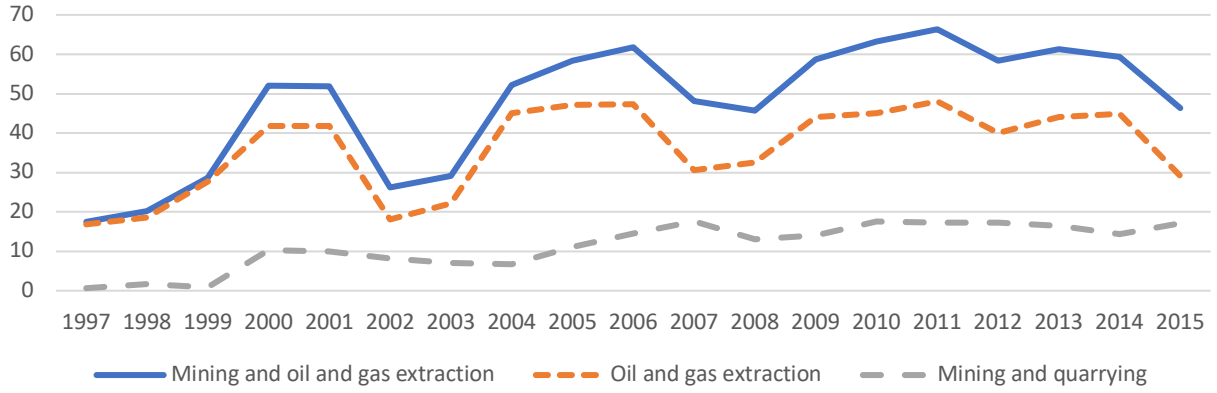
[40] Mining and oil and gas nominal exports are calculated from the sum of nominal international and interprovincial exports of this sector's related products. Nominal exports of these products are from two Statistics Canada tables (Tables 12-10-0086-01 and 12-10-0088-01). The former table ends in 2008 while the latter table spans from 2007 to 2015. Therefore, we use the former table for data from 1997 to 2006 and the latter for data from 2007 to 2015.

From 1997 to 2006, mining and oil and gas extraction consists of mineral fuels, petroleum and coal products, metal ores and concentrates, non-metallic minerals, services incidental to mining, primary metal products, fabricated metal products and non-metallic mineral products. Oil and gas extraction is comprised of the first two products. Mining and quarrying contains mining and oil and gas products other than mineral fuels and services incidental to mining.

From 2007 to 2015, mining and oil and gas extraction consists of mineral fuels, metal ores and concentrates, non-metallic minerals, mineral support services, mineral and oil and gas exploration, non-metallic mineral products, primary metallic products and fabricated metallic products. Oil and gas extraction is comprised of mineral fuels while mining and quarrying contains mining and oil and gas extraction products other than mineral support services and mineral and oil and gas exploration.

Throughout the 1997-2015 period, oil and gas extraction shares were always higher than mining and quarrying.

Chart 33: Nominal Exports of Mining and Oil and Gas Extraction Products as a Share of Total Economy Nominal Exports, Newfoundland and Labrador, 1997-2015



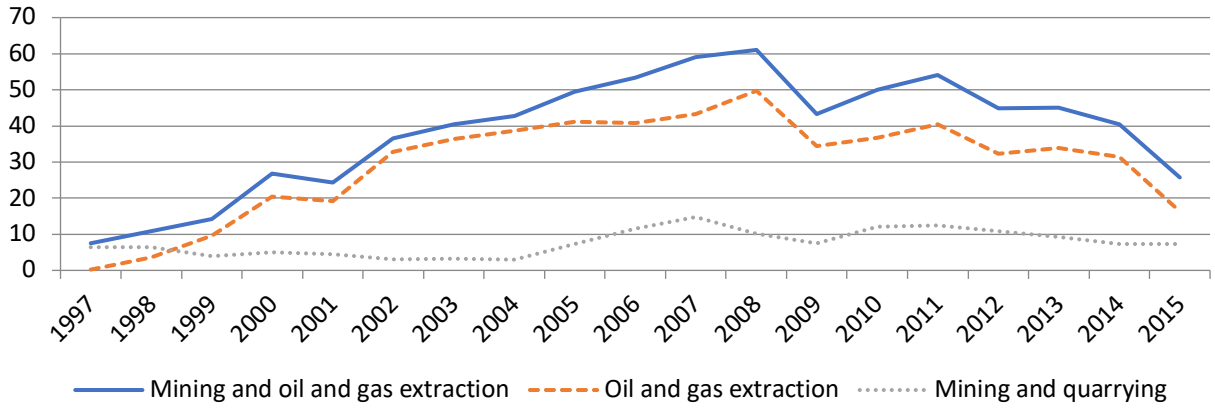
Source: CSLS calculations based on the Supply, Use and Input-output Tables from Statistics Canada (Tables 12-10-0086-01 and 12-10-0088-01) and the Provincial and Territorial Gross Domestic Product by Income and by Expenditure Accounts of Statistics Canada (Table 36-10-0222-01)..

ii. Role of Mining and Quarrying in Newfoundland and Labrador

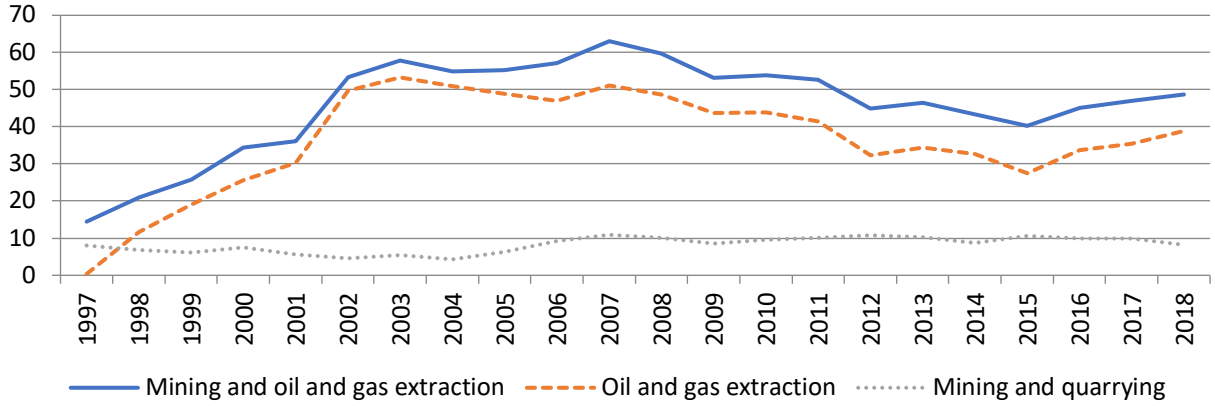
In this report, we refer at multiple occasions to the growth of the mining and oil and gas extraction sector as the main driver of Newfoundland and Labrador's economy. Most of the time, we assume that this extensive growth is from the increase in oil production. However, it is also important to acknowledge the importance of growth in the mining sector since 2004 (Chart 34). Specifically, after 2007, the mining and quarrying sector has accounted for about 10 per cent of the province's business sector nominal GDP.

Chart 34: Mining and Quarrying Nominal GDP and Oil and Gas Extraction Nominal GDP and Real GDP as a Per Cent of the Business Sector, Newfoundland and Labrador, 1997-2015 and 1997 – 2018

Panel A: Nominal GDP (1997-2015)



Panel B: Real GDP (1997-2018)



Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Table 36-10-0480-01).

III. Productivity in Newfoundland and Labrador

This part of the report provides a detailed examination of Newfoundland and Labrador's productivity performance (both in terms of growth rates and levels) during the 1997-2018 period, comparing it to Canada's performance. We first look at trends and levels of labour productivity. We also quantify the contribution from capital intensity, labour quality and multifactor productivity to Newfoundland and Labrador's business sector labour productivity growth, repeating that analysis for each two-digit NAICS sector. Finally, we examine the trends and levels of the business sector capital productivity and multifactor productivity in the province.

During the 1997-2007 sub-period, Newfoundland and Labrador was the province that had the highest growth rates in all three productivity measures. However, during the 2007-2018 sub-period, the province ranked last in the growth rates of all three productivity measures. The decomposition of labour productivity growth by sector shows that the mining and oil and gas extraction sector contributed the most to the decline. This contribution from the sector was driven by the within-sector productivity decline, due to the decrease in oil production from 134.5 million barrels in 2007, the peak year for oil production, to 80.6 million barrels in 2018.

The decomposition of the labour productivity growth in Newfoundland and Labrador also finds that the business sector labour productivity slowdown between the 1998-2007 and the 2008-2017 sub-periods in the province was driven by the decline within the goods sector. The positive contribution from the service sector to the business sector labour productivity slowdown only partially offset the negative contribution from the goods sector.

From the perspective of the growth accounting approach, capital intensity and MFP are the two important factors affecting labour productivity growth in Newfoundland and Labrador and Canada throughout the 1997-2017 period, with a small influence from labour quality. At the business sector level, MFP was responsible for most of the labour productivity growth in the province while capital intensity accounts for the most in Canada during the 2007-2017 sub-period.

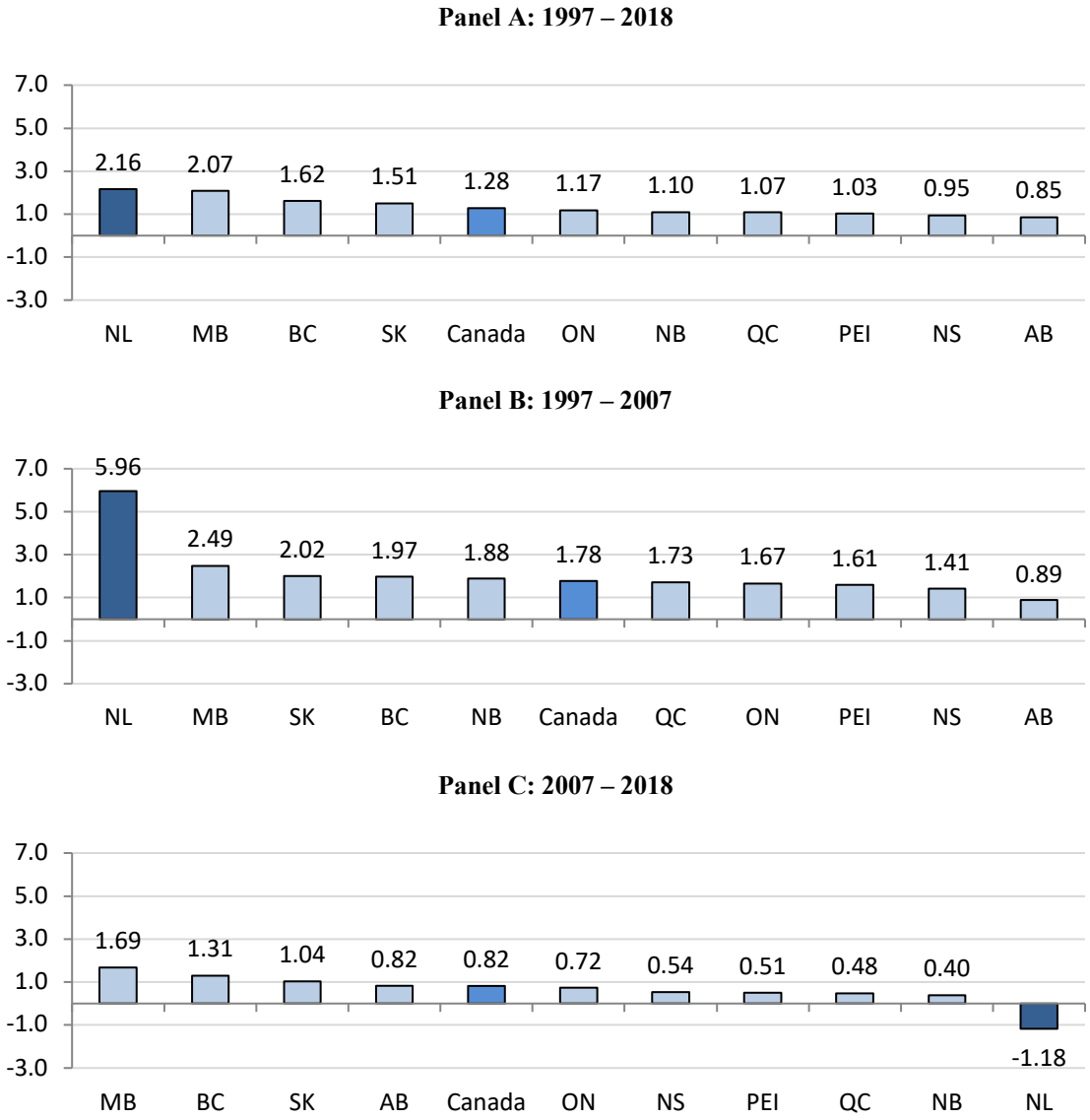
A. Labour Productivity

Labour productivity, defined here as real GDP (in chained 2012 dollars) per hour worked, increased at a rate of 2.2 per cent per year in Newfoundland and Labrador's business sector during the 1997-2018 period, above the 1.3 per cent national average (Chart 35). Compared to other provinces, Newfoundland and Labrador ranked the first in terms of compound annual average productivity growth in the 1997-2018 period.

The labour productivity growth in Newfoundland and Labrador during the 1997-2018 period reflected very divergent trends during the 1997-2007 and the 2007-2018 sub-periods.

Productivity growth was strong in the first sub-period (6.0 per cent per year), the best among all ten provinces, but negative during the second sub-period (-1.18 per cent per year), the worst provincial performance.

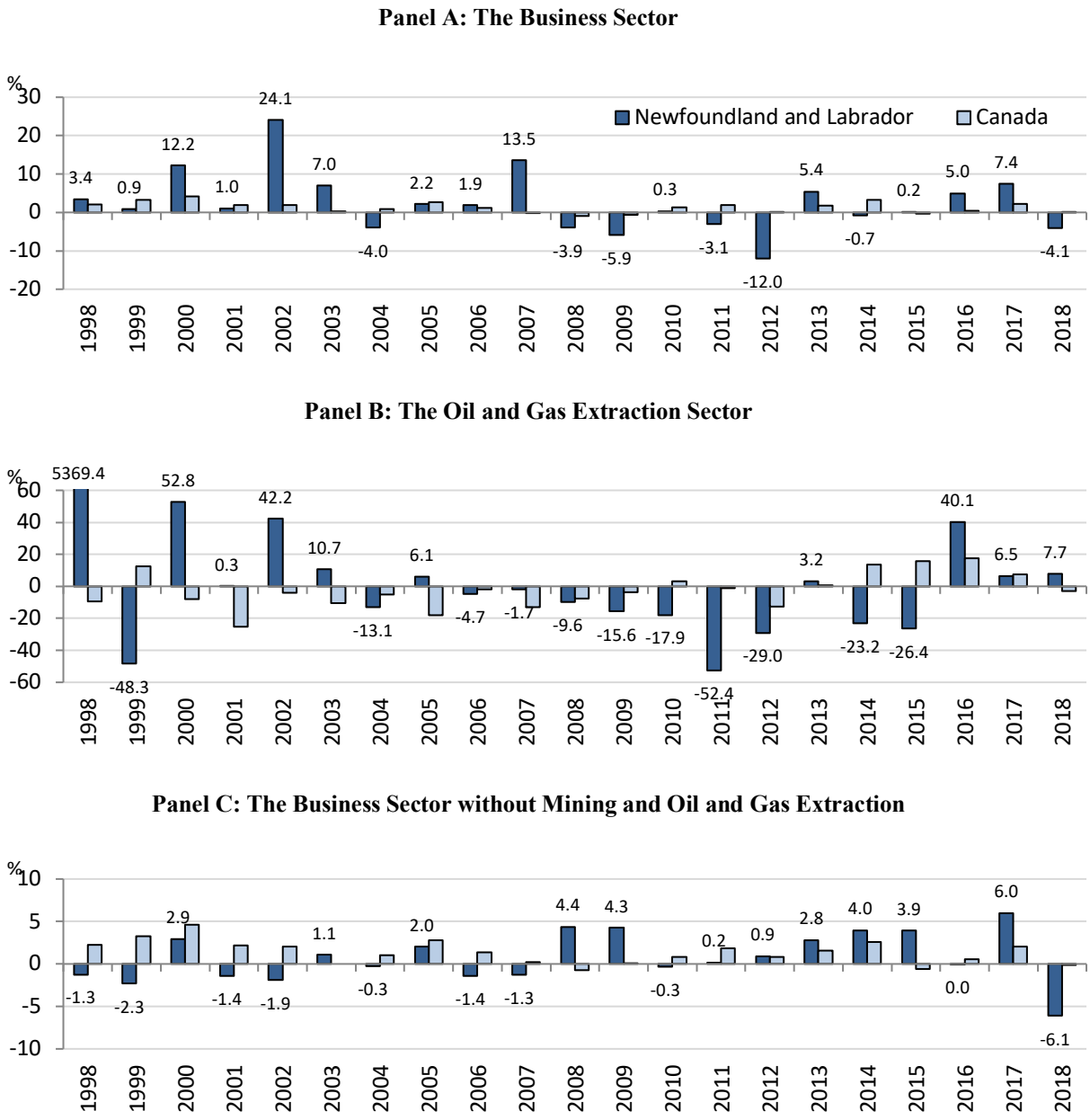
Chart 35: Labour Productivity Compound Annual Growth in Canada and the Provinces, Business Sector, 1997 - 2018



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

We observe a labour productivity slowdown during the 2007-2018 sub-period in Canada and in all provinces. However, the slowdown elsewhere in Canada was much less severe than the one experienced in Newfoundland and Labrador. For example, while labour productivity growth in Canada decreased from 1.8 per cent per year to 0.8 per cent per year (a reduction in 1.0 percentage points), growth in Newfoundland and Labrador dropped from 6.0 per cent per year to -1.18 per cent per year (7.14 percentage points per year).

Chart 36: Annual Labour Productivity Growth, Business Sector and Oil and Gas Extraction, Newfoundland and Labrador and Canada, 1998 – 2018



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Breaking down the province's labour productivity growth by year, Panel A of Chart 36 shows that Newfoundland and Labrador had exceptional performance in years 2000, 2002 and 2007. In 2000, the 12.2 per cent business sector labour productivity growth in the province was spurred by increased oil and iron ore production (Department of Finance, 2000). In 2002, the productivity growth was particularly impressive (24.1 per cent). This substantial increase was caused by the beginning of oil production in the Terra Nova oil field. There was also a marked productivity increase in 2007, due in large part to the return of Terra Nova to full capacity after a

six-month halt in operations in 2006 as well as increased production from the White Rose oil field. After 2007, the business sector labour productivity in Newfoundland and Labrador declined in 2008, 2009, 2011, 2012, 2014 and 2018.

Changes in labour productivity at the business sector level in Newfoundland and Labrador are largely driven by changes in labour productivity at the oil and gas sector given the importance of oil and gas in business sector GDP (Panel B of Chart 36). Indeed, the correlation coefficient between annual changes in the business sector labour productivity and in oil and gas extraction from 1999 to 2017[41] in the province was 0.67 (Table 32), which signifies a strong positive linear relationship. The correlation coefficient was even higher for mining and oil and gas extraction (0.82).

Table 32: Correlation between Annual Growth in Labour Productivity in the Business Sector and the Mining and Oil and Gas Extraction Sector, Newfoundland and Labrador, 1999-2018

		Annual Growth in Labour Productivity		
	Industry	**Business Sector**	**Mining and Oil and Gas Extraction**	**Oil and Gas Extraction**
Annual Growth in Labour Productivity	**Mining and Oil and Gas Extraction**	0.82	-	-
	Oil and gas extraction	0.67	0.64	-
Annual Growth in Exports	**Total Exports***	0.86	0.74	0.58
Annual Growth in Real GDP	**Business Sector**	0.86	0.68	0.37
	Mining and Oil and Gas Extraction	0.89	0.85	0.56
	Oil and gas extraction	0.76	0.85	0.41

Note *: Because the time series of total economy exports from Statistics Canada table 36-10-0222-01 spans only from 1997 to 2017, the calculation of the correlation between total exports and annual sectoral labour productivity growth only includes data from 1999 to 2017.
Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

Changes in labour productivity in the oil and gas extraction sector are in turn driven by changes in oil and gas production. In fact, direct labour input (hours worked) in oil and gas extraction is relatively stable over time, such that a one per cent increase in production translates

[41] We exclude the year of 1998 because the province's oil production began at the end of 1997. Therefore, the relationship in 1998 was not linear. As the Pearson correlation coefficient measures linear relationships, we exclude the year of 1998 from the calculation.

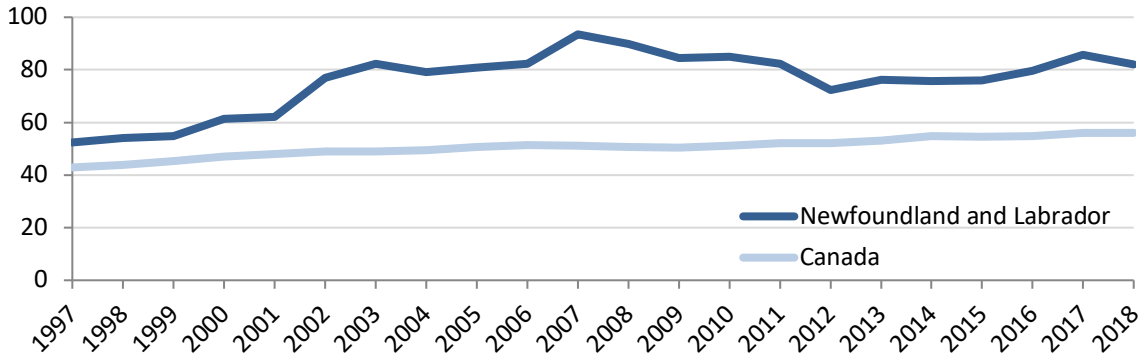
almost one to one into an increase in labour productivity. Also supporting this observation, the correlation coefficient between annual changes in real output in oil and gas extraction and the business sector labour productivity annual growth in Newfoundland and Labrador from 1999 to 2018 was 0.76. For mining and oil and gas extraction, it was 0.89.

Because a significant share of Newfoundland and Labrador's exports (both international and interprovincial) are from the mining and oil and gas extraction sector (Chart 33), annual growth in total exports and the annual growth in the business sector labour productivity in the province had a strong positive relationship. Specifically, the correlation coefficient from 1999 to 2017 was 0.86.

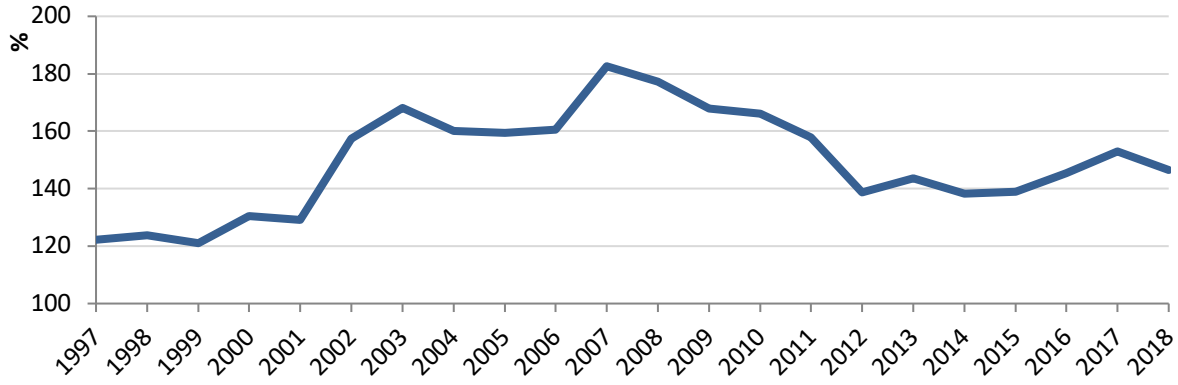
Given the importance of mining and oil and gas extraction in Newfoundland and Labrador's economy, the state of the mining and oil and gas extraction sector largely reflect the business sector productivity development.

Chart 37: Labour Productivity Level, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2018

Panel A: Labour Productivity Level (Chained 2012 Dollars per Hour Worked)



Panel B: Labour Productivity Level in Newfoundland and Labrador as a Per Cent of Canada

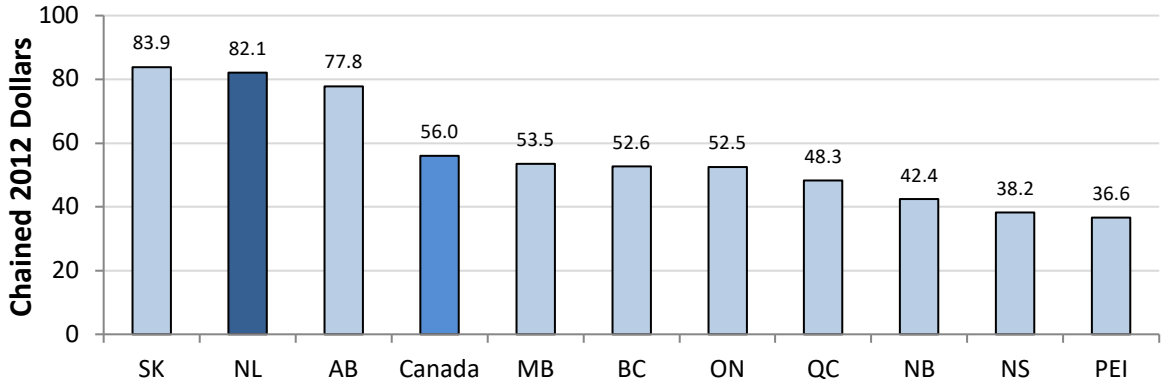


Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Table 36-10-0480-01).

Throughout the 1997-2018 period, the business sector labour productivity levels in Newfoundland and Labrador were higher than the national average (Panel A of Chart 37). The relative business sector labour productivity level between Newfoundland and Labrador and Canada followed the same trend as the province's business sector labour productivity level (Panel B of Chart 37). Interestingly, the trend in the relative labour productivity level is also the same as the trend in the province's oil production (Chart 29), with a rising trend from 1997 to 2007, the peak year of oil production, and a falling trending from 2007 to 2018. The similarity between the three trends (business sector labour productivity in the province, the relative labour productivity level between the province and the national average, and the province's oil production) reflects the considerable influence of the oil production on the province's business sector labour productivity during the 1997-2018 period.

Comparing the business sector labour productivity levels among provinces and the national average, we see that in 2018 Saskatchewan ranked the first ($83.9 chained 2012 dollars per hour) (Chart 38). Newfoundland and Labrador ranked second ($82.1 chained 2012 dollars per hour), followed by Alberta ($77.8 chained 2012 dollars per hour). These three provinces are the only provinces in Canada that had labour productivity levels higher than the national average ($56.0 chained 2012 dollars per hour). The business sector labour productivity level in Newfoundland and Labrador was higher than the national average by a factor of 1.5.

Chart 38: Labour Productivity Levels, Business Sector, Canada and the Provinces, 2018



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

With respect to labour productivity growth, both the goods and service sectors in the province had higher growth than Canada's during the 1997-2018 period (2.9 per cent per year versus 1.4 per cent and 1.6 per cent per year versus 1.4 per cent per year respectively). Among all subsectors of the business sector, 11 of 16 subsectors in Newfoundland and Labrador had higher labour productivity growth than their counterparts in Canada during the 1997-2018 period. During this period, in the province, mining and oil and gas extraction had the highest growth (6.1 per cent per year), followed by information and cultural industries (5.4 per cent per year) and wholesale trade (4.1 per cent per year).

Table 33: Labour Productivity Compound Annual Growth by Two-digit NAICS Sector, Business Sector, Newfoundland and Labrador and Canada, 1997-2018

	Newfoundland and Labrador		
	1997-2018	1997-2007	2007-2018
	(compound annual growth rates, per cent)		
Business sector industries	**2.16**	**5.96**	**-1.18**
Agriculture, forestry, fishing and hunting	3.26	5.26	1.46
Mining and oil and gas extraction	6.07	20.03	-5.21
Utilities	2.37	0.98	3.65
Construction	-0.30	-0.66	0.03
Manufacturing	2.95	0.49	5.23
Goods-producing Sector	**2.94**	**11.41**	**-4.20**
Wholesale trade	4.09	3.87	4.30
Retail trade	2.43	1.84	2.97
Transportation and warehousing	0.65	-0.21	1.44
Information and cultural industries	5.38	1.47	9.06
Finance and insurance, and holding companies	2.23	0.31	4.00
Real estate, rental and leasing	1.29	1.16	1.41
Professional, scientific and technical services	-0.48	-1.10	0.08
ASWMRS	0.98	1.08	0.88
Arts, entertainment and recreation	-1.24	-5.01	2.33
Accommodation and food services	1.91	1.46	2.33
Other private services	1.16	0.61	1.66
Service-producing sector	**1.64**	**0.79**	**2.42**
Business sector without mining and oil and gas	**0.73**	**-0.39**	**1.76**
	Canada		
	1997-2018	**1997-2007**	**2007-2018**
	(compound annual growth rates, per cent)		
Business sector industries	**1.29**	**1.80**	**0.82**
Agriculture, forestry, fishing and hunting	3.28	2.92	3.61
Mining and oil and gas extraction	-0.82	-2.65	0.87
Utilities	0.35	0.00	0.67
Construction	0.41	0.95	-0.09
Manufacturing	1.85	2.26	1.47
Goods-producing Sector	**1.36**	**1.63**	**1.12**
Wholesale trade	3.09	4.03	2.24
Retail trade	2.29	3.66	1.07
Transportation and warehousing	1.34	1.29	1.39
Information and cultural industries	1.84	3.25	0.58
Finance and insurance, and holding companies	1.92	2.40	1.48
Real estate, rental and leasing	0.23	-0.31	0.72
Professional, scientific and technical services	0.65	1.03	0.30
ASWMRS	-0.08	0.26	-0.39
Arts, entertainment and recreation	-1.09	-1.83	-0.42
Accommodation and food services	1.21	2.00	0.49
Other private services	0.60	1.17	0.09
Service-producing sector	**1.44**	**2.16**	**0.79**
Business sector without mining and oil and gas	**1.35**	**1.96**	**0.80**

Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01, 36-10-0211-01 and 36-10-0480-01).

During the 1997-2007 sub-period, while labour productivity in the goods sector in Newfoundland and Labrador grew much more quickly than in Canada (11.4 per cent per year vs. 1.6 per cent per year), labour productivity in the service sector grew slower than Canada's (0.8 per cent per year vs. 2.2 per cent per year). It is notable that less than one half of all subsectors (5 of 16 subsectors) in the province grew faster than the national level even though business sector productivity growth was over three times as much as the national average (6.0 per cent versus 1.8 per cent). In particular, output per hour in the mining and oil and gas extraction sector in the province grew at a 20.0 per cent average annual rate, compared to the 2.7 per cent per year decline in Canada.

During the 2007-2018 sub-period, labour productivity in three sub-sectors of the province's business sector grew slower than in their counterparts in Canada (agriculture, forestry, fishing and hunting, mining and oil and gas extraction and professional, scientific and technical services). In particular, the mining and oil and gas sector's labour productivity level declined at a rate of 5.2 per cent per year in the province but rose at a rate of 0.9 per cent per year in Canada. The decline in labour productivity was due to the fall in oil production. Specifically, oil production in the province dropped from 134.5 million barrels in 2007 to 84.0 million barrels in 2018.

Newfoundland and Labrador's labour productivity growth at the aggregate or business sector level is not indicative of the performance at the industry level. This observation reflects the importance of the oil and gas sector in the determination of the aggregate trend. In the 1997-2007 sub-period, labour productivity in the mining and oil and gas industry advanced at a 20.0 per cent average annual rate, resulting in the 6.0 per cent annual rise for business sector productivity. In contrast, output per hour in industries excluding the mining and oil and gas averaged only -0.4 per cent per year. The situation was reversed after 2007. Labour productivity in mining and oil and gas fell at a 5.2 per cent per year from 2007 to 2018, resulting in a 1.2 per cent annual decline in business sector productivity. In contrast, output per hour in industries excluding the mining and oil and gas advanced at 1.8 per cent per cent per year.

i. Sources of Labour Productivity Growth in Newfoundland and Labrador

To examine sources of the labour productivity growth in the business sector and the sub-sectors of the business sector in Newfoundland and Labrador and Canada, this subsection uses the standard growth accounting framework, which decomposes the growth in labour productivity into three broad factors: (1) improvement in the quality of labour, (2) capital deepening (i.e. increases in the amount of capital per labour unit, or more precisely, per hour worked) and (3) growth in multifactor productivity (MFP). MFP growth reflects labour productivity growth from factors other than human and physical capital. These factors include improvement in technology, capital utilization, increasing returns to scale and measurement errors of inputs and outputs.

Table 34: Contributions from Capital Intensity, Multifactor Productivity and Labour Quality to Labour Productivity Growth, Business Sector and Mining and Oil and Gas Extraction, Newfoundland and Labrador and Canada, 1997-2017, 1997 – 2007 and 2007 – 2017

	Newfoundland and Labrador				Canada			
	Business Sector							
	Labour Productivity	MFP	Capital Intensity	Labour Quality	Labour Productivity	MFP	Capital Intensity	Labour Quality
1997 – 2017	**2.47**	**0.56**	**1.74**	**0.15**	**1.37**	**0.20**	**0.89**	**0.27**
1997 – 2007	5.93	5.05	0.64	0.20	1.84	0.34	1.17	0.32
2007 – 2017	-0.89	-3.73	2.85	0.10	0.90	0.06	0.62	0.22
	Newfoundland and Labrador				**Canada**			
	Mining and Oil and Gas Extraction							
	Labour Productivity	MFP	Capital Intensity	Labour Quality	Labour Productivity	MFP	Capital Intensity	Labour Quality
1997 – 2017	**6.11**	**5.00**	**0.96**	**0.09**	**-0.90**	**-2.99**	**2.07**	**0.08**
1997 – 2007	19.99	20.59	-0.68	0.18	-2.64	-4.45	1.81	0.07
2007 – 2017	-6.17	-8.58	2.63	0.01	0.87	-1.52	2.33	0.09

Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

The decomposition of business sector labour productivity growth in Newfoundland and Labrador over the 1997-2017 period was drastically different in the 1997-2007 and the 2007-2017 sub-periods (Table 34). During the 1997-2007 sub-period, the province's business sector labour productivity growth was driven by the MFP growth due to the adoption of new technology for offshore oil drilling (5.1 percentage points of 5.9 percentage points). Labour productivity growth fuelled by MFP growth is usually regarded as sustainable growth because technological progress does not face decreasing returns. There are always new ideas to improve production. However, in Newfoundland and Labrador's case, the MFP growth was not sustainable because of the depletion of the province's oil fields operating at the time. Therefore, contributions from MFP to the business sector labour productivity growth turned negative during the 2007-2017 sub-period.

As we discuss in section II, Newfoundland and Labrador's growth in capital investment during the 2007-2017 sub-period was particularly high (11.1 per cent per year in the province versus -0.4 per cent per year in Canada). As a result, capital intensity made significant contribution to the province's business sector productivity growth during the 2007-2017 sub-period (2.9 percentage points of -0.9 percentage points). Unfortunately, labour productivity growth from this source is usually temporary because capital accumulation will eventually face decreasing returns. The productivity of capital stock decreases as capital per unit of labour increases.

The MFP-driven labour productivity growth during the 1997-2007 sub-period and the labour productivity growth fuelled by capital deepening during the 2007-2017 sub-period resulted in the capital deepening-driven business sector labour productivity growth in Newfoundland and Labrador. On the other hand, Canada's labour productivity was driven mainly by increases in capital intensity during the whole 1997-2017 period.

Because of the importance of the mining and oil and gas extraction sector in Newfoundland and Labrador's economy, the second panel of Table 34 shows sources of mining and oil and gas extraction labour productivity growth in the province and Canada. The compositions of the province's labour productivity growth in the mining and oil and gas extraction sector and the business sector during the 1997-2017 period and the 1997-2007 and 2007-2017 sub-periods demonstrated the same pattern, except that capital deepening made negative contributions to the mining and oil and gas extraction labour productivity growth during the 1997-2007 period (-0.7 percentage points).

Table 35 and Table 36 show sources of labour productivity growth in Newfoundland and Labrador and Canada by two-digit NAICS subsector of the business sector during the 1997-2007 and the 2007-2017 sub-periods. The province's goods sector, which was dominated by the mining and oil and gas extraction sector, had labour productivity growth driven by the MFP growth during the 1997-2007 sub-period and by capital deepening during the 2007-2017 period. However, the service sector labour productivity growth in the province was fuelled by capital deepening during the 1997-2007 and the 2007-2017 sub-periods. On the other hand, in Canada, labour productivity growth of the goods and the service sectors was driven mainly by capital deepening during the 1997-2007 and the 2007-2017 sub-periods.

The second part of Table 35 shows that the MFP of the province's service sector had the largest contribution to the increase in the service sector labour productivity growth rate (1.6 percentage points of 2.3 percentage points) between the 1997-2007 and the 2007-2017 sub-periods. This rise of the contribution from MFP growth is a good sign for the province's economy because, as discussed, labour productivity growth from MFP growth usually lasts longer than that from capital deepening.

Table 35: Contributions from Capital Intensity, Multifactor Productivity and Labour Quality to Labour Productivity Growth, Newfoundland and Labrador, 1997 – 2007 and 2007 – 2017

	Newfoundland and Labrador							
	1997-2007				2007-2017			
	Labour Productivity	MFP	Capital Intensity	Labour Quality	Labour Productivity	MFP	Capital Intensity	Labour Quality
Business sector	**5.93**	**5.05**	**0.64**	**0.20**	**-0.89**	**-3.73**	**2.85**	**0.10**
Agriculture, forestry, fishing and hunting	5.12	3.38	1.60	0.08	3.17	0.81	2.02	0.31
Mining and oil and gas extraction	19.99	20.59	-0.68	0.18	-6.17	-8.58	2.63	0.01
Utilities	0.99	2.12	-1.03	-0.08	3.98	-4.15	8.77	-0.26
Construction	-0.66	-0.98	0.51	-0.19	1.44	1.80	-0.42	0.06
Manufacturing	0.43	-0.28	0.01	0.69	5.77	3.98	1.45	0.27
Goods-producing sector	**11.36**	**9.60**	**1.37**	**0.24**	**-4.46**	**-6.21**	**1.78**	**0.09**
Wholesale trade	3.87	3.88	0.39	-0.40	5.13	3.07	2.37	-0.36
Retail trade	1.84	0.64	0.31	0.88	4.34	2.75	1.55	0.00
Transportation and warehousing	-0.19	-1.54	1.16	0.20	1.79	-1.13	2.73	0.22
Information and cultural industries	1.47	0.26	1.21	-0.01	10.77	6.98	3.47	0.07
FIRE	0.61	-1.36	2.02	-0.02	4.21	2.01	2.08	0.08
Professional, scientific and technical services	-1.10	-2.42	1.97	-0.60	0.33	-0.79	0.48	0.64
ASWMRS	0.70	4.17	-3.50	0.18	1.90	0.66	0.57	0.66
Arts, entertainment and recreation	-5.01	-4.45	-0.03	-0.56	3.28	-2.26	5.01	0.62
Accommodation and food services	1.46	0.62	0.61	0.22	3.08	1.09	2.00	-0.03
Other private services	0.61	-0.56	0.36	0.81	1.43	0.01	0.81	0.60
Service-producing sector	**0.77**	**-0.22**	**0.66**	**0.34**	**3.07**	**1.33**	**1.57**	**0.14**

	Newfoundland and Labrador			
	(Percentage Point Differences between 1997-2007 and 2007-2016)			
	Labour Productivity	MFP	Capital Intensity	Labour Quality
Business sector	**-6.82**	**-8.77**	**2.21**	**-0.11**
Agriculture, forestry, fishing and hunting	-1.95	-2.58	0.43	0.23
Mining and oil and gas extraction	-26.16	-29.17	3.30	-0.17
Utilities	3.00	-6.28	9.80	-0.18
Construction	2.10	2.78	-0.93	0.25
Manufacturing	5.35	4.26	1.43	-0.42
Goods-producing sector	**-15.82**	**-15.81**	**0.41**	**-0.15**
Wholesale trade	1.26	-0.81	1.98	0.04
Retail trade	2.50	2.11	1.24	-0.89
Transportation and warehousing	1.98	0.41	1.56	0.02
Information and cultural industries	9.30	6.72	2.25	0.08
FIRE	3.61	3.37	0.06	0.11
Professional, scientific and technical services	1.43	1.63	-1.48	1.24
ASWMRS	1.20	-3.51	4.07	0.48
Arts, entertainment and recreation	8.29	2.19	5.04	1.18
Accommodation and food services	1.62	0.47	1.39	-0.25
Other private services	0.82	0.57	0.45	-0.21
Service-producing sector	**2.30**	**1.55**	**0.92**	**-0.19**

Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

Table 36: Contributions from Capital Intensity, Multifactor Productivity and Labour Quality to Labour Productivity Growth, Canada, 1997 – 2007 and 2007 – 2017

	Canada							
	1997-2007				2007-2017			
	Labour Productiv-ity	MFP	Capital Inten-sity	Labour Quality	Labour Productivity	MFP	Capital Intensity	Labour Quality
Business sector	**1.84**	**0.34**	**1.17**	**0.32**	**0.90**	**0.06**	**0.62**	**0.22**
Agriculture, forestry, fishing and hunting	5.11	2.92	1.67	0.45	3.68	1.70	1.56	0.38
Mining and oil and gas extraction	-2.64	-4.45	1.81	0.07	0.87	-1.52	2.33	0.09
Utilities	-0.45	-0.39	-0.08	0.02	0.90	-1.47	2.34	0.06
Construction	1.26	1.00	0.19	0.07	0.14	-0.22	0.17	0.20
Manufacturing	2.25	1.16	0.74	0.33	1.48	0.96	0.37	0.15
Goods-producing sector	1.76	0.09	1.36	0.30	1.20	-0.13	1.17	0.16
Wholesale trade	3.69	2.01	1.32	0.33	2.60	1.20	1.25	0.14
Retail trade	3.35	2.08	0.96	0.28	1.16	0.81	0.08	0.27
Transportation and warehous-ing	1.37	-0.17	1.22	0.31	1.56	-0.64	2.06	0.15
Information and cultural industries	2.83	1.29	1.36	0.16	0.54	0.14	0.26	0.15
FIRE	1.63	-0.16	1.53	0.26	1.51	1.51	-0.18	0.17
Professional, scientific and technical services	1.32	0.11	0.94	0.26	0.38	-0.50	0.54	0.35
ASWMRS	0.76	-0.44	0.87	0.34	-0.04	-0.86	0.55	0.27
Arts, entertainment and recreation	-0.26	-1.56	1.26	0.05	-0.48	-1.22	0.53	0.22
Accommodation and food services	1.81	1.32	0.20	0.29	0.32	0.09	-0.10	0.33
Other private services	1.16	0.26	0.61	0.29	-0.18	-0.47	-0.01	0.30
Service-producing sector	2.13	0.58	1.18	0.36	0.89	0.24	0.36	0.28

	Canada			
	(Percentage Point Differences between 1997-2007 and 2007-2017)			
	Labour Productivity	MFP	Capital Intensity	Labour Quality
Business sector	**-0.94**	**-0.28**	**-0.55**	**-0.10**
Agriculture, forestry, fishing and hunting	-1.43	-1.23	-0.10	-0.07
Mining and oil and gas extraction	3.51	2.94	0.51	0.02
Utilities	1.35	-1.08	2.43	0.04
Construction	-1.12	-1.22	-0.02	0.12
Manufacturing	-0.76	-0.20	-0.37	-0.18
Goods-producing sector	**-0.56**	**-0.22**	**-0.20**	**-0.14**
Wholesale trade	-1.09	-0.81	-0.07	-0.19
Retail trade	-2.19	-1.27	-0.88	-0.01
Transportation and warehousing	0.19	-0.48	0.83	-0.16
Information and cultural industries	-2.29	-1.15	-1.10	-0.01
FIRE	-0.11	1.68	-1.70	-0.09
Professional, scientific and technical services	-0.94	-0.62	-0.40	0.09
ASWMRS	-0.81	-0.42	-0.31	-0.07
Arts, entertainment and recreation	-0.22	0.33	-0.73	0.17
Accommodation and food services	-1.49	-1.23	-0.30	0.04
Other private services	-1.35	-0.73	-0.62	0.01
Service-producing sector	**-1.25**	**-0.34**	**-0.81**	**-0.08**

Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

ii. Contribution to Labour Productivity by Sector

This section analyzes how much each sub-sector of the business sector in Newfoundland and Labrador contributed to the business sector labour productivity growth from 1998 to 2017. In particular, we decompose labour productivity growth in Newfoundland and Labrador using the framework developed by de Avillez (2012) and compare the contribution from each sector to labour productivity growth in Newfoundland and Labrador during the 1998-2018 period and the 1998-2007 and the 2008-2018 sub-periods. Section 2 in the Appendix contains a detailed discussion about the decomposition. Contribution from each sector can be broken down into the following three components.

- The **within-sector effect**, as the name implies, captures the change in labour productivity that happens within a sector, driven by increased capital intensity, increased labour quality, technical change, economies of scale, etc.

- The **reallocation level effect** indicates whether changes in the share of hours have favoured sectors with above (or below) average labour productivity *levels*. This effect is positive for an industry when the labour input share is growing in industries that have above average labour productivity levels or when the labour input share is falling in industries with below average labour productivity levels. It is negative when labour is moving into industries with below average productivity levels or leaving industries with above average productivity levels.

- The **reallocation growth effect** measures whether labour is shifting towards sectors with above (or below) average labour productivity *growth*. This effect is positive for an industry if the growth rate of labour productivity is above average and the labour input share of the industry is increasing or if the growth rate is below average and the labour share is decreasing. It is negative if the growth rate of labour productivity is above average and the labour input share is decreasing or if the rate of growth is below average and the labour input share is rising.

The sum of these three effects – the total effect – constitutes the percentage point contribution from each sector to the growth in Canada. The sum of total effects from each sector is the growth of the business sector.[42] According to CSLS calculations, Newfoundland and Labrador's mining and oil and gas extraction sector was responsible for 60.1 per cent (1.5 percentage points of 2.4 percentage points) of the province's business sector labour productivity average annual growth during the 1998-2018 period (Table 37). Contribution from this sector alone is larger than the double of the sum of all sub-sectors of the service sector (1.5 percentage points versus 0.7

[42] Growth rates and percentage point contributions to growth rates in this part of the report (section II.A.i) are average annual percentage changes.

percentage points). It was followed by manufacturing (0.23 percentage points); agriculture, forestry, fishing and hunting (0.21 percentage points); and retail trade (0.20 percentage points).

Table 37: Sectoral Contribution to Business Sector Labour Productivity Average Annual Growth Decomposed into Within-Sector, Reallocation Level and Reallocation Growth Effects, Newfoundland and Labrador, 1998 – 2018

	1998-2018			
	Total	**Within-Sector Effect**	**Reallocation Level Effect**	**Reallocation Growth Effect**
			(percentage point contribution)	
Business sector Industries	**2.43**	**1.74**	**1.39**	**-0.70**
Agriculture, forestry, fishing and hunting	0.21	0.08	0.13	0.00
Mining and oil and gas extraction	1.46	0.67	1.33	-0.55
Utilities	0.06	0.07	0.00	-0.01
Construction	-0.20	0.01	-0.22	0.00
Manufacturing	0.23	0.17	0.09	-0.02
Goods-producing industries	**1.76**	**1.00**	**1.34**	**-0.58**
Wholesale trade	0.15	0.12	0.04	-0.01
Retail trade	0.20	0.21	0.01	-0.03
Transportation and warehousing	0.02	0.01	0.01	0.00
Information and cultural industries	0.18	0.23	-0.01	-0.04
Finance and insurance, and holding companies	0.14	0.12	0.03	-0.01
Real estate, rental and leasing	0.04	0.05	0.00	-0.01
Professional, scientific and technical services	-0.04	-0.03	0.00	-0.01
Administrative and support, waste	-0.01	0.03	-0.03	-0.01
Arts, entertainment and recreation	-0.01	-0.01	0.00	-0.01
Accommodation and food services	0.06	0.05	0.02	-0.01
Other private services	-0.08	-0.05	-0.02	0.00
Service-producing industries	**0.67**	**0.74**	**0.05**	**-0.12**
Business sector without mining and oil and gas	**0.97**	**1.06**	**0.06**	**-0.15**
	1998-2007			
	Total	**Within-Sector Effect**	**Reallocation Level Effect**	**Reallocation Growth Effect**
			(percentage point contribution)	
Business sector Industries	**6.23**	**5.35**	**1.45**	**-0.57**
Agriculture, forestry, fishing and hunting	0.37	0.19	0.17	0.00
Mining and oil and gas extraction	5.25	4.28	1.41	-0.44
Utilities	0.05	0.05	0.00	0.00
Construction	-0.01	-0.02	0.02	-0.01
Manufacturing	0.16	0.13	0.02	0.00
Goods-producing industries	**5.82**	**4.64**	**1.62**	**-0.44**
Wholesale trade	0.19	0.14	0.05	0.00
Retail trade	0.05	0.22	-0.14	-0.04
Transportation and warehousing	0.00	-0.04	0.04	0.01
Information and cultural industries	0.19	0.21	0.01	-0.03
Finance and insurance, and holding companies	0.05	0.05	0.00	0.00
Real estate, rental and leasing	0.03	0.05	0.00	-0.01
Professional, scientific and technical services	-0.05	-0.04	0.01	-0.02
Administrative and support, waste	-0.07	0.05	-0.12	0.00
Arts, entertainment and recreation	-0.05	-0.02	-0.02	-0.01
Accommodation and food services	0.08	0.06	0.03	-0.01
Other private services	-0.01	0.05	-0.04	-0.01
Service-producing industries	**0.42**	**0.71**	**-0.17**	**-0.12**
Business sector without mining and oil and gas	**0.98**	**1.07**	**0.04**	**-0.13**

	2008-2018			
	Total	Within-Sector Effect	Reallocation Level Effect	Reallocation Growth Effect
	(percentage point contribution)			
Business sector Industries	**-1.03**	**-1.55**	**1.34**	**-0.82**
Agriculture, forestry, fishing and hunting	0.06	-0.03	0.09	0.00
Mining and oil and gas extraction	-1.99	-2.61	1.27	-0.65
Utilities	0.07	0.09	0.00	-0.02
Construction	-0.37	0.04	-0.43	0.02
Manufacturing	0.30	0.19	0.15	-0.04
Goods-producing industries	**-1.93**	**-2.31**	**1.08**	**-0.70**
Wholesale trade	0.12	0.10	0.03	-0.01
Retail trade	0.33	0.20	0.15	-0.02
Transportation and warehousing	0.04	0.06	-0.01	-0.01
Information and cultural industries	0.17	0.25	-0.03	-0.05
Finance and insurance, and holding companies	0.23	0.18	0.06	-0.01
Real estate, rental and leasing	0.05	0.05	0.01	-0.01
Professional, scientific and technical services	-0.03	-0.02	-0.01	0.00
Administrative and support, waste	0.06	0.01	0.05	-0.01
Arts, entertainment and recreation	0.02	0.01	0.02	0.00
Accommodation and food services	0.05	0.05	0.00	-0.01
Other private services	-0.14	-0.14	0.00	0.00
Service-producing industries	**0.89**	**0.76**	**0.26**	**-0.12**
Business sector without mining and oil and gas	**0.96**	**1.06**	**0.07**	**-0.17**
	Differences between 1998-2007 and 2007-2018			
	Total	Within-Sector Effect	Reallocation Level Effect	Reallocation Growth Effect
	(percentage point contribution)			
Business sector Industries	**-7.27**	**-6.90**	**-0.11**	**-0.26**
Agriculture, forestry, fishing and hunting	-0.31	-0.22	-0.08	-0.01
Mining and oil and gas extraction	-7.24	-6.89	-0.14	-0.22
Utilities	0.03	0.04	0.00	-0.01
Construction	-0.37	0.06	-0.45	0.03
Manufacturing	0.15	0.06	0.14	-0.05
Goods-producing industries	**-7.75**	**-6.95**	**-0.54**	**-0.26**
Wholesale trade	-0.07	-0.04	-0.02	0.00
Retail trade	0.29	-0.03	0.30	0.02
Transportation and warehousing	0.04	0.10	-0.05	-0.02
Information and cultural industries	-0.02	0.05	-0.05	-0.02
Finance and insurance, and holding companies	0.18	0.13	0.06	-0.02
Real estate, rental and leasing	0.01	0.00	0.01	0.00
Professional, scientific and technical services	0.01	0.03	-0.03	0.01
Administrative and support, waste	0.13	-0.03	0.17	0.00
Arts, entertainment and recreation	0.07	0.03	0.03	0.00
Accommodation and food services	-0.03	0.00	-0.03	0.00
Other private services	-0.13	-0.19	0.04	0.02
Service-producing industries	**0.48**	**0.05**	**0.43**	**0.00**
Business sector without mining and oil and gas	**-0.02**	**-0.01**	**0.03**	**-0.04**

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA) and the Gross Domestic Product by Industry - Pro-vincial and Territorial (Annual), Statistics Canada (Tables 36-10-0480-01 and 36-10-0400-01).

During the 1998-2018 period, the within-sector effect was the most important, and accounted for 1.7 percentage points of the 2.4-per-cent business sector labour productivity growth in the province. Moreover, as mentioned, the mining and oil and gas extraction sector contributed the most to the overall business sector labour productivity growth. Much of this sector's contribution arises from the reallocation level effect (1.33 percentage points of 1.46 percentage

points), with labour input shifting from less productive sectors to this more productive sector whose change in labour productivity level from 1998 to 2018 was the largest ($585.3 chained 2012 dollars per hour worked) among all sub-sectors of the business sector.

During the 1998-2007 sub-period, the within-sector growth contributed the most to the business sector labour productivity growth in Newfoundland and Labrador (85.9 per cent, or 5.4 percentage points of 6.2 percentage points). In particular, the mining and oil and gas extraction was the largest contributor among sub-sectors of the business sector, and alone contributed 5.3 percentage points, 4.3 percentage points of which are from this sector's within-sector effect. Excluding the mining and oil and gas extraction sector, other sub-sectors of the business sector altogether contributed 1.0 percentage points. Therefore, the business sector labour productivity growth in Newfoundland and Labrador during the 1998-2007 sub-period was driven by the mining and oil and gas extraction sector.

During the 2008-2018 sub-period, the reallocation level effect was the only positive contributor (1.3 percentage points of -1.0 percentage point) to the business sector labour productivity growth among the three components. Contributions from the within-sector effect and the reallocation growth effect were negative (-1.6 percentage points and -0.8 percentage points respectively). The negativity of the business sector's within-sector effect was due largely to the negative contribution from the mining and oil and gas extraction sector (-2.0 percentage points) because of the reduction in the oil production. All other sub-sectors of the business sector except construction (-0.4 percentage points), professional, scientific and technical services (-0.03 percentage points) and other private services (-0.14 percentage points) had positive within-sector effects.

The mining and oil and gas extraction sector and the construction sector in the province are closely intertwined during the 2008-2018 sub-period. The reduction in the oil production due to natural depletion during the sub-period caused the negative within-sector effect of the mining and oil and gas extraction sector in the province. To sustain the province's oil production, the province needs a new oil field. Consequently, the development of the new Hebron oil field increased construction's labour input. With a lower-than-average labour productivity in the construction sector, construction's reallocation level effect was hence negative (-0.4 percentage points).

Comparing the sectoral contributions to the province's business sector labour productivity growth during the 1998-2007 and the 2008-2018 sub-periods, the mining and oil and gas extraction sector was attributable to the decline in the business sector labour productivity growth in the province (-7.2 percentage points of -7.3 percentage points). Of the 7.3-percentage-point business sector labour productivity slowdown in the province, the within-sector effect from the mining and oil and gas extraction sector was responsible for 7.0 percentage points, signifying the

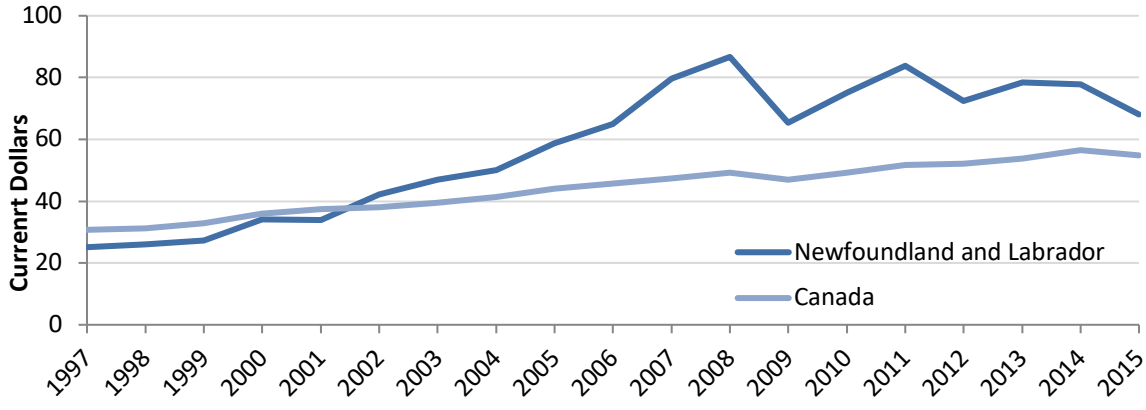
effects of the decline in the province's oil production on the province's business sector labour productivity growth.

While the province had lower business sector labour productivity growth rate during the 2008-2018 sub-period than the 1998-2007 sub-period because of the mining and oil and gas extraction sector, the service sector actually made larger contribution to the province's business sector labour productivity growth in the second sub-period (0.4 percentage points during the 1997-2007 sub-period versus 0.9 percentage points during the 2008-2018 sub-period). However, this contribution from the service sector was still too small to mitigate the effects from mining and oil and gas extraction on the province's business sector labour productivity growth.

iii. Nominal GDP Per Hour Worked

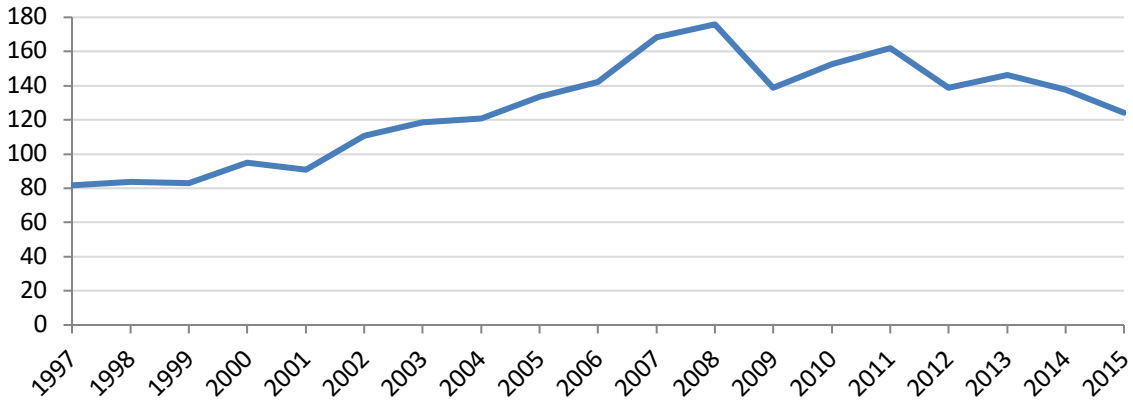
Since oil production in Newfoundland and Labrador began in 1997, nominal GDP per hour worked in the province has been rising, reaching its peak in 2008 (Chart 39). Indeed, in 2002, nominal GDP per hour worked surpassed that in Canada (Chart 40). Despite the sharp drop in the province's nominal GDP per hour worked in 2009 due to the oil price shock, the province's nominal GDP per hour worked was still higher than the national average.

Chart 39: Nominal GDP Per Hour Worked, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2015



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

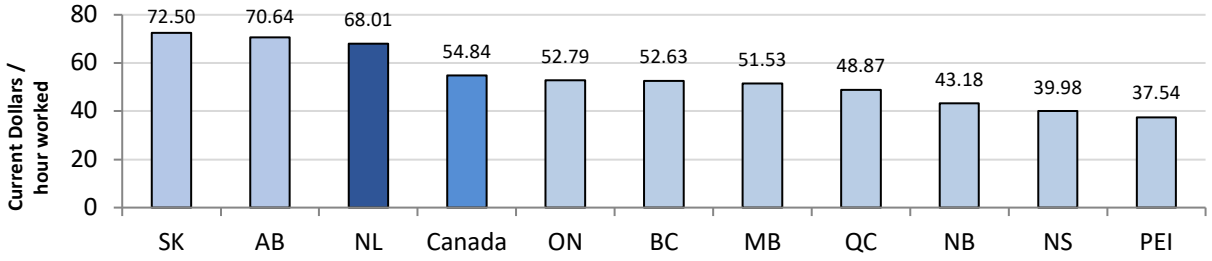
Chart 40: Nominal GDP Per Hour Worked in Newfoundland and Labrador as a Per Cent of Canada, Business Sector, 1997 – 2015



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

In comparison to other provinces, Newfoundland and Labrador ($68.01 per hour) is one of the three provinces that have a nominal GDP per hour worked (in current dollars per hour worked) higher than the national level ($54.84 per hour). Chart 41 shows that in 2015 Saskatchewan had the highest ($72.50 per hour), followed by Alberta ($70.64 per hour) and Newfoundland and Labrador. Prince Edward Island was the weakest performer, with an output of $37.54 per hour worked. It is notable that both these provinces have significant gas production.

Chart 41: Nominal GDP Per Hour Worked in Canada and the Provinces, Business Sector, 2015



Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

It is interesting to note that the overall ranking of the provinces does not change significantly when using labour productivity (real GDP in chained 2012 dollars per hour worked. Comparing the ranks of nominal output per hour worked and labour productivity levels, Saskatchewan, Alberta and Newfoundland and Labrador are still the only three provinces higher than the Canadian average, while Prince Edward Island was still the weakest performer. These differences in ranks reveal price level differences in the provinces.

Table 38: Nominal GDP Per Hour Worked in Newfoundland and Labrador and Canada, Business Sector, 1997, 2007 and 2015

	Newfoundland and Labrador			Canada			NL / Canada		
	1997	**2007**	**2015**	**1997**	**2007**	**2015**	**1997**	**2007**	**2015**
	(current dollar per hour worked)						(Per cent)		
Business sector industries	**25.11**	**79.58**	**68.01**	**30.73**	**47.30**	**54.84**	**81.7**	**168.2**	**124.0**
Agriculture, forestry, fishing and hunting	20.06	33.73	74.37	17.45	24.77	43.86	115.0	136.2	169.6
Mining and oil and gas extraction	59.59	1185.93	340.27	109.28	262.31	170.47	54.5	452.1	199.6
Utilities	71.98	100.67	123.78	149.22	178.80	218.54	48.2	56.3	56.6
Construction	21.42	33.29	56.13	26.44	41.77	50.18	81.0	79.7	111.9
Manufacturing	28.74	43.10	75.91	38.20	51.58	65.19	75.2	83.6	116.4
Goods-producing sector	**29.72**	**196.57**	**99.35**	**37.56**	**61.51**	**68.15**	**79.1**	**319.6**	**145.8**
Wholesale trade	23.21	37.26	59.70	30.27	48.58	62.21	76.7	76.7	96.0
Retail trade	14.66	22.84	35.84	15.93	26.82	30.36	92.0	85.2	118.0
Transportation and warehousing	25.93	34.86	48.84	30.04	40.86	51.97	86.3	85.3	94.0
Information and cultural industries	61.16	65.83	160.73	57.10	82.04	95.03	107.1	80.2	169.1
Finance and insurance, and holding companies	34.44	44.85	66.26	37.56	59.74	72.25	91.7	75.1	91.7
Real estate, rental and leasing	85.63	109.29	135.42	102.12	113.40	141.78	83.8	96.4	95.5
Professional, scientific and technical services	30.07	37.85	61.78	29.45	42.14	53.28	102.1	89.8	116.0
ASWMRS	14.68	24.69	37.57	19.84	29.10	35.85	74.0	84.9	104.8
Arts, entertainment and recreation	15.88	13.37	23.64	22.13	25.59	28.95	71.8	52.2	81.7
Accommodation and food services	9.98	15.96	24.36	12.42	19.83	23.34	80.4	80.5	104.4

Other private services	15.76	23.85	34.14	19.91	29.24	36.20	79.2	81.6	94.3
Service-producing sector	**22.81**	**31.03**	**47.14**	**26.99**	**40.58**	**49.05**	**84.5**	**76.5**	**96.1**
Business sector without mining oil and gas	23.98	33.86	53.20	29.54	42.96	52.36	81.2	78.8	101.6

Source: CSLS calculations based on the Canadian Productivity Accounts (CPA), Statistics Canada (Tables 36-10-0480-01).

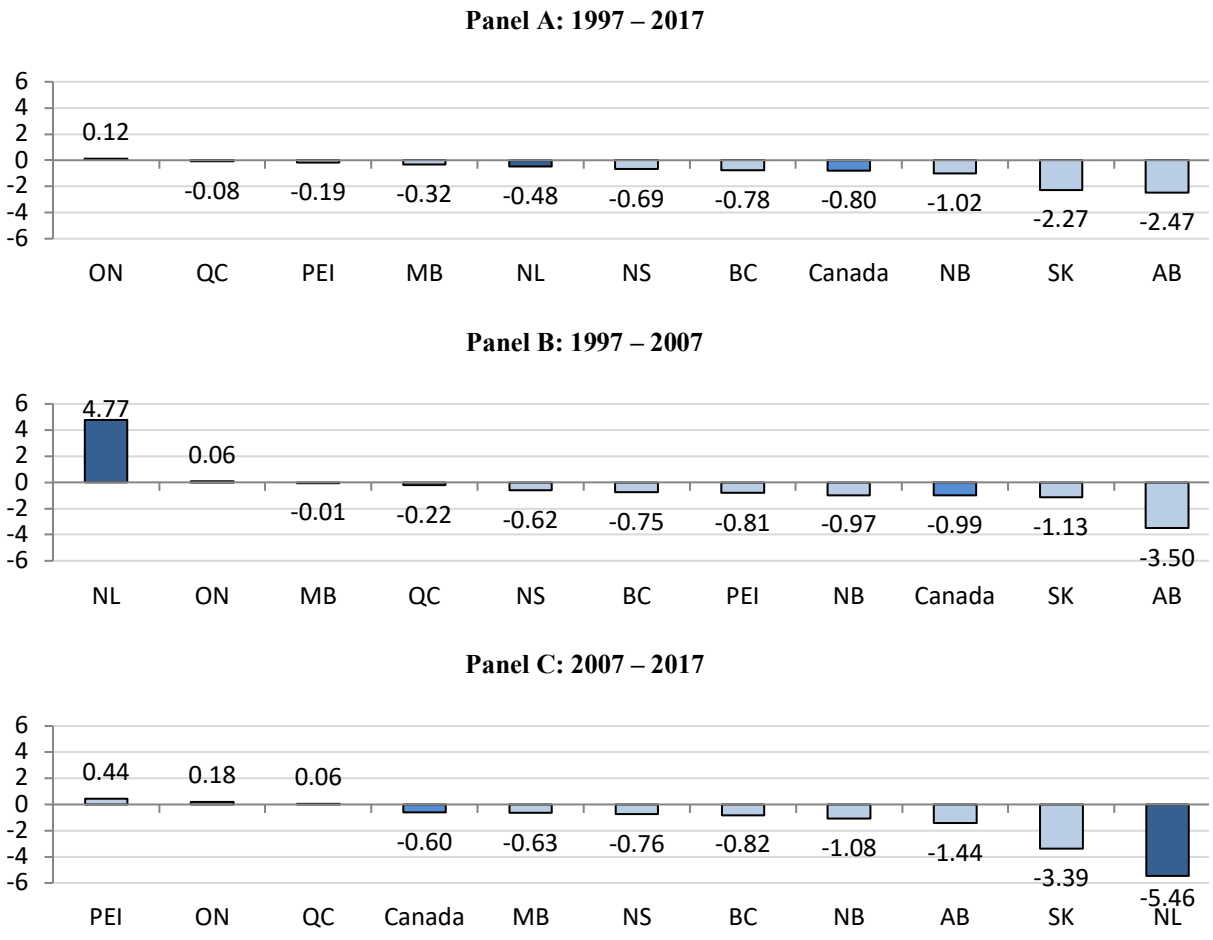
Compared with Canada, in 2015, 9 of 16 sectors (consisting of 4 of 5 sub-sectors of the goods-producing sector and 5 sub-sectors of the service sector) in Newfoundland and Labrador had higher nominal GDP per hour worked than Canada (Table 38). It is notable that only agriculture, forestry, fishing and hunting and information and cultural industries in the province had higher nominal GDP per hour worked than Canada in 1997; in 2007, only agriculture, forestry, fishing and hunting and mining and oil and gas extraction had higher nominal GDP per hour worked.

It is interesting to note that the relative nominal GDP per hour worked of the business sector without mining and oil and gas extraction between Newfoundland and Labrador and Canada rose significantly from 81.2 per cent in 1997 to 101.6 per cent in 2015 (Table 38). This rise in the nominal GDP per hour worked in the business sector without mining and oil and gas extraction signifies that although this sector played an important role in the province, the other sectors are actually improving relative to Canada.

B. Capital Productivity

Capital (services) productivity, defined as real GDP per unit of services, in Newfoundland and Labrador decreased by 0.5 per cent per year during the 1997-2017 period (Chart 42). During the 1997-2007 sub-period, capital productivity in the province grew at 4.8 per cent per year while that of all other provinces and Canada except Ontario (0.1 per cent per year) declined. However, during the 2007-2017 sub-period, Newfoundland and Labrador ranked the last in terms of capital productivity growth (-5.5 per cent per year). This pattern demonstrated by capital productivity growth is the same as labour productivity growth's pattern. Between the 1997-2007 and the 2007-2017 sub-periods, Newfoundland and Labrador experienced the greatest capital productivity slow-down among provinces in Canada (10.2 percentage points).[43]

Chart 42: Capital Services Productivity Compound Annual Growth in Canada and the Provinces, Business Sector, 1997 – 2017

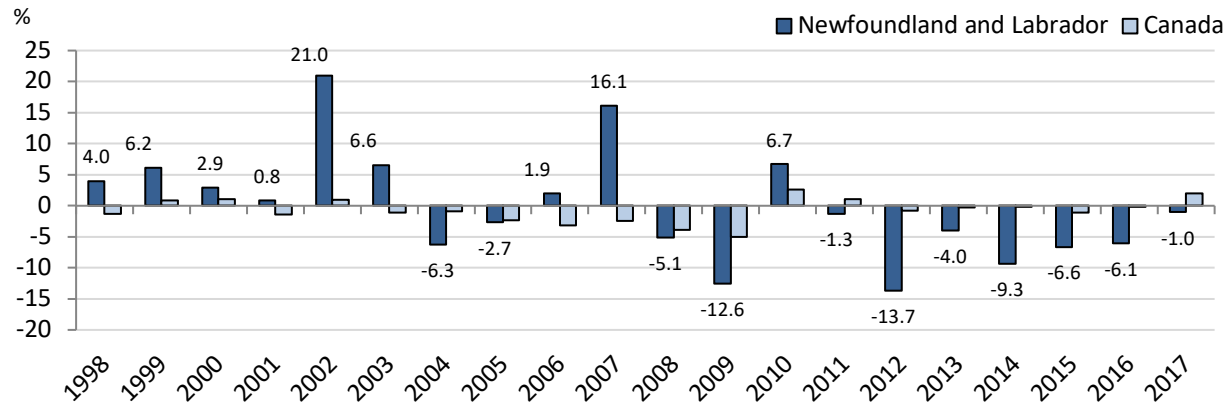


[43] The other five provinces that experienced capital productivity slowdown between the 1997-2007 and the 2007-2017 periods were Saskatchewan (2.3 percentage points), Manitoba (0.6 percentage points), New Brunswick (0.1 percentage points), Nova Scotia (0.1 percentage points) and British Columbia (0.1 percentage points).

Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

A closer look at Newfoundland and Labrador's annual capital productivity growth during the 1998-2017 period shows that the province experienced above-average growth from 1998-2007 sub-period except in 2001, 2004 and 2005, after which annual growth slowed down considerably except in 2010 (Chart 43). From 2014 to 2017, the business sector capital productivity in the province declined at a slower rate each year.

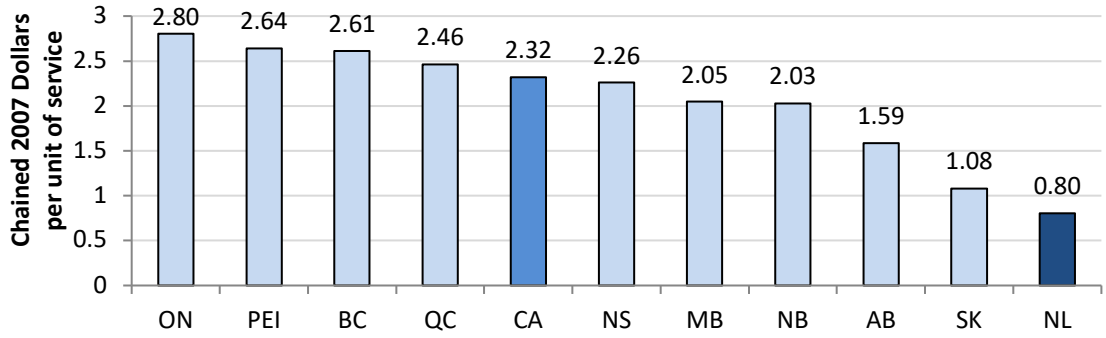
Chart 43: Capital Services Productivity Annual Growth, Business Sector, Newfoundland and Labrador and Canada, 1998 – 2017



Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

Chart 44 shows capital productivity levels in Canada and the provinces in 2016. Newfoundland and Labrador had the lowest the lowest capital productivity level, with $0.80 (chained 2007 dollars) of output being produced per unit of capital services, significantly less than the national average, $2.32 (chained 2007 dollars).This low capital productivity of Newfoundland and Labrador is particularly problematic because of the dominance of the capital-intensive mining and oil and gas extraction and utilities in the province.

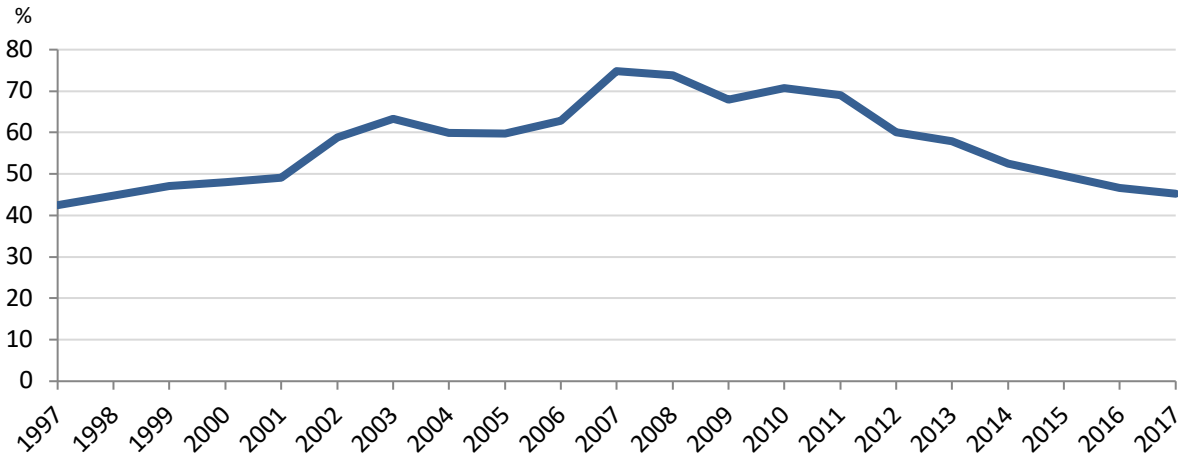
Chart 44: Capital Services Productivity Levels in Canada and the Provinces, Business Sector, 2016



Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

In addition, the gap between the Newfoundland and Labrador and Canada widened (Chart 45) after 2007. Capital productivity levels in Newfoundland and Labrador as a per cent of Canada was rising in general before 2007. After 2007, the province's capital productivity had a declining trend and decreased from 58.0 per cent in 2007 to 34.7 per cent in 2016 because the massive post-2007 investment in the new Hebron oil field and the Muskrat Falls project depressed the capital productivity level.

Chart 45: Capital Services Productivity Levels in Newfoundland and Labrador as a Per Cent of Canada's, Business Sector, 1997 – 2017



Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

Table 39 shows that 11 of 15 sub-sectors of the business sector in Newfoundland and Labrador had lower capital productivity than Canada in 2016. Among all subsectors, the case of mining and oil and gas extraction is interesting. The mining and oil and gas extraction capital productivity in the province grew from 11.6 per cent of the sector's capital productivity in Canada in 1997 to 99.1 per cent in 2007, and then fell to 49.4 per cent in 2016. The mining and oil and gas extraction capital productivity in 1997 was lower than the national average because a large amount of capital accumulated but the oil production only begun at the end of November 1997, leading to a low level of capital productivity in compared with Canada. As production increased, the mining and oil and gas extraction capital productivity level rose and became closer to the national average (Chart 45). The higher mining and oil and gas extraction capital productivity level in Newfoundland and Labrador as a percentage of Canada's in 2007 was also due to a decline in the capital productivity level in Canada from $1.89 (chained 2007 dollars) per unit of capital service in 1997 to $1.13 (chained 2007 dollars) per unit of capital service in 2007.

Table 39: Capital Services Productivity Levels in Newfoundland and Labrador and Canada by Two-digit NAICS Sector, Business Sector, 1997, 2007 and 2017

	Newfoundland and Labrador			Canada			NL / Canada		
	1997	2007	2017	1997	2007	2017	1997	2007	2017
	(chained 2012 dollars per unit of capital services)						(Per cent)		
Business sector industries	**1.26**	**2.01**	**1.14**	**2.96**	**2.68**	**2.52**	**0.42**	**0.75**	**0.45**
Agriculture, forestry, fishing and hunting	1.28	1.50	1.35	1.98	2.35	2.59	0.64	0.64	0.52
Mining and oil and gas extraction	125.07	4.77	0.70	2.64	1.58	1.27	47.37	3.01	0.55
Utilities	6.55	2.70	0.62	1.88	1.81	1.39	3.49	1.49	0.44
Construction	1.09	6.56	18.61	15.42	14.88	12.70	0.07	0.44	1.47
Manufacturing	0.32	2.37	7.64	2.80	2.90	3.02	0.11	0.82	2.53
Goods-producing sector	28.87	3.57	0.92	3.06	2.74	2.40	9.44	1.31	0.38
Wholesale trade	0.80	1.74	1.98	2.48	2.46	2.33	0.32	0.71	0.85
Retail trade	12.27	5.08	3.23	3.97	3.79	4.15	3.09	1.34	0.78
Transportation and warehousing	0.49	0.77	0.85	1.61	1.43	1.16	0.30	0.54	0.74
Information and cultural industries	0.34	1.18	2.03	1.63	1.73	1.73	0.21	0.69	1.17
FIRE	1.29	1.48	1.61	1.84	1.65	1.97	0.70	0.90	0.81
Professional, scientific and technical services	21.55	9.20	5.44	21.79	11.22	7.80	0.99	0.82	0.70
ASWMRS	91.03	28.07	11.23	15.02	9.16	6.44	6.06	3.07	1.74
Arts, entertainment and recreation	580.63	18.03	1.04	6.96	4.47	3.52	83.42	4.03	0.29
Accommodation and food services	14.47	6.31	2.82	8.05	8.43	9.44	1.80	0.75	0.30
Other private services	37.97	12.77	7.12	8.78	6.56	6.49	4.33	1.95	1.10
Service-producing sector	2.24	2.39	2.16	2.92	2.63	2.61	0.76	0.91	0.83
Business sector without mining and oil and gas	3.00	3.09	2.65	3.30	3.03	2.86	0.91	1.02	0.93

Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

Table 40 shows that the mining and oil and gas extraction sector had the largest capital productivity growth among subsectors of the business sector in Newfoundland and Labrador during the 1997-2017 period (4.9 per cent per year). This strong growth in the mining and oil and gas extraction capital productivity over the whole period reflects an even stronger growth during the 1997-2007 sub-period (20.8 per cent per year) and a large decline during the 2007-2017 sub-period (-8.9 per cent per year). This trend was driven by the rise (1997 to 2007) and the decline (2007 to 2017) in the oil production, and the rise in the capital stock for mining and oil and gas extraction since 2007.

Table 40: Capital Services Productivity Compound Annual Growth by Two-digit NAICS Sector, Business Sector, 1997 – 2017

	Newfoundland and Labrador		
	1997-2017	**1997-2007**	**2007-2017**
	(compound annual growth rates, per cent)		
Business sector industries	**-0.48**	**4.77**	**-5.46**
Agriculture, forestry, fishing and hunting	0.73	1.88	-0.41
Mining and oil and gas extraction	4.93	20.81	-8.85
Utilities	-3.84	2.56	-9.84
Construction	0.30	-4.26	5.07
Manufacturing	-0.21	-0.23	-0.20
Goods-producing sector	**0.70**	**9.10**	**-7.05**
Wholesale trade	0.85	2.61	-0.89
Retail trade	0.10	0.89	-0.68
Transportation and warehousing	-2.44	-2.19	-2.69
Information and cultural industries	2.32	-0.32	5.04
FIRE	-1.44	-2.99	0.12
Professional, scientific and technical services	-7.17	-11.89	-2.20
ASWMRS	5.74	17.51	-4.85
Arts, entertainment and recreation	-8.53	-4.63	-12.26
Accommodation and food services	-3.61	-2.01	-5.19
Other private services	-3.55	-2.61	-4.47
Service-producing sector	**-0.90**	**-0.83**	**-0.97**
Business sector without mining and oil and gas	**-0.62**	**0.31**	**-1.54**
	Canada		
	1997-2017	**1997-2007**	**2007-2017**
	(compound annual growth rates, per cent)		
Business sector industries	**-0.80**	**-0.99**	**-0.60**
Agriculture, forestry, fishing and hunting	1.34	1.72	0.95
Mining and oil and gas extraction	-3.59	-4.99	-2.17
Utilities	-1.48	-0.37	-2.58
Construction	-0.97	-0.35	-1.57
Manufacturing	0.37	0.35	0.40
Goods-producing sector	**-1.21**	**-1.11**	**-1.31**
Wholesale trade	-0.31	-0.09	-0.53
Retail trade	0.22	-0.45	0.89
Transportation and warehousing	-1.65	-1.21	-2.09
Information and cultural industries	0.30	0.57	0.03
FIRE	0.35	-1.12	1.83
Professional, scientific and technical services	-5.01	-6.42	-3.57
ASWMRS	-4.14	-4.83	-3.45
Arts, entertainment and recreation	-3.35	-4.33	-2.36
Accommodation and food services	0.80	0.46	1.14

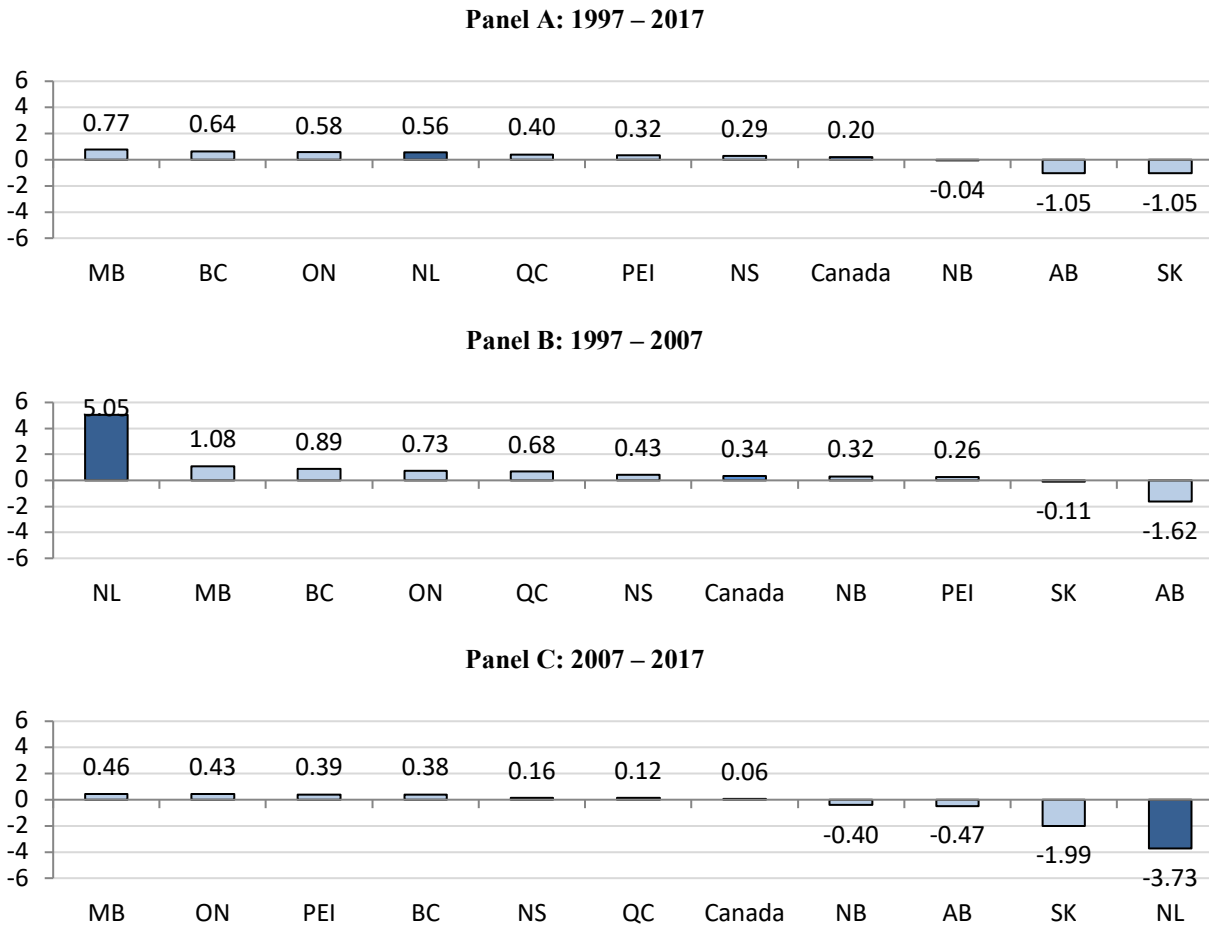
Other private services	-1.50	-2.86	-0.12
Service-producing sector	**-0.56**	**-1.05**	**-0.07**
Business sector without mining and oil and gas	**-0.71**	**-0.85**	**-0.57**

Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

C. Multifactor Productivity

Multifactor productivity (MFP) represents output growth that is not accounted for by measured input growth. It captures the effect of several different factors, such as disembodied technological growth, capital utilization, returns to scale. MFP also incorporates errors due to mismeasurement of inputs and outputs.

Chart 46: Multifactor Productivity Compound Annual Growth in Canada and the Provinces, Business Sector, 1997 – 2017

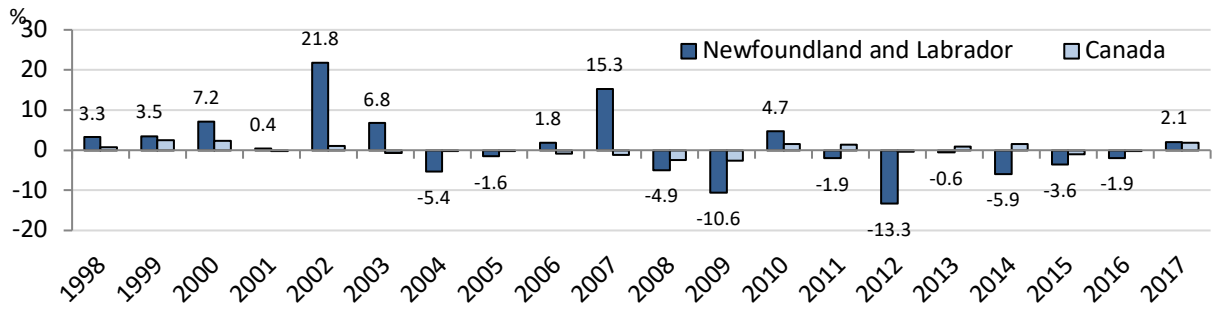


Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

Similar to labour productivity growth, MFP growth in Newfoundland and Labrador ranked first among provinces during the 1997-2007 and last during the 2007-2017 period (Chart 46).

Specifically, during the 1997-2007 period, the province's MFP growth was almost five times as high as the province with the second highest growth (5.1 per cent per year in Newfoundland and Labrador versus 1.1 per cent per year in Manitoba). During the 2007-2017 period, Newfoundland and Labrador had the largest MFP decline (3.7 per cent per year) among provinces. Because the province's decline in MFP was large during the 2007-2017 period, the province's MFP growth during the 1997-2017 period only ranked 4th among all provinces.

Chart 47: Multifactor Productivity Annual Growth, Business Sector, Newfoundland and Labrador and Canada, 1998 – 2017

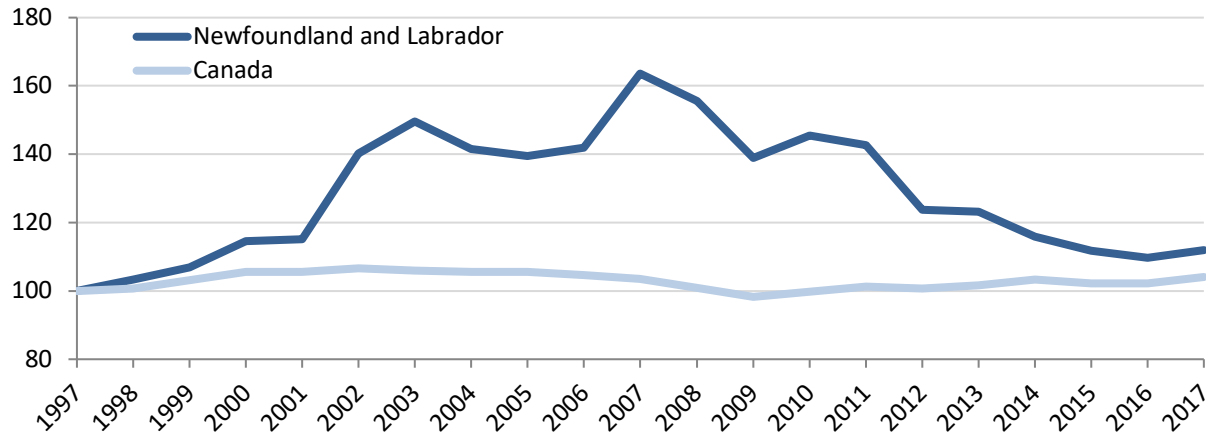


Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

The pattern of annual MFP growth from 1998 to 2017 is consistent with that of the annual labour productivity growth and the annual capital productivity growth (Chart 47). Specifically, labour productivity, capital productivity and MFP had the highest annual growth in 2002 (24.2 per cent, 21.0 per cent and 21.8 per cent respectively), and the largest decline in 2012 (12 per cent, 13.7 per cent and 13.3 per cent respectively). All three productivity measures also experienced strong compound annual growth during the 1997-2007 sub-period (5.96 per cent, 4.77 per cent and 5.05 per cent respectively).

Although the province's annual MFP growth was 3.8 percentage points lower than the national average (-0.01 per cent per year versus 3.7 per cent per year) during the 2007-2017 period, the province's MFP level has never fallen below the 1997 level (Chart 48) throughout the 1997-2017 period. However, the MFP level in Canada dropped below its 1997 level in 2009 and 2010 after the financial crisis.

Chart 48: Multifactor Productivity in Newfoundland and Labrador and Canada, Business Sector, 1997 – 2017 (1997 = 100)



Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

Table 41 provides MFP growth rates for two-digit NAICS sectors in Newfoundland and Labrador and Canada. Given the dominance of the mining and oil and gas extraction sector in the province's economy in terms of real output and labour productivity, we see that the sector's MFP growth is indicative of the province's MFP growth in the goods sector and the business sector. During the 1997-2007 period, the province' mining and oil and gas extraction MFP grew at an impressive annual rate of 20.6 per cent (compared to the -4.5 per cent national average) while the province's business sector MFP growth rate was almost 15 times as high as that in Canada (5.1 per cent per year versus 0.3 per cent per year). The adoption of new technology with the offshore oil field was responsible for the impressive MFP growth in the province's mining and oil and gas extraction sector during the 1997-2007 period.

Table 41: Multifactor Productivity Compound Annual Growth in Newfoundland and Labrador and Canada by Two-digit NAICS Sector, Business Sector, 1997 – 2017

	Newfoundland and Labrador		
	1997-2017	1997-2007	2007-2017
	(compound annual growth rates, per cent)		
Business sector	**0.56**	**5.05**	**-3.73**
Agriculture, forestry, fishing and hunting	2.09	3.38	0.81
Mining and oil and gas extraction	5.00	20.59	-8.58
Utilities	-1.06	2.12	-4.15
Construction	0.40	-0.98	1.80
Manufacturing	1.83	-0.28	3.98
Goods-producing sector	**1.38**	**9.60**	**-6.21**
Wholesale trade	3.48	3.88	3.07
Retail trade	1.69	0.64	2.75
Transportation and warehousing	-1.33	-1.54	-1.13
Information and cultural industries	3.57	0.26	6.98
FIRE	0.31	-1.36	2.01
Professional, scientific and technical services	-1.61	-2.42	-0.79
ASWMRS	2.40	4.17	0.66
Arts, entertainment and recreation	-3.36	-4.45	-2.26
Accommodation and food services	0.86	0.62	1.09

Other private services	-0.27	-0.56	0.01
Service-producing sector	**0.55**	**-0.22**	**1.33**
	Canada		
	1997-2017	**1997-2007**	**2007-2017**
	(compound annual growth rates, per cent)		
Business sector	**0.20**	**0.34**	**0.06**
Agriculture, forestry, fishing and hunting	2.31	2.92	1.70
Mining and oil and gas extraction	-2.99	-4.45	-1.52
Utilities	-0.93	-0.39	-1.47
Construction	0.38	1.00	-0.22
Manufacturing	1.06	1.16	0.96
Goods-producing sector	-0.02	0.09	-0.13
Wholesale trade	**1.60**	**2.01**	**1.20**
Retail trade	1.44	2.08	0.81
Transportation and warehousing	-0.40	-0.17	-0.64
Information and cultural industries	0.71	1.29	0.14
FIRE	0.67	-0.16	1.51
Professional, scientific and technical services	-0.19	0.11	-0.50
ASWMRS	-0.65	-0.44	-0.86
Arts, entertainment and recreation	-1.39	-1.56	-1.22
Accommodation and food services	0.70	1.32	0.09
Other private services	-0.11	0.26	-0.47
Service-producing sector	**0.41**	**0.58**	**0.24**

Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

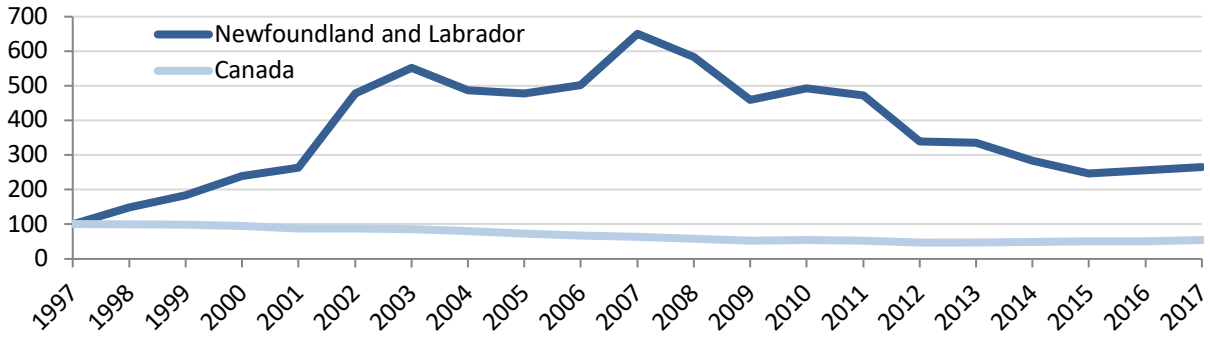
During the 2007-2017 period, the MFP of the province's business sector declined at an annual rate of 3.7 per cent as the province's mining and oil and gas extraction MFP decline at 8.6 per cent per year. The decline in the province's mining and oil and gas extraction MFP was almost six times as large as that in Canada (8.6 per cent per year versus 1.5 per cent per year). One of the reasons was the depletion of oil reserves in the province.

Many sectors other than mining and oil and gas extraction had significant MFP growth during the 2007-2017 period. In particular, MFP in 9 of the 15 two-digit NAICS subsectors of the business sector in the province grew more rapidly than the national average, 7 of which are subsectors of the service sector. For example, the information and cultural industries in the province had the highest MFP growth among subsectors of the service sector and the business sector (7.0 per cent per year) during the 2007-2017 period.

It is paradoxical that given the higher growth in the province's R&D expenditure than Canada's during the 2007-2016 period (3.3 per cent per year versus 1.4 per cent per year),[44] the province's MFP growth in the business sector was negative (-3.7 per cent per year) while that in Canada was weakly positive (0.06 per cent per year). One possible reason could be the difference between the composition of R&D performers in Newfoundland and Labrador and Canada, as we discuss in section IV.[45]

[44] The next section discusses trends in R&D.
[45] Guellec and van Pottelsberghe de la Potterie (2001) shows that at the country level the effect of R&D on MFP growth is larger in countries where the share of universities is higher.

Chart 49: Multifactor Productivity in Newfoundland and Labrador and Canada, Mining and Oil and Gas Extraction Sector, 1997 – 2017 (1997 = 100)



Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

The gap between the growth rates of MFP in mining and oil and gas extraction in Newfoundland and Labrador and Canada was massive during both the 1997-2007 and the 2007-2017 sub-periods (Chart 49). Comparing Chart 49 with Chart 48, we can confirm that the MFP growth of the province's mining and oil and gas extraction sector is a good indicator of the province's business sector MFP growth.

IV. Productivity Drivers

The previous part described in detail the productivity performance of Newfoundland and Labrador's business sector over the 1997-2018 period, and how it compared to the performance of the Canadian business sector as a whole. It did not, however, analyze the factors behind productivity development in the province.

In order to develop policies to improve productivity performance, it is important to identify the drivers of productivity growth. The standard starting point for the discussion of the dynamics of productivity growth is the simple standard growth accounting model, briefly mentioned in the last section. In this model, there are three key factors determining labour productivity growth. The first is investment in human resources, which determines the quality of labour input. More human capital makes a worker more productive. The second is investment in capital goods, which determines the size of the capital stock and hence the amount of machinery and equipment and structures available to each worker and firm. Higher ratios of capital to labour, or capital intensity, boost labour productivity. The third is often referred to as the pace of technological progress (or innovation), but in fact encompasses all factors not captured by the previous two measures. It is very roughly proxied by the rate of multifactor productivity growth. In this report, we look at technological progress through one of its main drivers – the development of new knowledge through R&D. These three drivers are in turn affected by the industrial structure and resource base of the province as well as by both the macroeconomic and microeconomic environments and policies.

Exhibit 3 presents a framework for analyzing the drivers of productivity growth and the issues associated with these drivers. For each of the three drivers identified above, a number of more precise and relevant issues are identified. Each of the three drivers encompasses a large number of issues, each important to any explanation of productivity growth.

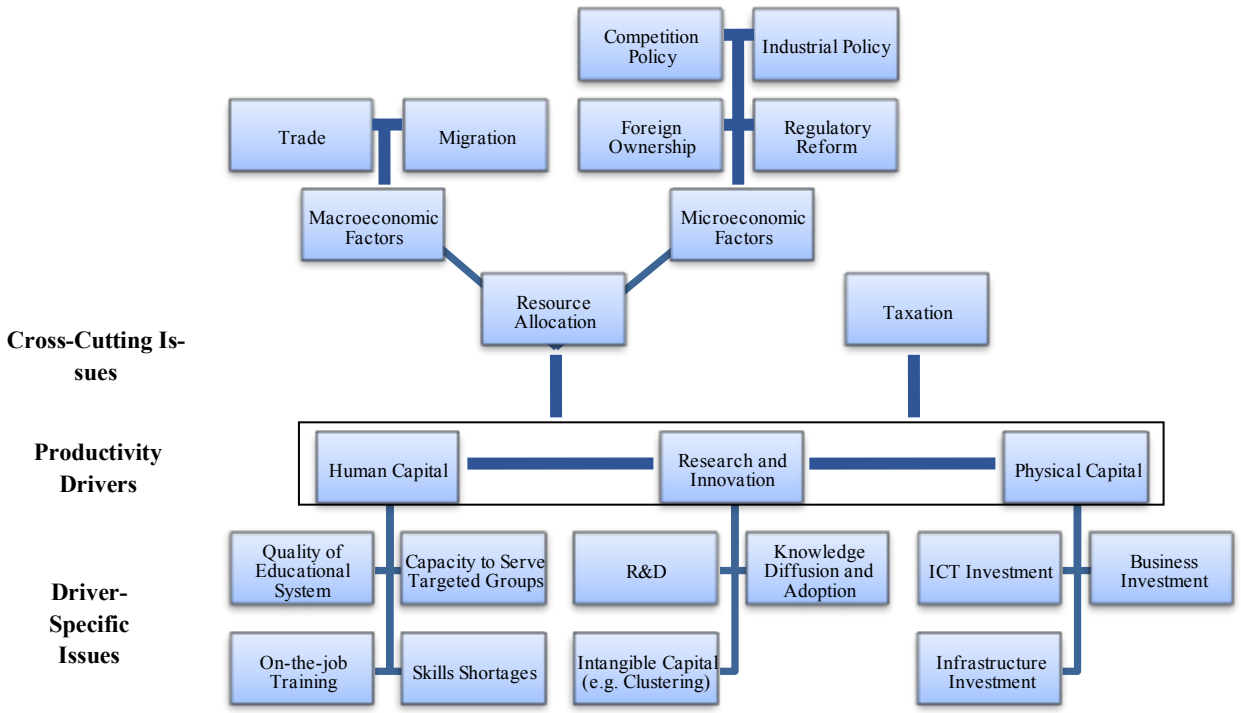
Exhibit 3 also identifies a number of cross-cutting issues, which affect more than one of the productivity drivers. The first category of cross-cutting issues is resource allocation. The capacity of an economy to adapt and allocate resources efficiently is a central issue for productivity growth. Issues related to resource allocation can be divided roughly between microeconomic and macroeconomic issues. We recognize that the differentiation between micro and macro factors in this fashion is somewhat artificial, but we believe that to deal with such an extensive issue as resource allocation, it is necessary to organize the issues in two distinct parts. Aside from issues of resource allocation, there are also issues related to taxation, which can have a large influence on investment, the amount of R&D undertaken and educational decisions

Microeconomic factors include issues such as competition policy, industrial policy, and market regulation and could be the subject of a report. Regulatory reform is also of paramount importance in this process.

Macroeconomic issues (i.e., trade and migration) are rich territory in the context of productivity. They benefit from some commonality as trade relate to the movement of goods and services while migration relates to the movement of individuals.

Exhibit 3: CSLS Framework for Analyzing Productivity[46]

[46] This productivity analysis framework was also used in two previous CSLS study on provincial productivity that focused respectively on British Columbia (Murray and Sharpe,2011) and Nova Scotia (Sharpe and Avillez, 2012).



A. Human Capital

This section addresses an important driver of productivity – human capital. We start this section with an overview of average years of schooling in Newfoundland and Labrador and compare them to the national level. Then we discuss Statistics Canada's labour composition measure and compare labour quality in the province with Canada. This is followed by a general analysis of other measures of human capital in the province, including adult literacy, employer-supported training and workplace injury. We also analyse human capital measure with respect to the province's students, including Programme for International Student Assessment (PISA) scores, apprenticeship training and early childhood education. We end this section with a discussion of interprovincial and demographic developments in Newfoundland and Labrador and labour shortages.

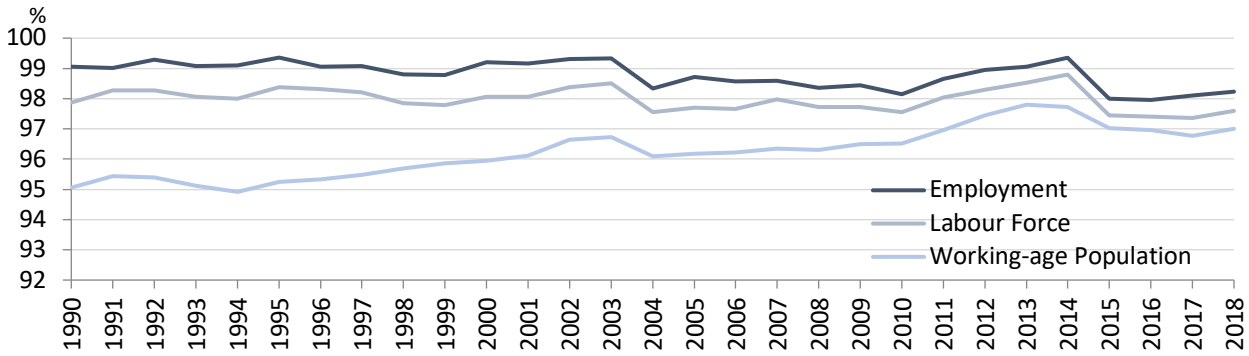
i. Average Years of Schooling[47]

We look into the average years of schooling of the working-age population (15-64 years of age), the labour force and the employed in Newfoundland and Labrador and Canada from 1990 to 2018. During the 1990-2018 period, the average years of schooling among the working-age (15-64 years of age) population, the labour force and the employed population in

[47] In calculating average years of education, the following number of years were assigned to each level of education, then total years were divided by the total population: 8 years for 0-8 years; 10 years for some high school; 12 years for high school graduate; 13 years for some post-secondary; 14 years of non-university post-secondary; 16 years for bachelor's degree; and 18 years for above bachelor's.

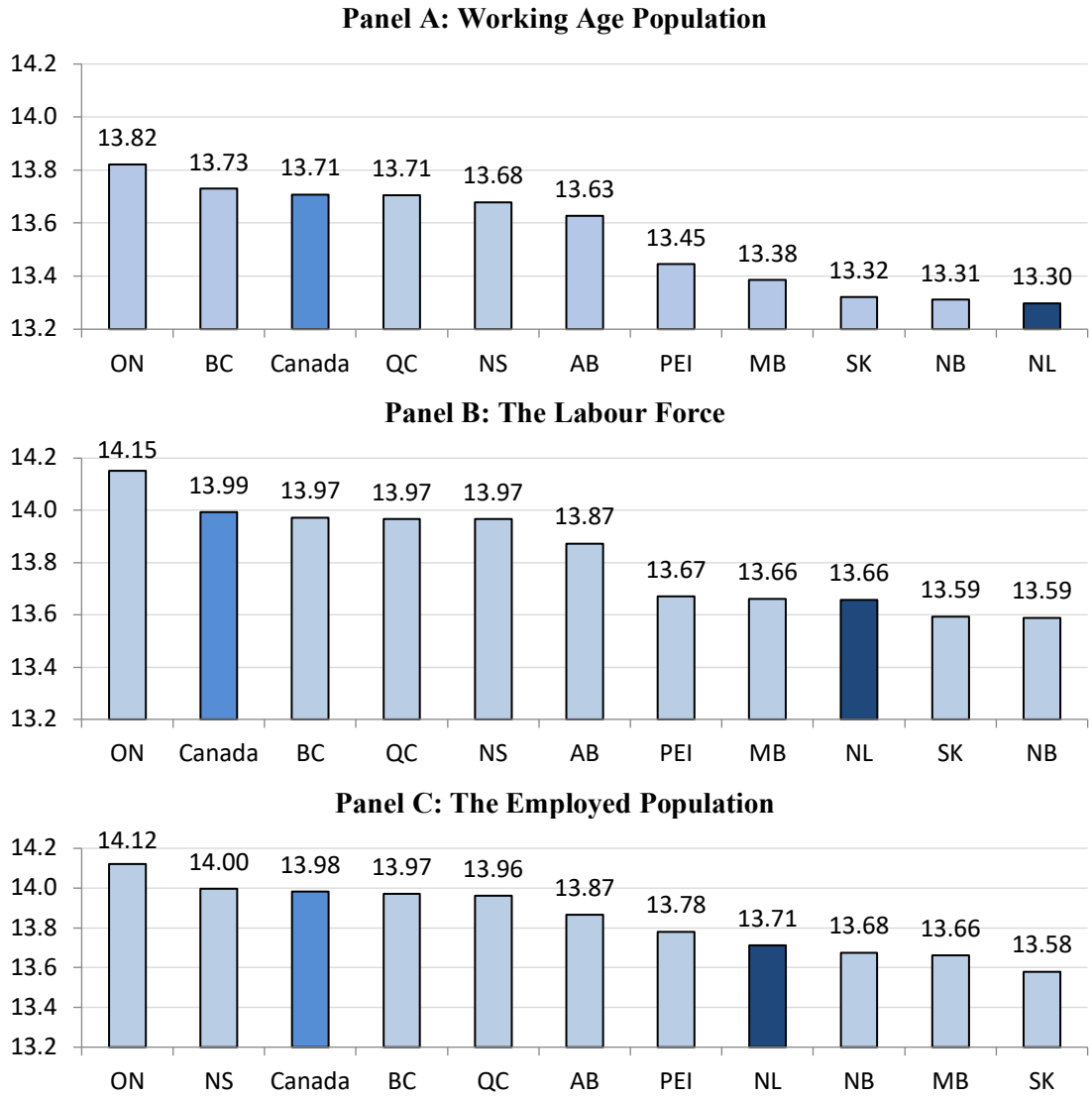
Newfoundland and Labrador was always below the national average (Chart 50). Only the average years of schooling in the working-age population of the province demonstrated a slightly increasing trend as a per cent of Canada (from 95.1 per cent in 1990 to 96.8 per cent in 2018). The declining average years of schooling in the province as a per cent of Canada for the employed population and the labour force reflects the decreasing educational level of the labour supply in the province compared to the national average.

Chart 50: Newfoundland and Labrador's Average Years of Schooling as a Per Cent of Canada, Employed, Labour Force and Working Age Population, Total Economy, 1990 – 2018



Source: CSLS calculations based on the Labour Force Survey, Statistics Canada (Table 14-10-0018-01).

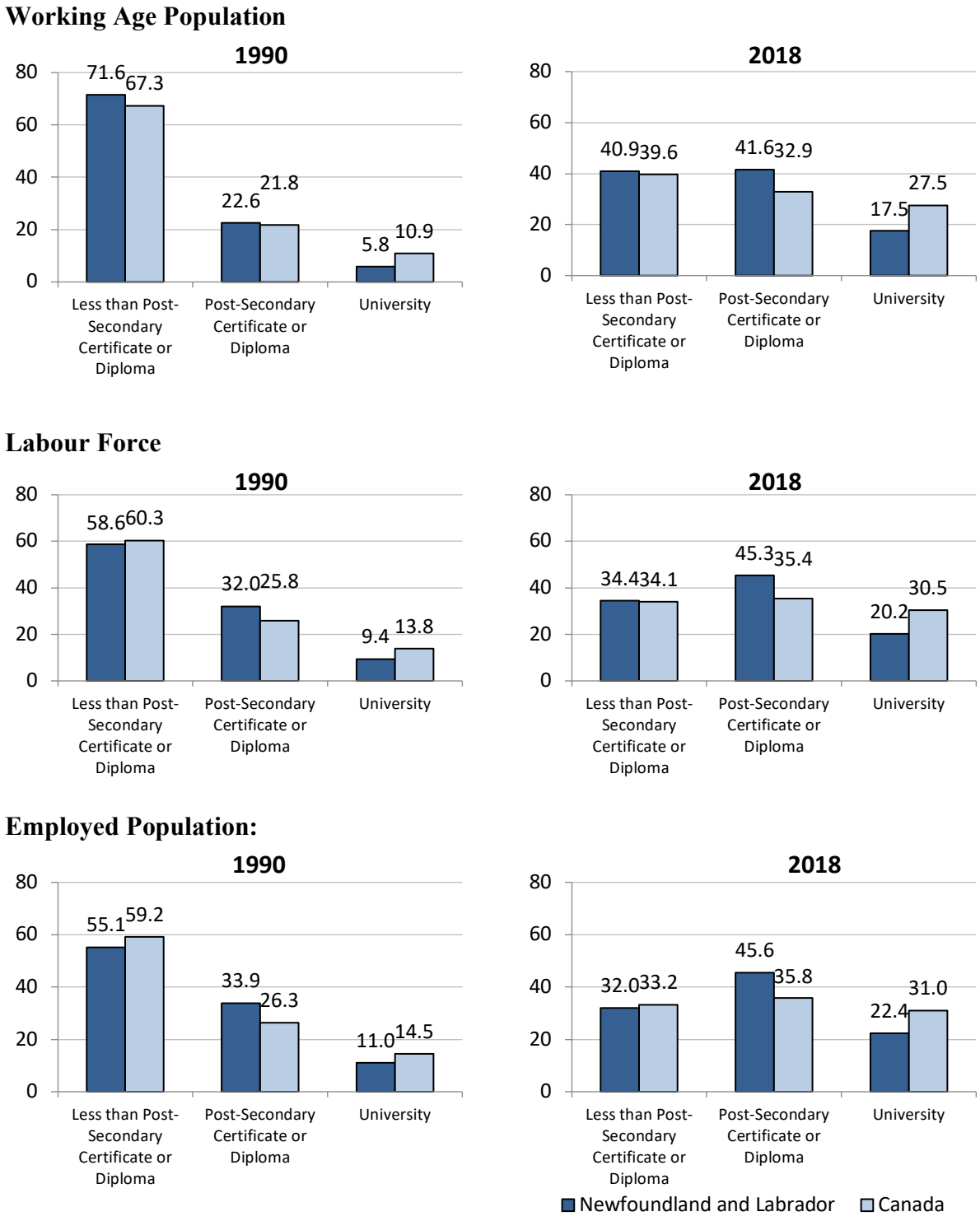
Chart 51: Average Years of Schooling in Canada and the Provinces, Working Age Population, 2018



Source: CSLS calculations based on the Labour Force Survey, Statistics Canada (Table 14-10-0020-01).

The average years of schooling of the working age population, the labour force and the employed in Newfoundland and Labrador are ranked low compared with other provinces in 2018. Specifically, the province ranked last for years of schooling in the working age population, third last in the labour force and fourth last in the employed population among all provinces (Chart 51). It is notable that with respect to the employed population, the gap between Newfoundland and Labrador's and Canada's average years of schooling was significantly smaller than that of the working-age population (Panel C of Chart 51). In particular, in 2018, the gap between the province and Canada with respect to the employed population was 0.3 year (13.98 year – 13.71 year) while that with respect to the working age population was 0.5 year (13.71 year - 13.30 year).

Chart 52: Workers by Highest Level of Educational Attainment as a Share of the Working-age Population, the Labour Force and the Employed Population, Newfoundland and Labrador and Canada, 1990 and 2018



Source: CSLS calculations based on the Labour Force Survey, Statistics Canada (Table 14-10-0020-01).

Another way to gauge the level of human capital in the workforce is to look at the highest level of educational attainment in the population. Chart 52 illustrates the significant improvement in educational attainment in both Newfoundland and Labrador and Canada. There was a significant increase in the percentage of population with a post-secondary certificate or diploma or university degree. For example, the percentage of working population in the province with a post-secondary certificate or diploma almost doubled from 22.6 per cent in 1990 to 41.6 per cent in 2018, which is higher than the national average of 32.9 per cent in that year. Also, the percentage of working age population with a university degree almost tripled from 5.8 per cent in 1990 to 17.5 per cent in 2018, but the percentage is 1.6 times lower than the national average of 27.5 per cent in 2017. Among the labour force and the employed, we observe a similar pattern of educational attainment comparing 1990 and 2018, although the province has a slightly lower percentage of the employed than Canada with less than a post-secondary certificate or diploma in 2018 (32.0 per cent versus 33.2 per cent).

Overall, Newfoundland and Labrador had lower average years of schooling than other provinces. The differences between the average years of schooling between the province and other provinces are smaller for the employed population. Looking at the highest level of educational attainment in Newfoundland and Labrador and Canada, we observe that the province had significantly lower shares of the population with university degree than Canada. For example, in 2018, 22.4 per cent of the province's employed population had university degree while 31.0 per cent of the employed in Canada had university degree. The lower educational level and highest educational attainment in Newfoundland and Labrador than the national average deterred the development of the province's labour productivity because jobs with high productivity in general requires high educational level.

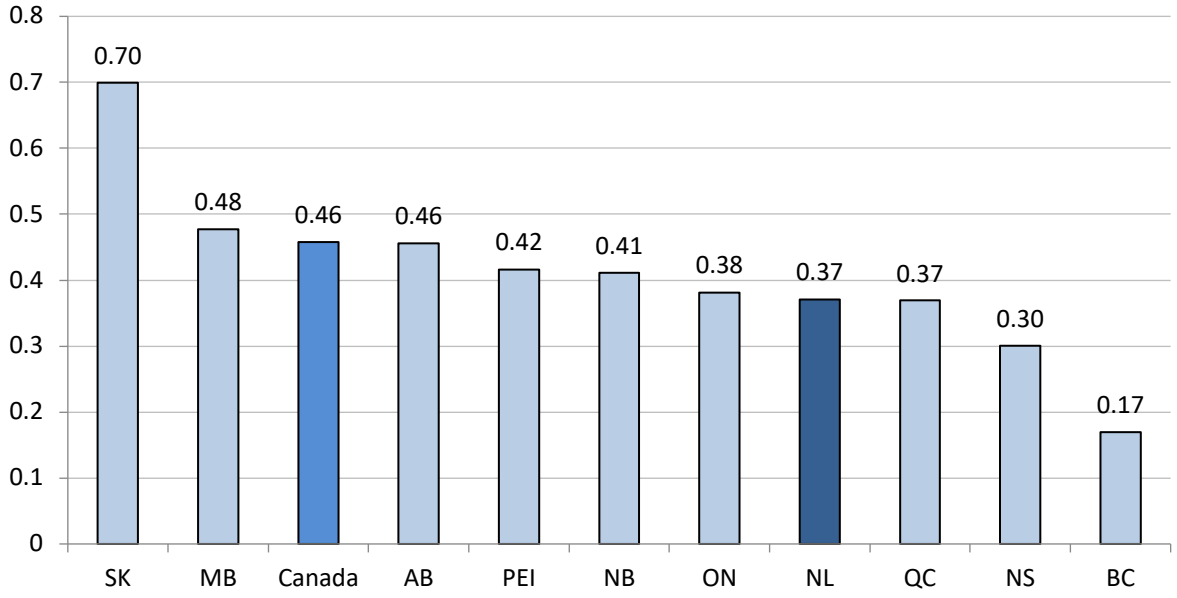
ii. Labour Composition

Changes in the human capital embodied in Newfoundland and Labrador's labour force are captured by Statistics Canada's measure of labour composition (also sometimes known as labour quality), which is the ratio of labour input or labour services to hours worked. The labour input, in turn, is the weighted sum of hours worked across different categories of workers, with the weights being equal to the relative labour compensation shares, i.e. categories of workers that receive a higher share of total labour compensation receive a higher weight. Thus, the labour services input can be decomposed into an hour component and a labour quality (or composition) component. The variables used to differentiate labour composition are education (four education levels), experience (proxied by seven age groups) and class of workers (paid employees versus self-employed workers). Overall, there are 56 different categories of workers.

According to data from the CPA, labour composition in Newfoundland and Labrador's business sector increased at a compound annual rate of 0.37 per cent during the 1997-2017 period, which is below the national average of 0.46 per cent (Chart 53). In comparison to other provinces, Newfoundland and Labrador ranked 7th in terms of labour composition growth. After

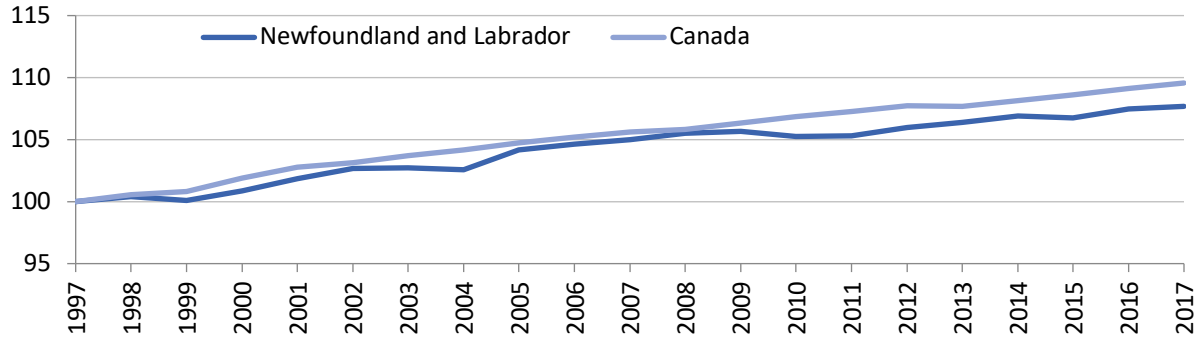
2000, the growth of labour composition in the province had been slower than the national average (Chart 54).

Chart 53: Labour Composition Growth in Canada and the Provinces, 1997 – 2017



Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

Chart 54: Labour Composition in Newfoundland and Labrador and Canada, 1997 – 2017 (1997 = 100)



Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

At the two-digit NAICS level, labour composition growth in Newfoundland and Labrador during the 1997-2017 period was higher than the national average in 6 of 15 sectors, namely manufacturing (0.67 per cent versus 0.39 per cent), retail trade (0.63 per cent versus 0.38 per cent), transportation and warehousing (0.51 per cent versus 0.47 per cent), administrative and support, waste management and remediation services, or ASWMRS (0.44 per cent versus 0.36 per cent), arts, entertainment and recreation (0.22 per cent versus 0.19 per cent) and other private services (0.80 per cent versus 0.36 per cent) (Table 35). On the other hand, Newfoundland and

Labrador's labour quality growth was outpaced by Canada's in sector like mining and oil and gas extraction (0.26 per cent versus 0.38 per cent) and utilities (-0.47 per cent versus 0.14 per cent), among others. Overall, the growth in labour composition could not explain any significant divergence in productivity growth during this period.

Table 42: Labour Composition Growth in Newfoundland and Labrador and Canada, Two-digit NAICS Sectors, 1997 – 2017

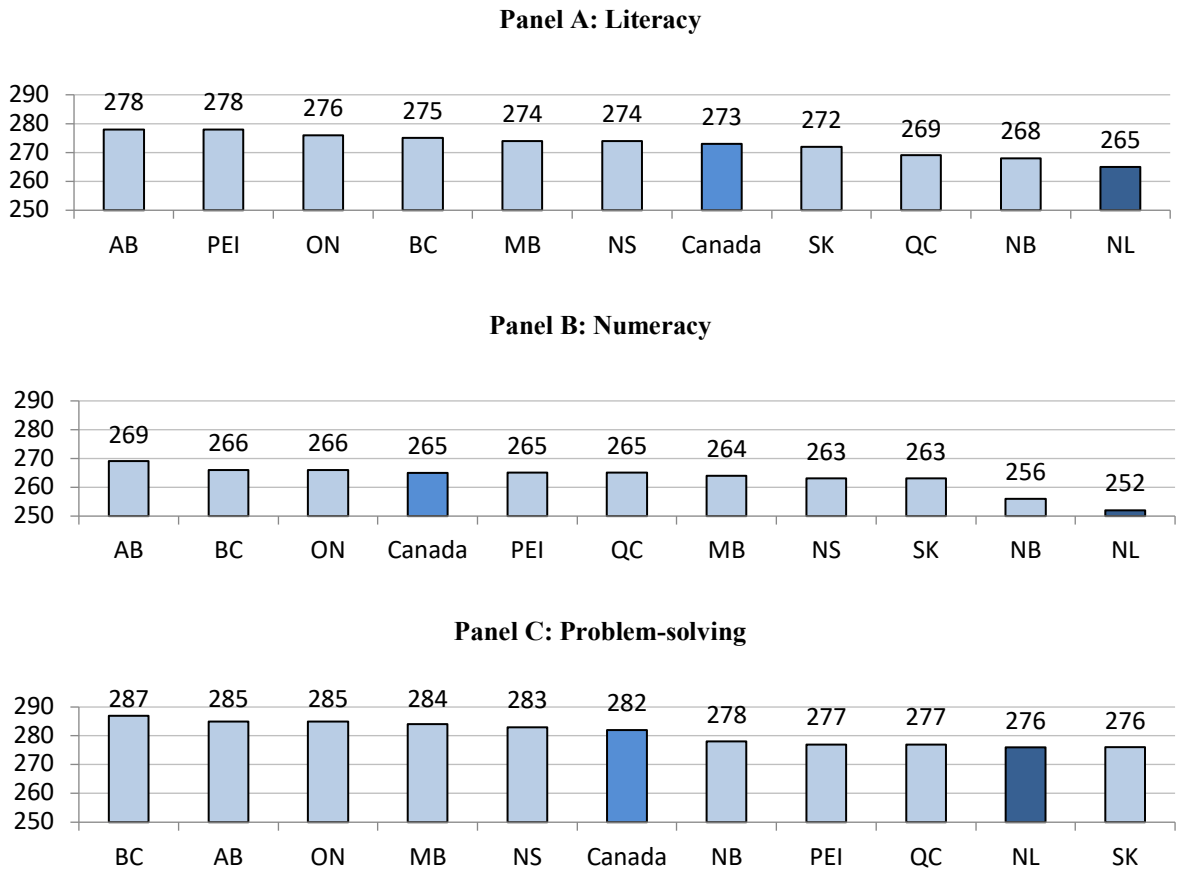
	Newfoundland and Labrador			Canada		
	1997-2017	1997-2007	2007-2017	1997-2017	1997-2007	2007-2017
	(annual compound growth rate, per cent)					
Business sector industries	0.37	0.49	0.25	0.46	0.55	0.37
Agriculture, forestry, fishing and hunting	0.41	0.10	0.72	0.93	0.91	0.94
Mining and Oil and Gas Extraction	0.26	0.29	0.24	0.38	0.36	0.41
Utilities	-0.47	-0.7	-0.77	0.14	0.09	0.18
Construction	-0.08	-0.22	0.06	0.15	0.09	0.22
Manufacturing	0.67	1.02	0.33	0.39	0.55	0.23
Goods-producing sector	**0.50**	**0.70**	**0.31**	**0.43**	**0.57**	**0.30**
Wholesale Trade	-0.58	-0.58	-0.59	0.36	0.49	0.23
Retail Trade	0.63	1.26	0.00	0.38	0.38	0.37
Transportation and Warehousing	0.51	0.48	0.54	0.47	0.60	0.34
Information and Cultural Industries	0.17	-0.04	0.37	0.36	0.40	0.33
FIRE	0.07	-0.04	0.19	0.48	0.58	0.38
Professional, Scientific and Technical Services	0.05	-0.69	0.79	0.35	0.30	0.40
ASWMRS	0.44	0.18	0.70	0.36	0.40	0.32
Arts, Entertainment and Recreation	0.22	-0.58	1.03	0.19	0.08	0.30
Accommodation and Food Services	0.10	0.25	-0.04	0.36	0.33	0.38
Other private services	0.80	0.92	0.69	0.36	0.34	0.37
Service-producing sector	**0.40**	**0.57**	**0.24**	**0.51**	**0.57**	**0.45**

Source: CSLS calculations based on the Canadian Productivity Account (CPA), Statistics Canada (Tables 36-10-0208-01 and 36-10-0211-01).

iii. Adult Literacy

Another important indicator of human capital is adult literacy. In general, the ability of workers to understand written text and draw inferences from it has a direct bearing on the quality of the work being performed. The Organisation for Economic Co-operation and Development (OECD) initiated the Program for the International Assessment of Adult Competencies (PIAAC) in 2012. It is a survey of adults' skills in three domains: (1) literacy, (2) numeracy and (3) problem-solving in technology-rich environments. The survey is conducted among adults between the ages of 16 and 65 in OECD countries and all of Canada's provinces.

Chart 55: PIAAC Literacy, Numeracy and Problem-solving Average Scores, Canada and the Provinces, 2012



Source: OECD Skills Surveys.

The mean scores in Newfoundland and Labrador were below the national average in all three domains (Chart 55). In particular, Newfoundland and Labrador ranked last in literacy and numeracy and the second last in problem-solving among all provinces. The differences between the province and other provinces (except New Brunswick) in terms of literacy and numeracy scores are statistically significant while the problem-solving score in Newfoundland and Labrador is not statistically different from that in Quebec and the Prince Edward Island.

Table 43 shows the PIACC scores of Newfoundland and Labrador and Canada of five 10-year bands. Although the scores in the province were lower than the national average in all three domains, only the differences among the age groups 45-54 and 55-65 were statistically significant. We also observe that the difference between scores was lower in younger age groups, which implies that the difference between adult's literacy of the younger workforce in the province and that in Canada was narrower than the older workforce.

Table 43: PIAAC Scores, Age in 10-Year Bands, Newfoundland and Labrador and Canada, 2012

	Newfoundland and Labra-			Canada			NL - Canada		
	Literacy	Numeracy	Problem Solving	Literacy	Numeracy	Problem Solving	Literacy	Numeracy	Problem Solving
	Estimated Average Scores						Difference		
16 –	274	267	292	276	268	294	-2	-1	-2
25 –	281	271	288	285	277	292	-4	-6	-4
35 –	276	264	281	280	272	288	-4	-8	-7
45 –	260*	245*	264*	268	261	274	-8	-16	-10
55 –	247*	227*	246*	260	251	261	-13	-24	-15

Note: * means the difference between the province and Canada in the domain was statistically significant. Source: OECD Skills Surveys.

iv. PISA Scores

Educational outcomes affect productivity not only in the short-run, but in the long-run as well. Like technical changes, which take some time to be introduced to the market through new investments, increases in educational outcome may take some time to affect the productivity of individuals in the marketplace. After all, if current high school students are now receiving a better education, it will only be reflected in labour productivity statistics after they enter the workforce. In this sense, it is important to keep track of the educational performance of the population that will be entering the labour force in the next 5 to 10 years. The Program for International Student Assessment (PISA), developed by the OECD, measures the performance of high school students in three key areas: science, reading, and mathematics.

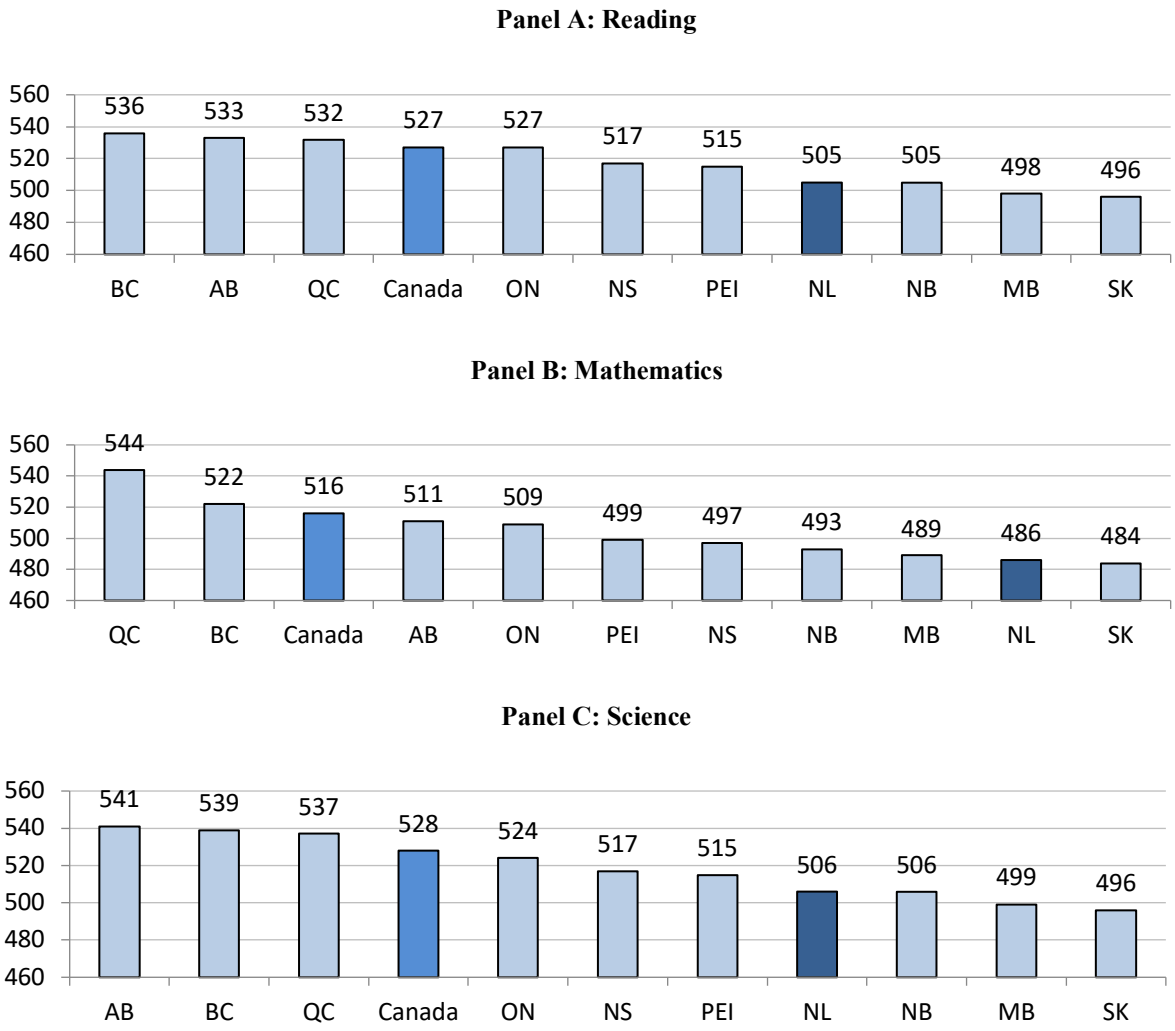
Scores of Newfoundland and Labrador in all three domains were lower than the national averages in all years. In 2015,[48] out of the 10 provinces, the province ranked 7th in reading, 9th in mathematics and 7th in science (

[48] As of April 11th, 2019, the series of estimated PISA scores in Canada and the provinces end in 2015.

Chart 56). In both Newfoundland and Labrador and Canada, scores in the three domains declined over time, but the decline in Newfoundland and Labrador was generally greater than the national average (Table 44). In all three domains, Newfoundland and Labrador's scores were lower than the national average for the 6 years of the study.[49]

[49] It is noticeable that the four largest provinces in Canada (Alberta, British Columbia, Ontario and Quebec) dominated the top four places in all three domains.

Chart 56: Estimated Average PISA Reading, Mathematics and Science Scores, Canada and the Provinces, 2015



Source: Statistics Canada (Table 37-10-0133-01).

Table 44: Estimated PISA Average Reading, Mathematics and Science Scores, Newfoundland and Labrador and Canada, 2000, 2003, 2006, 2009, 2012 and 2015

	Newfoundland and Labrador			Canada			NL - Canada		
	Reading	Mathematics	Science	Reading	Mathematics	Science	Reading	Mathematics	Science
	(Estimated Average Scores)								
2000	517	N/A	N/A	534	N/A	N/A	-17	N/A	N/A
2003	521	517	N/A	528	532	N/A	-7	-15	N/A
2006	514	507	526	527	527	534	-13	-20	-8
2009	506	503	518	524	527	529	-18	-24	-11
2012	503	490	514	523	518	525	-20	-28	-11
2015	505	486	506	527	516	528	-22	-30	-22

Source: Statistics Canada (Table 37-10-0133-01).

v. Employer-supported Training

The quality of workers is also a function of how often firms are willing to invest in their workers and how many workers are willing to invest in themselves. According to Statistics Canada's Access and Support to Education and Training Survey (ASETS), Newfoundland and Labrador is characterized by the second lowest proportion of individuals participating in job-related training, although this proportion increased significantly between 2002 and 2008, from 19.7 per cent to 27.7 per cent. In comparison, the national average was at 30.6 per cent and provinces such as Saskatchewan and Alberta, which, similarly to Newfoundland and Labrador, are characterized by a large mining and oil and gas extraction sector, had proportions of 39.9 and 37.2 per cent of the population, respectively, who participated in job-related training in 2008 (Table 38).

Table 45: Training-related Statistics for Canadians and Employed Canadians Aged 25-64, 2002 and 2008

	Proportion of Canadians who participated in job-related training		Proportion of job-related training taken by employed Canadians that were sponsored by employers	
	2002	**2008**	**2002**	**2008**
Canada	24.6	30.6	88.3	90.5
Newfoundland and Labrador	19.7	27.7	86.7	92.9
Prince Edward Island	24.5	35.7	91.3	83.7
Nova Scotia	27	33	91.7	93.3
New Brunswick	24.6	30.6	92.7	95.8
Quebec	21.4	22.9	94.1	93
Ontario	24.9	32.9	85.1	88.9
Manitoba	28.8	34.2	86.2	92
Saskatchewan	28.4	39.9	88.3	92.9
Alberta	26.3	37.2	89.9	89.5
British Columbia	27.1	29.7	88.1	91.1

Source: Lifelong Learning among Canadians Aged 18 to 64 Years: First Results from the 2008 Access and Support to Education and Training Survey, Appendix Table 1.4 and 1.9

Note: data for 2002 represent activities undertaken between January and December 2002 while data for 2008 represents activities undertaken between July 2007 and July 2008.

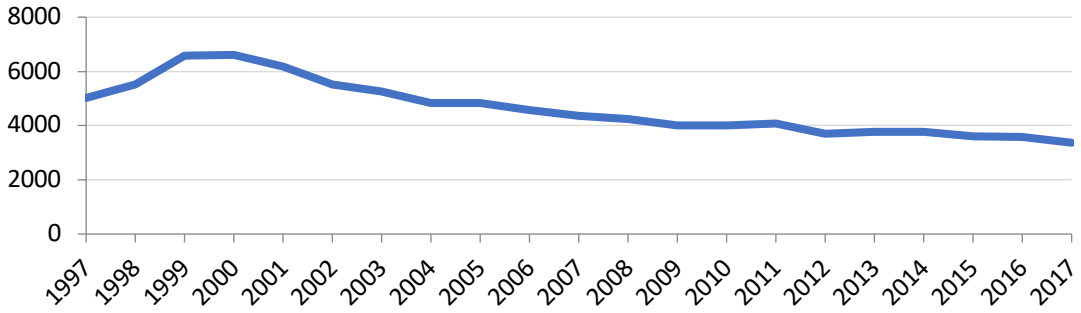
However, when workers do participate in job-related training, Newfoundland and Labrador employers are among the most generous when it is time to financially support the training of their employees. In 2008, 92.9 per cent of the job-related training activities taken by employed Newfoundlanders and Labradorians were sponsored by their employers, the fourth highest proportion among the Canadian provinces. It was also an improvement from 2002, when only 86.7 per cent of job-related trainings were sponsored by employers in the province.

vi. Workplace Injury

The quality of life in a workplace can affect the productivity performance of the workers in that location. One aspect of workplace quality of life is the extent of workplace injuries and fatalities. In jurisdictions and enterprises where the incidence of workplace injuries and death is high and/or rising, worker's morale and commitment might decline, and hence productivity will be negatively affected. Conversely, the effect may be the opposite in jurisdictions and enterprises

where the incidence of injuries or death is low and/or falling. This section looks at trends in workplace injuries and deaths in Newfoundland and Labrador.

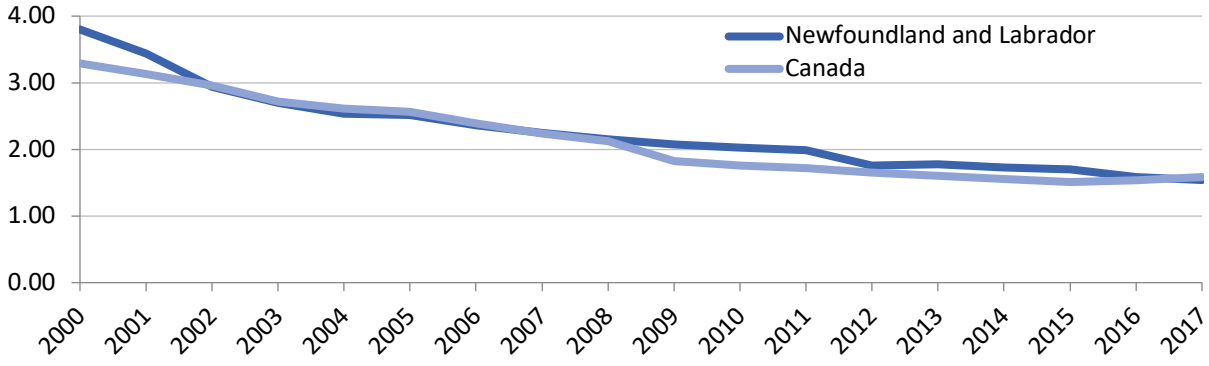
Chart 57: Number of Workplace Time-Loss Injuries in Newfoundland and Labrador, 1997 – 2017



Source: Association of Workers' Compensation Boards of Canada (AWCBC).

Chart 57 shows that 3,368 time-loss injuries were compensated by Newfoundland and Labrador's Workplace Health Safety and Compensation Commission in 2017, down from 5,029 compensated time-loss injuries in 1997. In 2017, in comparison to Canada as a whole, the incidence of workplace time-loss injuries was slightly lower in the province, with an incidence of 1.54 per cent versus 1.58 per cent in Canada (Chart 58). In Newfoundland and Labrador, in terms of time-loss injuries, the number of injuries dropped by half from 6,609 persons in 2000 to 3,368 persons in 2017. The incidence also fell from 3.8 time-loss injuries per 100 workers in 2000 to 1.5 in 2017. Similar declines took place at the national level. In conclusion, Newfoundland and Labrador workplaces, like Canadian workplaces in general, are becoming much less prone to injuries. Moreover, they are essentially not different from Canada in terms of injuries.

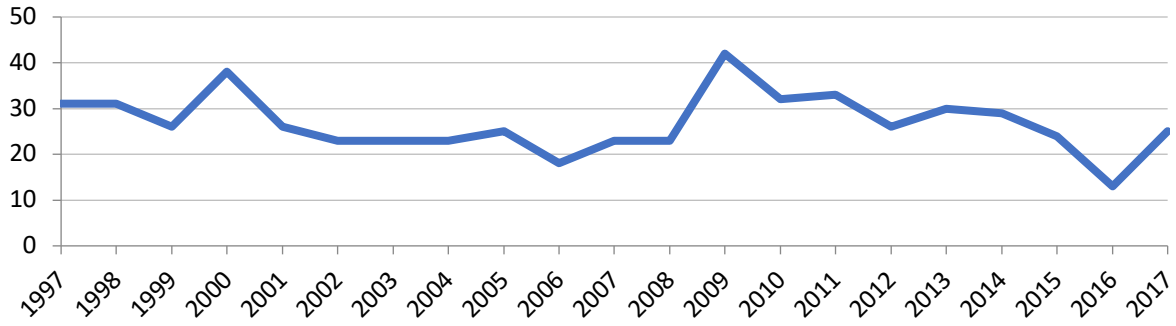
Chart 58: Incidence of Workplace Time-Loss Injuries (per 100 Workers) in Newfoundland and Labrador and Canada, 2000 – 2017



Source: Association of Workers' Compensation Boards of Canada (AWCBC).

Chart 59 illustrates the downward trend in the number of workplace fatalities in Newfoundland and Labrador from 1997 to 2017. The fall during the 2009-2016 period was particularly profound, from 42 persons to 13 persons. However, the number of workplace fatalities almost doubled from 13 persons in 2016 to 25 persons in 2017.

Chart 59: Number of Workplace Fatalities in Newfoundland and Labrador, 1997 – 2017



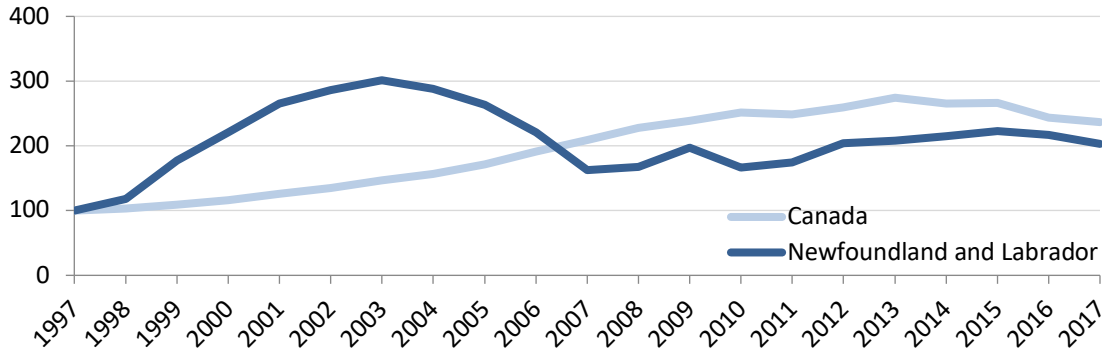
Source: Association of Workers' Compensation Boards of Canada (AWCBC).

vii. Apprenticeship Training

A competent and skilled labour force is essential for productivity growth. A key component of such a labour force is a well-trained and qualified skilled trades workforce. Statistics Canada's Registered Apprenticeship Information System (RAIS) survey collects data on apprenticeship registrations and completions broken down by age, gender, trade group, and province.

The number of apprenticeship registrations in Newfoundland and Labrador experienced an unusual progression during the 1997-2003 period (from 3,531 registrations in 1997 to the peak 10,641 registrations in 2003). It then tumbled to 5,739 in 2007 and rose to 7,188 in 2017 (Table 46). In Canada, apprenticeship registrations experienced a more linear increase, growing at a compound annual rate of 4.4 per cent per year during the 1997-2017 period. Chart 60 illustrates the unusual expansion (from 1997 to 2003) and regression (from 2003 to 2007) of apprenticeship registrations in Newfoundland and Labrador.

Chart 60: Apprenticeship Registrations in Newfoundland and Labrador and Canada, 1997 – 2017 (1997=100)



Source: CSLS calculations based on the Registered Apprenticeship Information System, Statistics Canada (Table 37-10-0023-01).

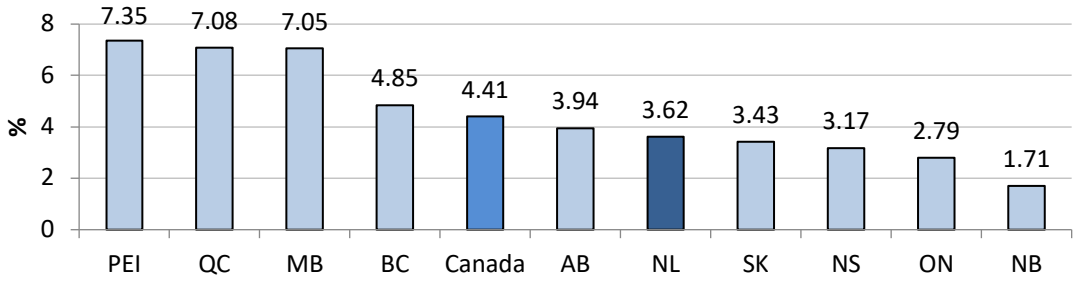
Table 46: Apprenticeship Registrations, Canada and the Provinces, 1997 – 2017

	1997	2007	2017
	(persons)		
Canada	**171,183**	**358,557**	**405,699**
Newfoundland and Labrador	3,531	5,739	7,188
Prince Edward Island	408	861	1686
Nova Scotia	4,260	5,292	7,953
New Brunswick	3,939	4,548	5,532
Quebec	30,483	70,029	119,667
Ontario	63,987	120,189	110,904
Manitoba	3,630	8,139	14,190
Saskatchewan	5,637	9,081	11,055
Alberta	34,215	85,206	74,151
British Columbia	20,241	48,417	52,158
	(share of national apprenticeship)		
Canada	**100**	**100**	**100**
Newfoundland and Labrador	2.06	1.60	1.77
Prince Edward Island	0.24	0.24	0.42
Nova Scotia	2.49	1.48	1.96
New Brunswick	2.30	1.27	1.36
Quebec	17.81	19.53	29.50
Ontario	37.38	33.52	27.34
Manitoba	2.12	2.27	3.50
Saskatchewan	3.29	2.53	2.72
Alberta	19.99	23.76	18.28
British Columbia	11.82	13.50	12.86
	1997-2017	**1997-2007**	**2007-2017**
	(compound annual growth rates, per cent)		
Canada	**4.41**	**7.67**	**1.24**
Newfoundland and Labrador	3.62	4.98	2.28
Prince Edward Island	7.35	7.75	6.95
Nova Scotia	3.17	2.19	4.16
New Brunswick	1.71	1.45	1.98
Quebec	7.08	8.67	5.50
Ontario	2.79	6.51	-0.80
Manitoba	7.05	8.41	5.72
Saskatchewan	3.43	4.88	1.99
Alberta	3.94	9.55	-1.38
British Columbia	4.85	9.11	0.75

Note: According to footnote 4 of Statistics Canada table 37-10-0023-01, total figures may not add up because of random rounding.
Source: CSLS calculations based on the Registered Apprenticeship Information System, Statistics Canada (Table 37-10-0023-01).

Compared to other provinces, Newfoundland and Labrador ranked sixth in terms of apprenticeship registration growth between 1997 and 2017, at 3.62 per cent, 0.79 percentage points below the Canadian average (Chart 61). However, we must note that, due to the non-linear progression of apprenticeship registration in Newfoundland and Labrador, those numbers may lose much of their usefulness as a measure of comparison.

Chart 61: Apprenticeship Registrations Compound Annual Growth in Canada and the Provinces 1997-2017

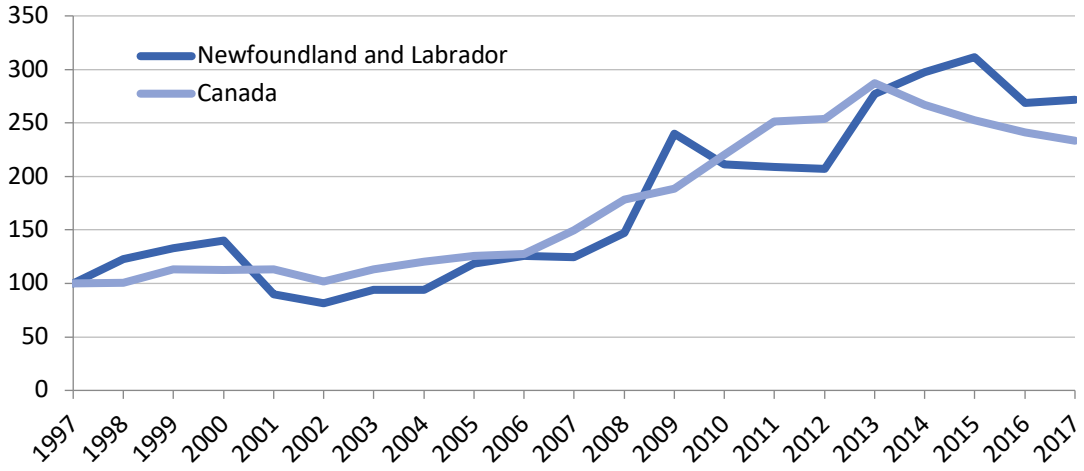


Source: CSLS calculations based on the Registered Apprenticeship Information System, Statistics Canada (Table 37-10-0023-01).

Apprenticeship completions during the 1997-2017 period increased at a higher rate in Newfoundland and Labrador (5.1 per cent per year) than in Canada as a whole (4.3 per cent) (Chart 62). In Newfoundland and Labrador, the number of apprenticeship completions rose from 210 in 1997 to 570 in 2017.

Another observation is that apprenticeship completions in the province declined under their 1997 level between 2000 and 2004. After that, the province experienced an important increase in apprenticeship completions between 2007 and 2017. Specifically, during the 1997-2017 period, the number of completions in the province grew at a rate of 8.1 per cent per year, which is the fastest among all provinces and is almost double that of the national average (4.5 per cent per year).

Chart 62: Apprenticeship Completions, Newfoundland and Labrador and Canada, 1997 - 2017 (1997=100)



Source: CSLS calculations based on the Registered Apprenticeship Information System, Statistics Canada (Table 37-10-0023-01).

Despite the increase in apprenticeship completions in Newfoundland and Labrador during the 2007-2017 period, the province's apprenticeship completions as a share of Canada's did not change as much because the number of completions in the province was insignificant compared with Canada (Table 47). For example, comparing the number of completions in 2007 and 2017, although apprenticeship completions more than doubled in the province, Newfoundland and Labrador's share in Canada only rose from 1.1 per cent in 2007 to 1.4 per cent in 2017.

Table 47: Apprenticeship Completions in Canada and the Provinces, 1997 – 2017

	1997	2007	2017
		(persons)	
Canada	**16,368**	**24,495**	**38,160**
Newfoundland and Labrador	210	261	570
Prince Edward Island	39	72	84
Nova Scotia	288	465	699
New Brunswick	462	504	639
Quebec	1,518	4,410	9,525
Ontario	5,562	7,575	10,575
Manitoba	366	855	1,203
Saskatchewan	552	813	1,452
Alberta	4,290	6,477	8,538
British Columbia	3,021	2,973	4,785
		(share of national apprenticeships)	
Canada	**100**	**100**	**100**
Newfoundland and Labrador	1.28	1.07	1.49
Prince Edward Island	0.24	0.29	0.22
Nova Scotia	1.76	1.90	1.83
New Brunswick	2.82	2.06	1.67
Quebec	9.27	18.00	24.96
Ontario	33.98	30.92	27.71
Manitoba	2.24	3.49	3.15
Saskatchewan	3.37	3.32	3.81
Alberta	26.21	26.44	22.37
British Columbia	18.46	12.14	12.54

	1997-2017	1997-2007	2007-2017
	(compound annual growth rates, per cent)		
Canada	**4.32**	**4.11**	**4.53**
Newfoundland and Labrador	5.12	2.20	8.12
Prince Edward Island	3.91	6.32	1.55
Nova Scotia	4.53	4.91	4.16
New Brunswick	1.63	0.87	2.40
Quebec	9.62	11.25	8.00
Ontario	3.26	3.14	3.39
Manitoba	6.13	8.86	3.47
Saskatchewan	4.95	3.95	5.97
Alberta	3.50	4.21	2.80
British Columbia	2.33	-0.16	4.87

Source: CSLS calculations based on the Registered Apprenticeship Information System, Statistics Canada (Table 37-10-0023-01).

The apprenticeship completion rate, defined as completion over total registration,[50] in Newfoundland and Labrador was low (Table 48). In particular, the province had the lowest completion rate among the 10 provinces in 1997 and 2007 (6.0 per cent in 1997 and 4.6 per cent in 2007). In 2017, Newfoundland and Labrador had the second lowest completion rate (7.9 per cent).

Table 48: Apprenticeship Completion Rates, Canada and the Provinces, 1997, 2007 and 2017

	1997	2007	2017
	(per cent)		
Canada	**9.56**	**6.83**	**9.41**
Newfoundland and Labrador	5.95	4.55	7.93
Prince Edward Island	9.56	8.36	4.98
Nova Scotia	6.76	8.79	8.79
New Brunswick	11.73	11.08	11.55
Quebec	4.98	6.30	7.96
Ontario	8.69	6.30	9.54
Manitoba	10.08	10.50	8.48
Saskatchewan	9.79	8.95	13.13
Alberta	12.54	7.60	11.51
British Columbia	14.93	6.14	9.17

Source: CSLS calculations based on the Registered Apprenticeship Information System, Statistics Canada (Table 37-10-0023-01).

viii. Early Childhood Education

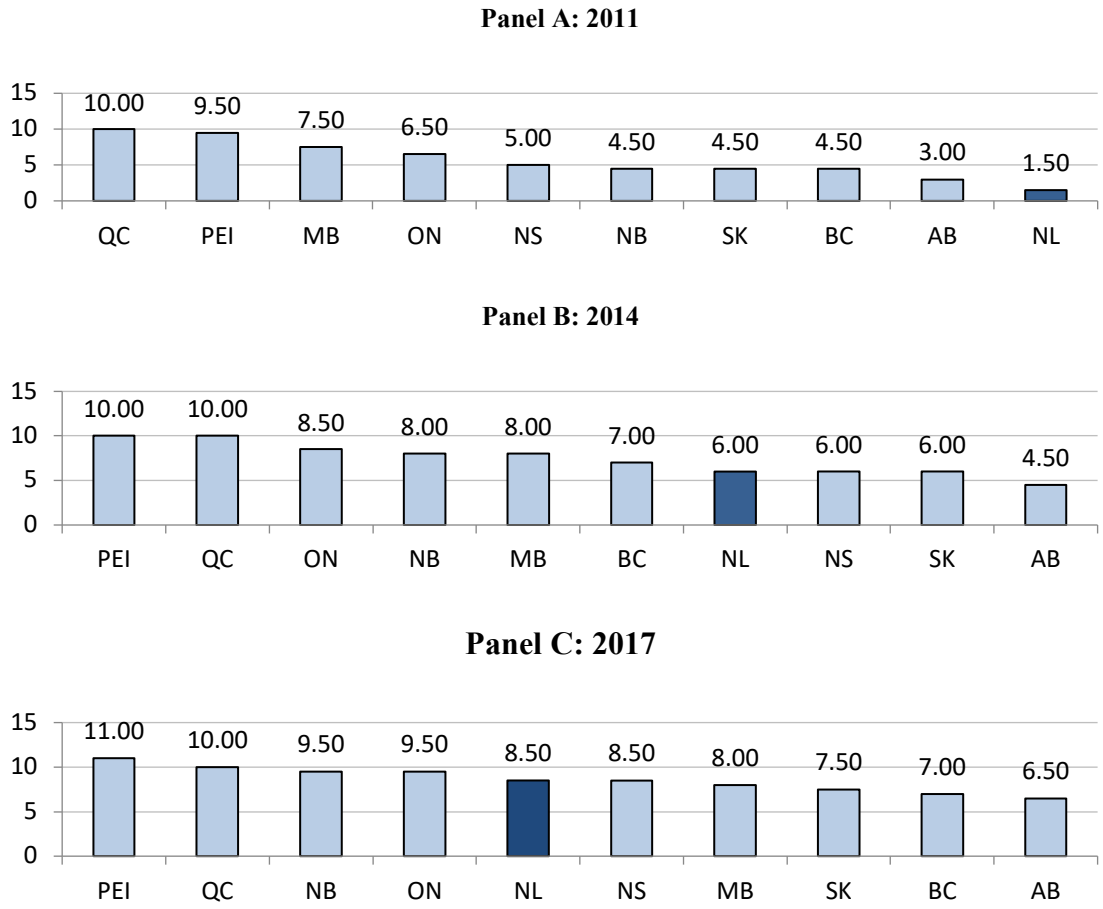
In addition to the quality of high school education, the quality of the future workforce also depends on the quality of early childhood education. The Early Childhood Education Index (ECEI) published in the *Early Childhood Education Report* assesses the quality of early childhood education in the Canadian provinces.[51] The index is based on 19 benchmarks organized

[50] The ideal apprenticeship completion rate is computed by following each trainee to see if they complete the apprenticeship. However, this information is not publicly available. Therefore, we use the number of completions over the number of total registrations as a proxy of the apprenticeship completion rate.

[51] This *Early Childhood Education Report* is published every three years and is maintained by the Atkinson Centre for Society and Child Development. The latest report is available at http://ecereport.ca/en/report/summary-report/summary-report2/.

under five categories: governance, funding, access, learning environment, and accountability. Each category is assigned 3 points for a total of 15 points.

Chart 63: Early Childhood Education Index 2011 and 2014



Note: The total is out of 15.Source: Early Childhood Education Report 2017.

Newfoundland and Labrador's improvement in early childhood education is encouraging. Specifically, the province ranked last in 2011, but fifth in 2017. Indeed, the province had the highest increase in the index between 2011 and 2017.[52] Detail on how Newfoundland and Labrador fared on the 19 benchmarks are found in the Appendix.

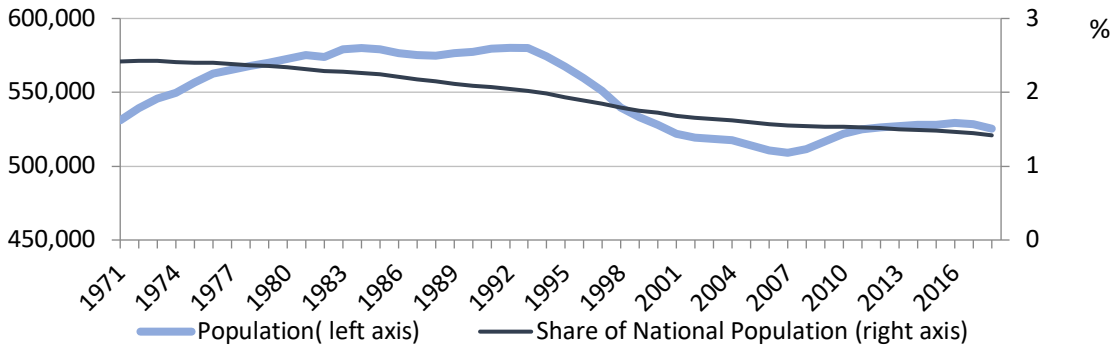
ix. Interprovincial Migration and Demographic Developments

The story of Newfoundland and Labrador's population is one of decline. In 1971, the province's population was 530,854, which accounted for 2.4 per cent of Canada's population (Chart 64). After reaching a peak in 1993, the population in Newfoundland and Labrador has

[52] All provinces except Quebec had higher points in 2017 than 2011. In particular, Newfoundland and Labrador had the greatest increase of 7 points, followed by 5 points in New Brunswick, 3.5 points in Nova Scotia and Alberta, 3 points in Ontario and Saskatchewan, 2.5 points in British Columbia and 1.5 points in Prince Edward Island.

been declining at a rate of 0.98 per cent per year from 1993 to 2007. Starting in 2000, population in the province was lower than its 1971 level. Despite the 0.29 per cent per year increase in the province's population during the 2007-2018 sub-period, the province's population was still below the 1971 level in 2018. Both the declining fertility rate and the large interprovincial out-migration explain this significant decline.[53] Ironically, population in Newfoundland and Labrador fell during the 1997-2007 sub-period when the province's real and nominal GDP were growing.

Chart 64: Newfoundland and Labrador's Population, 1971 – 2018



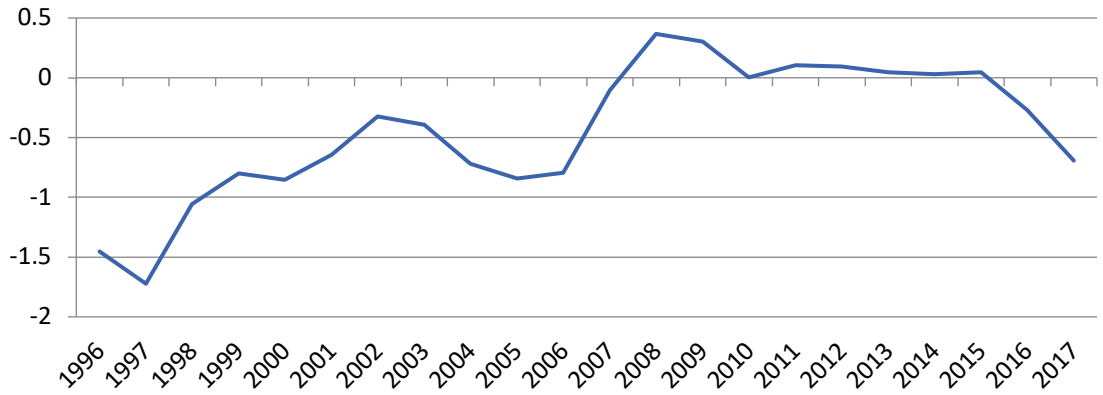
Source: CSLS calculations based on the Annual Demographic Estimates: Canada, Provinces and Territories, Statistics Canada (Table 17-10-0005-01).

Chart 65 illustrates the net interprovincial migration in the province between 1996 and 2017.[54] In 1997, the year when oil production began in the province, net migration of the province fell to -9,490, from -8,134 in 1996. Since then, the amount of outgoing net interprovincial migration diminished in the province because of the oil production. As a result, the net interprovincial migration rose to -5,695 persons in 1998 and reached a peak of 1,877 persons in 2008. During the 2008-2017 period, the net interprovincial migration in the province declined and became negative again in 2016 (-1,954 persons). In 2017, the province's negative net inter-provincial migration doubled and declined to its pre-2008 level (-3,656 persons).

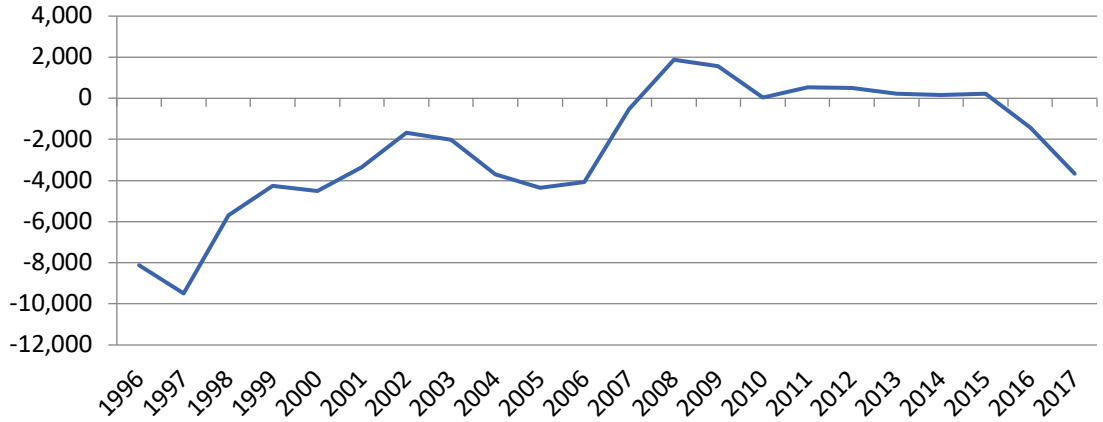
[53] According to Statistics Canada Table 13-10-0418-01, Newfoundland and Labrador's crude birth rate in 2017 was lowest since 2000 (7.7 live births per 1,000 persons in 2017 versus 9.1 live births per 1,000 persons in 2000).
[54] Because the last year available in Statistics Canada's table of net interprovincial migration (table 17-10-0021-01) is 2017, data in Chart 65 end in 2017.

Chart 65: Net Interprovincial Migration, Newfoundland and Labrador, 1996 – 2017

Panel A: As a Per Cent of Population



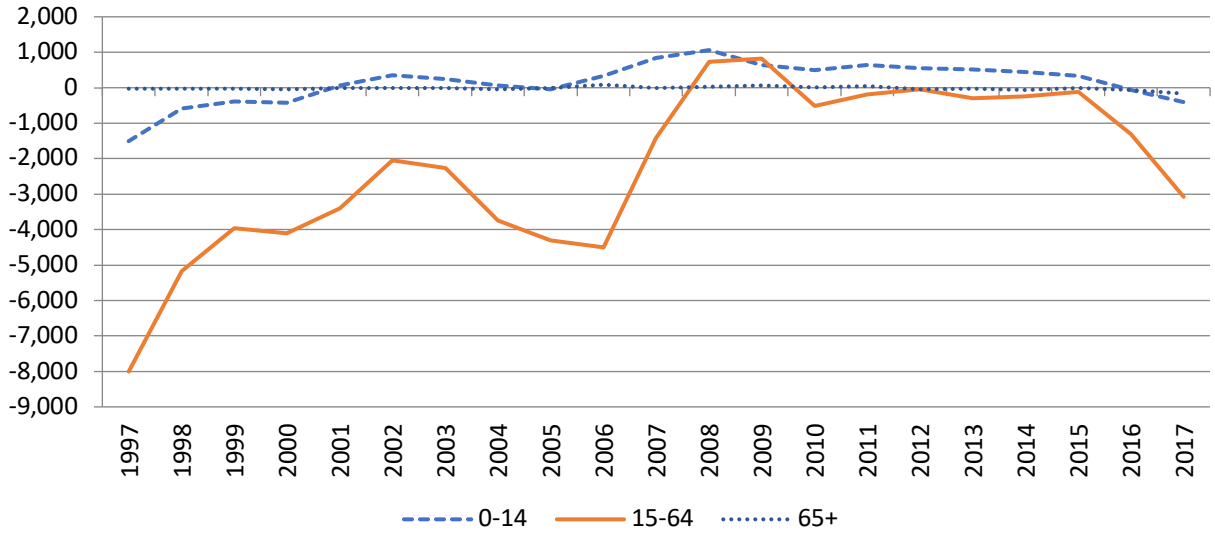
Panel B: Absolute Population Level



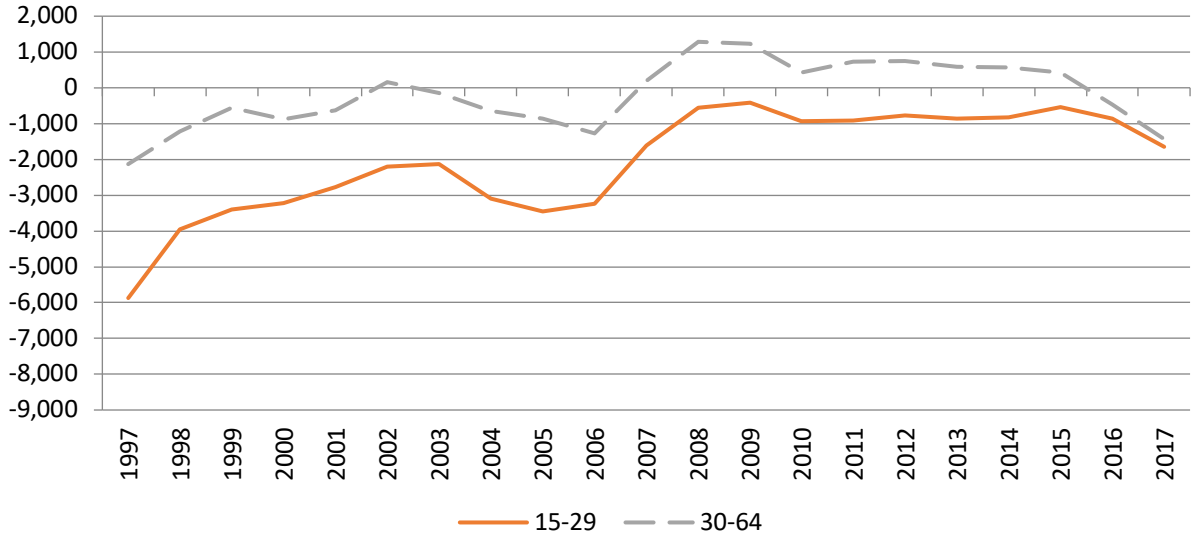
Source: CSLS calculations based on the Annual Demographic Estimates: Canada, Provinces and Territories, Statistics Canada (Table 17-10-0021-01).

Chart 66: Net Interprovincial Migration by Age Group, Newfoundland and Labrador, 1997 – 2017

Panel A: Non-working Age (0-14 and 65+) and Working Age (15-64) Groups



Panel B: Working Age Groups - 15 to 29 Years and 30 to 64 Years of Age



Source: CSLS calculations based on the Annual Demographic Estimates: Canada, Provinces and Territories, Statistics Canada (Table 17-10-0021-01).

Panel A of

Chart 66 further disaggregates Newfoundland and Labrador's absolute level of net interprovincial migration, as shown in Panel B of Chart 65, into the 0 to 14, 15 to 64 and 65 and above age groups. The net interprovincial migration of the population of age 65 and over was stable throughout the 1997-2017 period. During the 1997-2008 period, the net interprovincial migration of the working age population increased from -8,004 persons in 1997 to 727 persons in 2008 as nominal GDP in the province rose. The net interprovincial migration of the population of age 0 to 14 years old follow the same pattern.

The province's net interprovincial migration of the 0 to 14-year-old and the working age group increased during the 1997-2008 period as nominal GDP increased in the province. As the province's nominal GDP declines during the 2008-2017 period, the net interprovincial migration of the 0 to 14-year-old and the working age group fell from 1,060 persons to -404 persons and from 727 to -3,075 persons, respectively.

Despite the short-lived positive interprovincial migration of the working age population in 2008 and 2009 (727 persons and 821 persons respectively, or a total of 1,548 persons in these two years), the number of negative net interprovincial migration in 2017 alone (-3,075 persons) is twice as high as the gain in 2008 and 2009.

Panel B of

Chart 66 breaks down Newfoundland and Labrador's net interprovincial migration of the working age population into the group of age 15 to 29 and 30 to 64. The group of age 15 to 29 accounts for the largest share of the province's net interprovincial migration. Throughout the 1997-2017 period, the population of age 15 to 29 were leaving the province.

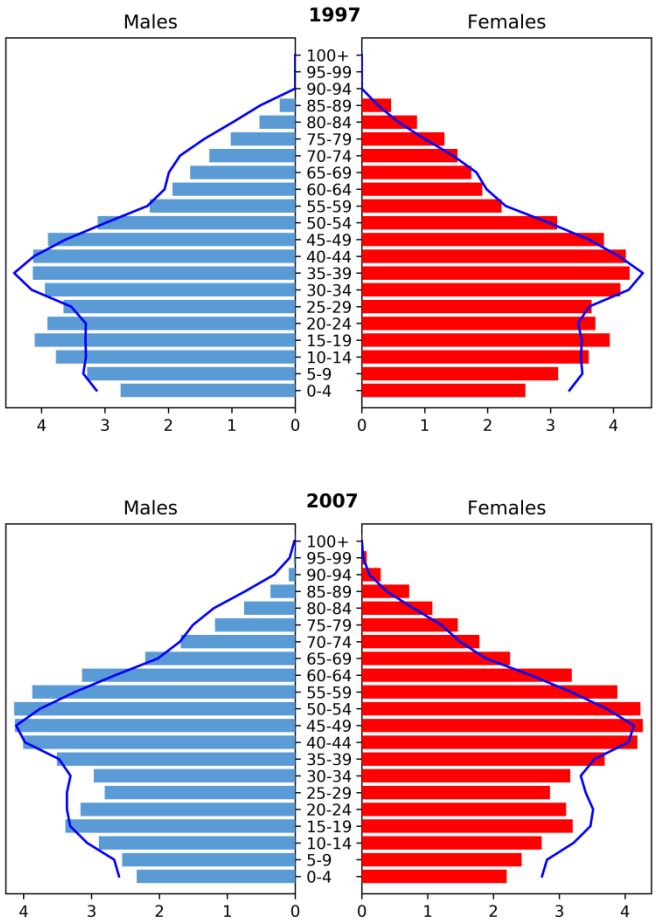
From the Canadian perspective, Tusz, Rodrigues and Calver (2015) showed that interprovincial migration provides significant output gain for Canada as a whole. In 2014, they estimate those gains to be of $15.8 billion (chained 2007 dollars). They also showed that interprovincial migration can increase the aggregate labour productivity of Canada due to a "geographical composition effect." For example, if a worker in one province moves to another province where labour productivity is higher, he will contribute to an increase in aggregate labour productivity since he will increase output without changing the level of national employment. The same phenomenon also happens if an unemployed person in one province finds a job in another province where the average level of labour productivity is higher than the national average. However, if new employment arising from interprovincial migration is disproportionately created in below-average productivity provinces, it would have the opposite effect, i.e. it will tend to decrease aggregate productivity at the national level.

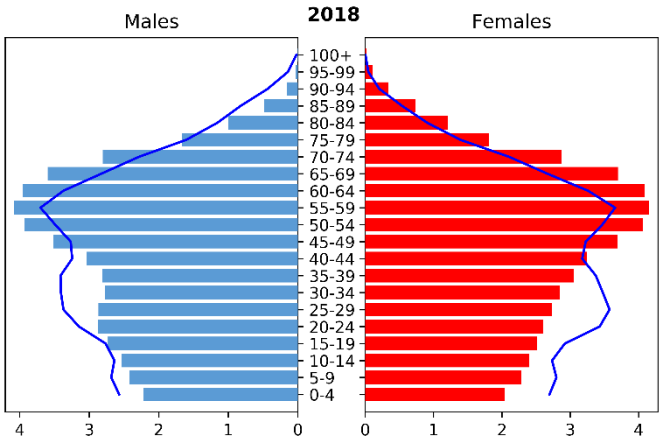
Sharpe, Arseneault and Ershov (2007) estimated that the impact of interprovincial migration on productivity was positive, contributing 0.02 percentage points to labour productivity growth in Canada each year during the 1987-2006 period , or 1.56 per cent of total labour productivity growth. Although this number may seem low, it is important to understand that the effects of interprovincial migration are cumulative, and therefore more important than the simple annual contribution. Therefore, out-migration from Newfoundland and Labrador helps increase the Canadian productivity by moving workers to the most productive sector of the economy, or simply by putting unemployed factors of production to work.

However, from the perspective of a policy planner in Newfoundland and Labrador looking at actual and future productivity, the fact that most of those who out-migrated from Newfoundland and Labrador are persons of age 15 to 29 (Panel B of Chart 62) and well-educated residents is an important problem. According to Coulombe and Tremblay (2007), Newfoundland and Labrador is the province where interprovincial migration is the most harmful to the mean skill level. Furthermore, between 1991 and 2001, there has been a 62 per cent increase in out-migration of skilled knowledge workers (those with more than a high school degree) (Lynch, 2007). Those facts draw attention to two important issues. First, a significant out-migration of well-educated workers can damper growth in human capital and can ultimately slow the growth in labour productivity, or even reduce the level of labour productivity. Second, increased investment in education has little benefit to Newfoundland and Labrador if the people who received this additional education leave the province. Therefore, policy planners in Newfoundland and Labrador will find crucial for the province's economy to create meaningful employment opportunities for well-educated citizens to remain in the province. This issue is further discussed in the section on public policy, at the end of the report.

Another implication of the outflow of the young population in the province was the aging problem. Population pyramids in Chart 67 illustrates the aging problem in Newfoundland and Labrador. While baby boomers in the province are retiring, there are not as many young people entering the workforce in the province. In 2018, 8.2 per cent of Newfoundland and Labrador's population will reach their retirement age over the next 10 years but only 4.7 per cent of population will be at least 15 years of age at the time. The resulting decrease in the working age population in the province may lead to a decline in labour input in the province and a reduction in productivity in the future (Tang and MacLeod, 2006; and Sharpe, 2011). Although Canada is facing the same problem, the problem is more serious in Newfoundland and Labrador, as shown by the profound gap between the curves (representing Canada) and the bars (representing the province) corresponding to ages 15 to 39 of Chart 67.

Chart 67: Population Pyramids, Per Cent of Population by Age Group, Newfoundland and Labrador (Bars) and Canada (Curves), 1997, 2007 and 2018





Source: CSLS calculations based on Annual Demographic Estimates: Canada, Provinces and Territories, Statistics Canada (Table 17-10-0005-01).

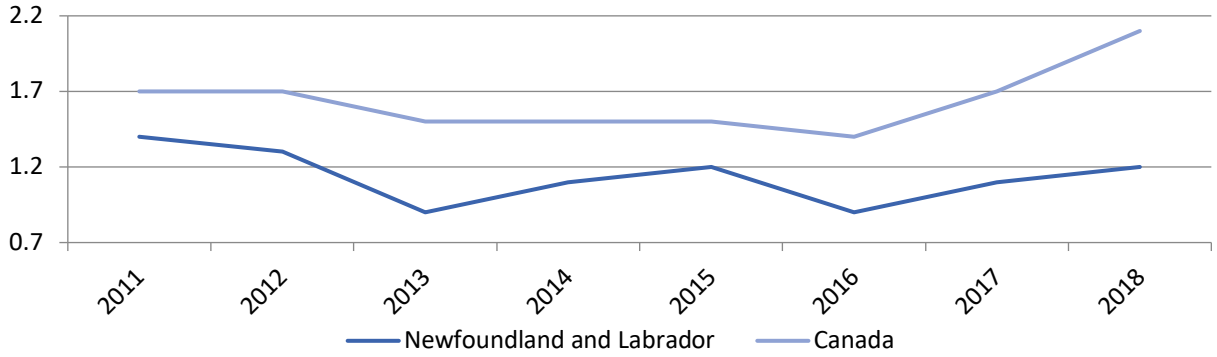
x. Labour Shortages

The existence of labour shortages is often seen as evidence that the supply of labour is inadequate to meet demand, and may indicate that policies on skills development of the work-force have been inadequate. This section briefly discusses the evidence of such shortages in Newfoundland and Labrador, and the implications of shortages for productivity growth.

The best measure of labour shortages is job vacancies. Fortunately, starting in January 2011, Statistics Canada began gathering and providing statistics on job vacancies. Because this is a new data series, long-term trends are not yet available. Those data show no evidence of any general labour shortage in Newfoundland and Labrador. Throughout the 2011-2018 period, the province's job vacancy rates[55] were lower than the national average (Chart 68), and had one of the lowest job vacancy rates. Between 2011 and 2018, the vacancy rate in the province decreased from 1.4 per cent to 1.2 per cent, which is equivalent to a fall of 200 (2600-2400) vacancies.

[55] Job vacancy rate is defined as the number of vacant positions divided by the total labour demand (i.e. vacant positions plus occupied positions).

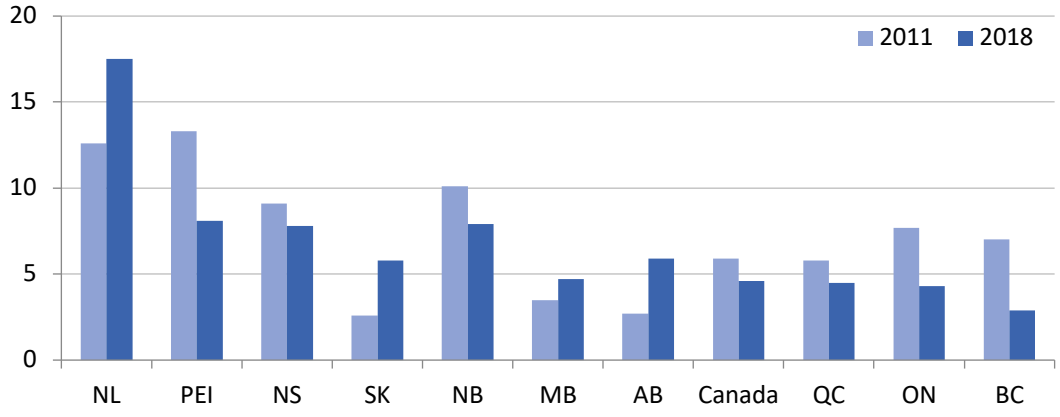
Chart 68: Job Vacancy Rate, Business Sector, Newfoundland and Labrador and Canada, 2011 – 2017



Source: Survey of Employment, Payrolls and Hours, Statistics Canada (Table 14-10-0225-01).

Another useful indicator of labour shortages is the ratio of unemployed people to job vacancies. The existence of a general labour shortage in Newfoundland and Labrador is even less plausible when looking at this indicator (Chart 69). In 2018, the province had the highest ratio of all provinces, at 15.3. In other words, there were around 15.3 unemployed persons looking for a job in Newfoundland and Labrador for each job vacancy. In 2011, that ratio was 12.6. In comparison, the national unemployment-to-job vacancies ratio was 5.9 in 2011 and 3.4 in 2018.

Chart 69: Unemployment-to-job Vacancies Ratio, All Unemployed, by Province, 2011 and 2018



Source: Survey of Employment, Payrolls and Hours, Statistics Canada (Table 14-10-0225-01).

There are, however, some worries of labour shortages in specific industries or specific areas of the province. For instance, Solace Power, a technology company located Mount Pearl in the province, expects to hire from outside the province because the company cannot find the high-skilled workers it needs in the province (Dearing 2018). Also, Vale, the firm building the $4.2 billion nickel processing plant in Long Harbour, had to spend a significant sum of money on cross-country job advertising as well as hire workers outside Newfoundland and Labrador and

Canada (McCarthy, 2011). All things considered, it is more accurate to speak of a labour shortage for certain types of skills rather than a general labour shortage.

B. Investment and Capital Intensity

The relationship between physical capital and productivity is relatively intuitive. If a worker has more capital to work with, he will produce more output per hour. Therefore, if capital input increases at a faster pace than labour input, then the amount of capital per labour input increases, i.e. there is **capital deepening**. The main point to understand here is that the absolute level of capital input is not in itself an indicator of productivity. What matters to productivity is the amount of capital per worker or, better yet, capital per hour worked.

Another reason why investment in physical capital is relevant is because it is the primary means by which technical advances are introduced into the production process. Spending on R&D leads to innovations that ameliorate the quality and efficiency of machinery and equipment. However, the quality improvements introduced by R&D will only affect productivity when these innovations are embodied in the capital stock, through investment.

i. Investment Intensity[56]

Fixed non-residential investment intensity (defined here as real gross investment per hour worked) in Newfoundland and Labrador's total economy grew at a compound annual rate of 4.7 per cent during the 1997-2017 period, higher the national average of 1.4 per cent (Table 49). During the 2007-2017 period, the province's investment intensity of engineering construction grew the fastest compared with other major types of assets in the province (16.2 per cent per year). Therefore, in 2017, among all four major types of assets, the province's investment intensity level of engineering construction was the highest ($14.63 chained 2012 dollars per hour worked), which is more than four times higher than the national average ($3.48 chained 2012 dollars per hour worked). The strong growth in the province's engineering construction investment intensity during the 2007-2017 period and the province's high investment intensity of the asset in 2017 is not a surprise because engineering construction is the principal type of asset used in the mining and oil and gas extraction sector and utilities that had various development projects in the province.

[56] Sharpe and Grand-Maison (2013) examined investment and capital intensity of the business sector in Newfoundland and Labrador. However, this report can only focus on the total economy instead because the business sector aggregate in chained dollars is no longer available on Statistics Canada's website.

Table 49: Fixed Non-residential Real Gross Investment Intensity, Total Economy, Newfoundland and Labrador and Canada, 1997 – 2017

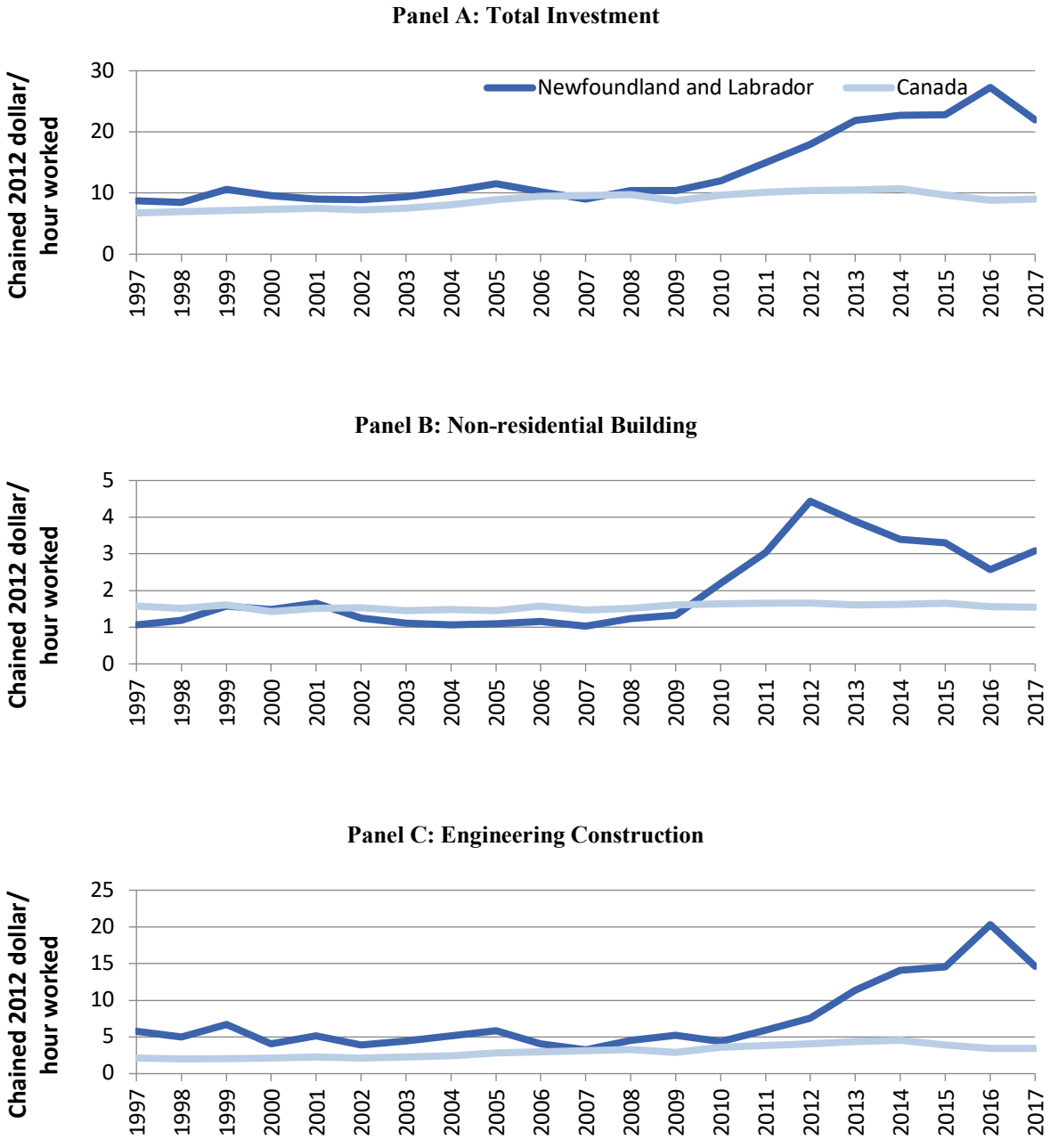
	Newfoundland and Labrador			Canada		
	1997	2007	2017	1997	2007	2017
	(chained 2012 dollars of gross investment per hour worked)					
Total Investment	**8.74**	**9.02**	**21.94**	**6.75**	**9.54**	**8.99**
Building	1.06	1.03	3.08	1.58	1.47	1.54
Engineering	5.81	3.26	14.63	2.10	3.11	3.48
Machinery and Equipment	1.67	2.82	2.54	1.92	3.01	2.40
Intellectual Property Products	0.85	1.85	1.68	1.25	1.88	1.56
	1997-2017	**1997-2007**	**2007-2017**	**1997-2017**	**1997-2007**	**2007-2017**
	(compound annual growth rate, per cent)					
Total Investment	**4.71**	**0.31**	**9.30**	**1.44**	**3.52**	**-0.59**
Building	5.47	-0.31	11.59	-0.12	-0.69	0.45
Engineering	4.73	-5.63	16.22	2.56	4.02	1.12
Machinery and Equipment	2.12	5.39	-1.06	1.12	4.59	-2.24
Intellectual Property Products	3.45	8.06	-0.97	1.11	4.15	-1.84
	1997		**2007**			**2017**
	(NL as a Per Cent of Canada)					
Total Investment	**129.6**		**94.5**			**244.2**
Building	67.2		69.8			199.9
Engineering	276.8		104.6			420.6
Machinery and Equipment	86.9		93.7			105.8
Intellectual Property Products	68.2		98.7			107.7

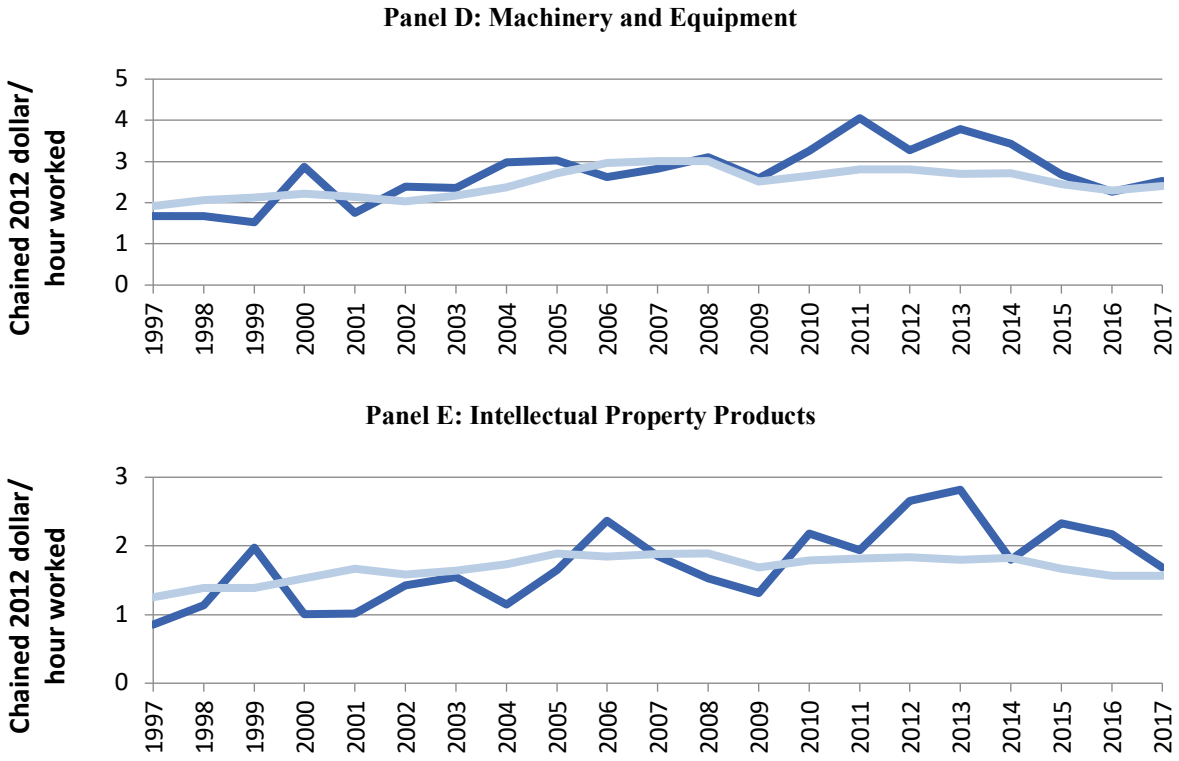
Source: CSLS calculations based on the Canadian Productivity Account (CPA) (Table 36-10-0208-01 and 36-10-0211-01) and the Stock and Consumption of Fixed Non-residential Capital Program (Table 36-10-0096-01), Statistics Canada.

Yet, it is also important to focus on specific capital assets that have a greater impact on productivity. We observe that Newfoundland and Labrador's investment intensity growth during the 1997-2017 period was higher than Canada's in machinery and equipment assets (2.1 per cent per year versus 1.1 per cent per year) as well as in intellectual property products assets (3.5 per cent per year versus 1.1 per cent per year), two types of assets that economists believe to be strongly correlated with productivity growth.

Chart 70 shows the investment intensity levels of the total investment, non-residential building, machinery and equipment, intellectual property products and engineering construction in the total economy of Newfoundland and Labrador and Canada from 1997 to 2017. Newfoundland and Labrador's total investment intensity took off in 2007. Among the four major types of assets, the province's investment intensity of engineering construction and non-residential building took off in 2007 also, but that of non-residential building declined from 2012 to 2017. The province's investment intensity of the remaining two major types of assets, intellectual property products and machinery and equipment, fluctuated over the 1997-2017 period.

Chart 70: Fixed Non-residential Real Gross Investment Intensity by Asset Type, Total Economy, Newfoundland and Labrador and Canada, 1997 – 2017





Source: CSLS calculations based on the Canadian Productivity Account (CPA) (Table 36-10-0480-01) and the Stock and Consumption of Fixed Non-residential Capital Program (Table 36-10-0096-01), Statistics Canada.

Table 50 provides investment intensity levels and growth rates at the two-digit NAICS level for both Newfoundland and Labrador and Canada for the 1997-2017 period. It is not surprising that mining and oil and gas extraction and utilities in both the province and Canada had the highest investment intensity levels compared with other sub-sectors of the business sector because these two sectors are capital intensive. Other sub-sectors, on the other hand, require relatively less capital. Therefore, the goods sector investment intensity levels in the province were higher than the services sector. In particular, in 2017, the province's investment intensity level in the goods sector was higher than the service sector by a factor of 11 ($64.33 chained 2012 dollars per hour versus $5.90 chained 2012 dollars per hour).

The difference in investment intensity among sub-sectors in Newfoundland and Labrador was massive. In particular, in 2017, the utilities sector ($713.43 chained 2012 dollars per hour worked) had investment intensity level almost 16 times as high as that of the third highest sector (manufacturing, $44.81 chained 2012 dollars per hour worked) because of the Muskrat Falls project. In addition, the investment intensity level of the mining and oil and gas extraction sector ($220.86 chained 2012 dollars per hour worked) in 2017 was almost five times as high as that of the manufacturing sector. This large difference in investment intensity levels matches with the predominance of the mining and oil and gas extraction sector in the province's economy with respect to output.

Table 50: Fixed Non-residential Real Gross Investment Intensity by Two-digit NAICS Sector, Business Sector, Newfoundland and Labrador and Canada, 1997 – 2017

	Newfoundland and Labrador			Canada		
	1997	2007	2017	1997	2007	2017
	(chained 2012 dollars of investment per hour worked)					
Total Economy	**8.74**	**9.02**	**21.94**	**6.75**	**9.54**	**8.99**
Business sector industries	**10.64**	**9.96**	**28.14**	**6.69**	**9.29**	**8.46**
Agriculture, forestry, fishing and hunting	2.34	4.16	4.90	5.02	6.26	8.23
Mining and oil and gas extraction	211.54	128.20	220.86	119.93	148.20	100.15
Utilities	32.43	28.21	713.43	55.47	110.40	143.75
Construction	1.13	3.13	1.22	1.66	2.21	2.29
Manufacturing	6.90	6.50	44.81	6.78	6.84	7.00
Goods-Producing Industries	**24.42**	**22.53**	**64.33**	**11.68**	**16.59**	**15.09**
Wholesale trade	2.18	1.85	4.94	2.99	3.68	3.70
Retail trade	2.09	2.54	1.98	2.05	3.50	2.43
Transportation and warehousing	16.59	13.97	15.94	8.39	11.99	19.53
Information and cultural industries	15.10	19.49	39.20	19.46	19.09	25.37
Finance and insurance, and holding companies	3.61	6.89	2.87	7.01	10.10	4.89
Real estate, rental and leasing	2.03	21.81	42.52	19.01	26.74	22.23
Professional, scientific and technical services	1.91	5.29	4.32	1.97	3.18	3.26
ASWMRS	2.22	0.85	0.81	0.87	1.23	1.63
Arts, entertainment and recreation	0.47	0.88	30.82	3.17	4.93	5.93
Accommodation and food services	0.67	0.88	3.19	1.10	1.99	1.99
Other private services	0.19	0.45	0.39	0.81	1.35	0.69
Service-producing Industries	**3.76**	**4.60**	**5.90**	**4.08**	**5.82**	**5.69**
Business sector without mining and oil and gas extraction	**4.24**	**5.12**	**17.76**	**4.87**	**6.47**	**6.59**
	Newfoundland and Labrador			**Canada**		
	1997-2017	**1997-2007**	**2007-2017**	**1997-2017**	**1997-2007**	**2007-2017**
	(compound annual growth rates, per cent)					
Total Economy	**4.71**	**0.31**	**9.30**	**1.44**	**3.52**	**-0.59**
Business sector industries	**4.98**	**-0.66**	**10.95**	**1.18**	**3.35**	**-0.94**
Agriculture, forestry, fishing and hunting	3.76	5.93	1.63	2.51	2.25	2.77
Mining and oil and gas extraction	0.22	-4.88	5.59	-0.90	2.14	-3.84
Utilities	16.71	-1.38	38.13	4.88	7.12	2.68
Construction	0.42	10.75	-8.96	1.62	2.92	0.34
Manufacturing	9.80	-0.59	21.29	0.16	0.09	0.23
Goods-Producing Industries	**4.96**	**-0.80**	**11.06**	**1.29**	**3.57**	**-0.94**
Wholesale trade	4.18	-1.61	10.30	1.07	2.09	0.07
Retail trade	-0.27	1.96	-2.44	0.86	5.51	-3.59
Transportation and warehousing	-0.20	-1.70	1.33	4.31	3.63	5.00

Information and cultural industries	4.88	2.58	7.24	1.34	-0.19	2.89
Finance and insurance, and holding companies	-1.15	6.67	-8.41	-1.78	3.72	-6.99
Real estate, rental and leasing	16.42	26.79	6.90	0.79	3.47	-1.83
Professional, scientific and technical services	4.18	10.75	-2.00	2.54	4.89	0.25
ASWMRS	-4.93	-9.09	-0.58	3.20	3.53	2.87
Arts, entertainment and recreation	23.32	6.58	42.70	3.18	4.52	1.87
Accommodation and food services	8.14	2.79	13.78	2.99	6.09	-0.02
Other private services	3.84	9.31	-1.36	-0.81	5.20	-6.47
Service-producing Industries	**2.28**	**2.04**	**2.53**	**1.67**	**3.61**	**-0.23**
Business sector without mining and oil and gas extraction	**7.42**	**1.89**	**13.25**	**1.52**	**2.87**	**0.19**

Source: CSLS calculations based on the Canadian Productivity Account (CPA) (Table 36-10-0208-01 and 36-10-0211-01) and the Stock and Consumption of Fixed Non-residential Capital Program (Table 36-10-0096-01), Statistics Canada.

Because of the development of the Hebron oil field and the Muskrat Falls project, investment intensity in the province's mining and oil and gas extraction and utilities switched from decline during the 1997-2017 sub-period (-4.9 per cent per year and -1.4 per cent per year respectively) to growth during the 2007-2017 sub-period (5.6 per cent per year and 38.1 per cent per year respectively). Among the other sub-sectors of the province, arts, entertainment and recreation (42.7 per cent) had the highest annual growth during the 2007-2017 sub-period because of the construction and restoration of numerous recreational facilities in the province. The manufacturing sector also had a robust annual growth (21.3 per cent) during the 2007-2017 sub-period.

Table 51 shows that the business sector investment intensity level in Newfoundland and Labrador was higher than the national average in 1997, 2007 and 2017.[57] At the two-digit NAICS level, in 2017, 9 of 16 sub-sectors of the business sector had higher investment intensity level in the province than Canada. The relative level of investment intensity was the largest in manufacturing (640.2 per cent), followed by arts, entertainment and recreation (519.4 per cent), utilities (496.3 per cent) and mining and oil and gas extraction (220.5 per cent).

Table 51: Newfoundland and Labrador's Real Gross Investment Intensity as a Per Cent of Canada's by Two-digit NAICS Sector, Business Sector, 1997 – 2017

	Newfoundland and Labrador		
	1997	**2007**	**2017**
	(province's investment intensity level as a percent of Canada's)		
Total Economy	**129.6**	**94.5**	**244.2**
Business sector industries	**159.2**	**107.1**	**332.7**
Agriculture, forestry, fishing and hunting	46.7	66.5	59.5
Mining and oil and gas extraction	176.4	86.5	220.5

[57] Indeed, the business sector investment intensity in Newfoundland and Labrador from was higher than the national average throughout the 1997-2017 period. Database tables 122 and 123 contain sectoral annual investment intensity in Newfoundland and Labrador and Canada respectively.

Utilities	58.5	25.6	496.3
Construction	67.9	141.4	53.5
Manufacturing	101.8	95.1	640.2
Goods-Producing Industries	**209.0**	**135.8**	**426.2**
Wholesale trade	72.9	50.4	133.4
Retail trade	102.1	72.5	81.6
Transportation and warehousing	197.6	116.6	81.6
Information and cultural industries	77.6	102.1	154.5
Finance and insurance, and holding companies	51.5	68.3	58.5
Real estate, rental and leasing	10.7	81.5	191.3
Professional, scientific and technical services	96.5	166.3	132.6
ASWMRS	255.3	69.5	49.4
Arts, entertainment and recreation	14.7	17.9	519.4
Accommodation and food services	60.4	44.0	160.3
Other private services	22.8	33.5	57.0
Service-producing Industries	**92.0**	**78.9**	**103.7**
Business sector without mining and oil and gas extraction	**87.1**	**79.1**	**269.5**

Source: CSLS calculations based on the Canadian Productivity Account (CPA) (Table 36-10-0208-01 and 36-10-0211-01) and the Stock and Consumption of Fixed Non-residential Capital Program (Table 36-10-0096-01), Statistics Canada.

ii. Capital Stock Intensity[58]

Investment intensity growth is a good indicator of the pace at which technical change and innovation are introduced into the production process. However, even more important in the analysis of productivity trends is the positive relationship between the amount of capital per worker, or even better, capital per hour worked, and labour productivity (output per hour). In this section, we study this relationship with the help of capital stock intensity, defined here as real net capital stock per hour worked.

Table 52: Fixed Non-residential Real Net Capital Stock Intensity in Newfoundland and Labrador and Canada, Total Economy, 1997-2017

	Newfoundland and Labrador			Canada		
	1997	**2007**	**2017**	**1997**	**2007**	**2017**
	(chained 2012 dollars of gross investment per hour worked)					
Total Investment	**83.04**	**87.66**	**159.67**	**52.13**	**58.82**	**70.16**
Building	14.01	14.18	28.45	17.31	16.64	17.89
Engineering	55.37	52.44	104.85	22.47	24.81	35.48
Machinery and Equipment	8.89	12.05	13.92	8.49	10.62	10.40
Intellectual Property Products	5.97	9.11	13.10	4.41	6.62	6.48
	1997-2017	**1997-2007**	**2007-2017**	**1997-2017**	**1997-2007**	**2007-2017**
	(compound annual growth rate, per cent)					
Total Investment	**3.32**	**0.54**	**6.18**	**1.50**	**1.21**	**1.78**
Building	3.61	0.12	7.21	0.17	-0.39	0.73
Engineering	3.24	-0.54	7.17	2.31	0.99	3.64
Machinery and Equipment	2.27	3.09	1.45	1.02	2.27	-0.22

[58]It would be better to look at capital service intensity instead of capital stock intensity. However, Statistics Canada does not provide capital service levels by asset type. Therefore, we examine capital stock intensity instead.

Intellectual Property Products	4.01	4.32	3.70	1.94	4.13	-0.21
	1997		**2007**			**2017**
	(NL as a Per Cent of Canada)					
Total Investment	**159.27**		**149.04**			**227.57**
Building	80.96		85.24			159.07
Engineering	246.39		211.35			295.49
Machinery and Equipment	104.70		113.45			133.85
Intellectual Property Products	135.24		137.73			202.16

Source: CSLS calculations based on the Canadian Productivity Account (CPA) (Table 36-10-0208-01 and 36-10-0211-01) and the Stock and Consumption of Fixed Non-residential Capital Program (Table 36-10-0096-01), Statistics Canada.

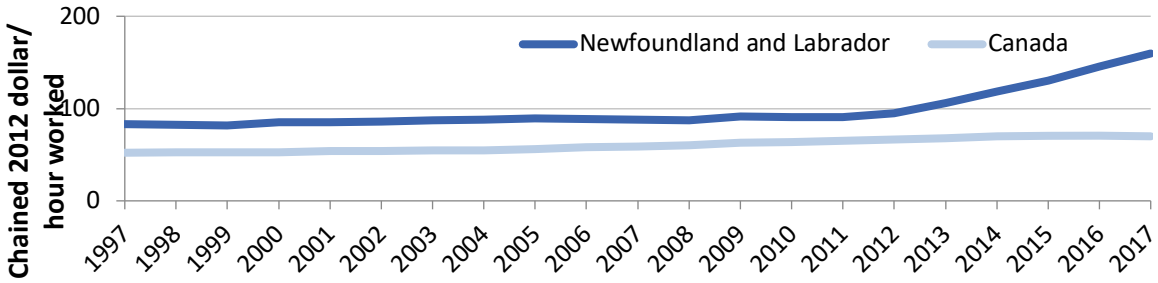
In 2017, the capital intensity levels of total (fixed, non-residential) investment and all four major types of assets in Newfoundland and Labrador's total economy were all higher than the corresponding national average (Error! Reference source not found.). In particular, the capital intensity of the province's total investment was 2.3 times as high as that in Canada ($159.67 chained 2012 dollars per hour versus $70.16 chained 2012 dollars per hour). Among all major types of assets in the province, the capital intensity level of engineering construction was the highest in 2017, as well as in 1997 and 2007.[59] It is notable that the capital intensity of engineering construction in the province almost doubled between 2007 and 2017 ($52.44 chained 2012 dollars per hour versus $104.85 chained 2012 dollars per hour worked), which is equivalent to having grown at a rate of 7.2 per cent per year during the 2007-2017 period. It is notable that the compound annual growth rate of the capital intensity of engineering construction in the province during the 2007-2017 period was small compared with the investment intensity of the province's engineering construction (7.2 per cent per year versus 16.2 per cent per year) because of high depreciation.

Because the capital-intensive mining and oil and gas extraction sector dominated the province's output and capital stock, the province had a higher capital intensity level in total investment, engineering construction and intellectual property products than the national average throughout the 1997-2017 period (Panel A, C and E of Chart 71). The capital intensity level of engineering construction and hence that of total investment took off in 2012 owing to increases in investment in various mining and oil and gas extraction projects, as mentioned in section II. Moreover, the capital intensity of non-residential building in the province started to increase in 2008 and exceeded the national average in 2012 (Panel B of Chart 71). The relative machinery and equipment capital intensity level between the province and Canada also rose since 2000 (Panel D of Chart 71).

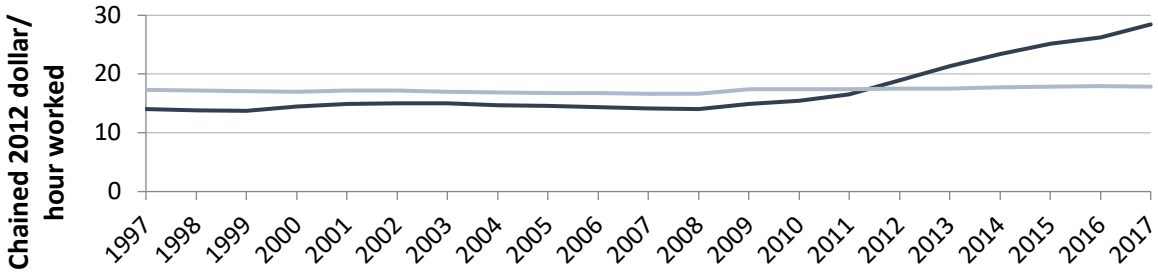
Chart 71: Fixed Non-residential Real Net Capital Intensity by Asset Type, Total Economy, Newfoundland and Labrador and Canada, 1997 – 2017

Panel A: Total Investment

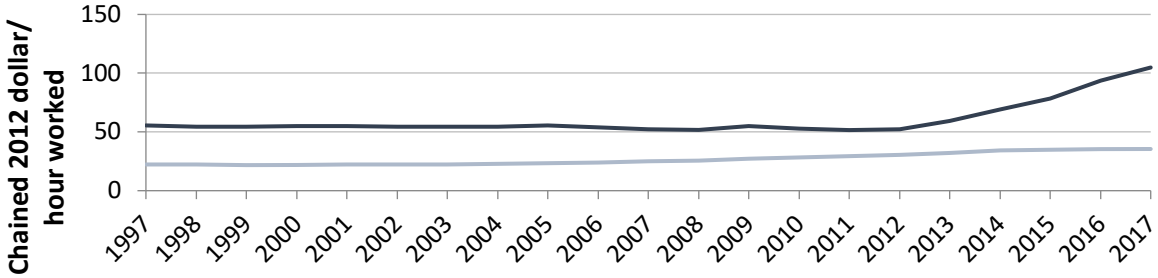
[59] Indeed, the capital intensity level of engineering construction in the province's total economy was the highest for every year from 1997 to 2017. Table 128 in the database contains the capital intensity level of all four major types of assets in the province's total economy from 1997 to 2017.



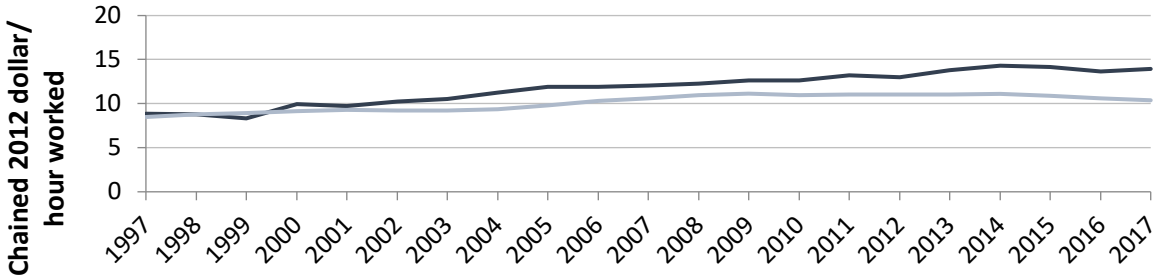
Panel B: Non-residential Building



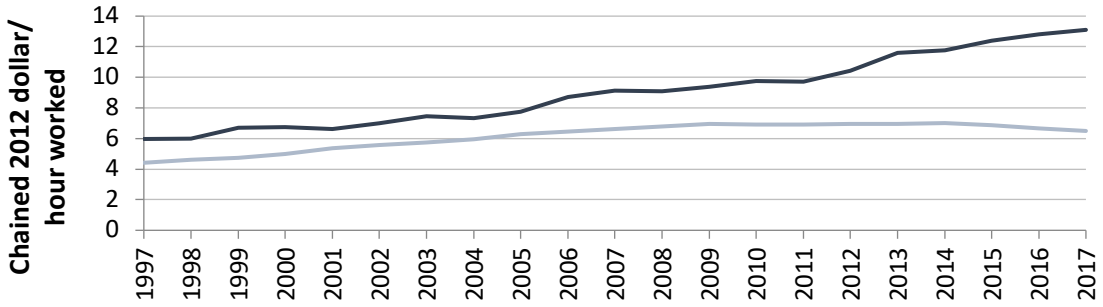
Panel C: Engineering Construction



Panel D: Machinery and Equipment



Panel E: Intellectual Property Products



Source: CSLS calculations based on the Canadian Productivity Account (CPA) (Table 36-10-0208-01 and 36-10-0211-01) and the Stock and Consumption of Fixed Non-residential Capital Program (Table 36-10-0096-01), Statistics Canada.

Table 53: Non-residential Real Net Capital Stock Intensity in Newfoundland and Labrador and Canada, Business Sector, Sectoral Breakdown, 1997 – 2017

	Newfoundland and Labrador			Canada		
	1997	2007	2017	1997	2007	2017
	(chained 2012 dollars of capital stock per hour worked)					
Total Economy	**83.04**	**87.66**	**159.67**	**52.13**	**58.82**	**70.16**
Business sector industries	**92.64**	**99.24**	**196.67**	**48.77**	**56.41**	**66.53**
Agriculture, forestry, fishing and hunting	30.72	43.12	61.29	36.87	46.92	57.12
Mining and oil and gas extraction	1737.90	1631.92	2166.70	773.20	947.56	1241.58
Utilities	798.12	625.58	3041.54	1138.69	1047.19	1480.89
Construction	8.43	11.00	7.27	9.12	9.57	10.80
Manufacturing	51.90	50.23	332.15	40.02	41.32	42.81
Goods-Producing Industries	**237.96**	**285.26**	**462.91**	**91.09**	**112.67**	**149.74**
Wholesale trade	11.36	12.58	21.50	11.26	14.34	18.06
Retail trade	10.65	11.75	19.54	11.18	15.82	15.69
Transportation and warehousing	61.71	68.32	107.10	70.87	80.74	119.35
Information and cultural industries	87.80	93.45	168.15	86.83	96.46	99.53
Finance and insurance, and holding companies	14.81	25.21	19.05	25.21	35.96	23.27
Real estate, rental and leasing	129.25	129.63	147.79	236.98	168.10	133.81
Professional, scientific and technical services	4.06	11.11	14.99	5.36	9.78	11.13
ASWMRS	9.76	2.49	5.14	3.26	4.07	7.60
Arts, entertainment and recreation	17.69	17.31	91.70	25.00	28.71	34.84
Accommodation and food services	5.69	7.81	18.20	11.28	12.96	14.75
Other private services	1.86	4.21	8.84	4.76	8.62	8.62
Service-producing Industries	**20.23**	**21.97**	**33.28**	**25.80**	**29.75**	**31.52**
Business sector without mining and oil and gas extraction	**38.24**	**36.06**	**90.32**	**36.83**	**38.30**	**42.45**

	Newfoundland and Labrador			Canada		
	1997-2017	1997-2007	2007-2017	1997-2017	1997-2007	2007-2017
	(compound annual growth rates, per cent)					
Total Economy	**3.32**	**0.54**	**6.18**	**1.50**	**1.21**	**1.78**
Business sector industries	**3.84**	**0.69**	**7.08**	**1.56**	**1.47**	**1.66**
Agriculture, forestry, fishing and hunting	3.51	3.45	3.58	2.21	2.44	1.99
Mining and oil and gas extraction	1.11	-0.63	2.88	2.40	2.05	2.74
Utilities	6.92	-2.41	17.13	1.32	-0.83	3.53
Construction	-0.74	2.69	-4.06	0.85	0.48	1.22
Manufacturing	9.73	-0.33	20.79	0.34	0.32	0.35
Goods-Producing Industries	**3.38**	**1.83**	**4.96**	**2.52**	**2.15**	**2.88**
Wholesale trade	3.24	1.02	5.50	2.39	2.45	2.33
Retail trade	3.08	0.99	5.22	1.71	3.53	-0.09
Transportation and warehousing	2.80	1.02	4.60	2.64	1.31	3.99
Information and cultural industries	3.30	0.63	6.05	0.69	1.06	0.31
Finance and insurance, and holding companies	1.27	5.47	-2.76	-0.40	3.62	-4.26

Real estate, rental and leasing	0.67	0.03	1.32	-2.82	-3.38	-2.26
Professional, scientific and technical services	6.74	10.58	3.04	3.72	6.21	1.30
ASWMRS	-3.15	-12.78	7.53	4.32	2.23	6.44
Arts, entertainment and recreation	8.58	-0.22	18.14	1.67	1.40	1.95
Accommodation and food services	5.98	3.21	8.83	1.35	1.39	1.30
Other private services	8.12	8.53	7.72	3.02	6.12	0.00
Service-producing Industries	**2.52**	**0.83**	**4.24**	**1.01**	**1.43**	**0.58**
Business sector without mining and oil and gas extraction	**4.39**	**-0.59**	**9.62**	**0.71**	**0.39**	**1.03**

Source: CSLS calculations based on the Canadian Productivity Account (CPA) (Table 36-10-0208-01 and 36-10-0211-01) and the Stock and Consumption of Fixed Non-residential Capital Program (Table 36-10-0096-01), Statistics Canada.

Table 53 provides fixed, non-residential capital stock intensity level and growth rate at the two-digit NAICS level for both Newfoundland and Labrador's and Canada's business sector for the 1997-2017 period. All these subsectors of the business sector in Newfoundland and Labrador except construction had higher capital stock intensity growth rates than Canada during the 2007-2017 sub-period. In fact, it is surprising to see that Newfoundland and Labrador's construction was the only sector that experienced a decline in capital stock intensity during the 1997-2017 period. Specifically, it decreased from $8.43 per hour worked in 1997 to $7.27 per hour worked in 2017 (both in chained 2012 dollars). This reduction in capital intensity level was due to a significant increase in hours worked, as capital stock grew at a slower rate (3.39 per cent per year versus 4.16 per cent per year) during the 1997-2017 period.

Table 54: Newfoundland and Labrador's Real Net Capital Intensity as a Canadian Average, Sectoral Breakdown, 1997, 2007 and 2017

	Newfoundland and Labrador		
	1997	**2007**	**2017**
	(province's investment intensity level as a percent of Canada's)		
Total Economy	**159.3**	**149.0**	**227.6**
Business sector industries	**189.9**	**175.9**	**295.6**
Agriculture, forestry, fishing and hunting	83.3	91.9	107.3
Mining and oil and gas extraction	224.8	172.2	174.5
Utilities	70.1	59.7	205.4
Construction	92.5	115.0	67.3
Manufacturing	129.7	121.6	776.0
Goods-Producing Industries	**261.3**	**253.2**	**309.2**
Wholesale trade	100.9	87.7	119.0
Retail trade	95.2	74.3	124.6
Transportation and warehousing	87.1	84.6	89.7
Information and cultural industries	101.1	96.9	168.9
Finance and insurance, and holding companies	58.7	70.1	81.9
Real estate, rental and leasing	54.5	77.1	110.5
Professional, scientific and technical services	75.8	113.5	134.6
ASWMRS	299.1	61.1	67.7
Arts, entertainment and recreation	70.8	60.3	263.2
Accommodation and food services	50.5	60.3	123.4
Other private services	39.0	48.8	102.6
Service-producing Industries	**78.4**	**73.9**	**105.6**
Business sector without mining and oil and gas extraction	**103.8**	**94.2**	**212.8**

Source: CSLS calculations based on the Canadian Productivity Account (CPA) (Table 36-10-0208-01 and 36-10-0211-01) and the Stock and Consumption of Fixed Non-residential Capital Program (Table 36-10-0096-01), Statistics Canada.

Table 54 shows that most subsectors of the business sector in Newfoundland and Labrador became more capital intensive from 1997 to 2017. In particular, in 1997 only 5 of 16

subsectors of the business sector had capital intensity level higher than the national average while in 2017 most subsectors of the business sector (12 of 16 subsectors) in the province were more capital intensive than the national averages.

C. Innovation[60]

In the introduction to this section, we establish that increases in labour productivity come from three sources: (1) human capital, (2) capital intensity and (3) innovation. Innovation can be either embodied in physical capital or disembodied in the form of, for example, organizational change. Productivity can also be significantly raised if more appropriate management practices are introduced, if firms learn how to better exploit existing technologies or if new and enhanced processes are developed.

The question then becomes how firms, governments and individuals can develop better-quality physical capital and how knowledge can be created and diffused, thus improving the quality of human capital and creating intangible value in the form of better management practices and production processes. The innovation process is complex and necessitates a suitable incentive structure, the appropriate a priori knowledge and considerable investment in knowledge creation and knowledge diffusion. It is this final element, expenditures on research and development (R&D), on which we focus our attention here.

Table 55: R&D Expenditures Levels and Growth in Canada and the Provinces, 1997 – 2016

	1997	2007	2016
	(Million Current Dollar)		
Canada	**14,635**	**30,038**	**34,350**
Newfoundland and Labrador	103	261	361
Prince Edward Island	18	60	82
Nova Scotia	257	509	610
New Brunswick	127	324	356
Quebec	3,953	7,950	8,761
Ontario	7,525	14,059	15,258
Manitoba	271	600	828
Saskatchewan	288	503	723
Alberta	1051	2,709	3,155
British Columbia	1038	2,838	4,035
	1997-2016	**1997-2007**	**2007-2016**
	(compound annual growth rates, per cent)		
Canada	**4.59**	**7.46**	**1.50**
Newfoundland and Labrador	6.82	9.74	3.67
Prince Edward Island	8.31	12.79	3.53
Nova Scotia	4.65	7.07	2.03
New Brunswick	5.57	9.82	1.05
Quebec	4.28	7.24	1.09
Ontario	3.79	6.45	0.91
Manitoba	6.05	8.27	3.64
Saskatchewan	4.96	5.73	4.11
Alberta	5.96	9.93	1.71
British Columbia	7.41	10.58	3.99

[60] Because Statistics Canada's data on R&D expenditure at the provincial level are most recently available in 2016, analysis in this subsection spans from 1997 to 2016.

	1997	2007	2016
	(province as a per cent of Canada)		
Canada	**100**	**100**	**100.00**
Newfoundland and Labrador	0.7	0.9	1.05
Prince Edward Island	0.1	0.2	0.24
Nova Scotia	1.8	1.7	1.78
New Brunswick	0.9	1.1	1.04
Quebec	27	26.5	25.51
Ontario	51.4	46.8	44.42
Manitoba	1.9	2	2.41
Saskatchewan	2	1.7	2.10
Alberta	7.2	9	9.18
British Columbia	7.1	9.4	11.75

Source: CSLS calculations based on Statistics Canada Table (Table 27-10-0273-01).

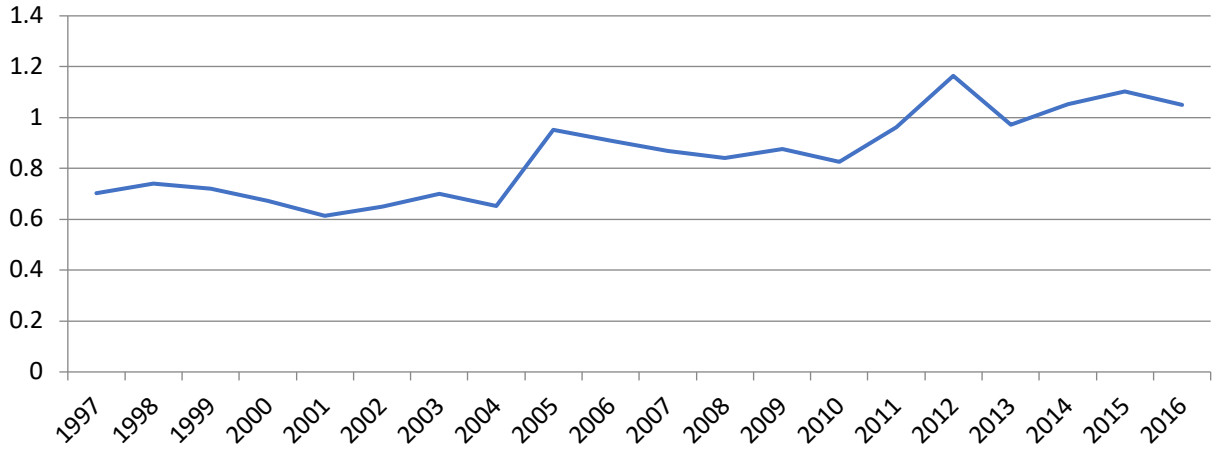
In 2016,[61] nominal R&D expenditure in Newfoundland and Labrador reached $361 million, up from $103 million in 1997 and $261 million in 2007 and grew at a rate of 6.8 per cent per year during the 1997-2016 period (Table 55). R&D expenditures increased at a lower rate in Canada during the 1997-2016 period (4.6 per cent per year). Compared to other provinces, Newfoundland and Labrador ranked third in terms of its R&D expenditure annual growth rate during the 1997-2016 period, behind Prince Edward Island (8.3 per cent per year) and British Columbia (7.4 per cent per year).

R&D expenditures in Newfoundland and Labrador as a share of Canada's had a two-step increase during the 1997-2016 period (Chart 72). The first step took place in 2005 when the share rose by 0.3 percentage points from 0.65 per cent in 2004 to 0.95 per cent. The second increase took place from 2010 to 2012 when the share rose from 0.83 per cent in 2010 to 1.16 per cent in 2012.

Given the increase in population in Newfoundland and Labrador at a rate of 0.5 per cent per year during the 2007-2015 period and the decline in nominal GDP at -0.7 per cent per year during the 2007-2015 period, the 4.5 per cent per year rise in R&D expenditure in the province was quite high.

[61] Statistics Canada provides data on R&D expenditure from 1963 to 2018 (Table 27-10-0273-01) at the national level. However, R&D expenditure data at the provincial level are available only up to and including 2016. Therefore, our analysis pertinent to R&D expenditure in this report ends in 2016.

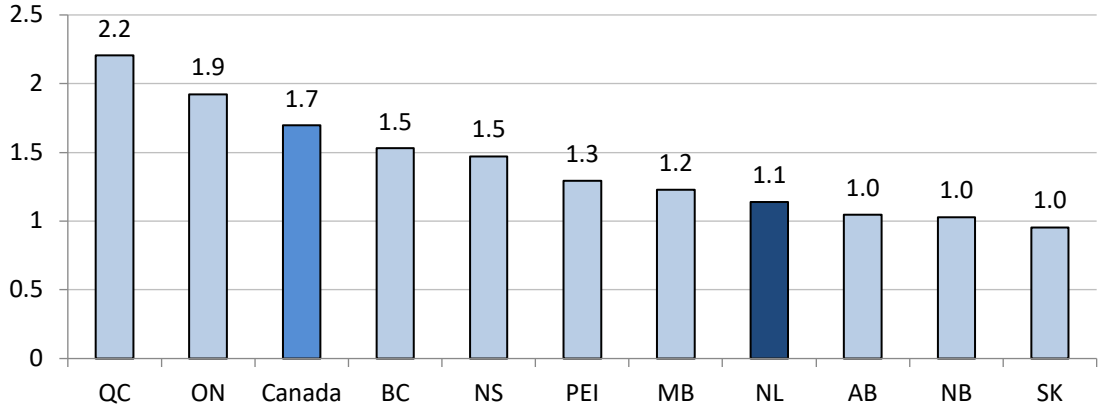
Chart 72: R&D Expenditures in Newfoundland and Labrador as a Share of Canada's, 1997 – 2016



Source: CSLS calculations based on Statistics Canada Table (Table 27-10-0273-01).

Since R&D expenditure levels do not take into account the size in the economic performance of each region, R&D intensity, defined here as the ratio of R&D expenditures to nominal GDP,[62] is usually considered as a better indicator of R&D effort. In 2016, R&D intensity in Newfoundland and Labrador was at 1.1 per cent, well below the national average at 1.7 per cent (Chart 73). Compared to the other provinces, Newfoundland and Labrador ranked 7th in terms of R&D intensity.

Chart 73: Total R&D Intensity (R&D as a percentage of GDP) in Canada and the Provinces, 2016

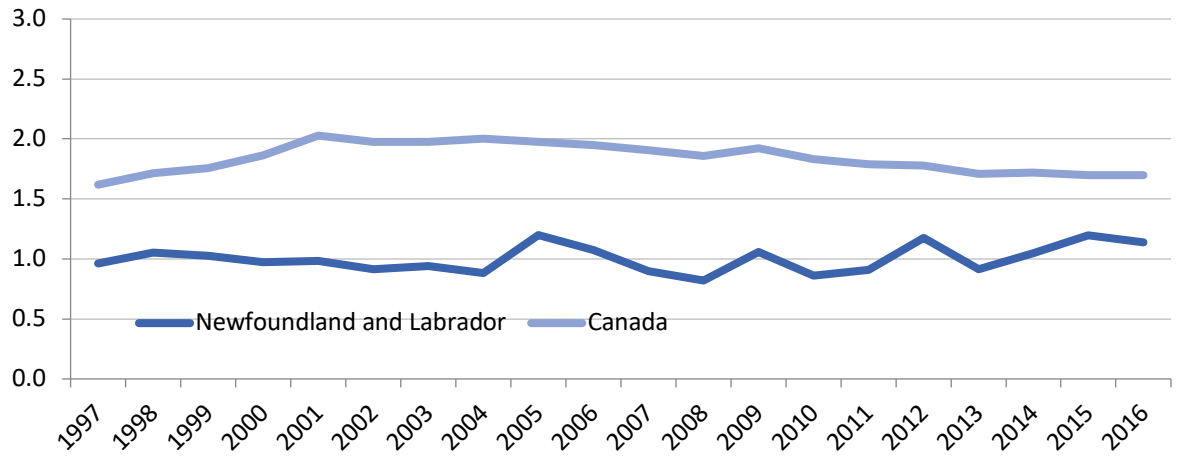


[62] Statistics Canada provides data on nominal value-added from 1997 to 2015, while the R&D expenditure data spans from 1997 to 2016 at the national and the provincial level. Fortunately, data on gross domestic product at market price are available from 1997 to 2016. Therefore, to calculate the R&D intensity, we use the gross domestic product at market price.

Source: Gross Domestic Expenditures on Research and Development (Table 27-10-0359-01), Statistics Canada.

Furthermore, Newfoundland and Labrador's under-spending in R&D is not unique to 2016. Chart 74 illustrates how, during the whole 1997-2016 period, R&D intensity was much higher in Canada than in Newfoundland and Labrador. The difference between R&D intensity was less pronounced in 2016 than in 1997. Specifically, the R&D intensity in the province in 1997 was 0.66 percentage points lower than the national average (1.62 per cent – 0.96 per cent). In 2016, the difference narrowed to 0.55 percentage points (1.70 per cent – 1.14 per cent). This reduction in the gap between the province and Canada as a whole is explained both by a declining trend in Canada, and an increasing trend in Newfoundland and Labrador.

Chart 74: Total R&D Intensity (R&D as a percentage of Nominal GDP) in Newfoundland and Labrador and Canada, 1997 – 2016



Source: CSLS calculations based on Statistics Canada data, 1) Input-Output Structure of the Canadian Economy in Current Prices (CANSIM Tables 379-0024 and 379-0025); 2) Research and Development in Canadian Industry(CANSIM Table 358-001).

R&D can be performed by the business sector (BERD, or business enterprise research and development), the higher education sector or the government. Although the focus of this report is on Newfoundland and Labrador's business sector, it is also important to take into account R&D performed by the higher education sector and by the government sector because of spill-over effects. It would be unwise to think that the province's business sector does not benefit from R&D even when it is conducted by the education or government sectors.

Table 56 shows the R&D expenditure of Newfoundland and Labrador and Canada broken down by the three performers from 1997 to 2016. Newfoundland and Labrador's BERD increased at an impressive compound annual rate of 9.4 per cent during the 1997-2016 period (vs.

an increase of 3.7 per cent per year in the nation-wide BERD), from $14 million in 1997 to $85 million in 2016. The province's R&D expenditure growth also outpaced Canada's in the high education sector (7.4 per cent per year vs. 6.4 per cent per year) but regressed in terms of R&D performed by the government sector. R&D expenditures in this sector declined at an annual rate of 2.0 per cent (vs. an increase of 0.9 per cent for Canada as a whole).

Table 56: Total R&D Expenditures by Performing Sector, Newfoundland and Labrador and Canada, 1997 – 2016

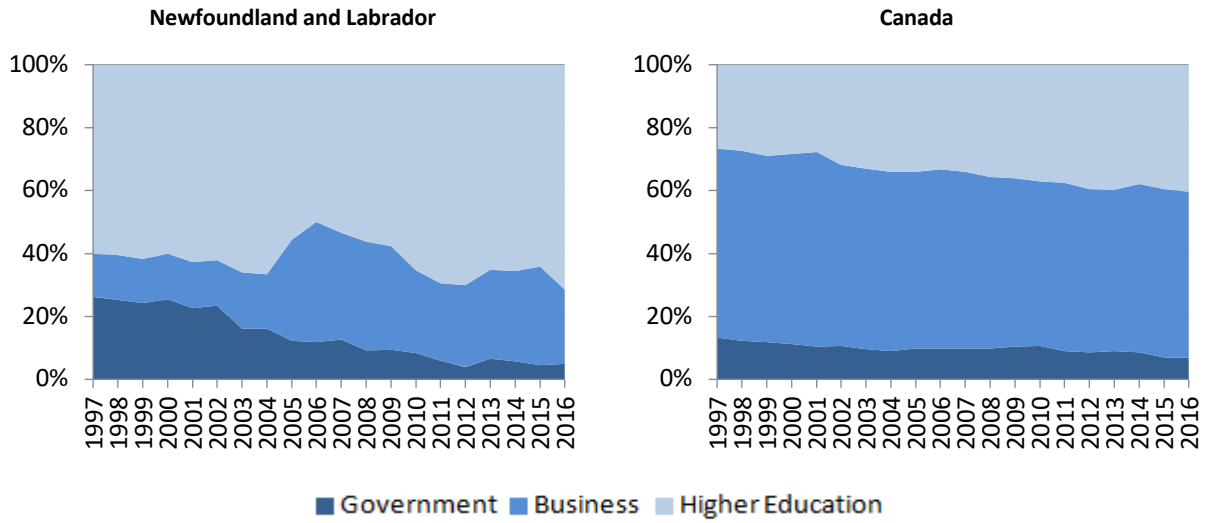
	Newfoundland and Labrador			Canada		
	1997	**2007**	**2016**	**1997**	**2007**	**2016**
	(millions, Current dollars)					
Total R&D Expenditures	**103**	**261**	**361**	**14,635**	**30,038**	**34,350**
Government Sector	27	33	18	1,934	2,924	2,326
Business Sector	14	89	85	8,739	16,756	18,058
Higher Education Sector	62	140	258	3,961	10,358	13,810
	1997	**2007**	**2016**	**1997**	**2007**	**2016**
	(as a share of total R&D expenditures)					
Total R&D Expenditures	**100**	**100**	**100**	**100**	**100**	**100**
Government Sector	26.2	12.6	5.0	13.2	9.7	6.8
Business Sector	13.6	34.1	23.5	59.7	55.8	52.6
Higher Education Sector	60.2	53.6	71.5	27.1	34.5	40.2
	1997	**2007**	**2016**	**1997**	**2007**	**2016**
	(as a share of total economy nominal GDP)					
Total R&D Expenditures	1.09	0.90	1.14	1.79	1.90	1.70
Government Sector	0.29	0.11	0.06	0.24	0.18	0.11
Business Sector	0.15	0.31	0.27	1.07	1.06	0.89
Higher Education Sector	0.66	0.48	0.81	0.49	0.66	0.68
	1997-2016	**1997-2007**	**2007-2016**	**1997-2016**	**1997-2007**	**2007-2016**
	(compound annual growth rates, per cent)					
Total R&D Expenditures	**6.47**	**9.74**	**3.30**	**4.36**	**7.46**	**1.35**
Government Sector	-2.01	2.03	-5.88	0.93	4.22	-2.26
Business Sector	9.44	20.32	-0.46	3.70	6.73	0.75
Higher Education Sector	7.39	8.49	6.30	6.44	10.09	2.92

Source: CSLS calculations based on Statistics Canada data, 1) Input-Output Structure of the Canadian Economy in Current Prices (CANSIM Tables 379-0024 and 379-0025); 2) Research and Development in Canadian Industry(CANSIM Table 358-001).

In 2016, the business sector played a more important role in total R&D spending in Canada than in Newfoundland and Labrador (Table 56). More specifically, the business sector was accountable for 52.6 per cent of all R&D expenditure in Canada, but only 23.5 per cent in Newfoundland and Labrador. Yet, the difference was already smaller than that in 1997 (59.7 per cent in Canada versus 13.6 per cent in the province).

Although R&D performed by the business sector has a more marginal role in Newfoundland and Labrador than the national average, there was an important increase in nominal business sector R&D expenditure since 2005. In particular, the business sector R&D spending in the province rose almost three times from $30 million in 2004 to $86 million in 2005. Therefore, the business sector R&D spending in the province grew extraordinarily by 20.3 per cent per year during the 1997-2007 period (Table 56).

Chart 75: R&D Expenditures by Performer, Newfoundland and Labrador and Canada, 1997 – 2016 (as a per cent of total)



Source: CSLS calculations based on Statistics Canada, Research and Development in Canadian Industry (Table 27-10-0273-01).

Chart 75 illustrates the composition of R&D spending in Newfoundland and Labrador and Canada by performer. In the province, the higher education sector was always the most important between 1997 and 2016. In Canada, on the other hand, the business sector consistently had the highest share, followed by the higher education sector and the government sector.

Chart 75 also shows the decline of government as a performer of R&D in both Newfoundland and Labrador and Canada. In the province, its share decreased from 26.2 per cent in 1997 to 5.0 per cent in 2017. At the national level, the decline was smaller (from 13.2 per cent in 1997 to 6.78 per cent in 2016).

Our analysis of the R&D expenditure and the R&D intensity shows that although the total R&D expenditure growth was higher than the national average (6.5 per cent per year and 4.4 per cent per year), Newfoundland and Labrador was less R&D intensive than the national average during the 1997-2016 period. In particular, in 2016, R&D intensity in Newfoundland and Labrador was only 0.1 percentage points higher than Alberta, New Brunswick and Saskatchewan. In addition, the higher education sector had the largest share of Newfoundland and Labrador's R&D expenditure in terms of performer while the business sector took the lead in Canada as a

whole. This difference in the composition of R&D expenditure could be accountable for the province's low R&D intensity because the business sector has higher incentive to use R&D products for profits.

V. Conclusion

The analysis of Newfoundland and Labrador's key economic variables shows that the mining and oil and gas extraction sector had a significant impact, either positive or negative, on the province's economy from 1997 to 2018. In particular, this sector was an excellent indicator of the province's overall business sector performance of most economic variables and productivity measures except employment because of this sector's considerable size in real output. Table 57 summarizes the compound annual growth rates of selected variables in the business sector, the mining and oil and gas extraction sector and the business sector without mining and oil and gas extraction sector in the provinces during the 1997-2018 period, and the 1997-2007 and the 2007-2018 sub-period.[63]

In terms of real output, the mining and oil and gas extraction sector was the most influential subsector of the business sector in the province. Indeed, during the 1997-2007 sub-period, the mining and oil and gas extraction real output grew at an extraordinary compound annual rate of 24.7 per cent per year because the province's oil production first started in 1997 and peaked in 2007. As a result, the province's business sector real output grew at 7.7 per cent per year, which was the highest amongst all provinces in Canada. During the 2007-2018 sub-period, the contribution of the mining and oil and gas extraction reversed as the sector's real output declined at 3.4 per cent per year, causing the decline in the province's business sector real output (1.1 per cent per year). Excluding the mining and oil and gas extraction sector, the business sector real output grew at an annual rate of 1.1 per cent during the former sub-period and 1.8 per cent during the latter sub-period. The huge difference between the growth rates of the business sector and the business sector without mining and oil and gas extraction show the importance of the sector in the province's business sector.

[63] Because Statistics Canada's tables of capital stock, capital investment, capital services, capital productivity and multifactor productivity span only from 1997 to 2017, the growth rates of these variables and variables derived from these variables (i.e. investment intensity and capital stock intensity) of the 1997-2018 column of Table 57 corresponds to the 1997-2017 period and the 2007-2018 column corresponds to the 2007-2017 sub-period.

Table 57: Compound Annual growth rates of Selected Variables, Business Sector, Mining and Oil and Gas Extraction and Business Sector without Mining and Oil and Gas Extraction, Newfoundland and Labrador, 1997-2018

	Newfoundland and Labrador								
	1997-2018			1997-2007			2007-2018		
	Business Sector	Mining and Oil and Gas Extraction	Business Sector without Mining and Oil and Gas Extraction	Business Sector	Mining and Oil and Gas Extraction	Business Sector without Mining and Oil and Gas Extraction	Business Sector	Mining and Oil and Gas Extraction	Business Sector without Mining and Oil and Gas Extraction
Output									
Real GDP	2.97	9.10	1.45	7.65	24.73	1.12	-1.11	-3.41	1.75
Labour Input									
Jobs	0.98	2.77	0.92	1.68	3.88	1.61	0.34	1.76	0.29
Hours Worked	0.80	2.86	0.71	1.60	3.92	1.51	0.07	1.90	-0.01
Nominal Labour Compensation	5.04	6.55	4.91	4.98	7.46	4.79	5.08	5.72	5.02
Capital Input									
Real Gross Investment*	5.87	3.53	8.22	0.92	-1.15	3.43	11.06	8.44	13.23
Real Net Capital Stock*	4.72	4.45	5.17	2.30	3.27	0.92	7.19	5.65	9.59
Real Capital Services*	3.84	4.46	3.02	2.75	3.25	2.90	4.95	5.69	3.15
Productivity									
Labour Productivity	2.16	6.07	0.73	5.96	20.03	-0.39	-1.18	-5.21	1.76
Capital Productivity*	-0.48	4.93	-1.15	4.77	20.81	-1.74	-5.46	-8.85	-0.56
Multifactor Productivity*	0.56	5.00	N/A	5.05	20.59	N/A	-3.73	-8.58	N/A
Productivity Drivers									
Investment Intensity*	4.98	0.22	7.42	-0.66	-4.88	1.89	10.95	5.59	13.25
Capital Stock Intensity*	3.84	1.11	4.39	0.69	-0.63	-0.59	7.08	2.88	9.62

Note: The real GDP (and hence the labour productivity and the capital productivity), real gross capital investment and real net capital stock (and hence the investment intensity and capital stock intensity) and capital services in the business sector without mining and oil and gas extraction are approximated. The real gross capital investment and real net capital stock (and hence the investment intensity and capital stock intensity) of the business sector are also approximated. For details, see subsection A of the Appendix.
Note *: Variables with * are available until 2017 only. Therefore, the growth rates of these variables are from 1997-2017, 1997-2007 and 2007-2017.
Source: Database attached to this report.

Despite the significant impact of the mining and oil and gas extraction sector on the province's business sector output, its role in the province's business sector employment growth was relatively weak, partly due to its low share of total employment. During the 1997-2007 sub-period, while the mining and oil and gas extraction employment grew at an annual rate of 3.9 per cent, the business sector growth rate was similar to the growth rate corresponding to the business sector without mining and oil and gas extraction (1.7 per cent per year and 1.6 per cent per year

respectively). The impact of mining and oil and gas extraction on the business sector's nominal labour compensation was also weak, as the nominal labour compensation of the business sector and the business sector without mining and oil and gas was similar (4.98 per cent per year versus 4.79 per cent per year) but that of mining and oil and gas extraction was much higher (7.46 per cent per year). We observe the same phenomenon during the 2007-2018 sub-period.

The mining and oil and gas extraction sector also had significant contributions to the province's capital input. During the 1997-2007 sub-period, the real gross capital investment of the province's business sector without mining and oil and gas extraction grew at 3.4 per cent per year. However, that of the mining and oil and gas extraction declined at 1.2 per cent per year because of the completion of oil rig development. As a result, the business sector growth rate dropped to 0.9 per cent per year. The province's real net capital stock and real capital services experienced the same phenomenon.

Because productivity levels are ratios between real output and input, it is not surprising that mining and oil and gas extraction also played an important role in the province's productivity growth. Indeed, the business sector labour productivity growth was 6.0 per cent per year during the 1997-2007 sub-period, while that of the business sector without mining and oil and gas extraction sector was -0.4 per cent per year and that of mining and oil and gas extraction was 20.0 per cent per year. Therefore, the mining and oil and gas extraction sector was the most important driver of the province's business sector labour productivity growth. During the 2007-2018 sub-period, the mining and oil and gas extraction labour productivity declined as that of the business sector fell (-5.2 per cent per year and -1.2 per cent per year respectively). Capital productivity and multifactor productivity mirrored the same pattern.

Although Newfoundland and Labrador had growth in R&D expenditure and investment and capital intensity higher than the national average, there are still some serious human capital questions that must be resolved. Indeed, the population in the province is not well-prepared for making full use of the gains from R&D, investment and capital intensity compared with the population in other provinces. Specifically, the province's youth and adult literacy is still significantly lower than the national average and other provinces. Together with the lower educational attainment in the province, the under-performance of these human capital indicators signifies skill shortages in the province. In addition, the province's aging population, its shrinking working-age population and increasing youth out-migration, especially among the population of age 15 to 29, further worsened the human capital issue by offsetting the province's recent success in raising the apprenticeship training completion rate from 5.6 per cent in 1997 to 7.9 per cent in 2017. Therefore, the province is facing a number of human capital challenges that can hinder its productivity in the short run and the long run.

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VII. Appendix

The Appendix provides supplementary information about different methodologies applied in this report. In particular, the first subsection in the Appendix discusses how we deal with chained Fisher indices and related issues. The second subsection outlines how we decompose the business sector labour productivity growth between two consecutive periods into percentage point contributions from each subsector of the business sector by the CSLS method developed by de Avillez (2012).

A. Dataset Construction

Since 2001, Statistics Canada has adopted the chained Fisher index for estimating real output. Although switching from the Laspeyres index to the chained Fisher index allows for a more accurate measure of the real GDP growth between consecutive periods and comparisons with data from the United States, Canadian data in real terms are no longer additive. Specifically, the arithmetic sum of all components' real values is not equal to the aggregate's real value, except in the base year when every component's real GDP equals its nominal GDP. Therefore, there are no simple ways to create sub-aggregates by eliminating one or more components. The remainder of this subsection discusses how we overcome non-additivity and other pertinent issues.[64]

i. Real GDP of the Business Sector without Mining and Oil and Gas Extraction

Because of the non-additivity of real GDP data, we use have to the Tornqvist approximation[65] to approximate the real GDP of the business sector without mining and oil and gas extraction in Newfoundland and Labrador and Canada. Given the real GDP and the nominal GDP of the business sector and its subsectors in Newfoundland and Labrador and Canada from Statistics Canada Table 36-10-0480-01, we can approximate the growth rate of the real GDP of the business sector without mining and oil and gas extraction between period $t-1$ and t by rearranging the formula below (Whelan, 2002).

$$\frac{\Delta Y_t}{Y_{t-1}} = \theta_t \cdot \frac{\Delta X_t}{X_{t-1}} + (1-\theta_t) \cdot \frac{\Delta Z_t}{Z_{t-1}} \qquad (1)$$

where Y_t is the business sector real GDP, X_t is the real GDP of the mining and oil and gas extraction sector, Z_t is the real GDP of the business sector without mining and oil and gas extraction, and θ_t is the average of the ratio of nominal X to nominal Y in periods t and $t-1$. Equation (1) expresses the growth rate of an aggregate as a weighted sum of the growth rates of its

[64] Chevalier (2003) discusses the non-additivity in detail in Section 5.0 of the paper.
[65] See Diewert (1978), Whelan (2002) and Liu et al. (2013). Houseman et al. (2015) and Schmalensee (2018) use the Tornqvist approximation. Other approximate methods include the Fisher of Fisher approximation method and the Laspeyres approximation method. See Liu et al. (2003) for details.

components. Using equation (1), we can obtain an estimate of the growth rate of Z. After that, we can obtain the level of Z by setting Z equal to the nominal Y minus the nominal X in the base year (2012), and then chain forward and back from the base year (2012) using the calculated growth rate.

To estimate the real GDP of the business sector without mining and oil and gas extraction in Newfoundland and Labrador and Canada, we need the nominal GDP percentage share by sector (θ_t) in Canada and the province. We assume that nominal GDP of each subsector of the business sector from 2016 to 2018 grew at its compound annual growth rate during the 2010-2015 period.

We compare the growth rates of Newfoundland and Labrador's GDP deflator of the business sector without mining and oil and gas extraction between the time series generated by direct arithmetic subtraction (i.e. subtracting the business sector real GDP by the mining and oil and gas extraction real GDP) and by the approximation method. Table 58 compares the business sector without mining and oil and gas extraction GDP deflator obtained by arithmetic subtraction and approximation.

Table 58: Comparison between the Business Sector without Mining and oil and Gas Extraction GDP Deflator obtained by Arithmetic Subtraction and Approximation, Newfoundland and Labrador, 2011-2015

	Real GDP		Nominal GDP	GDP Deflator	
	Arithmetic Subtraction	Approximation			
	A	B	C	D = (C/A) *100	E = (C/B) * 100
2011	11,284	11,471	11,136	102	97
2012	12,290	12,290	12,290	100	100
2013	12,805	12,804	13,489	103	105
2014	13,313	13,215	14,346	103	109
2015	13,785	13,430	15,319	90	114
Percentage Change					
2011 & 2015				19.83	9.78

As shown in Chart 32, oil prices fell rapidly from 2011 to 2015. If we obtain the real GDP of the business sector without mining and oil and gas extraction by arithmetic subtraction, an additional unit of real mining and oil and gas output had a much larger effect on price changes. Therefore, the arithmetic subtraction will overstate the GDP deflator growth in the business sector without mining and oil and gas extraction.

ii. Contribution to Growth

There are numerous ways to compute the percentage point contribution from each subsector of the business sector to the business sector real GDP growth between period $t-1$ and t.[66] In this report, we use the method suggested by Whelan (2002), which expresses the growth rate of the business sector real GDP between period $t-1$ and t as

$$\frac{\Delta Y_t}{Y_{t-1}} = \sum_i \frac{\left(P_{i,t-1} + \frac{P_{i,t}}{\Pi_t}\right) \cdot \Delta Y_{i,t}}{\left[\sum_i \left(P_{i,t-1} + \frac{P_{i,t}}{\Pi_t}\right) \cdot \Delta Y_{i-1,t}\right]} = \sum_i c_{i,t} \ , \tag{2}$$

where Y_t is the business sector real GDP, $Y_{i,t}$ is the real GDP of subsector i of the business sector, $P_{i,t}$ is the price of sector i at period t and Π_t is the growth rate of the of the business sector GDP deflator between period $t-1$ and t. Equation (2) decomposes the growth rate of a chained aggregate into the contributions due to the change in the quantity corresponding to each subsector ($c_{i,t}$) and expresses the contribution as a weighted sum of individual chain growth rates.

As mentioned, sectoral nominal GDP time series at the national level and the provincial level are not available from 2016 to 2017. For consistency, we use the nominal GDP extrapolated for the Tornqvist approximation to calculate the GDP deflator for each sector in Canada.

iii. Contribution to the Business Sector Inflation Rate

According to Liu et al. (2003), we can compute the contribution from each subsector of the business sector to the business sector inflation by

$$\frac{\Delta P_t}{P_t} = \sum_i \frac{\left(1 + \frac{G_{i,t}}{G_t}\right) y_{i,t-1}}{\left[\sum_i \left(1 + \frac{G_{i,t}}{G_t}\right) \cdot y_{i,t-1}\right]} \cdot \frac{\Delta P_{i,t}}{P_t} \ , \tag{3}$$

Equation (3) expresses the aggregate inflation rate as a weighted sum of its components' inflation rates where the weights are determined by the component's nominal share adjusted by relative chain growth rates.

iv. Capital Investment Levels and Net Capital Stock Levels

[66] See Liu et al. (2003) and Chevalier (2003) for examples of other methods to calculate the percentage point contribution from each subsector of the business sector to the business sector real GDP growth.

We use the Laspeyres approximation to estimate the capital investment levels and the net capital stock levels of the finance, insurance and holding companies (FIRE) sector, other private services, the business sector, the goods sector, the service sector and the business sector without mining and oil and gas extraction. According to Liu et al. (2003), we can approximate the growth rate of an aggregate with components i by

$$\frac{\Delta Y_t}{Y_{t-1}} = \sum_i G_{i,t} \cdot \frac{X_{i,t-1}}{Y_{t-1}} \tag{4}$$

where Y_t is the real value of the aggregate at time t, $G_{i,t}$ is the ratio of the real value of component i at time t to its value at time $t-1$ and $X_{i,t}$ is the nominal value of component i at time t. In other words, Equation (4) expresses the growth rate of the aggregate as a weighted sum of the growth rates of the components, with weights being nominal shares of the previous period.

B. Decomposing Labour Productivity Growth by Sector[67]

To begin we note that at any given point in time, assuming that real output of the aggregate is equal to the arithmetic sum of each component's real output, we have

$$P \equiv \frac{Q}{H} = \frac{\sum Q_i}{H} = \frac{\sum H_i P_i}{H} = \sum P_i \, h_i \tag{5}$$

where

$P =$ Aggregate labour productivity level

$P_i =$ Labour productivity level in sector i

$H =$ Aggregate hours worked

$H_i =$ Hours worked in sector i

$h_i =$ Share of hours worked in sector i

$Q =$ Aggregate real output

$Q_i =$ Real output of sector i

Equation (5) says that aggregate labour productivity P is equal to the weighted average of labour productivity in each of the sectors that make up the economy. The weight for each sector is its share of the total number of hours worked in the economy.

[67] This subsection of the Appendix is an extract from Sharpe and Thomson (2010).

Because we are interested in how shifts in hours worked across sectors affect aggregate labour productivity growth, we must move beyond a single point in time. Equation (6) expresses the absolute change in aggregate labour productivity from period 0 to period 1, $\Delta P = P^1 - P^0$ where superscripts denote the period.

$$\Delta P = \sum h_i^0 \Delta P_i + \sum P_i^0 \Delta h_i + \sum \Delta h_i \Delta P_i \quad (6)$$

In equation (6) h_i^0 and P_i^0 are respectively the share of total hours worked in sector *i* and the level of labour productivity in sector *i* in period 0, expressed in dollars.

In order to obtain economically meaningful sectoral contributions to aggregate productivity growth, we adjust the second term of equation (6) by subtracting the average level of labour productivity $\bar{P}^0$ from the level of labour productivity in each sector in period 0, P_i^0. In the third term, we subtract the average change in labour productivity $\Delta\bar{P}$ $\Delta\bar{P}$ from the change in labour productivity in each sector, ΔP_i ΔP_i. The first adjustment ensures that an increase in the hours share in a sector with a below-average labour productivity level makes a negative contribution to aggregate labour productivity growth. The second adjustment also ensures that an increase in the hours share in a sector with below-average absolute growth in labour productivity makes a negative contribution to aggregate labour productivity growth. The result of these adjustments is equation (7):

$$\Delta P = \sum h_i^0 \Delta P_i + \sum (P_i^0 - \bar{P}^0)\Delta h_i + \sum \Delta h_i (\Delta P_i - \Delta\bar{P}) \quad (7)$$

We are able to subtract $\bar{P}^0$ $\bar{P}^0$ from equation (6) because the terms $\Delta\bar{P}\Delta h_i$ and $\bar{P}^0\Delta h_i$ each sum to zero across all sectors, since $\bar{P}^0$ and $\Delta\bar{P}$ are constant and all changes in hours share Δh_i Δh_i sum to zero across sectors.

The three terms in equation (7) represent respectively the within-sector, reallocation level and reallocation growth effects. The within-sector effect captures the change in labour productivity within a sector. The reallocation level effect indicates whether changes in hours share have favoured sectors with above- or below-average labour productivity levels. The reallocation growth effect is the sum of the product of the absolute change in the share of hours worked and the absolute change in the labour productivity level for each of the *i* sectors. It measures whether an economy is subject to a phenomenon akin to Baumol's cost disease, *i.e.* the tendency of labour to move towards sectors with relatively small absolute increases in labour productivity. A negative reallocation growth effect at the aggregate level means that labour is moving to sectors with relatively smaller absolute labour productivity increases.

There are some limitations to this analysis. First, the analysis assumes that differences in technological, institutional and market structures across sectors lead to differences in average levels of labour productivity, even if marginal products are the same. It also assumes that when a

sector loses or gains labour, the changes in output per hour are equal to the sector's average output per hour worked. Second, these results are sensitive to the level of disaggregation. For instance, we use 16 sectors at the two-digit level. If within a sector, resources shift from one subsector to another, and these subsectors have different levels of labour productivity, then the measured impact of the reallocation effect on aggregate labour productivity growth would be different.

i. Accommodating the General Non-additivity of Real Output Data

As shown above, the labour productivity growth decomposition method assumes that the arithmetic sum of each subsector's real output must be equal to the business sector real output. However, because real output data from Statistics Canada are in chained Fisher indices, as discussed in the previous subsection, the assumption of arithmetically additive real output does not hold.

Fortunately, real output in the base year and the percentage point contributions from each subsector to the business sector real GDP growth for every year are additive. Making use of these two properties, we can construct a new data set of real GDP so that in a given year the arithmetic sum of each subsector's real GDP is equal to the business sector real GDP. Specifically, following notations of equation (2), we have

$$\Delta Y_t = \sum_i (c_{i,t} \cdot Y_{t-1}) = \sum_i \mathcal{C}_{i,t} \, .$$

To get the sectoral real GDP contribution for years after the base year (2012), we add the previous year's sectoral real GDP to $\mathcal{C}_{i,t}$. For years before the base year (2012), we subtract $\mathcal{C}_{i,t}$ from next year's real GDP. Essentially, the resultant timeseries are contributions from each subsector to the business sector real GDP. The resultant business sector labour productivity and hence the labour productivity annual growth will be consistent with data from Statistics Canada.