July 2013

151 Slater Street, Suite 710
Ottawa, Ontario K1P 5H3
613-233-8891, Fax 613-233-8250
csls@csls.ca

CENTRE FOR THE STUDY OF LIVING STANDARDS

A DETAILED ANALYSIS OF NEWFOUNDLAND AND LABRADOR'S PRODUCTIVITY PERFORMANCE, 1997-2010: THE IMPACT OF THE OIL BOOM

CSLS Research Report 2013-05

Etienne Grand'Maison and Andrew Sharpe

July 2013

Prepared for the Collaborative Applied Research (CARE) initiative,
Department of Economics, Memorial University of Newfoundland
By the Centre for the Study of Living Standards

A Detailed Analysis of Newfoundland and Labrador's Productivity Performance, 1997-2010: The Impact of the Oil Boom

Abstract

Propelled by the mining and oil and gas sector, Newfoundland and Labrador's economy experienced impressive growth in the past decade. During the 1997-2010 period, real GDP in the province's business sector increased at nearly twice the rate of Canada's, while the province's labour productivity growth was more than three times greater than Canada's. This report provides a detailed analysis of Newfoundland and Labrador's labour, capital and multifactor productivity performance and the factors behind this performance. It identifies the province's shift to high-productivity oil extraction activities as the main factor responsible for this remarkable productivity growth while also discussing the positive spill-over effects that this shift has had on Newfoundland and Labrador's economy as a whole.

A Detailed Analysis of Newfoundland and Labrador's Productivity Performance, 1997-2010: The Impact of the Oil Boom

Table of Contents

List of Charts, Exhibits, and Tables

Charts

Exhibits

Tables

Appendix Tables

A Detailed Analysis of Newfoundland and Labrador's Productivity Performance, 1997-2010: The Impact of the Oil Boom

Executive Summary

Propelled by the mining and oil and gas sector, Newfoundland and Labrador's economy experienced impressive growth in the past decade. Real GDP in the province's business sector increased at nearly twice the rate of Canada's (4.55 per cent vs. 2.50 per cent per year), while the province's labour productivity growth was more than three times greater than Canada's (3.86 per cent vs. 1.29 per cent). The objective of this report is to understand these trends in Newfoundland and Labrador, emphasizing developments in labour, capital and multifactor productivity growth during the 1997-2010 period.

This report is divided in six major sections. The first section discusses productivity concepts and definitions as well as data sources. The second section provides an overview of the economy of Newfoundland and Labrador in general, focusing on real output, labour input and capital input trends. The third section presents a comprehensive analysis of productivity trends during the 1997-2010 period and the fourth section describes the sources of labour productivity growth. Finally, the fifth section examines the drivers of labour productivity growth while the sixth section looks at the role of public policy in fostering growth in productivity and its potential role for the province's future productivity.

Highlights

- During the 1997-2010 period, labour productivity in Newfoundland and Labrador's business sector increased by 3.86 per cent per year, significantly more than the growth observed for Canada as a whole, which was 1.29 per cent per year. In 2010, the province's labour productivity level, at $75.20 per hour, was 157.4 per cent of the national average of $47.79 per hour.

- Mining and oil and gas extraction was responsible for most of the output and productivity growth that occurred in Newfoundland and Labrador's business sector during the 1997-2010 period. Nearly 70 per cent of the additional nominal output produced between 1997 and 2010 is attributable to an increase in the output of the mining and oil and gas extraction sector. In 2010, the output of this sector represented 50.4 per cent of Newfoundland and Labrador's business sector (nominal) output, up from 8.2 per cent in 1997. Furthermore, labour productivity in mining and oil and gas extraction grew at a

compound annual rate of 11.34 per cent during the 1997-2010 period, much higher than any other sector in the province.

- The year 2002 was a remarkable one for Newfoundland and Labrador in terms of real output and productivity growth. Real output, as well as labour, capital and multifactor productivity all grew by at least 20 per cent during that year. This upsurge in output and productivity was largely caused by the beginning of operations at the Terra Nova oil field, which, coupled with an increase of production at Hibernia, nearly doubled the province's annual production of oil.

- Capital intensity in the province grew at a very slow pace over the 1997-2010 period, well below the national average, mainly because an important quantity of capital had been accumulated in the 1990s in the mining and oil and gas extraction sector. Therefore, when production began at the offshore oil platforms, the sector experienced a much higher growth in hours worked (2.76 per cent over the 1997-2010 period) than in real capital stock (1.24 per cent), leading to a decline in the capital intensity of the sector. Since the mining and oil and gas extraction sector accounts for an important part of the province's capital stock, the decline in capital intensity in this sector dragged down the capital intensity of the whole business sector. In fact, despite Newfoundland and Labrador's poor performance in terms of aggregate business sector capital intensity growth, nine of the thirteen sectors for which capital intensity estimates were available experienced higher growth in the province than the national average.

- Total R&D expenditures in Newfoundland and Labrador grew at a faster pace than in Canada as a whole during the 1997-2010 period (7.38 per cent per year vs. 5.69 per cent per year, respectively). Despite strong growth, Newfoundland and Labrador still had R&D intensity well below the national average in 2010 (0.99 per cent of provincial GDP vs. 1.97 per cent of national GDP).

- Unlike the national picture, where the business sector plays a fundamental role in performing R&D, it has a supporting role in Newfoundland and Labrador, with the bulk of R&D expenditures being performed by the higher education sector (63.8 per cent in the province vs. 38.5 per cent in Canada as a whole). Yet, the role of the business sector as a performer of R&D in the province has increased substantially in the last decade, from only 12.3 per cent of total R&D expenditures in 1997 to 27.7 per cent in 2010. BERD (business expenditures in R&D) intensity in Newfoundland and Labrador was around one quarter of the Canadian average in 2010.

Output trends

Nominal GDP

Newfoundland and Labrador business sector nominal GDP increased from $5,858 million in 1997 to $19,919 million in 2010, as the province experienced the highest growth in business sector nominal GDP in Canada at a compound annual rate of 9.87 per cent (vs. the national average of 4.89 per cent). This led to an increase in Newfoundland and Labrador's share of national nominal GDP from 0.96 per cent in 1997 to 1.76 per cent in 2010.

The main reason for Newfoundland and Labrador's upsurge in nominal business sector GDP was the remarkable growth of its mining and oil and gas sector, which grew 26.4 per cent per year during the period. The rapid growth of the mining and oil and gas sector in Newfoundland and Labrador also increased the relative size of the province's business sector, from 62.3 per cent of the total economy nominal GDP in 1997 to 76.1 per cent in 2010. In comparison, Canada's business sector represented 74.9 per cent of total economy GDP in 1997 and 74.7 per cent in 2010.

Real GDP

Real business sector GDP in Newfoundland and Labrador increased from $11,040 million (chained 2007 dollars) in 1997 to $19,679 million in 2010 (chained 2007 dollars), representing a compound annual growth rate of 4.55 per cent, nearly twice the national average of 2.50 per cent. It is interesting to note that if we exclude the mining and oil and gas extraction sector from the calculation of business sector real GDP, Newfoundland and Labrador's output actually grew at the same pace as Canada's output during the 1997-2010 period (2.66 per cent per year versus 2.63 per cent per year, respectively).

On a year-by-year basis, the largest annual increase happened in 2002, when real GDP increased by 20.5 per cent. This was largely caused by the beginning of operations at the Terra Nova oil field, which nearly doubled the province's annual production of oil. Furthermore, the impact of the recent economic downturn was much stronger in Newfoundland and Labrador than in Canada as a whole, with the province's real business sector GDP declining 12.30 per cent in 2009, while business sector real GDP in Canada dropped 4.58 per cent.

Implicit Price Deflator

The GDP deflator grew at a much faster pace in Newfoundland and Labrador than in Canada during the 1997-2010 period, with the province's implicit price deflator growing 5.09 per cent per year versus 2.34 per cent per year in Canada. Unsurprisingly, the rapid growth in the

province's implicit price deflator was largely driven by prices in the mining and oil and gas extraction sector output, which increased at an annual rate of 10.48 per cent during the period. In the province, the Consumer Price Index actually grew at a slower pace than the national average (1.87 per cent per year vs. 1.97 per cent per year, respectively).

Labour Input

Due to continued net out-migration, the number of jobs in Newfoundland and Labrador increased at only half of the pace experienced by the country as a whole during the 1997-2010 period (0.85 per cent vs. 1.59 per cent). Increases in both Newfoundland and Labrador's number of jobs and hours worked were concentrated in the 1997-2002 period, with the rate of growth dropping markedly after that. Although nominal output in the mining and oil and gas extraction sector represented more than 50 per cent of Newfoundland and Labrador's business sector nominal GDP in 2010, hours worked in this sector represented only 4.6 per cent of total hours worked.

An important element to consider is the substantial decline in the labour compensation share of nominal business sector GDP due to the increase in capital compensation associated with the mining and oil and gas extraction sector in Newfoundland and Labrador. From 58.9 per cent in 1997, it felt down to 34.1 per cent in 2010.

Capital Input

Real gross investment in fixed, non-residential capital goods grew 2.34 per cent per year in Newfoundland and Labrador during the 1997-2010 period, below the rate observed in Canada as a whole (3.58 per cent per year). Due to the large increases in output, nominal gross investment as a share of GDP fell from 35.0 per cent in 1997 to 16.8 per cent in 2010, reflecting the substantial level of investment that took place in the 1990s in the mining and oil and gas extraction sector.

Real gross M&E investments increased considerably in Newfoundland and Labrador during the 1997-2010 period (5.88 per cent per year vs. 3.74 per cent per year in Canada). Real ICT investment in the province also experienced robust growth, increasing 8.54 per cent per year, although weaker than in Canada, where it grew 10.20 per cent per year. Real investment in intellectual property products saw the highest growth among major capital asset categories, at 11.20 per cent per year, driven largely by mining and oil and gas exploration.

Real net (fixed, non-residential) capital stock in Newfoundland and Labrador increased 0.96 per cent per year during the 1997-2010 period (vs. 2.25 per cent per year in Canada). In components of capital stock most likely to affect productivity, real M&E capital stock in the

province grew 3.94 per cent per year during the period (vs. 2.92 per cent in Canada) while real ICT capital stock increased 3.39 per cent per year (vs. 7.11 per cent per year in Canada).

Finally, as hinted by the decline in the share of labour compensation in GDP, capital compensation as a share of business sector nominal GDP increased considerably, from 41.1 per cent in 1997 to 65.9 per cent in 2010 due to rise of the capital-intensive oil sector in Newfoundland and Labrador`s economy.

Productivity Trends

Labour productivity

Labour productivity, defined as output per hour worked, increased from $24.10 in 1997 to $75.20 in 2010 in Newfoundland and Labrador's business sector. In real terms, this represents an increase of 3.86 per cent per year, a growth rate that is considerably higher than the national rate of at 1.29 per cent per year. The province's labour productivity growth was particularly impressive in 2002, when it increased 21.9 per cent. In 2010, Newfoundland and Labrador had the highest labour productivity level of all provinces, representing 157.4 per cent of Canada's labour productivity level. Despite impressive improvements at the aggregate level, in 2010, labour productivity in Newfoundland and Labrador was higher than the national average in only 6 of 15 two-digit NAICS sectors.

The impressive performance of Newfoundland and Labrador in terms of labour productivity growth was not limited to the mining and oil and gas sector. A total of 12 of the 15 two-digit NAICS sectors had higher growth than the national average during the 1997-2010 period. Mining and oil and gas extraction experienced the fastest labour productivity growth among all NAICS sectors in the province, at 11.34 per cent per year.

Capital Productivity

Capital productivity, defined as real GDP per unit of capital services, increased 2.88 per cent per year in Newfoundland and Labrador during the 1997-2010 period, largely outpacing the growth experienced at the national level (-1.66 per cent per year). However, Newfoundland and Labrador ranked last in terms of the capital productivity level, at $1.22 of output being produced per unit of capital stock in 2010. Due to the above-average growth, Newfoundland and Labrador's overall level of capital productivity as a share of Canada's rose steadily, from 32.0 per cent in 1997 to 57.3 per cent in 2010.

Multifactor Productivity

Multifactor productivity (MFP) measures output growth that is not accounted for by measured input growth. During the 1997-2010 period, Newfoundland and Labrador's multifactor productivity grew at an annual compound rate of 2.95 per cent, far above the national average of -0.24 per cent. Newfoundland and Labrador's business sector industries outperformed their Canadian counterparts in 11 of the 15 sectors included in our study. The sector that saw the fastest increase in multifactor productivity in the province was mining and oil and gas extraction, which grew at an average annual rate of 13.38 per cent.

Sources of Labour Productivity Growth in Newfoundland and Labrador

Newfoundland and Labrador labour productivity growth during the 1997-2010 period was driven mainly by multifactor productivity growth, which accounted for 79.7 per cent of the overall business sector labour productivity growth. Of the remaining 20.3 per cent, 15.7 per cent is attributable to an increase in capital intensity (defined here as capital service per hour worked) and 4.6 per cent to an increase in labour quality. Changes in capital composition had nearly no impact on the labour productivity growth in the province.

On a sectoral basis, 78.3 per cent of the overall labour productivity growth can be explained by the mining and oil and gas extraction sector, both because it grew at a faster pace than all other sector and because its share of hours worked increased.

Overall, 82.1 per cent of the growth in the province's labour productivity can be explained by the within-sector effect, i.e. productivity increases in labour productivity that take place within a sector, driven by increased capital intensity, increased labour quality, technical change, economies of scale, etc. Another 14.2 per cent of the labour productivity growth can be explained by the reallocation growth effect, which measures the impact of an increase in labour input share in sectors having an above-average growth in labour productivity. Finally, the reallocation level effect, which measures whether changes in the distribution of labour input among all industries have favoured sectors with above (or below) average labour productivity levels, can only explain 3.7 per cent of the growth in labour productivity.

In terms of accounting for the business sector's higher labour productivity in Newfoundland and Labrador relative to Canada, we identified that the 63.7 percentage point difference in their respective level of labour productivity can be more than explained by the mining and oil and gas sector, both because it had a higher productivity level than its Canadian counterpart, and because the share of hours worked in this sector was higher in the province than at the national level. The mining and oil and gas extraction sector explained 114 per cent of the difference between the

province`s labour productivity and the Canadian average with other sectors being below the average.

Productivity Spillover Effects from the Mining and Oil and Gas Extraction Sector

Our study found moderate evidences of productivity spillover effects from the mining and oil and gas extraction sector to the non-oil sectors of the economy, as shown by the acceleration of labour and multifactor productivity growth outside the mining and oil and gas extraction sector in the province after 1997. Although our analysis of this phenomenon is preliminary and largely speculative, we suggest many possible mechanisms that would explain the existence of such spillover effects, such as the productivity-augmenting effects of increased government spending financed by oil revenues, a tighter labour market, a more dynamic and competitive economy, and knowledge spillovers from the oil sector.

Productivity Drivers

Physical Capital

In 2010, the level of capital intensity in Newfoundland and Labrador's business sector was noticeably higher than in Canada, with $78.15 chained 2007 dollars of capital stock per hour worked in comparison to $53.64 chained 2007 dollars of capital stock per hour worked in Canada as a whole. However, during the 1997-2010 period, Newfoundland and Labrador lagged behind Canada in terms of capital intensity growth (defined here as real capital stock per hour worked), at 0.30 per cent per year vs. 1.04 per cent per year in Canada. Yet, in component of capital stock most likely to affect productivity, both Newfoundland and Labrador's M&E and ICT capital intensity saw significant growth during the period (2.80 per cent per year and 4.34 per cent per year, respectively).

At the two-digit NAICS level, capital intensity growth in Newfoundland and Labrador outpaced Canada in only eight of the 13 sectors for which capital intensity estimates were available. The mining and oil and gas sector in Newfoundland and Labrador experienced a considerable decline in its capital intensity during the 1997-2010 period (-1.48 per cent per year), as hours worked in this sector increased at a much faster pace than capital stock (2.86 per cent per year vs. 1.24 per cent per year). Given the size of the sector in the province and the important share of total capital stock it holds, the fall in capital intensity in the mining and oil and gas extraction sector largely explains why capital intensity growth in Newfoundland and Labrador was slower than in Canada as a whole.

Human Capital

In general, Newfoundland and Labrador's human capital indicators were slightly below the national average. Here, we highlight certain points that deserve attention:

- In 2010, a working-age individual in Newfoundland and Labrador had, on average, 12.6 years of education compared to 13.1 years for an average Canadian worker. It is important to highlight that the gap between the provincial and national average number of years of schooling is significantly smaller if we look only at the employed population. While the average years of schooling in the province accounted for 96.7 per cent of the national average for the total population, it accounted for 98.8 for the employed workers.

- In 2010, the number of workers with a post-secondary certificate or diploma as their highest educational attainment was much higher in Newfoundland and Labrador than in Canada (45.6 per cent vs. 35.5 per cent, respectively). However, workers with a university degree represent a higher share of Canadian than Newfoundland and Labrador's workers (25.6 per cent vs. 17.3 per cent).

- Although the number of apprenticeship registrations boomed during the 1997-2002 period in Newfoundland and Labrador, it has never really reflected on apprenticeship completion. In fact, Newfoundland and Labrador's share in the total number of apprenticeship completion in Canada remained virtually the same, from 1.29 per cent in 1997 to 1.23 per cent in 2010.

Innovation

In 2010, R&D intensity (defined here as nominal R&D expenditures divided by nominal GDP) in Newfoundland and Labrador was around half of the national average (1.97 per cent versus 0.97 per cent), ranking ninth when compared to other provinces (only Saskatchewan had a lower R&D intensity). Newfoundland and Labrador also had a very low BERD intensity, 0.38 per cent, around a quarter of Canada’s BERD intensity (1.45 per cent). It is important to note, however, that R&D expenditures performed by the business sector grew at a significant pace (13.42 per cent per year) in the province during the 1997-2010 period, increasing the share of total R&D that is performed by the business sector from 8.7 per cent in 1991 to 27.7 per cent in 2010).

Yet, most of the province’s R&D is still performed by the higher education sector, which accounted for 63.8 per cent of total R&D expenditures in 2010. At the national level, however, the situation is reversed, with the higher education sector accounting for 32.9 per cent of total R&D expenditures and the business sector accounting for 57.1 per cent in 2010. The role of government as a performer of R&D decreased in both Newfoundland and Labrador and Canada.

Productivity and Public Policy

Since most of the growth in labour productivity is attributable to the mining and oil and gas sector, it is clear that, in order to maintain its actual level of consumption, the province should invest strongly in reproducible capital so as to keep their labour productivity at the same level when the resource will be exhausted. This rule of thumb is known by economists as the Hartwick rule.

One of the main policy implications following this principle and the findings of this study is to invest strongly in innovation and education in order to close the gap with Canada in those two drivers of productivity. Strategies to favour greater R&D spending by the business sector are also a priority. From this perspective, the innovation strategy put forward by the provincial government since 2006 is a step in the right way. Finally, this report also specifies that any policy aimed at increasing human capital should be linked to a policy aimed at limiting the net loss of population in the province.

A Detailed Analysis of Newfoundland and Labrador's Productivity Performance, 1997-2010: The Impact of the Oil Boom[1]

Introduction

Propelled by the oil and gas sector, Newfoundland and Labrador's economy experienced impressive growth in the past decade. During the 1997-2010 period, real GDP in the province's business sector increased at nearly twice the rate of Canada's (4.55 per cent vs. 2.50 per cent), while the province's labour productivity growth was more than three times greater than Canada's (3.86 per cent vs. 1.29 per cent). By 2010, the province's labour productivity level was significantly above the national average.

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 majority of the province's value added, even though it employs only five per cent of its workers. From this perspective, productivity continues to represent a major challenge for the province; the enactment of public policies that would allow a strong and varied private sector presence to flourish is *still* a priority. Identifying the main sources and drivers of productivity growth is a necessary first step towards developing effective productivity-enhancing policies.

This report is organized as follows. Part one discusses definitions, concepts, and data sources used in this report. It also contains a short primer on some of the main issues related to productivity analysis. Part two analyzes output and input (labour and capital) trends in Newfoundland and Labrador during the 1997-2010 period. The third part looks at the evolution of labour, capital and multifactor productivity in the province. The fourth part identifies and discusses the fundamental factors that influence productivity growth in general, highlighting their possible effect in driving productivity growth in Newfoundland and Labrador. Part five provides general policy suggestions and part six concludes.

[1] The CSLS would like to thank the CARE and the Department of Economics of the Memorial University of Newfoundland for the financial assistance that made the preparation of this report possible. The authors would also like to thank Stephen Tapp from the Institute for Research on Public Policy for its comments during the presentation of this report at the annual meeting of the Canadian Economics Association at the HEC Montreal on June 2, 2013. Special thanks go to Doug May and Wade Locke from the Memorial University of Newfoundland for comments to earlier versions of this report. The CSLS would also like to thank Tanya Bagai and Ricardo De Avillez for editing.

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

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, 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 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, i.e. firms will only make changes to their production process if these changes are consistent with profit-maximizing behaviour. 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 (the link between value added labour productivity and living standards is further explored in Appendix 1); 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 mis-measurement 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*[2], 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 relative 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 as well as their purposes, advantages, and limitations.

[22] 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).

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. *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.	*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. *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-wide or 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

This report focuses on three value-added productivity measures:

- *Value-added labour productivity*, defined here as real GDP (at basic prices) per hour worked. Alternatively, value-added labour productivity could also have been defined as GDP per employed person. However, the hours worked measure provides more accurate estimates of labour input, since it takes into account: 1) changes in the duration of the work week; 2) shifts from full-time employment to part-time employment.

- *Value-added capital productivity*, defined here as real GDP (at basic prices) per unit of capital services. The difference between capital stock and capital services is explained in section III-C-iii.

- *Value-added multifactor productivity*, defined here as real GDP (at basic prices) per unit of *combined* capital and labour input.

The main data source for this report is the Canadian Productivity Accounts (CPA) produced annually by Statistics Canada. The data encompass the 1997-2010 period and are broken down at the two-digit NAICS[3] level (Exhibit 2), with business sector aggregates also being provided. The start of the period, the year 1997, also coincides with the beginning of oil production in the province of Newfoundland and Labrador. Since one of the main objective of this report is to analyze the impact of the oil boom on the aggregate level of labour productivity and to analyze productivity development in the non-mining and oil and gas extraction sector, the fact that the data series from Statistics Canada starts from 1997 is a happy coincidence and seems like an appropriate choice for the beginning of our study period.

[3] The acronym NAICS refers to the North American Industry Classification System. NAICS categorizes establishments into industries based on the similarity of their production processes. It has a hierarchical structure that divides the economy into 20 sectors, which are identified by two-digit codes. Below the sector level, establishments are classified into three-digit subsectors, four-digit industry groups, and five-digit industries. At all levels the first two digits always indicate the sector, the third digit the subsector, the fourth digit the industry group, and the fifth digit the industry. For more information on NAICS, see Statistics Canada (2007).

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)
61	Education Services
62	Health Care and Social Assistance
71	Arts, Entertainment, and Recreation
72	Accommodation and Food Services
81	Other Services (except Public Administration)
92	Public Administration

Source: Statistics Canada (2007).

For practical purposes, two adjustments are made to Statistics Canada's two-digit NAICS breakdown shown in Exhibit 2 by the CSLS Provincial Productivity Database. First, finance and insurance, real estate, rental and leasing, and management of companies and enterprises are grouped into a single sector, which will be referred to as the *finance, insurance, real estate, rental and leasing (FIRE)* sector. Second, unless stated otherwise, the business establishments classified under education services and health care and social assistance are grouped together with establishments in other services (except public administration). This new aggregate is called *other private services*. Since these changes are only a slight departure from the standard NAICS breakdown, we will still refer to the resulting 15 sectors as two-digit NAICS sectors.

This report focuses on business sector industries (both at an aggregate level and at the two-digit NAICS level). Real output of non-business establishments (e.g. public hospitals, public universities, government departments) is hard to estimate accurately, which has a significant impact on productivity estimates for non-business sector industries and for the total economy aggregate. While marketed goods and services can be valued at the prices at which they are actually sold, most government services are either provided free of charge or at subsidized prices. Due to a lack of reliable price data, output of non-business sector industries is valued based on the cost of inputs (labour, capital, and intermediate inputs). Furthermore, nominal outputs and nominal inputs for those industries are deflated using the same price index (based on

input prices). As a consequence, real output growth of non-business sector industries equals real-input growth, which implies that there is no MFP growth. Therefore, the inclusion of non-business sector industries in an industry aggregate, whether total business sector or total economy tends to distort productivity trends.[4]

Statistics Canada's general definition of the business sector includes four elements:

- The corporate sector (incorporated businesses);
- The unincorporated sector (self-employed and proprietorships);
- Government business enterprises (GBEs); and
- Owners who occupy their own dwelling.

Statistics Canada's Canadian Productivity Accounts (CPA) program adopts a stricter definition of the business sector than the one above, excluding owner occupied dwellings (which accounted for approximately 7.5 per cent of total economy nominal GDP in Canada during the 1997-2008 period). The business sector definition used in the CSLS Provincial Productivity Database is the same as the one used in the CPA. Establishments included in NAICS code 92 (public administration) and all other non-business establishments (public hospitals, public universities, etc.) are excluded from the business sector aggregation.

It is important to note that this definition of business sector includes business establishments classified under education services, as well as those under health care and social assistance. In practice, however, most of the establishments in those two sectors are part of the public sector in Canada, and thus *not* included in the business sector aggregation. As Table 1 shows, the business sector share of education represented on average only 4.7 per cent of total nominal GDP in the Canadian education sector during the 1997-2008 period, while the business sector share of health care and social assistance accounted for 39.6 per cent of total nominal GDP in that sector.

[4] For more on measuring output and productivity of non-business sector industries, see Yu (2004) and Diewert (2008).

Table 1: Business Sector and Non-Business Sector Nominal GDP Shares at the Two-Digit NAICS Level, Canada (1997-2008 Period Average)

	Business Sector	Non-Business Sector
	(as a share of the total economy)	
Agriculture, Forestry, Fishing and Hunting	97.1	2.9
Mining and oil and gas extraction	100.0	0.0
Utilities	94.5	5.5
Construction	100.0	0.0
Manufacturing	100.0	0.0
Wholesale trade	100.0	0.0
Retail trade	99.9	0.1
Transportation and warehousing	94.9	5.1
Information and cultural industries	94.8	5.2
FIRE*	98.8	1.2
Professional, scientific and technical services	99.4	0.6
ASWMRS**	99.7	0.3
Educational services	4.4	95.6
Health care and social assistance	39.6	60.4
Arts, entertainment and recreation	78.3	21.7
Accommodation and food services	99.2	0.8
Other private services	68.5	31.5
Public administration	0.0	100.0

* Finance, insurance, real estate, rental and leasing ** Administrative and support, waste management and remediation services

Source: Statistics Canada, GDP at basic price in current dollars, SNA benchmark values, by NAICS, annually (CANSIM Table 379-0023).

Another important data source for this report is Statistics Canada's Fixed Investment Flows and Stocks (FIFS) survey, which (as the name implies) provides data for fixed, non-residential investment and capital stock broken down by asset type and industry. The data span the 1961-2010 period and are available for Canada, the provinces, and territories.

All of the sources described above were used to construct the CSLS Newfoundland and Labrador Productivity Database, an extensive database of more than 90 tables that describes trends in output, labor and capital input as well as productivity in Canada, Newfoundland and Labrador and other Canadian provinces. The database is posted with this report at http://www.csls.ca/res_reports.asp.

II. An Overview of Newfoundland and Labrador's Economy, 1997-2010

This report focuses on three specific (value-added) productivity measures: labour productivity, capital productivity and multifactor productivity, all of which are calculated from data on nominal GDP, price deflators, labour input, and/or capital input. Before analyzing and discussing how trends in these productivity measures evolved in Newfoundland and Labrador in recent years, it is important to look at the underlying data used to construct these productivity measures. This serves a double-purpose: first, it allows us to look at the components of labour, capital and multifactor productivity independently, which can help us identify important trends that could individually influence actual and future trends in productivity; second, it highlights key facts about Newfoundland and Labrador economy at a macro-level.

This part of the report first explores output trends in Newfoundland and Labrador during the 1997-2010 period. Next, labour input and capital input trends in the province are analyzed.

A. Gross Domestic Product

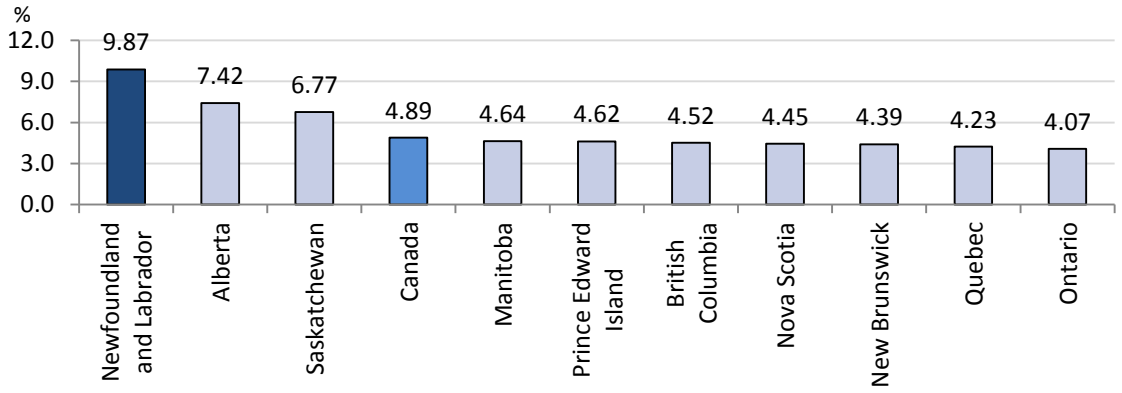
This section analyzes the recent evolution of business sector output in Newfoundland and Labrador, looking at nominal GDP, real GDP and implicit price deflator estimates for the 1997-2010 period. It also highlights major changes in the sectoral composition of Newfoundland and Labrador's economy.[5]

i. Nominal GDP

In 2010, Newfoundland and Labrador business sector nominal GDP was $19,919 million, up from $5,858 million in 1997. Given such a large increase, it is not surprising that Newfoundland and Labrador's business sector nominal GDP had the highest growth rate of all the Canadian provinces between 1997 and 2010, with a compound annual rate of 9.87 per cent, more than two percentage points higher than its nearest follower, Alberta (which had an annual growth rate of 7.42 per cent), and well above Canada's growth (4.89 per cent per year) (Chart 1). As a consequence of this rapid growth, Newfoundland and Labrador's share in national business sector nominal output nearly doubled, from 0.96 per cent in 1997 to 1.76 per cent in 2010 (Chart 2). Nominal GDP growth in the province can be attributed to both higher real growth (4.55 per cent vs. 2.50 per cent in Canada) and higher price growth (5.09 per cent vs. 2.34 per cent in Canada) (Chart 3).

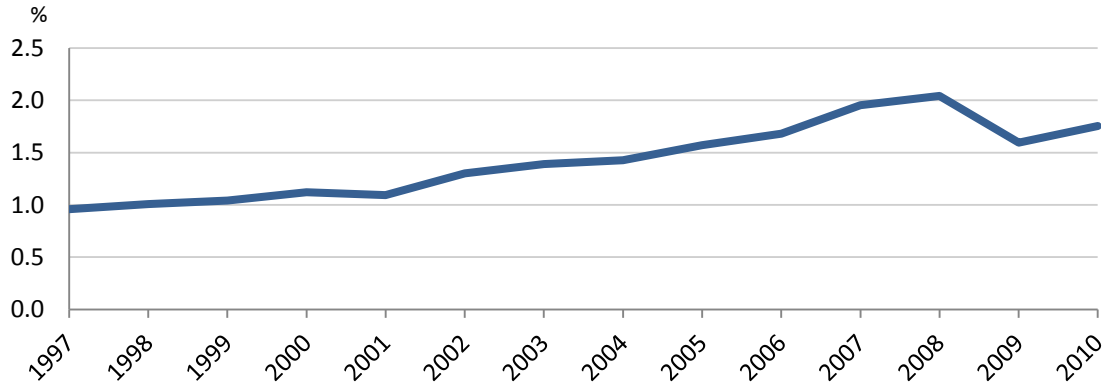
[5] Data on income, employment and other well being indicators are also available at the sub-provincial level for Newfoundland and Labrador through the *community accounts project*. Information can be retrieved for up to 400 communities, 80 census consolidated subdivisions (local areas) and 20 economic development zones. For more information, see nl.communityaccounts.ca

Chart 1: Nominal GDP Growth in Canada and the Provinces, Business Sector, 1997-2010 (Compound Annual Growth Rates)



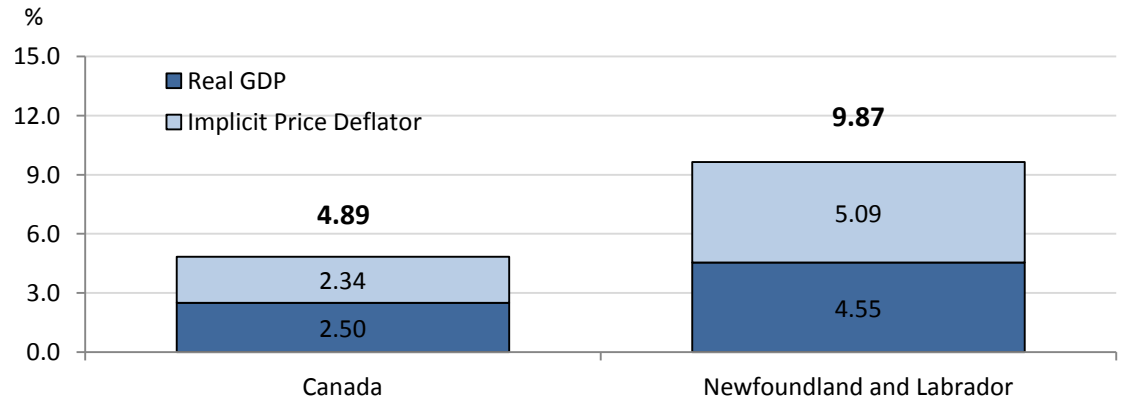
Source: CSLS Newfoundland and Labrador Productivity Database.

Chart 2: Newfoundland and Labrador's Nominal GDP as a Share of Canada's, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database.

Chart 3: Nominal GDP Growth Breakdown in Newfoundland and Labrador and Canada, Business Sector, 1997-2010 (Compound Annual Growth Rates)



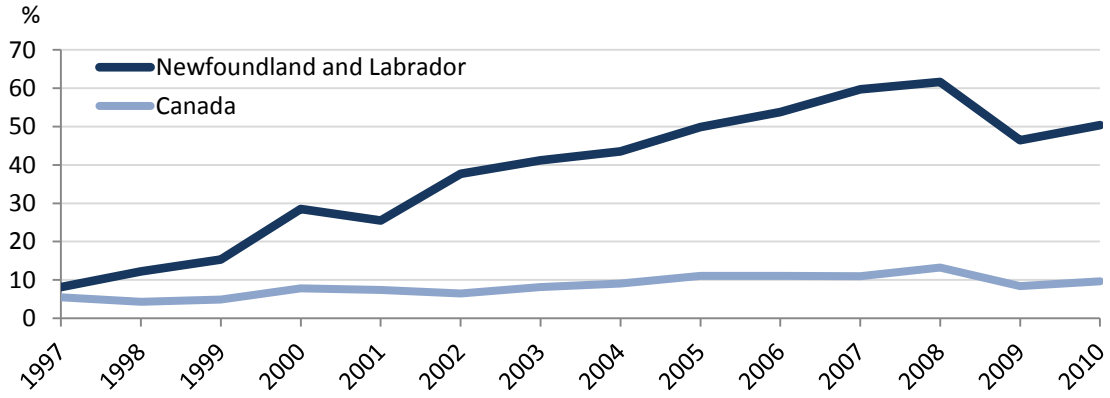
Source: CSLS Newfoundland and Labrador Productivity Database.

It is important to highlight the importance of the mining and oil and gas extraction sector in the boom that happened in Newfoundland and Labrador. In terms of nominal GDP shares, mining and oil and gas extraction rapidly became the dominant sector of Newfoundland economy. In 2010 (Table 2), it accounted for 50.4 per cent of the province's nominal business sector output, up from 8.2 per cent in 1997 (Chart 4) and down from a peak of 61.6 per cent in 2008. No province in Canada is as dominated by one sector of its economy as Newfoundland and Labrador is. Saskatchewan, with its mining and oil and gas sector accounting for 33.4 per cent of nominal GDP, comes second. If we include the territories, we can find that Northwest Territories had a mining and oil and gas sector that holds a higher share of GDP than Newfoundland and Labrador, but only by a slight margin, as it accounted for 53.6 per cent of nominal GDP in 2010. At the national level, the share of mining and oil and gas extraction also increased, from 5.5 per cent in 1997 to 9.6 per cent in 2010.[6]

It is no surprise to see that this growth in the mining and oil and gas extraction sector drastically increased the relative size of Newfoundland and Labrador's business sector, from 62.3 per cent of the total economy in 1997 to 76.1 per cent in 2010. In comparison, the Canadian business sector represented between 74.9 and 77.1 per cent of Canada's total economy during this period (Table 3 and Chart 5).

To summarize the importance of the mining and oil and gas extraction sector during the 1997-2010 period, we can conclude by saying that nearly 70 per cent of the nominal business sector output growth experienced by the province during the 1997-2010 period is attributable to the mining and oil and gas extraction sector while at the national level, mining and oil and gas extraction accounted for 14.5 per cent of the additional business sector output produced.

Chart 4: Mining and Oil and Gas Extraction Industries Output as a Share of Nominal GDP, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database

[6] Absolute level of nominal business sector GDP by industry can be found in Appendix Table 1.

Table 2: Nominal GDP Shares by Two-Digit NAICS Sectors and Special Industry Aggregations, Newfoundland and Labrador and Canada, 1997, 2000 and 2010

	Newfoundland and Labrador			Canada		
	1997	2000	2010	1997	2000	2010
	(as a share of business sector industries, per cent)					
Business sector industries	100.0	100.0	100.0	100.0	100.0	100.0
Agriculture, forestry, fishing and hunting	5.1	4.5	1.7	3.2	2.9	2.2
Mining and oil and gas extraction	8.2	28.5	50.4	5.5	7.8	9.6
Utilities	7.5	5.1	2.9	4.2	3.4	3.0
Construction	9.9	6.8	7.7	7.0	6.4	9.4
Manufacturing	11.1	9.9	4.8	23.3	24.4	14.4
Wholesale trade	6.4	4.9	3.5	7.2	6.6	7.1
Retail trade	9.8	8.2	6.2	6.9	6.7	7.6
Transportation and warehousing	7.2	4.7	3.0	6.2	5.7	5.9
Information and cultural industries	5.6	4.8	2.6	4.3	4.2	4.7
FIRE	13.1	9.0	6.0	15.0	14.1	15.7
Professional, scientific and technical services	3.8	3.6	3.1	4.9	5.7	6.8
ASWMRS	1.5	1.4	1.4	2.5	2.7	3.3
Arts, entertainment and recreation	0.7	0.4	0.2	0.9	0.9	1.0
Accommodation and food services	3.6	2.8	2.2	3.2	3.0	2.9
Other private services	6.6	5.5	4.4	5.7	5.5	6.5
Business sector without mining and oil and gas	91.8	71.5	49.6	94.5	92.2	90.4

Source: CSLS Newfoundland and Labrador Productivity Database.

Table 3: Nominal GDP Breakdown, Newfoundland and Labrador and Canada, 1997-2008 (as a share of the total economy)

	Newfoundland and Labrador		Canada	
	1997	2010	1997	2010
	(as a share of the total economy, per cent)			
Total Economy	**100**	**100**	**100**	**100**
Business Sector Industries*	62.3	76.1	74.9	74.7
Owner-Occupied Dwellings	9.5	5.2	8.3	8.1
Other Private Services (Non-Business Sector component) **	15.9	10.5	9.5	9.6
Public Administration	10.8	6.7	6.1	6.2
Other ***	1.6	1.5	1.2	1.4

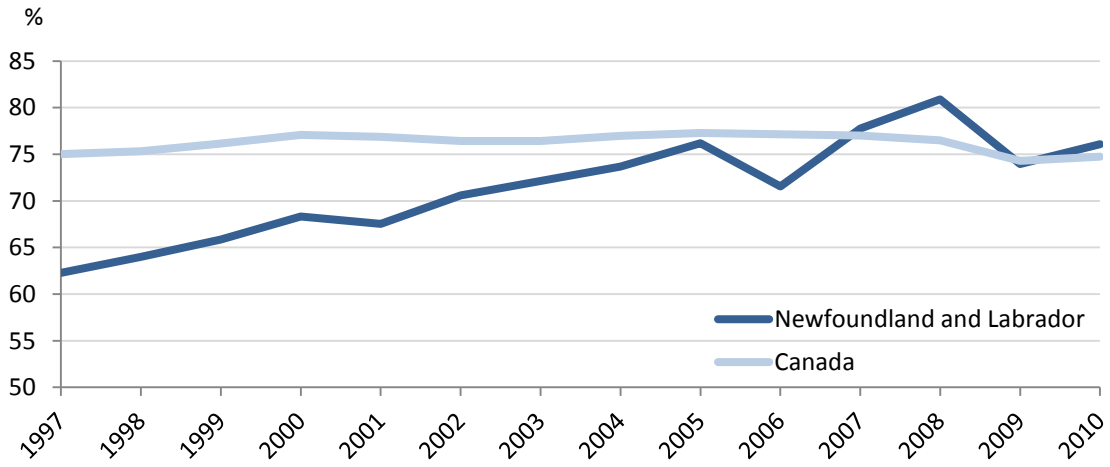
* Unlike Statistics Canada's general definition of the business sector, the CPA's definition of the business sector, which is used here, excludes owner-occupied dwellings.

** Includes non-business establishment classified under education services (NAICS code 61), health care and social assistance (NAICS code 62), and other services (except public administration) (NAICS code 81).

*** Includes non-business establishments classified under NAICS code 11-56, 71, and 72.

Source: Statistics Canada, 1) GDP at basic prices in current dollars, SNA benchmark values, by NAICS, annually (CANSIM Tables 379-0023 and 379-0024; 2) GDP at basic prices, by NAICS and provinces, annually (CANSIM Table 379-0025); 3) LPM- Provinces and Territories (annual) (CANSIM Tables 383-0011).

Chart 5: Business Sector as a Share of Total Economy, Newfoundland and Labrador and Canada, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database.

It is evident that we cannot ignore the important place that the mining and oil and gas sector has taken in the industry composition of Newfoundland and Labrador. Yet, an interesting perspective can be obtained by looking at the relative size of each industry, while excluding the mining and oil and gas sector from the calculation of nominal GDP. This exercise can be found in the Appendix Table 4 and 5. The conclusion that can be reached from those tables is that when mining and oil and gas extraction is not taken into account, Newfoundland and Labrador's business sector does not appear to be as well developed as the business sector in Canada as a whole. Without the mining and oil and gas extraction sector, Newfoundland and Labrador's business sector size increases only slightly, from 60.2 per cent in 1997 to 61.9 per cent of the total economy in 2008 (Canada's business sector accounted for 74.0 per cent of the economy in 2008). Therefore, the increase in the relative size of Newfoundland and Labrador's business sector and the decrease in the relative size of its public administration are direct consequences of the impressive growth of the mining and oil and gas extraction sector.

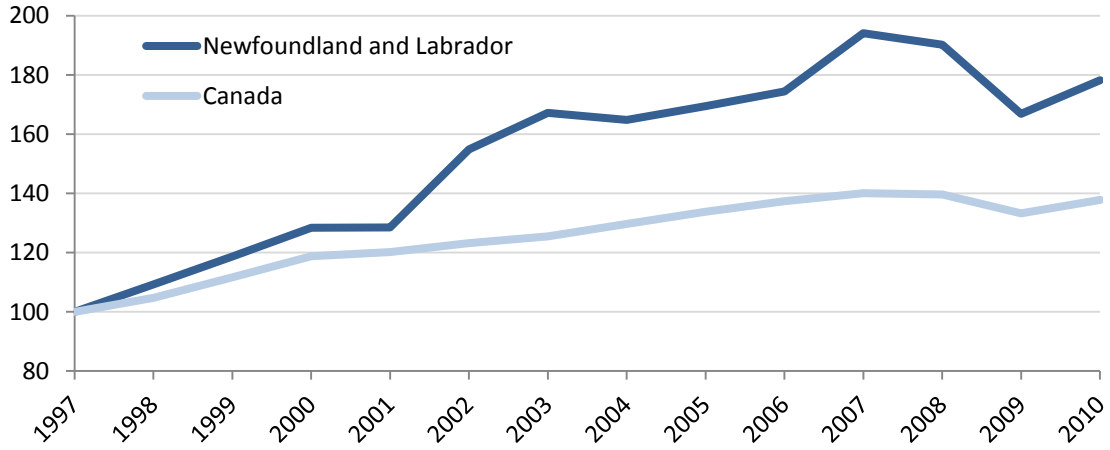
ii. Real GDP

In 2010, real business sector GDP in Newfoundland and Labrador's GDP was $19,679 million (chained 2007 dollars), up from $11,040 million (chained 2007 dollars) in 1997. This represents a compound annual rate of 4.55 per cent, nearly twice the national average rate of 2.50 per cent per year.

Chart 6 illustrates how real business sector GDP increased at a much faster rate in Newfoundland and Labrador than in Canada, particularly between 2001 and 2004, when Newfoundland and Labrador's real GDP grew at an annual compound rate of 8.63 per cent versus 2.56 per cent for the national average. It is interesting to note that the recent economic

downturn had a larger effect on Newfoundland and Labrador' business sector than on Canada's. In 2009, real business sector GDP declined 12.30 per cent in the province versus a decline of 4.58 per cent for Canada as a whole.[7]

Chart 6: Real Business Sector GDP Growth in Newfoundland and Labrador and Canada, Business Sector, 1997-2010 (1997=100)

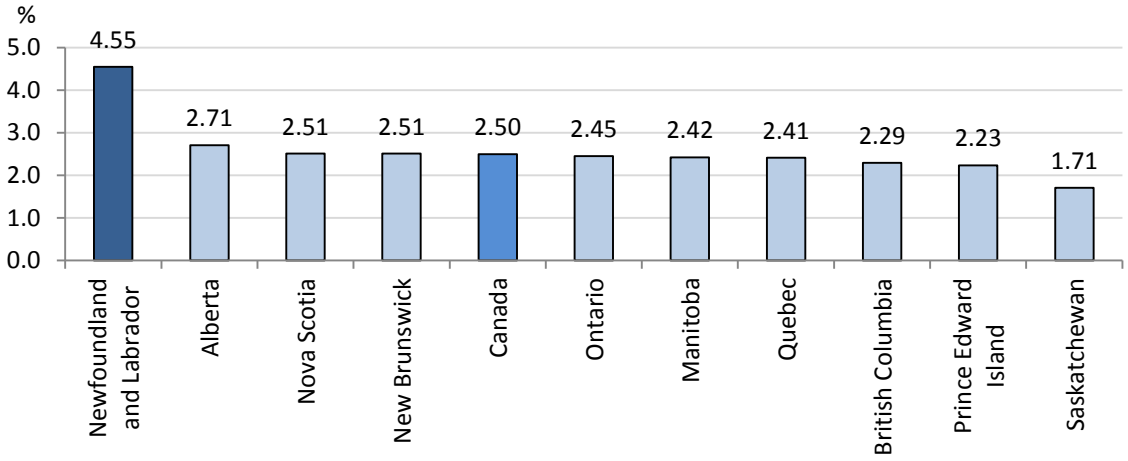


Source: CSLS Newfoundland and Labrador Productivity Database

Compared to the other provinces, Newfoundland and Labrador ranked first in terms of real GDP growth during the 1997-2010 period (Chart 8). Alberta, despite coming second, experienced real GDP growth well below that of Newfoundland and Labrador (2.71 per cent per year versus 4.55 per cent per year, respectively – a difference of 1.8 percentage points).

[7] It is difficult to assess if the decrease in output in 2009 was created directly by the worldwide economic downturn or by specific condition in the supply-side of the provincial economy. Practically all of the decline in the output of the business sector was due to the decrease in the output of the mining and oil and gas sector. It is easy to see why such a decline could be caused by the economic downturn, as it would reduce the demand for oil products and at the same time, the price of the oil barrel, reducing incentives for high production volumes. However, it is also possible that the decrease in oil production was only coincidental with the worldwide economic recession, and that the real reasons explaining the decline in oil production are due to supply-side effects. Those reasons would include a ‘‘natural production declines as well as downtime at White Rose to tie-in the North Amethyst satellite field and operational issues at Terra Nova’’(Department of Finance, 2009:11)

Chart 7: Real Business Sector GDP in Canada and the Provinces, Business Sector, 1997-2010 (Compound annual growth rates)



Source: CSLS Newfoundland and Labrador Productivity Database

Once again, it is important to note that most of this growth was driven by the mining and oil and gas extraction sector. Looking at the two-digit NAICS sector breakdown of real GDP growth in Newfoundland and Labrador, we see that mining and oil and gas extraction had the highest growth rate of all sectors (14.4 per cent per year) (Table 4). When compared to the performance of the mining and oil and gas extraction sector at the national level, which grew at a compound annual rate of only 0.7 per cent, Newfoundland and Labrador's performance is particularly impressive. Real output growth in Newfoundland and Labrador's mining and oil and gas extraction sector was particularly strong in the 1997-2005 period (26.64 per cent per year), slowing down significantly during the second half of the 2000s (1.06 per cent per year). When this sector is excluded, Newfoundland and Labrador's economic performance loses its luster, with real GDP growth falling from 4.55 per cent to only 2.66 per cent during the 1997-2010 period (while in Canada it increases from 2.50 per cent to 2.63 per cent if real growth from mining and oil and gas is excluded) (Chart 8).[8]

Following mining and oil and gas extraction, three out of the four most important sectors in Newfoundland and Labrador (in terms of nominal business sector GDP shares) performed either on par or slightly better than Canada as a whole in terms of real GDP growth: retail trade (4.2 per cent per year versus 4.1 per cent per year, respectively); construction (3.9 per cent per year versus 3.6 per cent per year); and manufacturing (1.3 per cent per year versus 0.2 per cent per year). Only the FIRE sector had a below-average performance during the period (2.1 per cent per year versus 3.4 per cent per year).

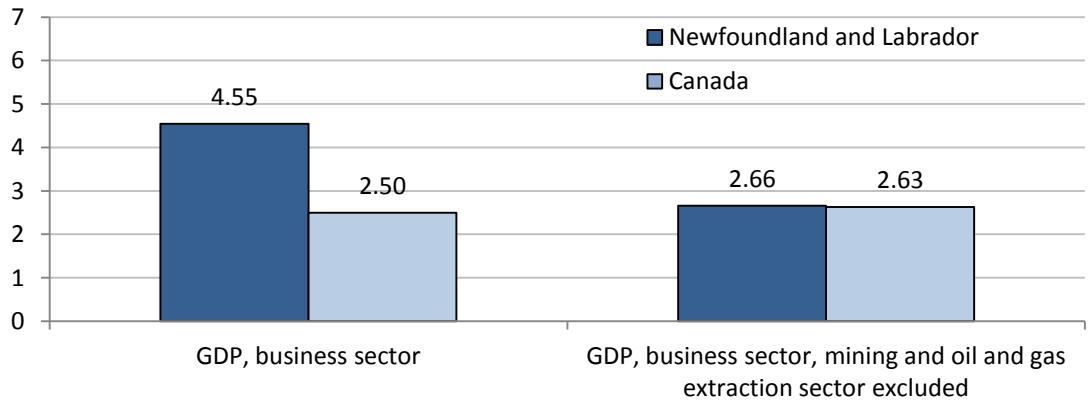
[8] The same exercise can be done with Nominal GDP. When the mining and oil and gas extraction sector is excluded from business sector GDP, Newfoundland and Labrador's GDP grew only 4.78 per cent per year compared to 9.87 per cent for total business sector. As a comparison, Canada's nominal business sector GDP grew 4.89 per cent per year and 4.52 per cent per year when mining and oil and gas is excluded.

Table 4: Real Business Sector GDP Growth by Two-Digit NAICS Sectors, Newfoundland and Labrador and Canada, 1997-2010

	Newfoundland and Labrador			Canada		
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
	(compound annual growth rates, per cent)					
Business sector	**4.55**	**8.70**	**3.33**	**2.50**	**5.90**	**1.49**
Agriculture, forestry, fishing and hunting	0.58	5.14	-0.75	1.30	4.34	0.40
Mining and oil and gas extraction	14.41	40.45	7.59	0.67	1.30	0.48
Utilities	0.02	-1.38	0.44	0.80	-0.14	1.08
Construction	3.91	0.50	4.96	3.62	4.43	3.37
Manufacturing	1.28	9.26	-0.99	0.20	7.72	-1.96
Wholesale trade	3.91	6.03	3.28	3.67	7.04	2.68
Retail trade	4.21	4.94	3.99	4.15	5.76	3.67
Transportation and warehousing	0.10	-2.22	0.81	2.31	4.72	1.59
Information and cultural industries	3.96	10.55	2.06	4.49	9.39	3.06
FIRE	2.06	0.00	2.68	3.40	4.94	2.95
Professional, scientific and technical services	4.78	8.57	3.66	4.50	11.08	2.60
ASWMRS	6.61	8.71	6.00	4.24	7.51	3.28
Arts, entertainment and recreation	0.59	-2.95	1.68	1.69	3.92	1.04
Accommodation and food services	2.46	4.06	1.98	1.60	4.35	0.79
Other private services	2.29	7.07	0.90	2.67	4.88	2.02
Business sector without mining and oil and gas	2.66	4.11	2.22	2.63	6.17	1.59

Source: CSLS Newfoundland and Labrador Productivity Database

Chart 8: Real Business Sector GDP Growth in Newfoundland and Labrador and Canada, Business Sector and Business Sector Excluding Mining and Oil and Gas Extraction Industries, 1997-2010



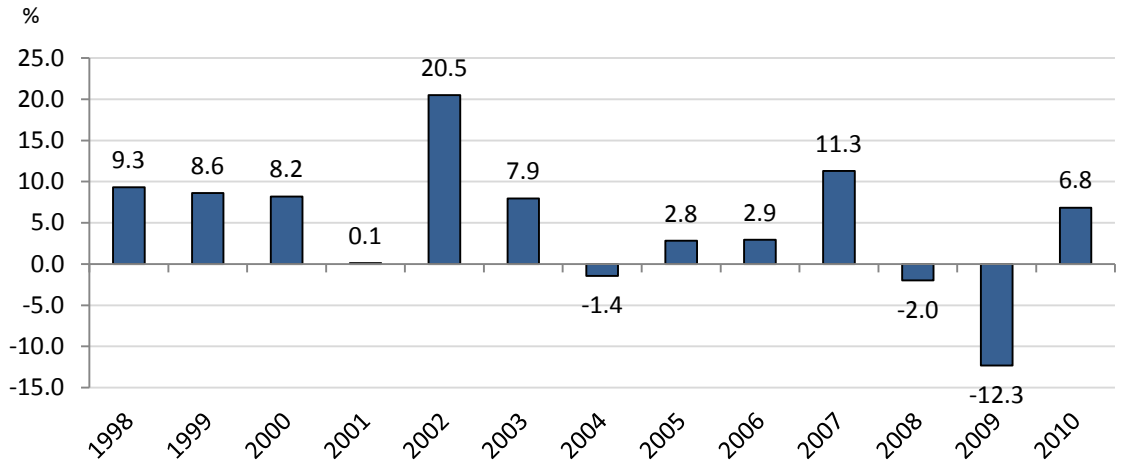
Note: Growth rates for the business sector (excluding the mining and oil and gas extraction sector) were calculated by the CSLS using a Tornqvist index.
Source: CSLS Newfoundland and Labrador Productivity Database.

The relationship between Newfoundland and Labrador's overall economic performance and the performance of its mining and oil and gas extraction sector is clear (see Box 1 for more detail on the oil sector boom after 1997). It is important to draw attention to one specific event during the 1997-2010 period. As we can see in Chart 9, Newfoundland and Labrador's real GDP experienced its fastest growth in 2002, when it increased by 20.5 per cent. This upsurge in output was mostly the consequence of one event: the beginning of production at the Terra Nova oil field, which "produced 38.5 million barrels of oil in 2002."(Newfoundland and Labrador Department of Finance, 2003). Real output in the mining and oil and gas sector nearly doubled in

2002, with an increase of 92 per cent over its 2001 level. As we will later see, 2002 is also the year when labour productivity, capital productivity and multifactor productivity experienced their highest growth rate during the 1997-2010 period. The beginning of oil production at the Terra Nova oil field is therefore an important economic landmark for our period of study and its significance should be kept in mind for the rest of this report.

In 2007, Newfoundland and Labrador also experienced strong real GDP growth (11.3 per cent). Once again, we can correlate this upsurge in output with the mining and oil and gas sector. In that year, oil production increased 21.3 per cent in terms of barrels of oil and the value of oil production increased by 26.6 per cent. This was due to two factors: 1) "Terra Nova resumed operations after being out of service for a six-month period in 2006 "; 2) an increase of production at the White Rose platform, due to the completion of regulatory approval that increased the facility maximum rate of production (Newfoundland and Labrador Department of Finance: 17-20).

Chart 9: Real GDP Growth in Newfoundland and Labrador, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database

Box 1: The Oil Boom in Newfoundland and Labrador

Source: CBC

Since first oil flowed at Hibernia in 1997, the face of Newfoundland and Labrador's economy has completely changed. It is estimated that nearly 50 per cent of the province's GDP growth during the 1997-2011 period was directly attributable to oil and gas production, the sector also accounting for more than 25 per cent of total capital expenditures during the period (Newfoundland and Labrador's Department of Economics, 2011). Newfoundland and Labrador now has three oil extraction platforms in production: Hibernia, Terra Nova and White Rose. Hibernia was the first offshore oil project to be developed in Newfoundland and Labrador and is also the largest offshore project in the province, with estimated recoverable reserves of 1.4 billion barrels[1]. Terra Nova and White Rose (including North Amethyst) were respectively the second and third offshore oil projects, production beginning respectively in 2002 and 2005. A fourth project, Hebron, has now received the approval from Exxon Mobil, the operator of the project, and extraction is expected to begin in 2017. With its 707 million barrels of estimated recoverable reserves, it would become, in terms of reserves, the second largest field in production after Hibernia.

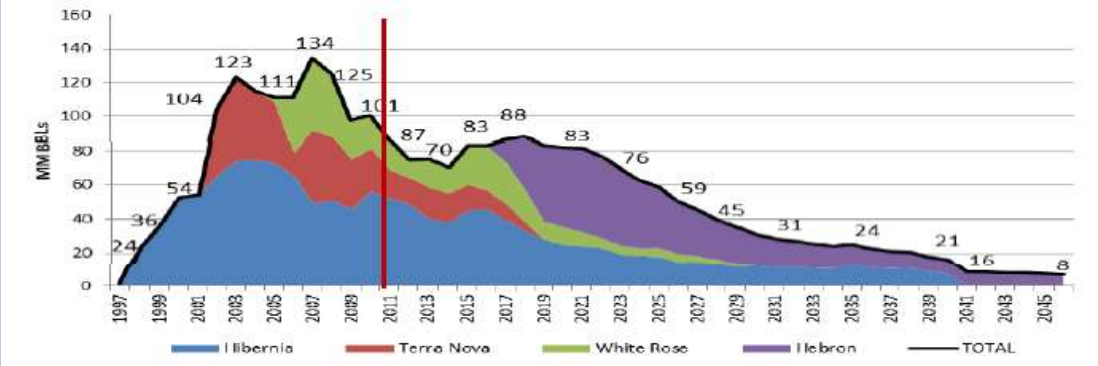
Is it already the end?

The beginning of production at the Hebron oil field will assuredly bring an upsurge in a production that has been on a downward trend since the 2007 peak. Yet, the golden days of Newfoundland and Labrador's oil production may be well behind. As of May 2013, with only 39.5 per cent of total reserves remaining in the Hibernia oil field, 32.8 per cent in Terra Nova's and 39.2 per cent in White Rose's, it is unlikely that Newfoundland and Labrador's oil production will ever reached again its 2007 peak of 134 million barrels (Canada-Newfoundland Offshore Petroleum Board). Between 2007 and 2012, production at Terra Nova and White Rose declined at respectively an average annual rate of 27.6 and 18.0 per cent. Extensions of the Hibernia project occurred in 2009 and 2011, and they are anticipated to extend the life of the project by five to 10 years, but estimations shows that production will eventually drop, as illustrated in Figure 1. At their 2012 level of production, which was far lower than their average level for the 1997-2010 period and unlikely to go up again, Hibernia could produce oil for 11.9 years, Terra Nova for 19.8 years and White Rose for 4.9 years.

1. Canada-Newfoundland Offshore Petroleum Board divides estimates of recoverable oil reserves between proven reserves, proven and probable reserves, and proven, probable and possible reserves. The numbers given here represent the proven and probable reserves.

Box 1: The Oil Boom in Newfoundland and Labrador (continued)

Figure 1: Annual Oil Production from Newfoundland and Labrador's Offshore- Actual and Expected (Millions of barrels)



Source: Wade Locke (June 2011)

There is still a considerable chance that a new, exploitable oil field will be discovered. In June 2012, Statoil announced the discovery of 100 to 200 million barrels of recoverable oil reserves in the Mizzen field, 500km northeast of St. John's. Yet, it must be understood that the discovery of oil does not necessarily equal future production. For example, it is uncertain that the Mizzen oil discovery will lead to a development plan, as the costly deep-sea drilling that would be necessary to recover the oil may make the whole operation unprofitable. Therefore, distance from land, depth of crude oil, dangerous conditions and environmental risks are all likely to prevent many future discoveries from further development.

The prospects of new discovery are particularly strong in Newfoundland and Labrador's West coast. Soal Point Energy intends to drill 12 exploration wells in the next few years in order to verify the viability of oil extraction from a field that is estimated to contain 23 billion barrels of oil. Once again, this viability of this project is far from assured, especially since it involves "fracking", a controversial process that involves injecting a mixture of water, sand and chemicals underground at high pressure in order to crack the rock.

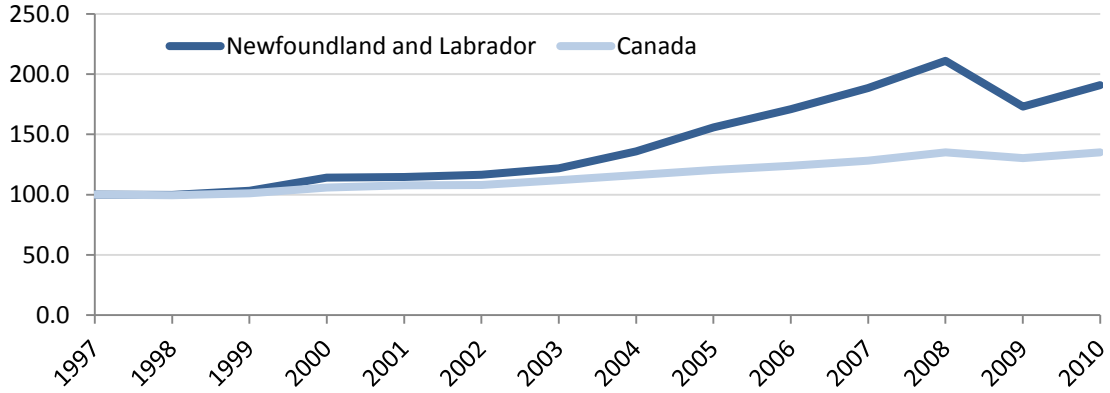
What about mining?

In this report, we refer at multiple occasions to the growth of the mining and oil and gas sector as one of the main reason behind Newfoundland and Labrador's upsurge in output and productivity. Most of the time, we assume that this extensive growth is a consequence of the massive increase in oil production. Yet, it is also important to acknowledge the important growth that occurred in the mining sector since 2004. Between 2004 and 2012, the value of Newfoundland and Labrador's mineral shipment grew at a compound annual rate of 24.0 per cent, from $684 million dollars to $4,539 million. Furthermore, as mineral development activity continued to be robust in Newfoundland and Labrador in 2012, prospects for Newfoundland and Labrador's mining sectors looks very good in both the short and the mid-term. In 2012, exploration are forecast to be at a record high of $195 million and capital investment is estimated to surpass 1 billion. Therefore, although this report focus mainly on the changes to the aggregate productive bought by the beginning of oil production in the province, it is important to know that the mining industry also played an important parts in those developments and is likely to do so in the future.

iii. Implicit GDP Price Deflators

The implicit price deflator (IPD), calculated as nominal GDP divided by real GDP, in the Newfoundland and Labrador business sector grew at a much higher pace than the national average during the 1997-2010 period (5.09 per cent per year vs. 2.34 per cent per year, respectively). As Chart 10 shows, this is especially true for the 2003-2008 period, when prices in Newfoundland and Labrador increased at three times the pace of Canada as a whole (11.61 per cent vs. 3.80 per cent).

Chart 10: Implicit Price Deflator Growth in Canada and Newfoundland and Labrador, Business Sector, 1997-2010 (1997=100)



Source: CSLS Newfoundland and Labrador Productivity Database.

Table 5 details the implicit price deflators for Newfoundland and Labrador and Canada at the two-digit NAICS sector level. The difference between the business sector deflators was caused, once again, by the mining and oil and gas extraction sector – more specifically, by the larger role of that sector in Newfoundland and Labrador's business sector compared to Canada's. Furthermore, a comparison between the implicit price deflator and the Consumer Price Index (CPI) shows that the increase in the nominal value of Newfoundland's and Labrador GDP in relation to its real GDP are much higher than increases in the CPI. The CPI is an indicator of changes in consumer prices experienced by Canadians, by comparing, over time, the cost of a fixed basket of goods and services at the cost purchased by Canadian consumers. Therefore, in contrary to the GDP implicit price deflator, which measures the variation in nominal value of every goods and services produced in Newfoundland and Labrador, the CPI only takes into account the goods consumed in the province, and therefore excludes components of GDP such as investment goods, government expenditures and exports while including imports.

During the 1997-2010 period, the CPI grew at a slower pace in Newfoundland and Labrador than in Canada (1.87 per cent per year vs. 1.97 per cent per year)[9]. The reason why the GDP implicit price deflator grew at a higher rate than the CPI is that the IPD was driven mostly

[9] Statistic Canada, CANSIM Table 326-0021

by exports and by the rising prices in the mining and oil and gas sector.[10] In 2009, as the large fall in the price of oil lead to an 18.0 per cent fall in the GDP implicit price deflator, the Consumer Price Index still grew 0.26 per cent in Newfoundland and Labrador.

Table 5: GDP Implicit Price Deflator Growth by Two-Digit NAICS Sectors, Newfoundland and Labrador and Canada, 1997-2010

	Newfoundland and Labrador			Canada		
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
	(compound annual growth rates, per cent)					
Business sector	**5.09**	**4.52**	**5.27**	**2.34**	**1.92**	**2.46**
Agriculture, forestry, fishing and hunting	0.39	3.00	-0.38	0.50	-0.57	0.82
Mining and oil and gas extraction	10.48	22.73	7.05	8.85	20.03	5.70
Utilities	2.20	1.12	2.53	1.38	1.16	1.44
Construction	3.71	-0.36	4.96	3.55	0.50	4.48
Manufacturing	1.69	0.09	2.17	0.90	1.78	0.63
Wholesale trade	0.88	-2.02	1.76	1.12	-1.68	1.98
Retail trade	1.82	1.80	1.83	1.46	0.91	1.63
Transportation and warehousing	2.70	0.91	3.25	2.08	0.13	2.67
Information and cultural industries	-0.31	-2.73	0.42	1.11	-1.97	2.05
FIRE	1.35	0.51	1.61	1.77	0.68	2.10
Professional, scientific and technical services	3.24	2.73	3.39	2.86	1.84	3.17
ASWMRS	2.55	2.43	2.58	2.81	2.29	2.96
Arts, entertainment and recreation	0.45	-1.67	1.10	3.34	3.25	3.37
Accommodation and food services	2.56	1.07	3.01	2.65	1.70	2.94
Other private services	4.11	0.04	5.37	3.10	1.63	3.54
Business sector without mining and oil and gas	2.07	0.40	2.58	1.85	0.82	2.16

Source: CSLS Newfoundland and Labrador Productivity Database

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 and labour compensation.

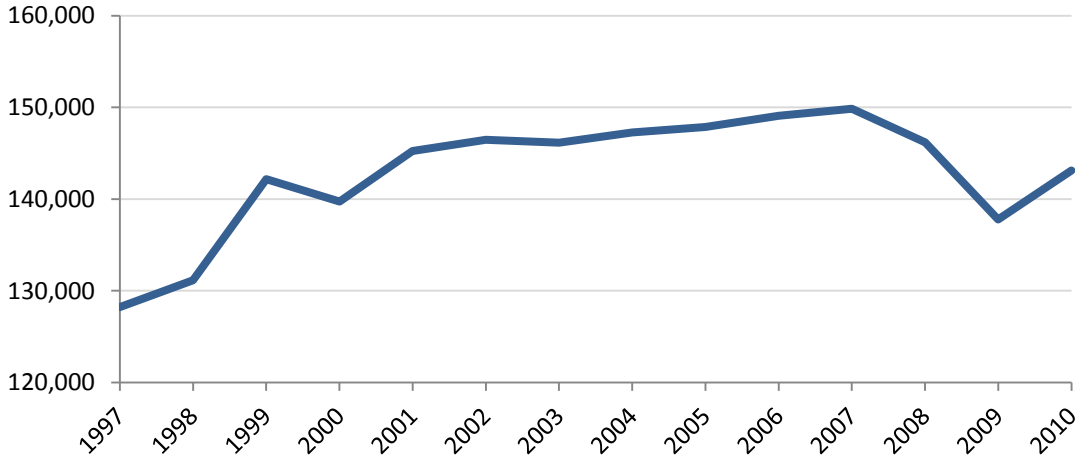
i. Number of Jobs

Overall, hours worked is a better measure of labour input than number of jobs, since they also take into account changes in the length of the work week and shifts from full-time employment to part-time employment. However, analyzing trends in the number of jobs can be informative as well, since employment is an important indicator of well-being.

[10]According to CANSIM Table 228-060, in 2010, 79.9 per cent of exports originating from Newfoundland and Labrador were classified as either energy products (55.7 per cent) or metal ores and non metallic mineral (24.2 per cent). The fact that the increase in the implicit price deflator was driven by exports can also be confirmed by looking at the difference between the GDP deflator and the exports deflator. The export deflator is calculated by dividing the nominal exports by the real exports. During the 1997-2010 period, for Newfoundland and Labrador's total economy, the export deflator grew 5.3 per cent per year versus 4.1 per cent for GDP deflator (Calculated from CANSIM Table 384-0002), showing that increases in the price level of production is driven mostly by increases in the price of exports.

During the 1997-2010 period, the number of jobs in Newfoundland and Labrador's business sector grew at an annual rate of 0.85 per cent, from 128,225 jobs in 1997 to 143,125 in 2010 (Chart 11). This represents approximately half of the growth rate experienced in Canada as a whole during the same period (1.59 per cent per year). The growth in the number of jobs in Newfoundland and Labrador was particularly fast during the 1997-2002 period (2.69 per cent per year), slowing down considerably after that. Indeed, the number of jobs in Newfoundland and Labrador's economy in 2010 was lower than in 2001.

Chart 11: Number of Jobs in Newfoundland and Labrador, Business Sector, 1997-2010



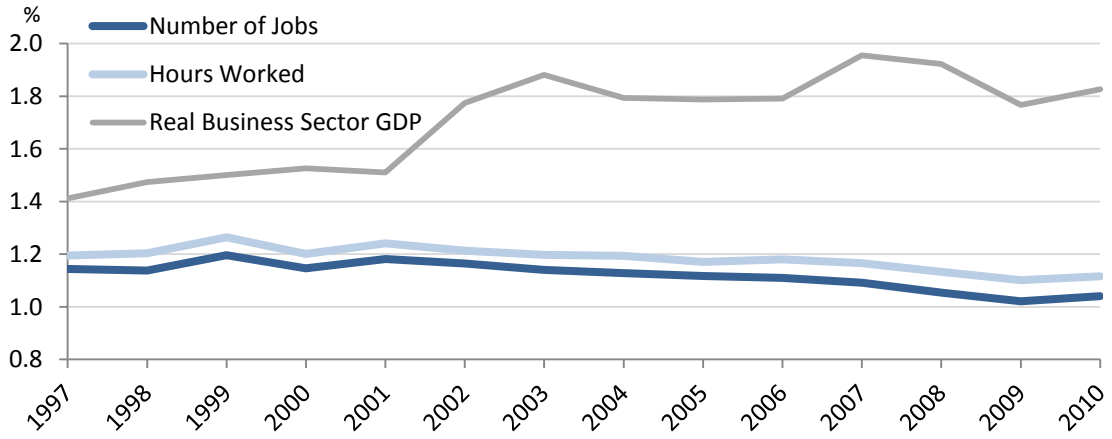
Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Labour Productivity Measures - Provinces and Territories, CANSIM Table 383-0011.

Two important observations can be drawn out of Chart 11. First, there is no significant correlation between the actual growth of the nominal business sector output and employment during the 1997-2010 period. For example, in the last section, we identified 2002 as an exceptional year in term of nominal business sector GDP growth (20.5 per cent), notably because of the beginning of production at the Terra Nova offshore oil platform. Yet, the number of jobs in the province barely increased in 2002, as it grew 0.83 per cent and even declined by -0.22 per cent in 2003. The same development occurs in 2007; as output grew by 11.3 per cent during that year, the number of jobs stayed practically the same. Secondly, we can see that the number of jobs felt considerably between 2007 and 2009. Agriculture, forestry, fishing and hunting and the manufacturing sector were the two sectors that experienced the highest relative drop in their number of jobs (-21.9 per cent and -20.8 per cent respectively).

As illustrated in Chart 12, the Newfoundland and Labrador share of business sector national employment declined from 1.14 per cent of national employment in 1997 to 1.08 per cent in 2010. Chart 12 also illustrate hours worked in Newfoundland and Labrador as a share of Canada's. Although we will only discuss hours worked later, we can already see that during the

1997-2010 period, it followed very closely the variations in number of jobs. Furthermore, the higher share of Newfoundland and Labrador's hours worked in comparison to the share of job is explained by the longer working week in the province, as will be discussed in the next section.

Chart 12: Hours Worked, Number of Jobs and Real GDP (chained 2007 dollars) in Newfoundland and Labrador as a Share of Canada, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Labour Productivity Measures - Provinces and Territories, CANSIM Table 383-0011.

It is interesting to see that, even though mining and oil and gas extraction represented more than 50 per cent of the Newfoundland and Labrador's business sector output in 2010, the sector accounted for only 3.8 per cent of the province's business sector total number of jobs. In terms of number of jobs, retail trade was the largest sector in Newfoundland and Labrador and in Canada in 2010, at respectively 23.7 per cent and 15.1 per cent of total business sector employment. Construction (9.5 per cent vs. 9.9 per cent) and manufacturing (8.2 per cent vs. 11.7 per cent) were also among the largest sector in both Newfoundland and Labrador and in Canada.

Table 6: Jobs Shares by Two-Digit NAICS Sectors, Newfoundland and Labrador and Canada, 1997-2010

	Newfoundland and Labrador		Canada		N.L. - Canada Gap	
	1997	2010	1997	2010	1997	2010
	(per cent)				(percentage points)	
	A	B	C	D	E=C-A	F=D-B
Business sector industries	100.00	100.00	100.00	100.00	--	--
Agriculture, forestry, fishing and hunting	4.67	1.90	4.74	2.53	-0.07	-0.63
Mining and oil and gas extraction	2.84	3.78	1.40	1.51	1.44	2.27
Utilities	1.68	1.50	0.83	0.80	0.85	0.70
Construction	9.32	9.51	8.02	9.89	1.30	-0.38
Manufacturing	9.51	8.21	16.86	11.68	-7.35	-3.47
Wholesale trade	5.43	4.53	6.72	6.09	-1.29	-1.56
Retail trade	22.65	23.70	14.22	15.10	8.43	8.60
Transportation and warehousing	7.22	5.92	5.81	5.54	1.41	0.38
Information and cultural industries	2.98	2.74	2.45	2.84	0.53	-0.10
FIRE	5.77	5.04	7.59	8.14	-1.82	-3.10
Professional, scientific and technical services	4.06	6.32	6.04	7.90	-1.98	-1.58
ASWMRS	2.62	4.60	4.34	6.27	-1.72	-1.67
Arts, entertainment and recreation	0.88	1.19	1.90	2.34	-1.02	-1.15
Accommodation and food services	8.83	8.79	8.50	8.53	0.33	0.26
Other private services	6.44	5.79	10.58	10.82	-4.14	-5.03

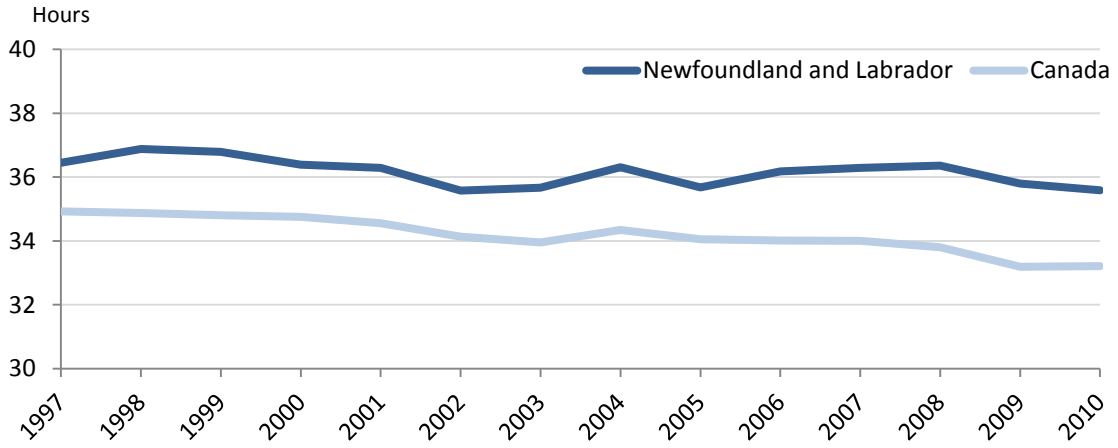
Source: Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Labour Productivity Measures - Provinces and Territories, CANSIM Table 383-0011.

ii. Average Weekly Hours Worked

Weekly hours worked were estimated by combining the data on total hours worked and number of jobs. We found that, during the 1997-2010 period, the average worker in Newfoundland and Labrador worked more hours per week than the average Canadian (Chart 13). In 2010, a worker in Newfoundland and Labrador worked on average 2.4 hours more than the average Canadian worker, working on average 35.6 hours per week instead of the national average of 33.2 hours per week. One explanation for the longer working week in the province is that the percentage of part-time worker is smaller in the province's economy than the national average. If more workers are working part-time, this will inevitably reduce the average weekly hours worked. In 2010, according to the Labour Force Survey, 85.2 per cent of the employed population in Newfoundland and Labrador was working full-time in the province, a proportion that is considerably higher than the national average at 80.6 per cent.

The difference in the length of the working week is especially visible in sectors like agriculture, forestry, fishing and hunting, and construction, where workers in Newfoundland and Labrador worked respectively 8.58 and 8.04 hours more per week than their Canadian counterpart (Table 7). Overall, the average length of the work week declined both in Newfoundland and Labrador and in Canada during the 1997-2010 period, but the drop was less pronounced in Newfoundland and Labrador (0.18 per cent per year) than in Canada as a whole (0.39 per cent per year).

Chart 13: Average Weekly Hours Worked per Worker in Newfoundland and Labrador and Canada, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database.

Table 7: Average Weekly Hours Worked by Two-Digit NAICS Sectors, Newfoundland and Labrador and Canada, 1997, 2000 and 2010

	Newfoundland and Labrador		Canada		N.L. - Canada Gap	
	1997	2010	1997	2010	1997	2010
	(per cent)				(percentage points)	
	A	B	C	D	E=C-A	F=D-B
Business sector industries	**36.4**	**35.6**	**34.9**	**33.2**	--	--
Agriculture, forestry, fishing and hunting	44.4	49.3	40.3	40.7	4.1	8.6
Mining and oil and gas extraction	44.9	43.0	41.6	42.1	3.3	0.9
Utilities	35.8	34.4	35.1	35.1	0.7	-0.7
Construction	43.6	44.8	38.1	36.7	5.5	8.1
Manufacturing	38.8	37.9	38.2	37.2	0.6	0.7
Wholesale trade	39.2	38.0	38.3	36.3	0.9	1.7
Retail trade	33.7	31.3	31.7	29.0	2.0	2.3
Transportation and warehousing	36.7	38.9	37.9	37.2	-1.2	1.7
Information and cultural industries	34.5	32.8	34.0	33.9	0.5	-1.1
FIRE	34.2	33.9	34.2	33.2	0.0	0.7
Professional, scientific and technical services	37.1	38.9	35.6	34.0	1.5	4.9
ASWMRS	29.3	33.1	32.1	31.3	-2.8	1.8
Arts, entertainment and recreation	30.3	30.6	28.4	27.3	1.9	3.3
Accommodation and food services	34.3	32.8	30.4	28.0	3.9	4.8
Other private services	32.7	31.4	31.1	30.3	1.6	1.1

Source: CSLS Newfoundland and Labrador Productivity Database.

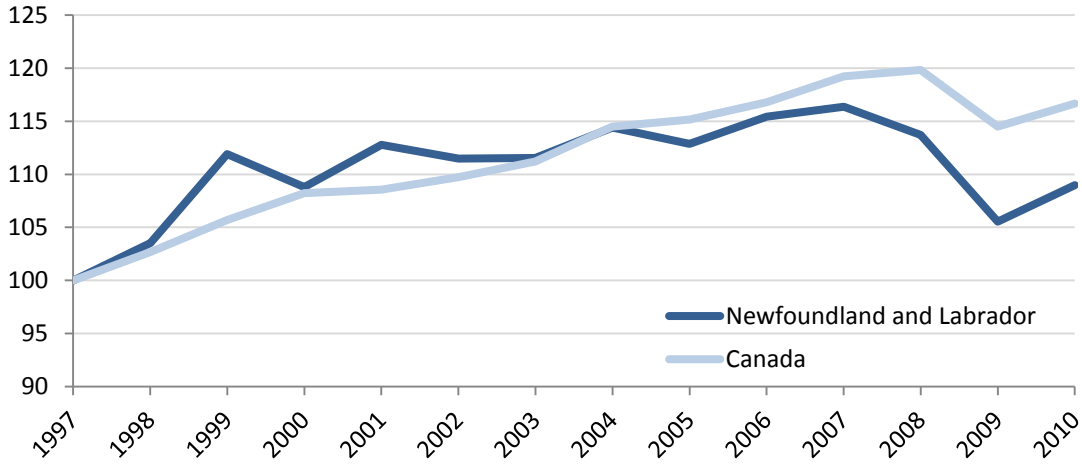
iii. Total Hours Worked

The number of hours worked is the main indicator of labour input in this report, since it is the one we use for the calculation of labour productivity (defined here as real GDP per hour worked). During the 1997-2010 period, the number of hours worked in Newfoundland and Labrador grew at a compound annual rate of 0.66 per cent, slower than the national growth of

hours worked, at 1.19 per cent per year. This led to a small decline in the province's share of total hours worked in Canada, from 1.19 per cent in 1997 to 1.12 per cent in 2010 (Chart 13).

As with the numbers of jobs, Newfoundland and Labrador growth in hours worked was far higher between 1997 and 2002 (2.20 per cent per year) than in the 2002-2007 period (0.86 per cent per year). Furthermore, the economic downturn had a much larger effect in Newfoundland and Labrador's economy than in Canada's economy, with hours worked decreasing at an annual rate of 2.16 per cent during the 2007-2010 period vs. 0.72 per cent for Canada.

Chart 14: Total Hours Worked per Worker in Newfoundland and Labrador and Canada, Business Sector, 1997-2010, (1997=100)



Source: CSLS Newfoundland and Labrador Productivity Database.

Throughout the 1997-2010 period, some goods-producing sectors like agriculture, forestry, fishing and hunting industries and manufacturing industries saw a decrease in hours worked while other goods-producing sectors such as mining and oil and gas exploration and construction saw an increase in their number of hours worked (Table 8).

On the other hand, in services-oriented sectors, Canada experienced a positive but moderate growth in total hours worked in all services-oriented sectors whereas in Newfoundland and Labrador there was a clear split between sectors which experienced a small but negative growth rate, and other sectors – such as professional, scientific and technical services – which experienced significant growth in terms of hours worked.

Table 8: Hours Worked Growth by Two-Digit NAICS Sectors, Newfoundland and Labrador and Canada, 1997-2010

	Newfoundland and Labrador			Canada		
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
	(compound annual growth rate- per cent)					
Business sector industries	**0.66**	**2.85**	**0.02**	**1.19**	**2.67**	**0.75**
Agriculture, forestry, fishing and hunting	-5.14	-0.61	-6.45	-3.12	-3.58	-2.98
Mining and oil and gas extraction	2.76	6.62	1.63	2.26	-2.07	3.59
Utilities	-0.36	-0.23	-0.4	1.3	-0.76	1.93
Construction	1.23	-2.28	2.3	2.95	0.81	3.61
Manufacturing	-0.46	7.85	-2.83	-1.43	2.47	-2.56
Wholesale trade	-0.78	-2.18	-0.36	0.42	2.09	-0.08
Retail trade	0.64	2.96	-0.05	1.38	1.55	1.33
Transportation and warehousing	-0.23	2.7	-1.09	1.08	3.18	0.46
Information and cultural industries	-0.21	-2.21	0.4	2.71	8.98	0.9
FIRE	-0.25	-0.23	-0.25	1.91	2.77	1.66
Professional, scientific and technical services	4.74	12.11	2.62	3.35	7.65	2.1
ASWMRS	6.31	12.78	4.44	4.3	7.6	3.32
Arts, entertainment and recreation	3.28	17.93	-0.75	2.91	5.34	2.19
Accommodation and food services	0.46	0.85	0.35	0.97	3.18	0.32
Other private services	1	3.46	0.27	1.56	2.64	1.24
Business sector without mining and oil and gas	0.58	2.70	-0.05	1.17	2.74	0.71

Source: CSLS Newfoundland and Labrador Productivity Database.

At the two-digit NAICS level, Newfoundland and Labrador's sectoral composition followed a similar trend than Canada's, with notable decrease of the share of hours worked in both the agriculture, forestry, fishing and hunting and the manufacturing sector, and notable increase in professional, scientific and technical services and ASWMRS. Comparing Table 2 and Table 9, it is clear that, at both provincial and national level, the share of the goods sector in terms of hours worked was much smaller than its share in terms of nominal GDP.

Table 9: Hours Worked Shares by Two-Digit NAICS Sectors, Newfoundland and Labrador and Canada, 1997, 2000 and 2010

	Newfoundland and Labrador			Canada		
	1997	2000	2010	1997	2000	2010
	(per cent)					
Business sector industries	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Agriculture, forestry, fishing and hunting	5.7	5.1	2.6	5.5	4.5	3.1
Mining and oil and gas extraction	3.5	3.9	4.6	1.7	1.4	1.9
Utilities	1.7	1.5	1.4	0.8	0.8	0.8
Construction	11.1	9.5	12.0	8.7	8.3	10.9
Manufacturing	10.1	11.7	8.7	18.4	18.3	13.1
Wholesale trade	5.8	5.0	4.8	7.4	7.2	6.7
Retail trade	20.9	21.0	20.9	12.9	12.5	13.2
Transportation and warehousing	7.3	7.2	6.5	6.3	6.4	6.2
Information and cultural industries	2.8	2.4	2.5	2.4	2.9	2.9
FIRE	5.4	4.9	4.8	7.4	7.5	8.1
Professional, scientific and technical services	4.1	5.3	6.9	6.2	7.1	8.1
ASWMRS	2.1	2.8	4.3	4.0	4.6	5.9
Arts, entertainment and recreation	0.7	1.1	1.0	1.5	1.7	1.9
Accommodation and food services	8.3	7.8	8.1	7.4	7.5	7.2
Other private services	10.4	10.6	10.8	9.4	9.4	9.9

Source: CSLS Newfoundland and Labrador Productivity Database

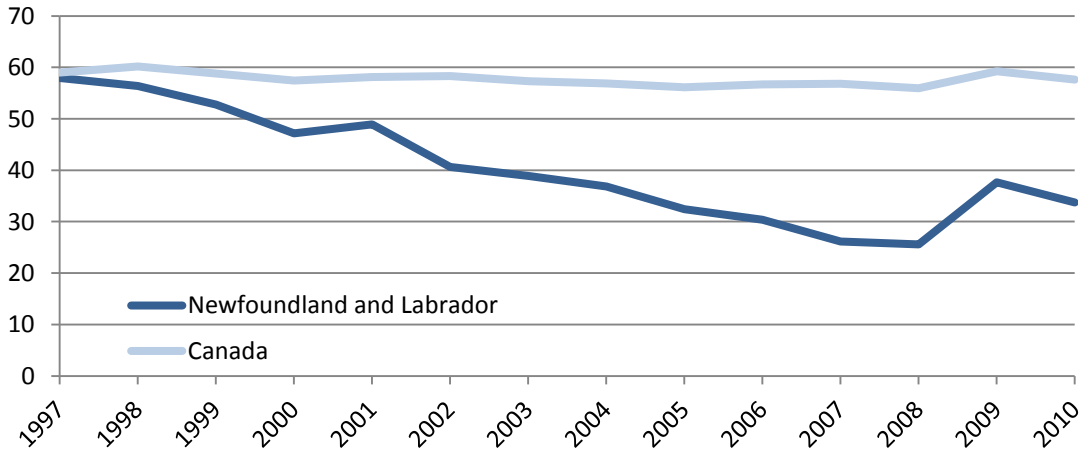
In terms of hours worked, the four largest sectors in Newfoundland and Labrador and in Canada were the same in 2010: retail trade (20.9 per cent vs. 13.2 per cent, respectively), manufacturing (8.7 per cent vs. 13.1 per cent), construction (12.0 per cent vs. 10.9 per cent) and other private services (10.8 per cent vs. 9.9 per cent).

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 GDP went to pay its workers, and how the labour compensation per worker increased during the 1997-2010 period.

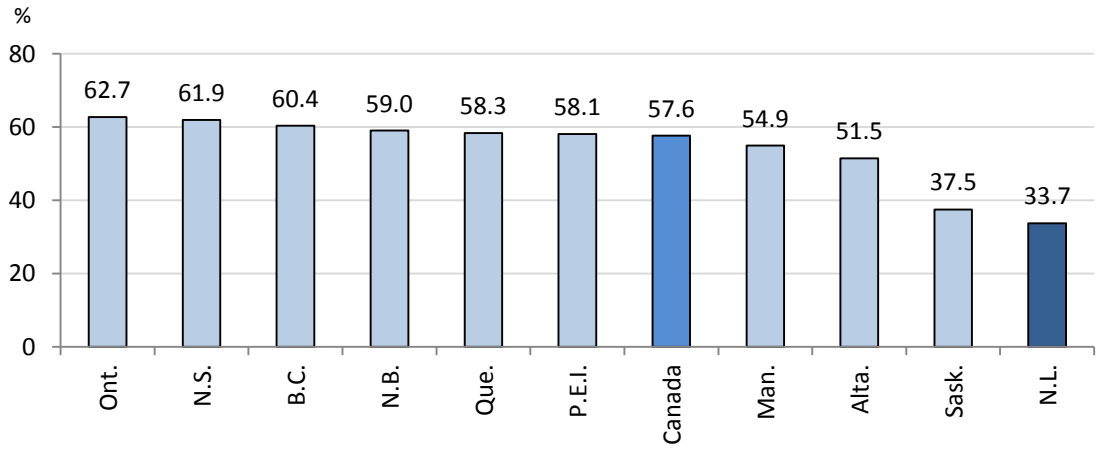
While Canada's labour compensation share remained fairly stable during the 1997-2010 period (ranging from 59.0 per cent in 1997 to 57.6 per cent in 2010), the labour compensation share of Newfoundland and Labrador's business sector fell drastically from 58.0 per cent in 1997 to 33.7 per cent (Chart 15). In 2010, Newfoundland and Labrador was the province with the lowest share of labour compensation as a share of GDP, well below the national average of 57.6 per cent (Chart 16). The sudden rise of the share of labour compensation during the economic crisis, from 25.6 per cent of nominal GDP in 2008 to 37.7 per cent in 2009, can be explained by plummeting profits; labour compensation grew at its normal pace, at 5.76 per cent.

Chart 15: Labour Compensation as a Share of Nominal GDP in Newfoundland and Labrador and Canada, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Labour Productivity Measures - Provinces and Territories, CANSIM Table 383-0011.

Chart 16: Labour Compensation as a Share of Nominal GDP in Canada and the Provinces, Business sector, 2010



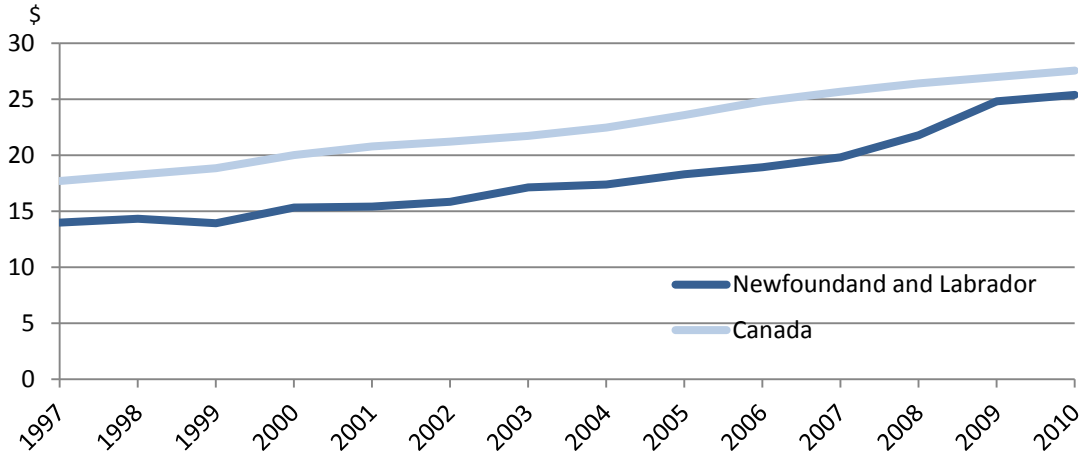
Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Labour Productivity Measures - Provinces and Territories, CANSIM Table 383-0011.

It is important to note that this large decrease in Newfoundland and Labrador's labour compensation share of nominal GDP is not due to a below average growth of labour compensation in itself. During the 1997-2010 period, total business sector labour compensation in Newfoundland and Labrador grew at a higher rate than in Canada (5.39 per cent per year vs. 4.70 per cent per year, 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.

This report puts a great focus on how an increase on productivity ultimately increases the living standards of individuals (see Appendix 1 for more detail). It is therefore important to observe if the hourly labour compensation in the province actually mirrors the increase in labour productivity during the last decade.

In 2010, hourly labour compensation in Newfoundland and Labrador was of $25.36 current dollars per hour, up from $13.97 current dollars per hour in 1997 (Chart 17). This represents a 4.69 per cent increase per year, a growth rate that is much higher than Canada's, at 3.47 per cent per cent. In 2010, the province's labour compensation per worker accounted for 92.1 per cent of Canada's, an important increase from 1997, when it accounted for only 79.0 per cent of the national average. Interestingly, mining and oil and gas is one of the only sectors -with agriculture, forestry, fishing and hunting and arts, entertainment and recreation- where labour compensation per worker growth was lower in Newfoundland and Labrador than in Canada (3.68 per cent vs. 4.80 per cent).

Chart 17: Nominal Hourly Labour Compensation in Newfoundland and Labrador and Canada, Business sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Labour Productivity Measures - Provinces and Territories, CANSIM Table 383-0011.

Table 10: Hourly Nominal Labour Compensation Growth by Two-Digit NAICS Sectors, Newfoundland and Labrador, Business Sector, 1997-2010

	Newfoundland and Labrador			Canada		
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
	(per cent)					
Business sector industries	**4.69**	**3.13**	**5.17**	**3.47**	**4.21**	**3.24**
Agriculture, forestry, fishing and hunting	2.06	3.61	1.59	4.17	8.59	2.87
Mining and oil and gas extraction	3.68	3.73	3.66	4.80	4.80	4.80
Utilities	4.07	1.78	4.77	2.84	3.18	2.74
Construction	4.31	2.85	4.75	3.58	4.07	3.44
Manufacturing	3.79	2.71	4.12	2.84	3.57	2.62
Wholesale trade	4.21	3.88	4.30	3.57	3.63	3.55
Retail trade	5.17	2.54	5.98	3.27	4.22	2.99
Transportation and warehousing	5.19	1.93	6.18	2.41	2.66	2.34
Information and cultural industries	6.44	9.18	5.63	3.13	3.69	2.96
FIRE	4.44	4.30	4.48	3.26	4.12	3.00
Professional, scientific and technical services	4.61	2.58	5.22	4.26	6.55	3.58
ASWMRS	4.58	-1.38	6.44	3.40	3.71	3.31
Arts, entertainment and recreation	1.65	-6.46	4.22	3.05	4.45	2.64
Accommodation and food services	5.38	4.11	5.76	3.67	3.26	3.79
Other private services	5.66	2.89	6.51	3.91	3.87	3.92
Business sector without mining and oil and gas	4.68	2.87	5.23	3.41	4.24	3.16

Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Labour Productivity Measures - Provinces and Territories, CANSIM Table 383-0011.

C. Capital Input

In this section, we analyze trends in the use of capital input in Newfoundland and Labrador and Canada during the 1997-2010 period. The focus of this section is on the estimates provided by Statistics Canada's Fixed Capital Flows and Stocks Program, which looks at the evolution of the capital stock of fixed, non-residential, reproducible business assets. This definition of capital stock includes four broad categories of capital assets: machinery and equipment (M&E); buildings; engineering structures; and intellectual property products. This report makes use of the geometric end-year net stock concept, which assumes that assets depreciate at a constant rate over time.

In addition to discussing growth rates and levels of capital stock (and investment) broken down by main asset types and sector, this section highlights the role of M&E capital in general and ICT capital in particular. The reason for this, as part five of the report makes clear, is that M&E capital plays an important role in boosting productivity. As for information and communication technologies (ICTs), they are a sub-category of M&E and intellectual property products that, according to recent research, plays a fundamental role in productivity growth.

Official investment and capital stock estimates for Newfoundland and Labrador have several data gaps, mainly due to confidentiality reasons. Unfortunately, investment data are not available for the province's mining and oil and gas extraction sector, as well as many other two-digit NAICS sectors. Furthermore, ICT investment and capital stock estimates are not available for Newfoundland and Labrador's business sector, only for the province's total economy. It is important, therefore, to keep in mind the following facts:

- In general, (nominal or real) investment and capital stock figures discussed in this subsection refer to Newfoundland and Labrador's or Canada's business sector.

- However, capital flows and stocks data for non-ICT M&E and ICT were not available for Newfoundland and Labrador at the business sector level. As a consequence, total economy numbers were used. Although business sector estimates for these variables were available for Canada, total economy estimates were used for consistency.

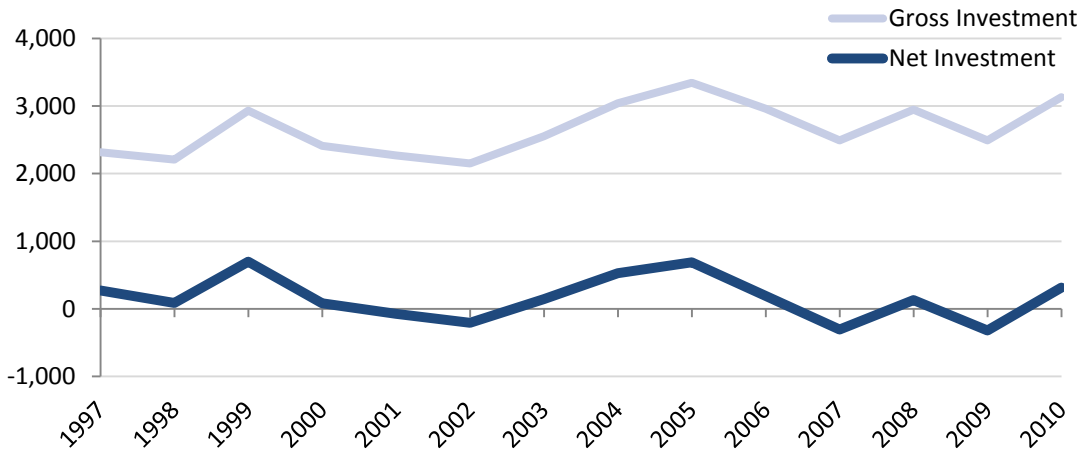
Finally, this section also discusses capital services trends in Newfoundland and Labrador. The relevant capital input in the production process is not capital stock *per se*, but capital services, i.e. the services provided by the capital stock during a certain period of time. This is an important distinction to remember because different capital goods provide services at different rates (this fact is explained in more detail later on). Estimates for capital services are taken from the CSLS Provincial Productivity Database and are based on the official estimates provided in the Canadian Productivity Accounts

i. Fixed Capital Flows

During the 1997-2010 period, real fixed non-residential investment in Newfoundland and Labrador's business sector grew at a compound annual rate of 2.34 per cent, from $2,317 million (chained 2007 dollars) in 1997 to $3,129 million (chained 2007 dollars) in 2010. Real business sector investment in Canada grew at a higher rate of 3.58 per cent per year. As Chart 18 shows, gross investment in Newfoundland and Labrador saw a substantial boost during the 2002-2005 period, after which it went back to its pre-2002 levels.

We can also look at Newfoundland and Labrador's investment performance in terms of net investment, defined here as gross investment minus depreciation. Using this indicator, we can see in Chart 18 that, althought Newfoundland and Labrador's business sector normally experienced a positive net investment, depreciation exceeded gross investment in 2001 and 2002, as well as in 2007 and 2008, in the wake of the global crisis.

Chart 18: Real Investment (Fixed, Non-Residential) in Newfoundland and Labrador, Business sector, 1997-2010 (Millions, Chained 2007 dollars)



Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002

Although our analysis focuses on the 1997-2010 period, it is interesting to note that there was significant investment in Newfoundland and Labrador's business sector in the last two years. Between 2010 and 2012, real gross non-residential investment in the province increased 39.9 per cent per year, from $3,129 million dollars in 2010, to $6,126 million dollars in 2012.[11]

[11] According to the Newfoundland and Labrador's Department of Finance (2012), the important capital investments in 2011 and 2012 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. The

Canada has also experienced substantial growth in the past two years, but not as impressive as Newfoundland and Labrador (8.16 per cent).

In terms of real investment growth by major asset categories, during the 1997-2010 period, Newfoundland and Labrador outperformed Canada in intellectual property products (11.20 per cent per year vs. 4.37 per cent per year, respectively), M&E (5.88 per cent vs. 3.74 per cent) and buildings investments (5.22 per cent vs. -1.18 per cent), but trailed behind in engineering investment (-2.95 per cent vs. 4.83 per cent) (Table 11).

Real investment growth in ICT assets in Newfoundland and Labrador was strong when compared to other asset categories, and very similar to the growth experienced in Canada as a whole (8.72 per cent per year vs. 8.67 per cent per year, respectively). However, the pattern of ICT investment growth differed between Newfoundland and Labrador and Canada. Newfoundland and Labrador experienced a slower growth in real software investment than Canada (4.03 per cent vs. 8.91 per cent), real telecom investment grew at a higher rate than Canada's (7.58 per cent vs. 4.58 per cent) while real investment in computers grew at a similar rate (19.25 per cent in Canada vs. 20.78 per cent).

Table 11: Real Gross Investment (Fixed, Non-residential) in Newfoundland and Labrador and Canada, Business Sector, 1997-2010

	Newfoundland and Labrador			Canada		
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
Total Investment	2.34	1.34	2.64	3.58	5.26	3.08
Building	5.22	-3.33	7.93	-1.18	-3.75	-0.39
Engineering	-2.95	-12.99	0.29	4.83	3.49	5.23
Machinery and Equipment	5.88	20.16	1.94	3.74	6.45	2.94
Intellectual Property Products	11.20	12.73	10.75	4.37	11.67	2.28
ICT	8.72	4.68	9.96	8.67	14.41	7.00
Computers	18.90	10.16	21.66	17.92	38.79	12.30
Telecommunication Equipment	7.41	16.20	4.90	4.42	12.59	2.08
Software	3.81	-8.80	7.92	7.08	8.68	6.61

Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002 and CANSIM Table 031-0003

Although it would be interesting to look at the investment data at the two-digit NAICS level, due to confidentiality reasons investment data are not available for most of Newfoundland and Labrador's sectors. Hence, we will not discuss these estimates.[12]

Chart 19 plots investment (fixed, non-residential) as a share of nominal business sector GDP in Newfoundland and Labrador and Canada as a whole. As we can see, the situation of

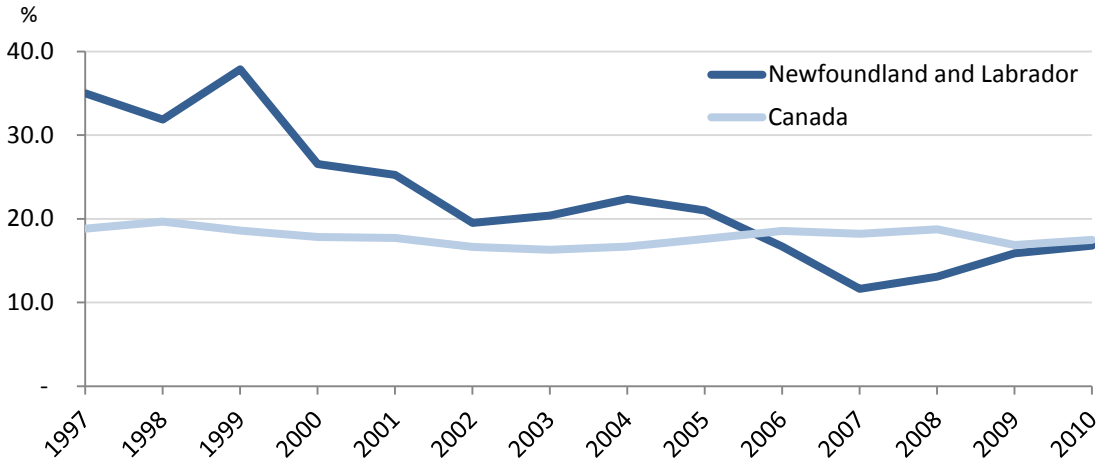
---

continuation of government's infrastructure strategy also contributed to the high level of non-residential investment spending in the last two years.

[12] Investment data for the whole 1997-2010 are only available for the construction, retail trade, wholesale trade and agriculture, forestry, fishing and hunting sectors. Investment data for sectors such as accommodation and food services and finance and insurance, and manufacturing are available for few selected years.

Newfoundland and Labrador is atypical. Beginning at 35.0 per cent of provincial nominal GDP in 1997[13], investment represented only 16.8 per cent of GDP in 2010, a decrease of 18.2 percentage points. In Canada, on the other hand, business sector investment as a share of GDP was basically stable throughout the entire period, oscillating between 19.7 per cent and 16.3 per cent. The significant change in Newfoundland and Labrador's investment share reflects the remarkable increase in nominal GDP between 1997 and 2010, as discussed in the previous sections. This remarkable increase in GDP reflects, in turn, high levels of investment during the 1990s that enabled the remarkable growth in GDP to take place. A more detailed discussion of those investments is made in Box 3, at the end of the section on fixed capital stock.

Chart 19: Gross Investment (Fixed, Non-Residential) as a Share of GDP in Newfoundland and Labrador, Business sector, 1997-2010

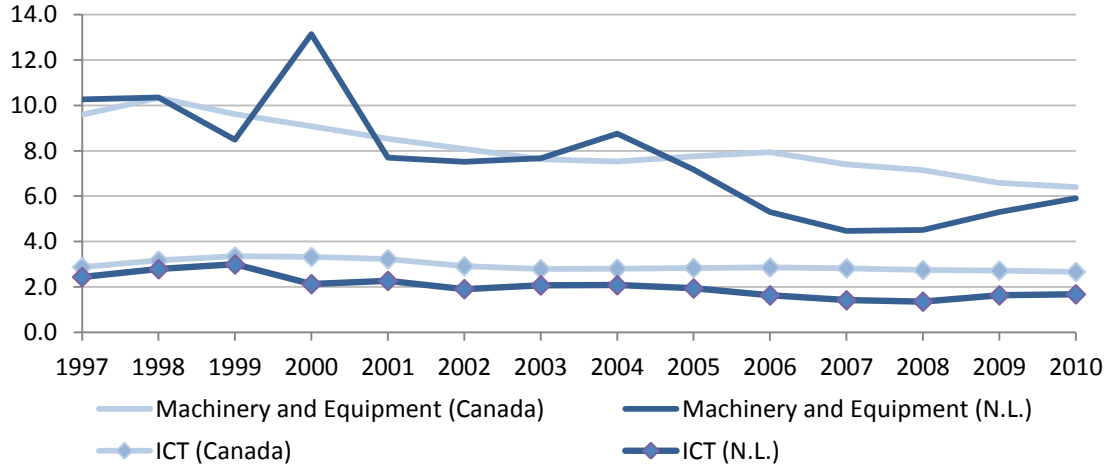


Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002

The same trend appears in Newfoundland and Labrador when we look specifically at M&E and ICT investment as a share of business sector nominal GDP.[14] In 1997, Newfoundland and Labrador's share of M&E and ICT investment in GDP was similar to Canada's (around 10.0 per cent and 4.0 per cent, respectively). However, by 2010, Newfoundland and Labrador's M&E and ICT investment shares had fallen below Canada's: M&E investment represented 5.9 per cent of Newfoundland and Labrador's GDP versus 6.4 per cent for Canada; while ICT investment represented 2.2 per cent of the province's GDP versus 3.6 per cent at the national level. It is interesting to note that the gap between Newfoundland and Labrador's and Canada's M&E investment as a share of GDP shrank considerably after 2008, as illustrated in Chart 20.

[13] More precision on capital investment before 1997 can be found in Box 2 at the end of this section.
[14] Gross ICT investment as a share of nominal GDP refers to total economy since data on business sector investment are not available for ICT assets.

Chart 20: M&E and ICT investments as a Share of Nominal GDP, Business Sector, Newfoundland and Labrador and Canada, 1997- 2010



Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002 and CANSIM Table 031-0003

In 2010, Newfoundland and Labrador's investment profile was quite similar to Canada's, with engineering and M&E investment accounting each for more than a third of total nominal investment, followed by intellectual property investment and finally building investment (Table 12). The similarities between Newfoundland and Labrador's and Canada's investment profiles were, however, much less pronounced in 1997. Due to the investment in the offshore oil rigs, engineering investment accounted for almost 60 per cent of nominal business sector investment in the province, while representing only one-fifth of nominal investment at the national level.

As a share of total investment, ICT investment has remained fairly constant in Newfoundland and Labrador during the 1997-2010 period, increasing only slightly from 9.6 per cent in 1997 to 9.7 per cent in 2010. In Canada, on the other hand, the ICT share in total nominal investment has fallen from 16.8 per cent to 14.8 per cent, although it still remains considerably higher than Newfoundland and Labrador's share.

Table 12 : Assets Shares of Total Business Sector Gross Investment in Newfoundland and Labrador and Canada, 1997, 2000 and 2010

	Newfoundland and Labrador			Canada		
	1997	2000	2010	1997	2000	2010
	(share of business sector nominal investment, per cent)					
Total Investment	100.0	100.0	100.0	100.0	100.0	100.0
Building	7.6	6.4	13.1	14.3	11.7	11.4
Engineering	57.4	36.1	33.9	20.8	20.5	35.6
Machinery and Equipment	29.3	49.5	35.2	50.8	50.9	36.6
Intellectual Property Products	5.7	7.9	17.8	14.1	17.0	16.3
	(share of total economy nominal investment, per cent)					
ICT	9.6	9.1	9.7	16.8	19.8	14.8
Computers	3.2	2.2	3.6	5.2	6.8	4.5
Telecommunication Equipment	3.3	4.7	3.2	4.7	5.7	2.9
Software	3.1	2.2	2.9	6.8	7.3	7.4

Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002 and CANSIM Table 031-0003

Box 2: Major Investment Projects

Newfoundland and Labrador has been home to impressive investments in the last two years with gross fixed non-residential investment more than doubling between 2010 and 2012 and expected to increase even more in 2013. The Newfoundland and Labrador Department of Finance estimates that "over $36 billion in major capital spending is planned or underway in the province". Three major projects account for more than two-thirds of this amount:

- First, the Hebron oil project is projected to have a capital cost of $14.0 billion dollars. The construction of the gravity-base structure began in 2012 and production is expected to begin in 2017 and to continue until 2046.

- An amount of $6.2 billion is also projected to be invested in the Lower Churchill project, which will be able to provide 16.7 terawatt hours of electricity per year. This project consists of the construction of two hydro-electric installations in Labrador, Gull Island and Muskrat Falls. First power is expected in 2017 from Muskrat falls.

- Finally, a final investment of $1.2 billion in 2013 is expected to bring the construction of a $4.25 billion nickel processing plant in Long Harbour to an end. This facility is part of a legally-binding agreement signed in 2002 between Vale and the Government of Newfoundland and Labrador, in order to process locally the nickel extracted at Voisey's bay mine. The mine's was initially expected to wind down operations around 2020, but recent plans for underground mining may extend the mine's life to 2035.

Other important investment projects in the mining sector include a $1.2 billion mine development for an open pit operation near Wabush and Labrador City by Alderon Iron Corp.; an $828 million mine expansion by the Iron Ore Company of Canada in Labrador City; and the $630 million reopening of former iron ore mines by Tata Steel Minerals Canada ltd. in the Elross Lake area.

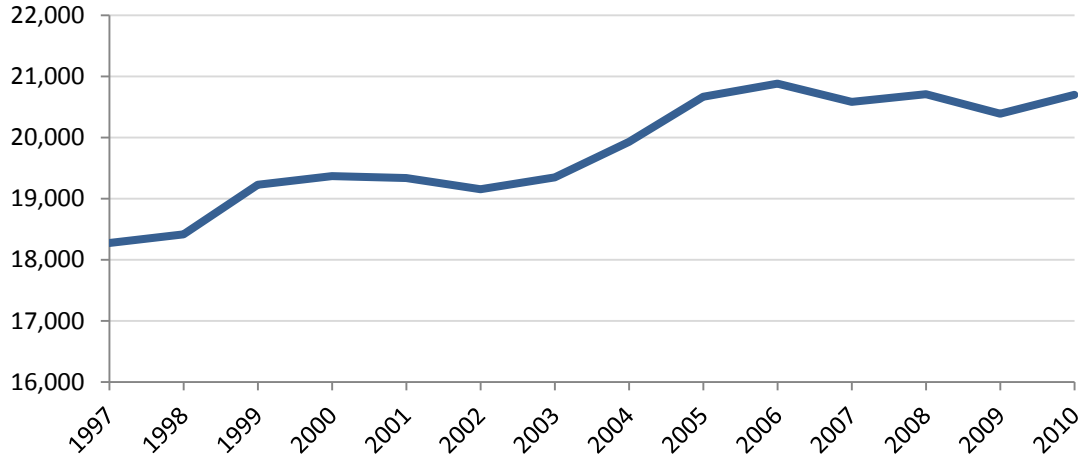
An Atlantic Provinces Economic Council Report on Major Project Inventory estimated that total investment in the province will amount to $9.4 billion in 2013 and $44.6 billion in 2014 (APEC, 2013). A complete inventory of all major capital projects and spending programs valued at $1 million or more in Newfoundland and Labrador is also available on the Newfoundland and Labrador Department of Finance website.

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.

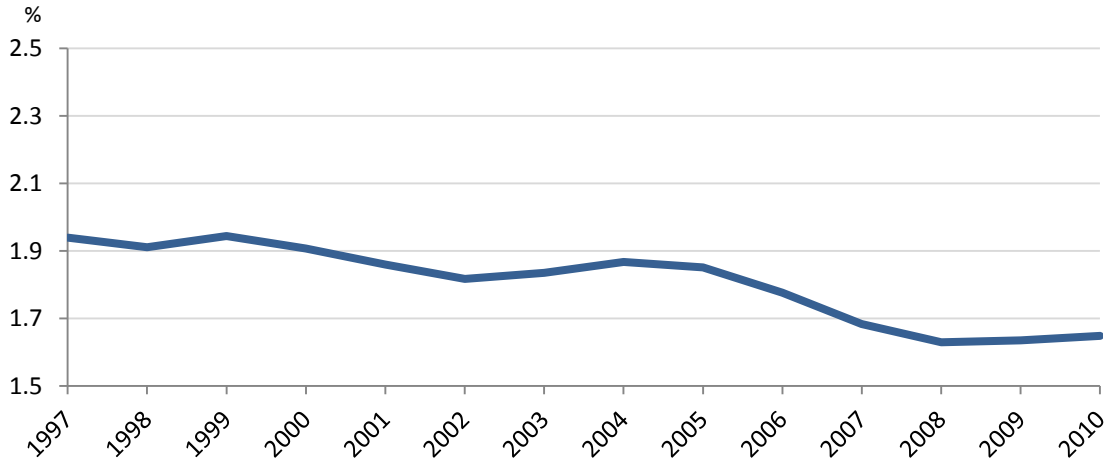
During the 1997-2010 period, Newfoundland and Labrador's real net capital stock (fixed, non-residential) grew at an annual compound rate of 0.96 per cent, considerably below the growth experienced by Canada as a whole, 2.25 per cent. Business sector real net capital stock in Newfoundland and Labrador increased from $18,276 million (2007 chained dollars) in 1997 to $24,811 million in 2010 (2007 chained dollars) (Chart 21). In nominal terms, the province's capital stock as a share of Canada's fell during the 1997-2010 period, from 1.93 per cent in 1997 to 1.65 per cent in 2010 (Chart 22). Yet, because of increased investment in 2011 and 2012, there was an increase in the province's share of the national capital stock back to 1.85 per cent.

Chart 21: Fixed Non-Residential Net Capital Stock in Newfoundland and Labrador, Business Sector, 1997-2010 (Millions, Chained 2007 Dollars)



Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002

Chart 22: Fixed Non-Residential Net Capital Stock, Newfoundland and Labrador as a Share of Canada, Business Sector, 1997-2010 (Nominal Shares)



Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002 and CANSIM Table 031-0003

Table 13 details some of the key figures related to real capital stock growth during the 1997-2010 period. As discussed before, real capital stock growth in Canada outpaced Newfoundland and Labrador's by a considerable margin (2.25 per cent per year vs. 0.96 per cent per year). Looking at a breakdown by major asset types, we can see that, even though total assets grew at a much higher rate in Canada than Newfoundland and Labrador during the 1997-2010 period, the province experienced a higher growth rate of capital stock in three out of four categories of capital assets: M&E (3.48 per cent per year vs. 2.92 per cent per year in Canada), intellectual property products (6.66 per cent vs. 5.64 per cent) and buildings (0.97 per cent vs. 0.53 per cent). Only engineering capital stock grew more slowly in Newfoundland and Labrador than in Canada (2.49 per cent per year vs. -0.64 per cent per year, respectively). It is important to understand that by 1997, the largest part of the investment that led to the beginning of oil production had already been done, therefore explaining the low growth of engineering assets in the province. However, since engineering assets represented the lion's share of business sector capital stock, total real capital stock in the province ended up growing at a more sluggish pace than in Canada. Finally, real ICT capital stock grew at a more vigorous rate in Canada (7.39 per cent per year) than in Newfoundland and Labrador (5.22 per cent per year).

Table 13 : Net Real Capital Stock Growth by Asset Type, Newfoundland and Labrador, Business Sector, 1997-2010

	Newfoundland and Labrador			Canada		
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
	(compound annual growth rates, per cent)					
Total Assets	**0.96**	**1.96**	**0.67**	**2.25**	**2.77**	**2.09**
Building	0.97	0.63	1.07	0.53	1.31	0.30
Engineering	-0.64	0.35	-0.93	2.49	1.34	2.84
Machinery and Equipment	3.48	5.51	2.89	2.92	4.54	2.44
Intellectual Property Products	6.66	11.39	5.28	5.64	8.56	4.78
ICT	5.22	4.89	5.31	7.39	9.95	6.63
Computers	19.80	17.51	20.49	19.42	38.21	14.30
Telecommunication Equipment	1.18	1.31	1.14	2.61	4.19	2.14
Software	4.70	8.34	3.63	7.38	9.97	6.62

Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0003 and CANSIM Table 031-0004

At the two-digit NAICS sector level, Table 14 reveals that Canada outperformed Newfoundland and Labrador in terms of real capital stock growth in practically all sectors during the 1997-2010 period, with the exception of: manufacturing; construction; professional, scientific and technical services; and accommodation and food services.

A few other important facts should be highlighted. First, most of the growth in capital stock during the 1997-2010 period happened before the turn of the century. Between 1997 and 2000, real net capital stock in Newfoundland and Labrador grew at a compound annual rate of 1.96 per cent, with notable increases in the mining and oil and gas extraction (3.75 per cent per year) and wholesale trade (4.17 per cent per year) sector. During the 2000-2010 period, Newfoundland and Labrador's real net capital stock only grew at an annual rate of only 0.67 per cent growth.

Secondly, the mining and oil and gas extraction sector experienced a very moderate increase in its capital stock during the 1997-2010 period, at 1.24 per cent per year, even if real output increased in this sector by more than 14 per cent annually during this period. The bulk of investment in the mining and oil and gas extraction sector happened before 1997. In fact, between 1980 and 1997, assets in mining and oil and gas extraction grew around six times faster than during the 1997-2010 period, at 7.29 per cent per year. Box 3, located at the end of this section, gives more details on how mining and oil and gas extraction assets increased in Newfoundland and Labrador economy before 1997.

Finally, looking beyond the time period of our study, it is important to draw attention to large increases in Newfoundland and Labrador's capital stock in two specific sectors in 2011 and 2012. First, in mining and oil and gas extraction, the real capital stock increased from $9,893 million (chained 2007 dollars) in 2010 to $12,414 million (chained 2007 dollars) in 2012, an annual increase of 12.02 per cent; second, an important increase in capital stock also occurred in the manufacturing sector, where real capital stock increased from $1,765 million (chained 2007

dollars) in 2010 to $3,163 million (chained 2007 dollars) in 2012, an annual increase of 33.9 per cent per year[15].

Table 14 : Real Net Capital Stock Growth by Two-Digit NAICS Sectors, Newfoundland and Labrador, Business Sector, 1997-2010

	Newfoundland and Labrador			Canada		
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
	(compound annual growth rate, per cent)					
Business sector industries	**0.96**	**1.96**	**0.67**	**2.25**	**2.77**	**2.09**
Agriculture, forestry, fishing and hunting	-0.70	-0.46	-0.77	-0.12	0.44	-0.29
Mining and oil and gas extraction	1.24	3.75	0.49	5.67	4.40	6.06
Utilities	n.a.	n.a.	n.a.	0.85	-1.65	1.61
Construction	4.86	2.85	5.47	4.57	4.81	4.49
Manufacturing	3.91	1.42	4.67	-0.75	1.39	-1.39
Wholesale trade	1.49	4.17	0.70	4.02	5.05	3.72
Retail trade	2.87	-0.75	3.98	4.12	3.47	4.31
Transportation and warehousing	2.11	5.20	1.20	2.57	5.81	1.61
Information and cultural industries	0.17	0.67	0.02	1.73	3.98	1.07
FIRE	1.02	3.89	0.18	1.30	3.88	0.54
Professional, scientific and technical services	13.04	18.01	11.59	9.88	23.25	6.15
ASWMRS	n.a.	n.a.	n.a.	7.69	2.26	9.37
Arts, entertainment and recreation	2.96	2.72	3.03	4.02	4.07	4.00
Accommodation and food services	3.72	0.79	4.62	2.04	0.31	2.56
Other private services	2.69	4.62	2.12	3.74	2.56	4.09
Business sector without mining and oil and gas	0.72	0.37	0.83	1.46	2.47	1.15

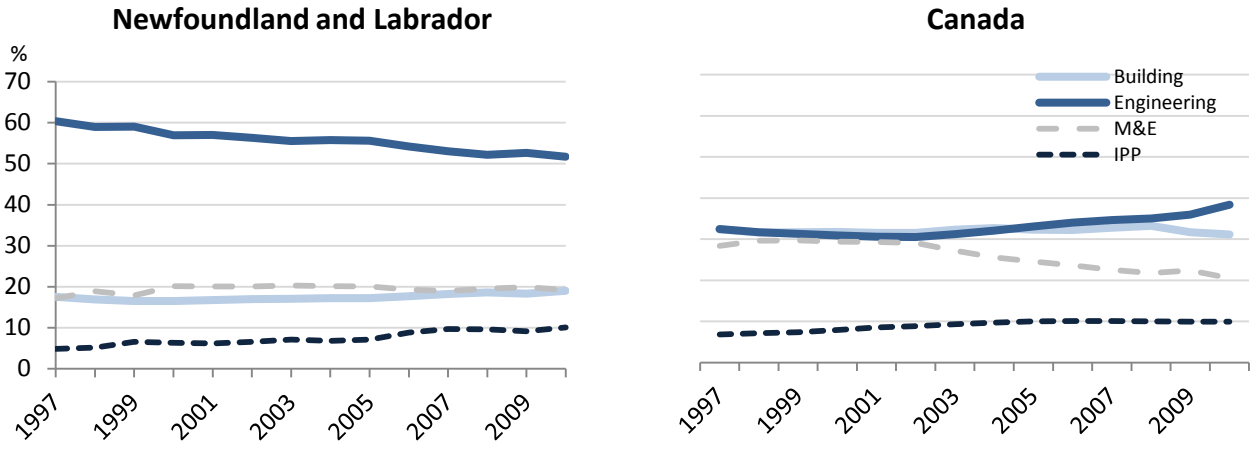
Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002

Chart 23 shows the breakdown of capital stock by major asset category for Newfoundland and Labrador and Canada. In 2010, engineering capital stock represented more than half (51.7 per cent) of Newfoundland and Labrador's business sector nominal capital stock, down from 60.4 per cent in 1997. The next most important asset category was machinery and equipment, accounting for 19.2 per cent of business sector nominal capital stock in 2010, followed by building (19.0 per cent), and intellectual property products (10.1 per cent). The 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, a sector very intensive in engineering capital. During the 1997-2010 period, the mining and oil and gas extraction sector capital stock represented between 45 and 48 per cent of the province's business sector capital stock. In fact, in 1997, engineering assets in the mining and oil and gas sector represented 37.1 per cent of the province's business sector capital stock by themselves. In 2010, this share had decreased to 33.3 per cent.

[15] The bulk of the increase in manufacturing capital stock is from capital expenditures in Vale's US$4.25 billion nickel processing plant in Long Harbour.

Canada's capital stock, on the other hand, had a more "balanced" capital stock, with engineering and buildings representing 38.4 per cent and 31.1 per cent of business sector capital stock, respectively, and machinery and equipment and intellectual property products accounting for the remaining one-third (20.5 per cent and 9.9 per cent, respectively).

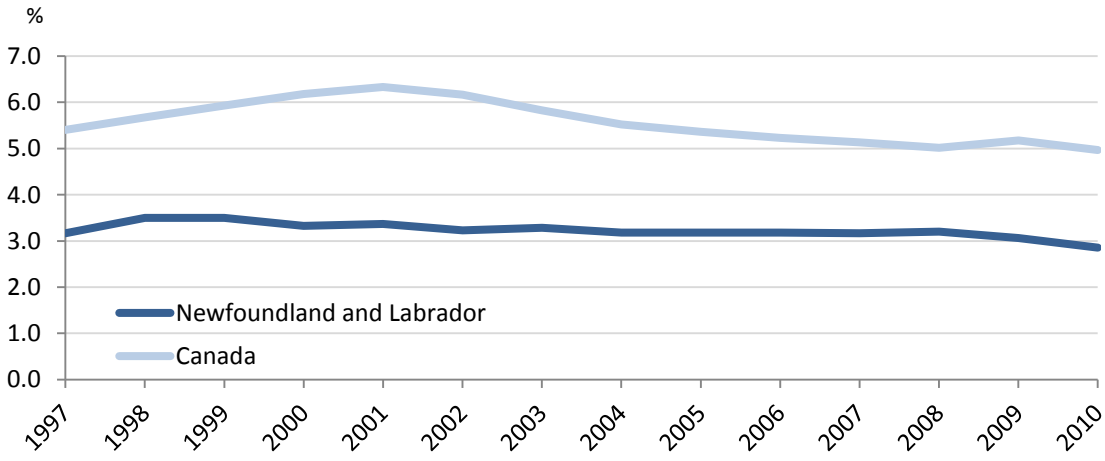
Chart 23: Capital Assets as a Share of Net Capital Stock in Newfoundland and Labrador and Canada, Business Sector, 1997-2010 (Nominal Shares)



Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0003 and CANSIM Table 031-0004

Throughout the entire 1997-2010 period, ICT capital stock as a share of total nominal capital stock in Newfoundland and Labrador was relatively stable, averaging 3.2 per cent, and significantly smaller than in Canada (where it fell from 4.5 per cent in 1997 to 3.7 per cent in 2010) (Chart 24).

Chart 24: ICT Capital Stock as a Share of Total Capital Stock in Newfoundland and Labrador and Canada, Total Economy, 1997-2010 (Nominal Shares)



Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0003 and CANSIM Table 031-0004

Box 3: Capital Investment before 1997

One might consider the lack of connection between the phenomenal growth of GDP and the slow growth of capital stock during the 1997-2010 period in the province paradoxical. During this period, the growth rate of Newfoundland and Labrador real net capital stock accounted for less than half the growth rate of Canada's. One possibility is that capital stock was accumulated before 1997, which could explain the growth rate in GDP that occurred after this landmark year for the province's economy.

During the 1980-1997 period, Newfoundland and Labrador business sector experienced a much higher growth in real net capital stock than during the 1997-2010 period, growing at an annual compound rate of 1.98 per cent per year (versus 0.96 per cent for the 1997-2010 period). However, the province's capital stock still grew at a lower rate than Canada's for the period, where capital stock grew 2.19 per cent per year. Therefore, the interesting story about Newfoundland and Labrador does not lie in the actual amount of new capital stock created in Newfoundland and Labrador business sector before 1997, but how and where increases in capital stock happened during that period.

Table A details the growth rate of each type of capital assets for the 1980-1997 period. Two important facts can be taken from this table: First, between 1980 and 1990, growth in the province's capital stock was driven mostly by investments in intellectual property products, which grew at 13.49 per cent per year. Secondly, in the following period, from 1990 to 1997, capital stock was, on the contrary, characterized by an important increase in engineering assets (5.81 per cent per year), as the actual amount of intellectual property products declined swiftly.

These developments in Newfoundland and Labrador's capital stock can easily be linked to the mining and oil and gas sector. The impressive increase in intellectual property products during the 1980-1990 period reflected in large part an increase in oil and gas exploration and most of the investment in engineering assets was in fact directed toward the mining and oil and gas sector. Between 1990 and 1997, growth in the engineering assets of the mining and oil and gas sector represented 109.1 per cent of the total growth in the engineering assets in the province. Between 1980 and 1997, increases in the mining and oil and gas extraction engineering assets represented 87.1 per cent of the growth in total engineering assets. To conclude, between 1980 and 1997, capital stock in mining and oil and gas extraction grew 7.29 per cent per year, much faster than the growth of 1.24 per cent between 1997 and 2010.

Table A: Fixed Non-Residential Real Net Capital Stock Growth Rate by Assets, Newfoundland and Labrador and Canada, Business Sector, 1980-1997

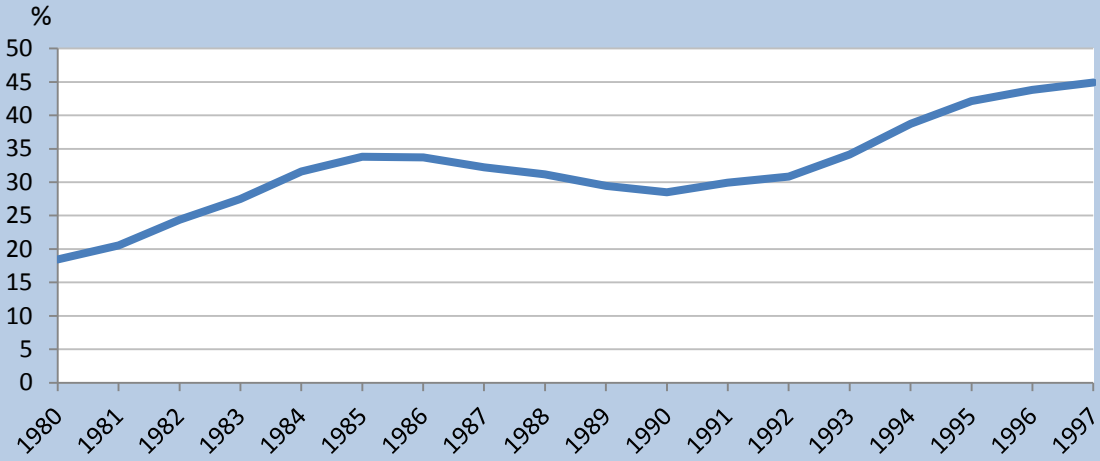
	Newfoundland and Labrador			Canada		
	1980-1997	1980-1990	1990-1997	1980-1997	1980-1990	1990-1997
	(compound annual growth rates, per cent)					
Total assets	**1.98**	**1.73**	**2.33**	**2.19**	**2.73**	**1.44**
Building	0.59	1.17	-0.23	2.68	3.85	1.04
Engineering	2.90	0.91	5.81	1.13	1.38	0.77
Machinery and equipment	0.20	1.40	-1.49	2.24	2.67	1.64
Intellectual property products	5.34	13.49	-5.30	6.44	6.47	6.41

Source : Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002.

Box 2: Capital Investment before 1997 (continued)

Chart A illustrates how the mining and oil and gas sector became more and more important in terms of capital stock during the 1980-1997 period. From 18.4 per cent in 1980, the share of total business sector capital stock accounted for by this sector grew to 44.9 per cent in 1997, reflecting a major change in the structural composition of Newfoundland and Labrador business sector capital. In 2010, the mining and oil and gas extraction sector's share of total capital stock was 48.2 per cent.

Chart A: Assets in the Mining and Oil and Gas Extraction Sector as a Share of Total Business Sector Assets (Nominal Shares), 1980-1997



Source : Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0004.

iii. Capital Services

The capital stock held by firms can be seen as a repository of capital services, 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 of their services in just a few years before they completely depreciate. Office buildings, on the other hand, provide their services over decades. As a consequence, over a single 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 provided relatively more services per dollar of capital stock (i.e. short lived assets). The CSLS Provincial Productivity Database provides capital services and capital composition estimates for Canada and the provinces for the 1997-2010 period.[16]

[16] It is important to note that the estimates for capital services and capital composition from the CSLS Provincial Productivity Database, based on the CPA data, are not entirely consistent with the estimates from Statistics Canada's

Table 15 shows that capital services in Newfoundland and Labrador's business sector grew at a compound annual rate of 1.62 per cent from 1997 to 2010, an unimpressive number compared to the growth rate of 4.19 per cent observed at the national level. The slow growth of Newfoundland and Labrador's capital services can be greatly explained by the weak growth in the mining and oil and gas sector. During the 1997-2010 period, capital services in this sector represented on average more than 80 per cent of Newfoundland and Labrador's business sector capital services, and they grew only 0.44 per cent per year during the period (Table 16).

Table 15: Capital Services Growth in Newfoundland and Labrador and Canada, Business Sector, 1997-2010

	Newfoundland and Labrador			Canada		
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
	(compound annual growth rates, per cent)					
Business sector industries	**1.62**	**2.78**	**1.27**	**4.19**	**5.40**	**3.84**
Agriculture, forestry, fishing and hunting	-1.49	-0.88	-1.67	-0.31	-0.65	-0.21
Mining and oil and gas extraction	0.44	1.20	0.21	6.50	4.56	7.09
Utilities	-1.11	-2.83	-0.58	1.61	-0.74	2.32
Construction	5.11	1.65	6.17	5.85	4.11	6.37
Manufacturing	0.84	1.28	0.70	0.52	3.53	-0.37
Wholesale trade	2.25	4.58	1.56	5.14	5.46	5.05
Retail trade	3.80	-1.58	5.47	5.77	4.91	6.03
Transportation and warehousing	5.73	5.25	5.88	4.66	8.37	3.57
Information and cultural industries	2.03	5.65	0.97	3.26	9.76	1.38
FIRE	4.57	7.23	3.78	4.52	8.21	3.43
Professional, scientific and technical services	10.89	9.06	11.44	7.99	16.15	5.66
ASWMRS	-7.50	-23.04	-2.25	6.31	-2.96	9.26
Arts, entertainment and recreation	1.79	1.44	1.90	4.52	5.13	4.34
Accommodation and food services	2.45	-2.75	4.06	1.33	-2.29	2.44
Other private services	12.05	11.89	12.10	10.22	15.14	8.78

Source: CSLS Newfoundland and Labrador Productivity Database.

Fixed Capital Flows and Stocks survey. The differences may be to a variety of reasons, including: data revisions, different definitions, differences in methodology, etc.

Table 16: Industry Share of Capital Services in Newfoundland and Labrador and Canada, Business Sector, 1997-2010[17]

	Newfoundland and Labrador			Canada		
	1997	2000	2010	1997	2000	2010
	(per cent)					
Business sector industries	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Agriculture, forestry, fishing and hunting	2.2	1.9	1.4	4.9	4.1	2.7
Mining and oil and gas extraction	88.2	84.2	75.8	15.6	15.3	20.8
Utilities	3.6	3.0	2.5	7.6	6.4	5.5
Construction	1.8	1.7	2.7	4.7	4.6	5.8
Manufacturing	2.7	2.5	2.4	21.8	20.7	13.7
Wholesale trade	1.8	1.9	2.0	5.8	5.8	6.5
Retail trade	1.6	1.4	2.1	4.3	4.2	5.2
Transportation and warehousing	0.8	0.9	1.4	4.4	4.8	4.7
Information and cultural industries	1.2	1.3	1.3	5.7	6.4	5.1
FIRE	2.7	3.0	3.9	16.6	17.9	17.2
Professional, scientific and technical services	0.2	0.2	0.5	2.0	2.7	3.2
ASWMRS	0.9	0.4	0.3	1.7	1.3	2.2
Arts, entertainment and recreation	0.0	0.0	0.0	0.6	0.6	0.6
Accommodation and food services	0.5	0.5	0.6	2.1	1.7	1.5
Other private services	1.0	1.2	3.4	2.3	3.1	4.9

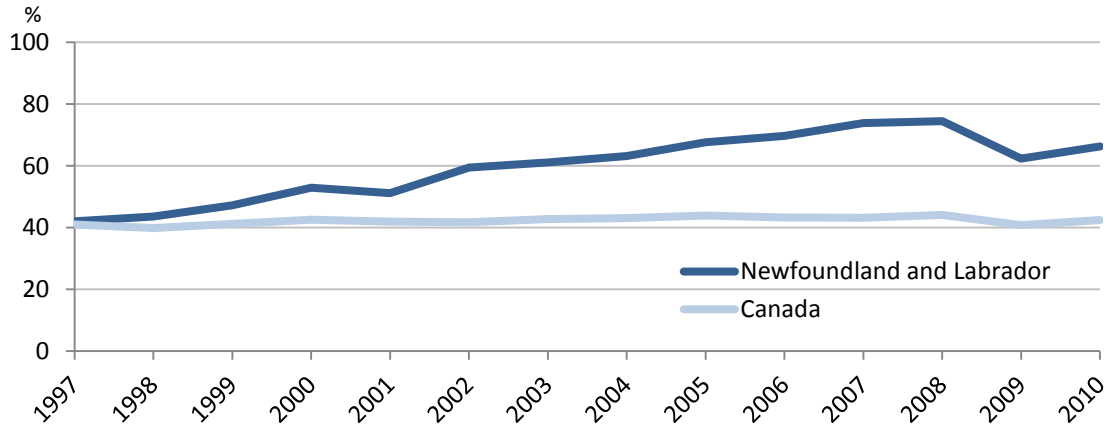
Source: CSLS Newfoundland and Labrador Productivity Database.

iv. Capital Compensation

Capital compensation is the share of nominal GDP that goes to capital. During the 1997-2010 period, the share of capital compensation in Newfoundland and Labrador's business sector nominal GDP saw a massive increase, from 42.0 per cent in 1997 to 66.3 per cent in 2010 (Chart 25). In comparison, the share of capital compensation in Canada increased from 41.0 per cent of nominal GDP to 42.4 per cent in 2010. Newfoundland and Labrador's biggest sector in terms of nominal output, mining and oil and gas extraction industries, experienced an even more abrupt increase in its capital compensation share of output, from 43.4 per cent in 1997 to 93.9 per cent in 2010 (Chart 26). As explained before, the fall in capital compensation as a share of nominal GDP after 2009 is due to reduced profit during the economic downturn.

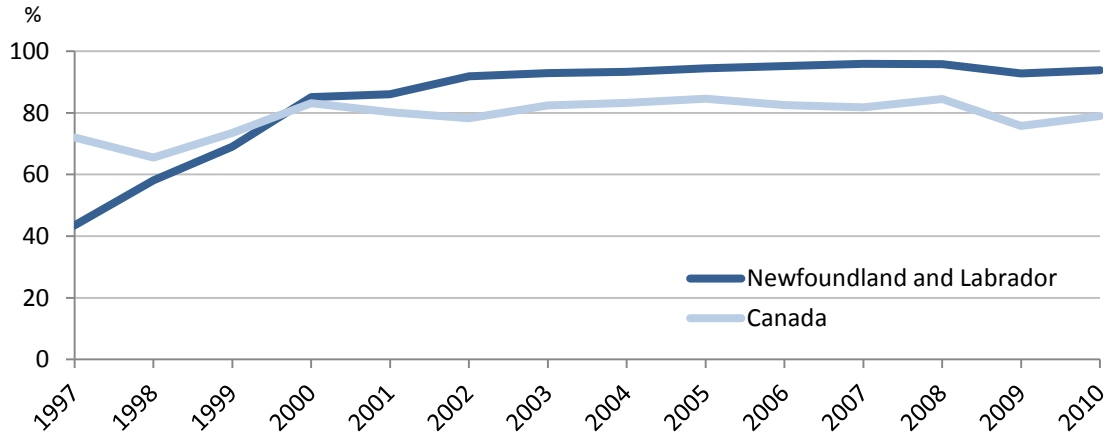
[17] The sum of all industry share may not sum up to 100 since capital services are calculated using chained 2007 dollars and are therefore not cumulative.

Chart 25: Capital Compensation as a Share of Nominal GDP, Newfoundland and Labrador and Canada, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database.

Chart 26: Capital Compensation as a Share of Nominal Output, Newfoundland and Labrador and Canada, Mining and Oil and Gas Extraction Industries, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database.

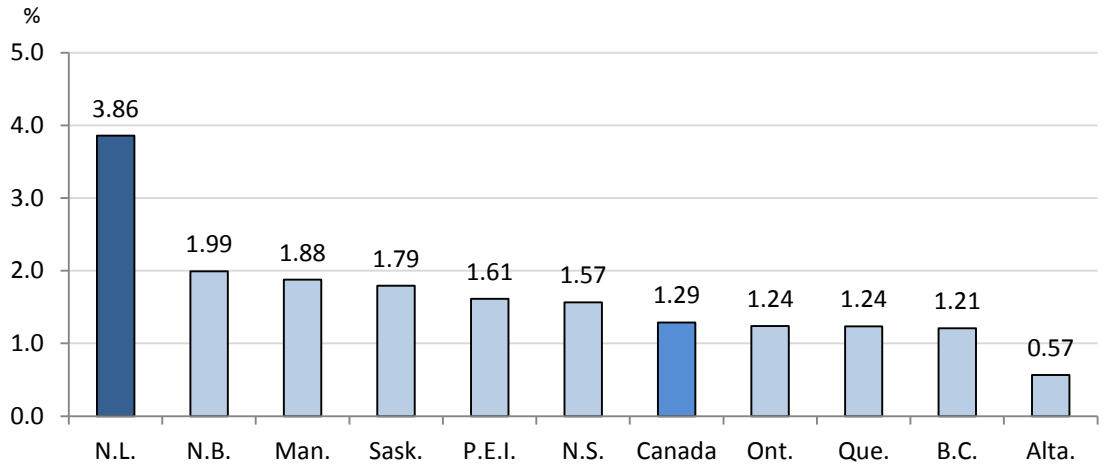
III. Productivity in Newfoundland and Labrador

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 1997-2010 period along with a comparison to Canada's performance. After looking at trends and levels of labour, capital, and multifactor productivity, we look at the sources of labour productivity growth in the province. We also quantify the contribution of each major industry sector to Newfoundland and Labrador's business sector labour productivity growth.

A. Labour Productivity

Labour productivity, defined here as real GDP per hour worked, increased 3.86 per cent per year in Newfoundland and Labrador during the 1997-2010 period, significantly above the growth of 1.29 per cent per year observed at the national level (Chart 27). Compared to the other provinces, Newfoundland and Labrador ranked 1st in terms of labour productivity growth, well above the second position, held by New Brunswick with a growth of 1.99 per cent per year.

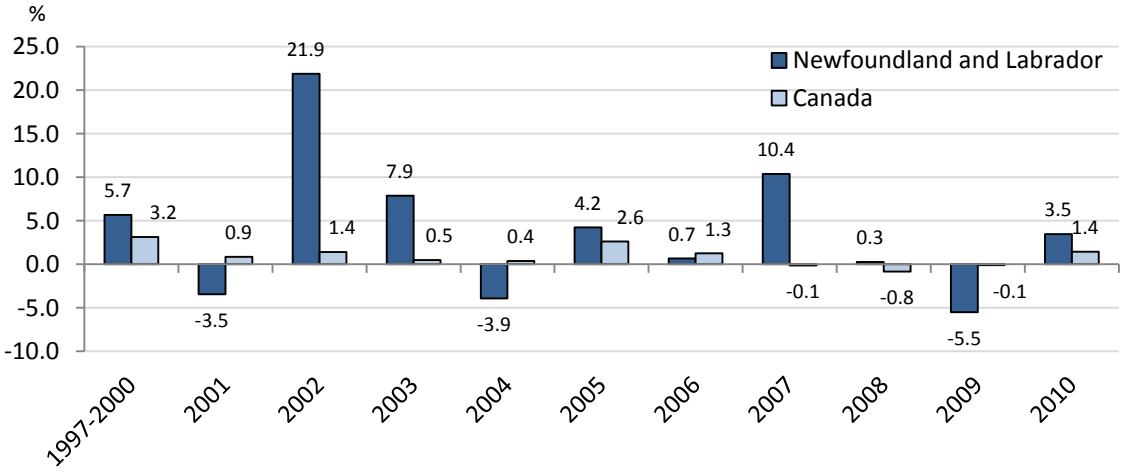
Chart 27: Labour Productivity Growth in Canada and the Provinces, Business Sector, 1997-2010 (Compound Annual Growth Rates)



Source: CSLS Newfoundland and Labrador Productivity Database.

Breaking down the province's labour productivity growth by year, Chart 28 shows that Newfoundland and Labrador had exceptional performances in many different years but especially in 2002, when labour productivity grew by 21.9 per cent. This substantial increase in the province's business sector productivity 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. Even though our period of study is generally characterized by significant improvements in Newfoundland and Labrador's labour productivity, there were some years when productivity actually declined, such as 2001, 2004 and 2009. Overall, labour productivity developments followed the province's oil production quite closely.

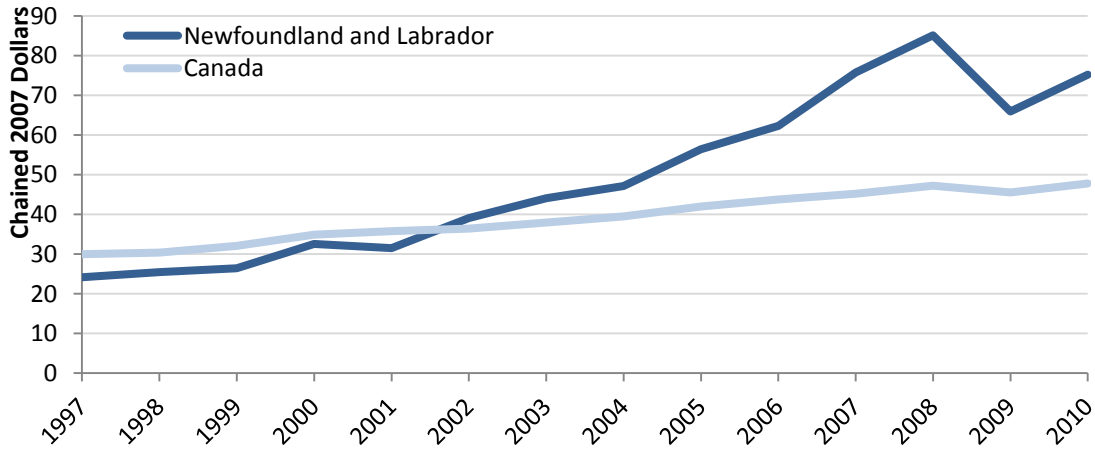
Chart 28: Labour Productivity Growth in Newfoundland and Labrador and Canada, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database.

Due to its rapid labour productivity growth, Newfoundland and Labrador's labour productivity *level* reached $75.20 per hour worked in 2010, up from $24.10 per hour in 1997. For Canada as a whole, labour productivity increased from $29.98 per hour in 1997 to $47.79 per hour in 2010 (Chart 29).

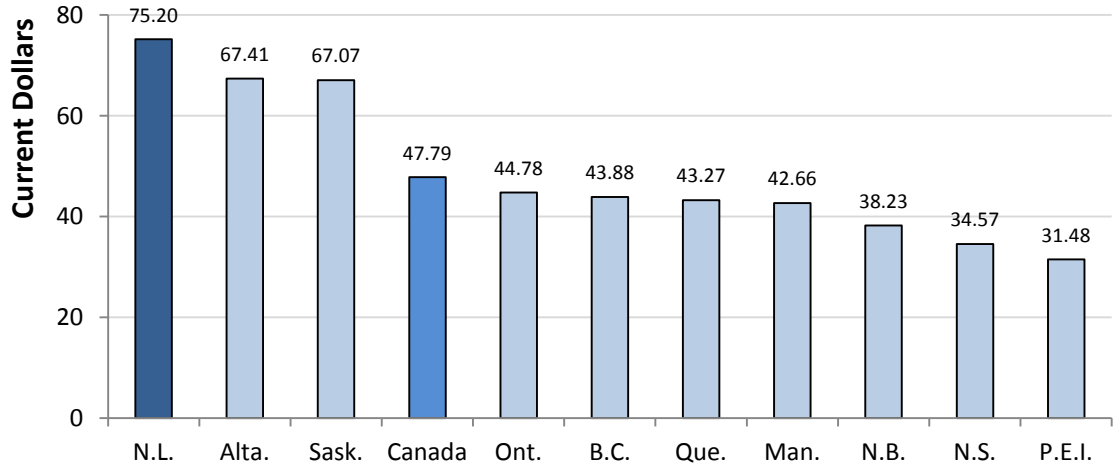
Chart 29: Labour Productivity Level in Newfoundland and Labrador and Canada, Business Sector, 1997-2010 (Nominal value)



Source: CSLS Newfoundland and Labrador Productivity Database.

In comparison to other provinces, Newfoundland and Labrador had the highest labour productivity level in 2010, followed by Alberta, with a labour productivity of $67.41 per hour (Chart 30). Prince Edward Island was the weakest performer, with an output of $31.48 per hour worked.

Chart 30 Labour Productivity Levels in Canada and the Provinces, Business Sector, 2010 (Current Dollars per Hour Worked)

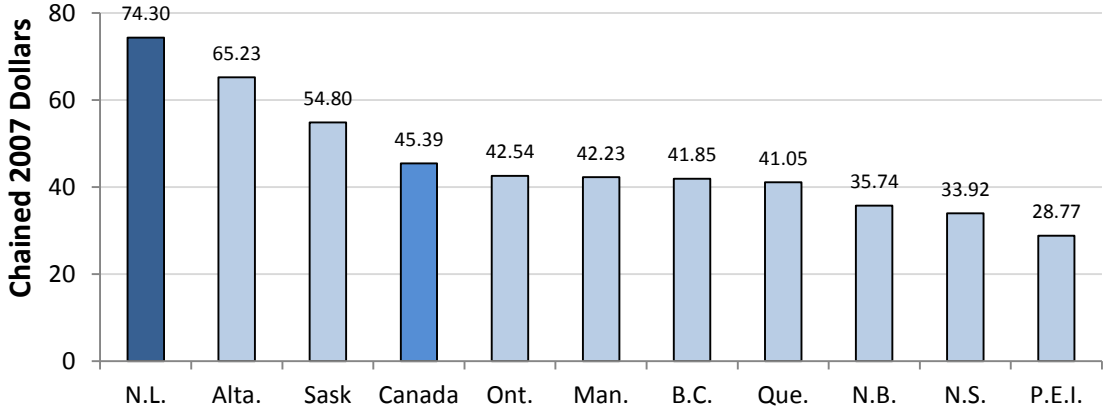


Source: CSLS Newfoundland and Labrador Productivity Database.

It is interesting to note that the overall ranking of the provinces does not change significantly if, instead of using nominal labour productivity levels (i.e. nominal GDP per hour worked), we use real labour productivity levels (i.e. real GDP per hour worked) (Chart 31). With nominal labour productivity levels, only three provinces change their relative position: Manitoba moves from 7th to 5th; British Columbia from 5th to 6th; and Quebec from 6th to 7th. In general, nominal labour productivity levels were not very different from the real levels (real levels calculated using chained 2007 dollars). An exception was Saskatchewan, which had a nominal labour productivity level much higher than its real one in 2010 ($67.07 vs. $54.80, respectively). However, the difference in the overall ranking of the provinces becomes more important as we get away from our reference year, particularly for Newfoundland and Labrador. For example, using nominal labour productivity levels, Newfoundland and Labrador ranks seventh in comparison to other province in 1997. However, using real labour productivity levels (2007 chained dollar per hour worked), the province ranks second in comparison to the other Canadian provinces. The sensitivity of real labour productivity measures to the choice of measures and the year of reference is further discussed in box 4 at the end of this section.

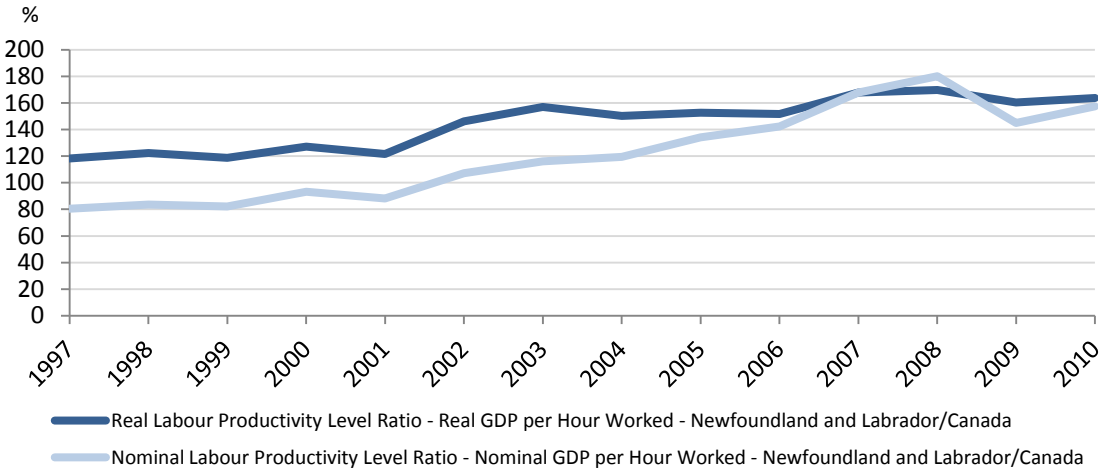
Relative to Canada, Newfoundland and Labrador's labour productivity level has increased significantly during the 1997-2010 period. In 2010, the province's real labour productivity level represented 163 per cent of Canada's, up from 118 per cent in 1997. In terms of nominal labour productivity, Newfoundland and Labrador's level relative to Canada's increased from 80 per cent in 1997 to 157 per cent in 2010 (Chart 32). This difference between nominal and real levels is a consequence of Newfoundland and Labrador's implicit price deflator increasing at a much faster pace than Canada's during the period.

Chart 31 Labour Productivity Levels in Canada and the Provinces, Business Sector, 2010 (Chained 2007 Dollars per Hour Worked)



Source: CSLS Newfoundland and Labrador Productivity Database.

Chart 32 Labour Productivity Levels in Newfoundland and Labrador as a Share of Canada, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database.

At the two-digit NAICS sector level, only three sectors in Newfoundland and Labrador (out of 15), underperformed their Canadian counterparts in terms of labour productivity growth – namely, transportation and warehousing; professional, scientific and technical services; and arts, entertainment and recreation (Table 17). Labour productivity in the mining and oil and gas extraction sector increased at a very rapid rate of 11.34 per cent per year during the 1997-2010 period. It is interesting to note that the sector's labour productivity saw particularly impressive increases during the 1997-2000 period, with a growth of 31.73 per cent per year.

Table 17: Labour Productivity Growth and Levels in Newfoundland and Labrador and Canada, Business Sector, 1997-2010

	Newfoundland and Labrador			Canada		
	1997	2000	2010	1997	2000	2010
	(current dollar per hour worked)					
Business sector industries	**24.10**	**32.50**	**75.20**	**29.98**	**34.83**	**47.79**
Agriculture, forestry, fishing and hunting	21.82	28.23	49.11	17.82	22.20	33.91
Mining and oil and gas extraction	56.24	237.64	830.00	98.34	188.20	241.48
Utilities	109.17	109.02	152.11	149.55	157.75	167.37
Construction	21.40	23.03	48.31	23.97	27.05	41.01
Manufacturing	26.58	27.71	41.42	37.94	46.47	52.68
Wholesale trade	26.32	31.52	53.76	29.11	31.89	50.90
Retail trade	11.31	12.63	22.49	16.04	18.62	27.49
Transportation and warehousing	23.83	21.13	35.19	29.63	31.09	45.26
Information and cultural industries	48.10	63.98	78.64	53.43	50.92	77.07
FIRE	58.10	59.40	93.10	60.54	65.79	91.86
Professional, scientific and technical services	22.14	21.79	33.65	23.99	27.84	39.95
ASWMRS	17.12	16.47	24.64	18.83	20.10	26.80
Arts, entertainment and recreation	21.64	11.46	16.29	17.97	18.99	23.61
Accommodation and food services	10.32	11.70	18.51	12.87	14.01	19.62
Other private services	15.38	17.07	30.67	18.28	20.48	31.33
Business sector without mining oil and gas	22.94	24.19	39.08	28.82	32.58	44.02
	(Chained 2007 dollar per hour worked)					
Business sector industries	**45.43**	**53.63**	**74.30**	**38.44**	**42.19**	**45.39**
Agriculture, forestry, fishing and hunting	23.39	27.69	50.05	17.99	22.81	32.10
Mining and oil and gas extraction	210.76	481.82	851.81	309.23	342.24	252.14
Utilities	142.58	137.72	149.73	177.76	181.10	166.56
Construction	30.92	33.64	43.47	34.63	38.50	37.65
Manufacturing	34.52	35.89	43.27	41.31	48.00	51.09
Wholesale trade	27.53	35.05	50.19	31.87	36.73	48.21
Retail trade	14.28	15.12	22.46	19.09	21.56	27.08
Transportation and warehousing	32.38	27.94	33.80	35.28	36.89	41.25
Information and cultural industries	43.39	62.71	73.88	56.45	57.10	70.56
FIRE	64.41	64.85	86.67	71.57	76.20	86.46
Professional, scientific and technical services	30.37	27.58	30.51	31.09	34.15	35.87
ASWMRS	23.00	20.59	23.87	25.39	25.32	25.22
Arts, entertainment and recreation	22.21	12.38	15.77	25.31	24.30	21.68
Accommodation and food services	13.36	14.67	17.25	16.77	17.34	18.18
Other private services	21.82	24.19	25.76	24.20	25.83	27.90
Business sector without mining oil and gas	28.46	29.64	37.13	34.33	37.88	41.33
	1997-2010	**1997-2000**	**2000-2010**	**1997-2010**	**1997-2000**	**2000-2010**
	(compound annual growth rates, per cent)					
Business sector industries	**3.86**	**5.69**	**3.31**	**1.29**	**3.15**	**0.73**
Agriculture, forestry, fishing and hunting	6.03	5.78	6.10	4.55	8.22	3.48
Mining and oil and gas extraction	11.34	31.73	5.86	-1.56	3.44	-3.01
Utilities	0.38	-1.15	0.84	-0.50	0.62	-0.83
Construction	2.66	2.85	2.60	0.65	3.60	-0.22
Manufacturing	1.75	1.31	1.89	1.65	5.13	0.63
Wholesale trade	4.73	8.39	3.66	3.24	4.85	2.76
Retail trade	3.55	1.92	4.04	2.73	4.14	2.31
Transportation and warehousing	0.33	-4.79	1.92	1.21	1.49	1.13
Information and cultural industries	4.18	13.05	1.65	1.73	0.38	2.14
FIRE	2.31	0.23	2.94	1.46	2.11	1.27
Professional, scientific and technical services	0.03	-3.16	1.01	1.11	3.18	0.49
ASWMRS	0.29	-3.62	1.49	-0.05	-0.09	-0.04
Arts, entertainment and recreation	-2.60	-17.71	2.45	-1.18	-1.35	-1.13
Accommodation and food services	1.99	3.19	1.63	0.62	1.13	0.47
Other private services	1.28	3.49	0.63	1.10	2.19	0.77
Business sector without mining oil and gas	2.07	1.37	2.28	1.44	3.33	0.88

Source: CSLS Newfoundland and Labrador Productivity Database.

Box 4: Sensitivity of the Measures of Labour Productivity to Different Measures of Real Value

Real values are preferred to nominal values by economists, as they adjust money value to remove effect of price level changes over time. This is why this report calculates growth in labour productivity as chained 2007 dollars per hour worked, as the CSLS believes it gives a better understanding of how productivity progressed during the 1997-2010 period in Newfoundland and Labrador and in Canada. Real GDP and, indirectly, real labour productivity, is calculated by using the nominal GDP in one year, the reference year, and by multiplying this nominal value by an index that represent changes in volume. Therefore, the choice of a base year is very important and will dictate the value of real GDP for all the other years.

However, the problem in the case of Newfoundland and Labrador is that the province experienced a much higher growth in its price level than Canada as a whole, as discussed previously in the section on the implicit price deflator. Therefore, for any given year, Newfoundland and Labrador's real labour productivity as a percentage of Canada's will always be higher when using chained 2007 dollar than chained 2002 dollars, since prices increased much faster in the province between 2002 and 2007 than at the national level. For example, according to Table 3.1, Newfoundland and Labrador's real labour productivity represented 118.2 per cent of Canada's in 1997 if we use chained 2007 dollars, but represented only 86.4 per cent if we use chained 2002 dollars.

It is important to understand that no reference year that is better than another when comparing real level of labour productivity. Since the price levels were different from one year to another between Newfoundland and Labrador's and Canada's economy, it is impossible to know if the nominal provincial labour productivity during a specific year either overestimates or underestimates productivity in comparison to the national level. In this report, we chose 2007 because most of the data on capital flows are given in this unit of measure and because 2007 is a more recent year than 2002.

Finally, it is important to understand that the use of different reference years only affects the respective level of labour productivity for Newfoundland and Labrador and Canada and not their respective the growth rate. Growth rates are identical either with the use of chained 2007 dollars or chained 2002 dollars.

Table B: Newfoundland and Labrador's Business Sector Labour Productivity as a Percentage of Canada's, Nominal and Real values, 1997-2010

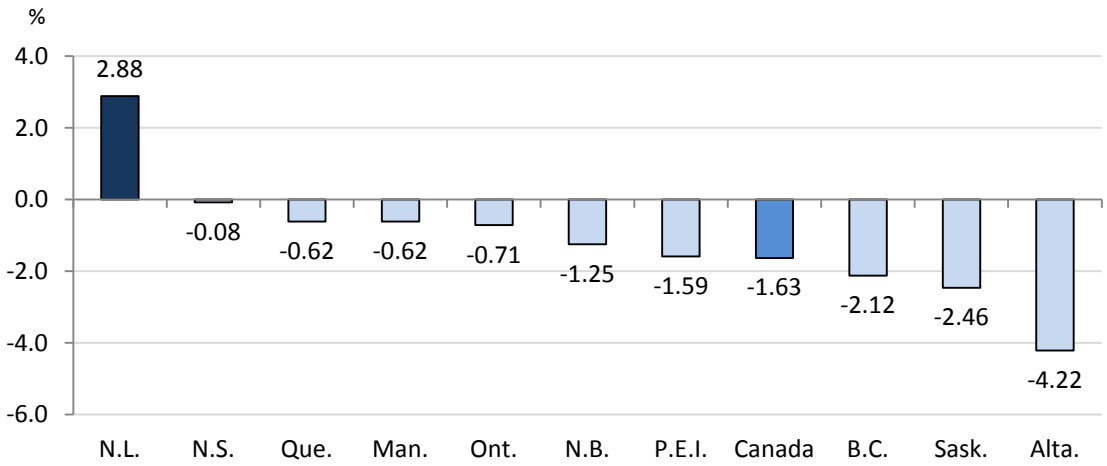
	Nominal	Chained 2002 Dollar	Chained 2007 Dollar
1997	80.4	86.4	118.2
1998	83.7	89.5	122.4
1999	82.3	86.7	118.7
2000	93.3	93.1	127.1
2001	88.2	89.1	121.7
2002	107.2	107.0	146.2
2003	116.1	114.7	157.0
2004	119.5	109.7	150.3
2005	134.2	111.7	152.7
2006	142.4	110.9	151.8
2007	167.8	122.8	167.8
2008	180.2	124.0	169.6
2009	144.9	117.5	160.5
2010	157.4	119.4	163.7

Source: CSLS Newfoundland and Labrador's Productivity Database

B. Capital Productivity

Capital productivity, defined here as real GDP per unit of capital services, increased by 2.88 per cent per year in Newfoundland and Labrador during the 1997-2010 period (Chart 33), while at the national level capital productivity actually declined 1.63 per cent per year. In fact, Newfoundland and Labrador was the only province that experienced positive capital productivity growth during the period. This comes from the fact that Newfoundland and Labrador had the slowest growth in capital services and at the same time, the highest growth in real output.

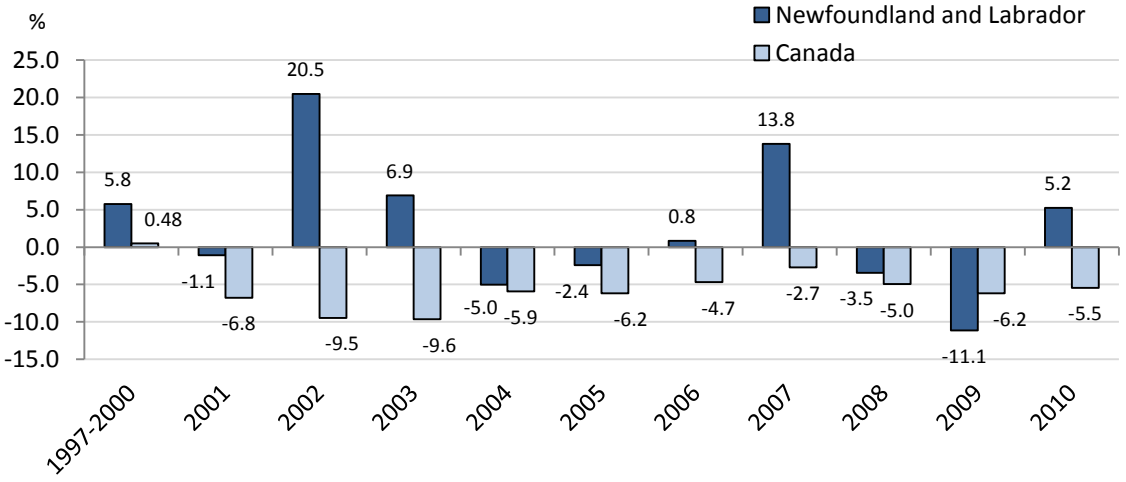
Chart 33: Capital Productivity Growth in Canada and the Provinces, Business Sector, 1997-2010 (Compound Annual Growth Rates)



Source: CSLS Newfoundland and Labrador Productivity Database.

A closer look at Newfoundland and Labrador's capital productivity growth during the period shows that it experienced above-average growth during the 1997-2003 period (7.08 per cent per year vs. -0.28 per cent per year), after which growth slowed down considerably (Chart 34). During the seven-year span between 2003 and 2010, Newfoundland and Labrador's business sector capital productivity declined in three out of seven years, with a significant drop of -11.1 per cent during the 2009 economic crisis.

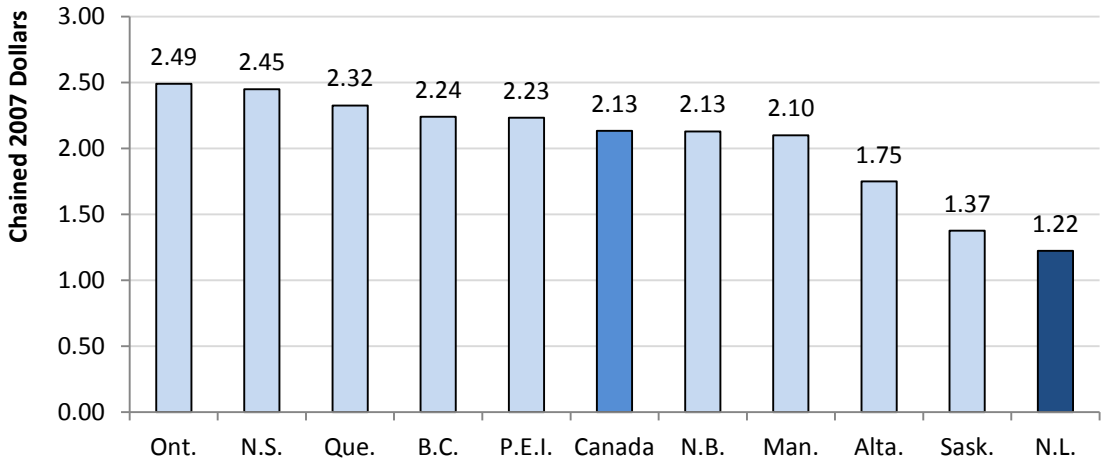
Chart 34: Capital Productivity Growth in Newfoundland and Labrador, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database.

Although Newfoundland and Labrador had the highest capital productivity growth rate of all provinces during the 1997-2010 period, the province still had the lowest capital productivity level in Canada in 2010, with $1.22 (chained 2007 dollars) of output being produced per unit of capital services, significantly less than the national average, $2.13 (chained 2007 dollars) (Chart 35).

Chart 35: Capital Productivity Levels in Canada and the Provinces, Business Sector, 2010

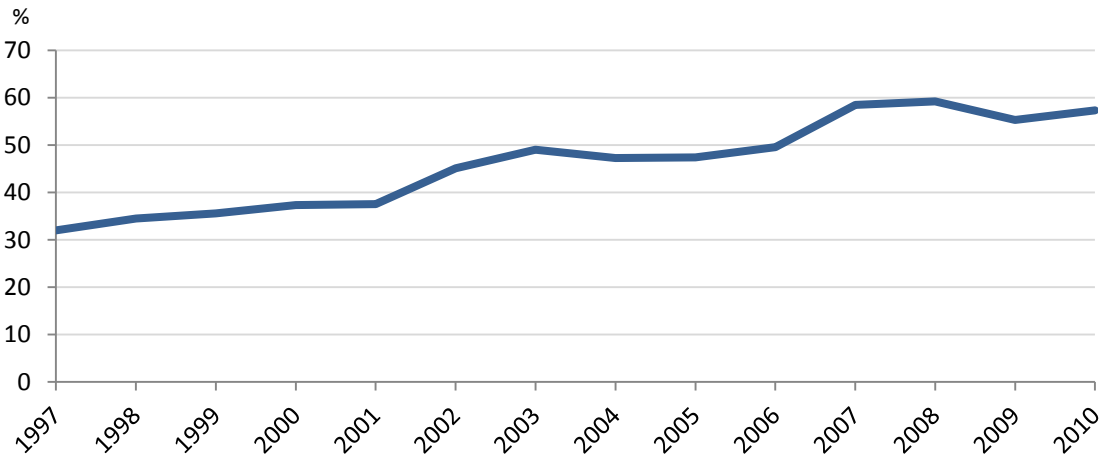


Source: CSLS Newfoundland and Labrador Productivity Database.

However, with such a high level of capital productivity growth in Newfoundland and Labrador, the gap between the province and Canada shrank considerably (Chart 36). By 2010, Newfoundland and Labrador's capital productivity level represented 57.3 per cent of the national

level, up from 32.0 per cent in 1997, a number depressed by the massive engineering investments made in the years that preceded the beginning of oil production in the province.

Chart 36: Capital Productivity Levels in Newfoundland and Labrador as a Percent of Canada's, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database.

Table 18 provides capital productivity growth rates and levels for two-digit NAICS sectors in Newfoundland and Labrador and Canada. During the 1997-2010 period, the province outperformed Canada in all sectors except transportation and warehousing (-5.3 per cent per year vs. -2.3 per cent per year); FIRE (-2.4 per cent per year vs. -1.1 per cent); and professional, scientific and technical services (-5.5 per cent per year vs. -3.2 per cent). Two sectors experienced exceptional capital productivity growth during the period: ASWMRS (15.3 per cent per year) and mining and oil and gas extraction (13.9 per cent per year).

Table 19 shows Newfoundland and Labrador's capital productivity as a share of Canada's. In 2010, half of the 15 sectors for which capital productivity estimates were available had a level of capital productivity higher than Canada's (vs. only five in 1997). The case of the mining and oil and gas extraction sector is singular. From 6.9 per cent of the Canadian capital productivity in 1997, the capital productivity of the mining and oil and gas sector accounted for 77.6 of Canada’s in 2010. This can be explained by two factors: in 1997, the province’s mining and oil and gas extraction sector had accumulated a large amount of capital but production had just begun, leading to a low level of capital productivity in comparison to Canada. As production increased, the level of capital productivity rose consequentially to come closer to the national average. Second, the higher relative capital productivity in Newfoundland and Labrador in 2010 in comparison to 1997 is also due to the declining capital productivity of its Canadian counterpart, which declined from $2.27 chained 2007 dollars per unit of capital services to $1.09 chained 2007 dollars per unit of capital services.

Table 18: Capital Productivity Growth and Levels in Newfoundland and Labrador and Canada by Two-Digit NAICS Sectors, Business Sector, 1997-2010

	Newfoundland and Labrador			Canada		
	1997	2000	2010	1997	2000	2010
	(chained 2007 dollars per unit of capital services)					
Business sector industries	**0.85**	**1.00**	**1.22**	**2.64**	**2.68**	**2.13**
Agriculture, forestry, fishing and hunting	1.14	1.36	1.50	1.39	1.61	1.71
Mining and oil and gas extraction	0.16	0.42	0.85	2.27	2.06	1.09
Utilities	1.23	1.29	1.42	1.33	1.36	1.2
Construction	3.65	3.52	3.14	4.4	4.44	3.33
Manufacturing	2.44	3.06	2.58	2.4	2.7	2.3
Wholesale trade	1.62	1.69	2	2.79	2.92	2.33
Retail trade	3.54	4.29	3.73	3.95	4.05	3.23
Transportation and warehousing	5.19	4.16	2.55	3.45	3.12	2.57
Information and cultural industries	1.88	2.15	2.39	1.63	1.61	1.9
FIRE	2.43	1.97	1.77	2.21	2.01	1.92
Professional, scientific and technical services	14.53	14.34	6.95	6.53	5.71	4.26
ASWMRS	1.04	2.94	6.61	4.09	5.56	3.17
Arts, entertainment and recreation	6.35	5.56	5.45	4.34	4.19	3.04
Accommodation and food services	3.82	4.68	3.83	4.02	4.89	4.16
Other private services	4.44	3.86	1.35	6.69	5.06	2.66
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
	(compound annual growth rates, per cent)					
Business sector industries	**2.9**	**5.8**	**2**	**-1.6**	**0.5**	**-2.3**
Agriculture, forestry, fishing and hunting	2.1	6.1	0.9	1.6	5	0.6
Mining and oil and gas extraction	13.9	38.8	7.4	-5.5	-3.1	-6.2
Utilities	1.1	1.5	1	-0.8	0.6	-1.2
Construction	-1.1	-1.1	-1.1	-2.1	0.3	-2.8
Manufacturing	0.4	7.9	-1.7	-0.3	4	-1.6
Wholesale trade	1.6	1.4	1.7	-1.4	1.5	-2.3
Retail trade	0.4	6.6	-1.4	-1.5	0.8	-2.2
Transportation and warehousing	-5.3	-7.1	-4.8	-2.3	-3.4	-1.9
Information and cultural industries	1.9	4.6	1.1	1.2	-0.3	1.7
FIRE	-2.4	-6.7	-1.1	-1.1	-3	-0.5
Professional, scientific and technical services	-5.5	-0.4	-7	-3.2	-4.4	-2.9
ASWMRS	15.3	41.3	8.4	-1.9	10.8	-5.5
Arts, entertainment and recreation	-1.2	-4.3	-0.2	-2.7	-1.2	-3.2
Accommodation and food services	0	7	-2	0.3	6.8	-1.6
Other private services	-8.7	-4.3	-10	-6.8	-8.9	-6.2

Source: CSLS Newfoundland and Labrador Productivity Database

Table 19: Capital Productivity Levels in Newfoundland and Labrador as a percentage of Canada's, Two-digit NAICS Sectors, 1997, 2000 and 2010

	1997	2000	2010
		(per cent)	
Business sector industries	**32.0**	**37.3**	**57.3**
Agriculture, forestry, fishing and hunting	82.4	84.9	87.7
Mining and oil and gas extraction	6.9	20.2	77.6
Utilities	92.2	94.7	118.6
Construction	82.9	79.4	94.2
Manufacturing	101.8	113.4	112.4
Wholesale trade	58.0	57.8	85.9
Retail trade	89.6	105.9	115.3
Transportation and warehousing	150.3	133.5	99.2
Information and cultural industries	115.2	133.4	126.0
FIRE	110.0	97.8	92.2
Professional, scientific and technical services	222.6	251.1	163.3
ASWMRS	25.5	52.8	208.5
Arts, entertainment and recreation	146.3	132.7	179.2
Accommodation and food services	95.1	95.7	92.0
Other private services	n.a	n.a	n.a

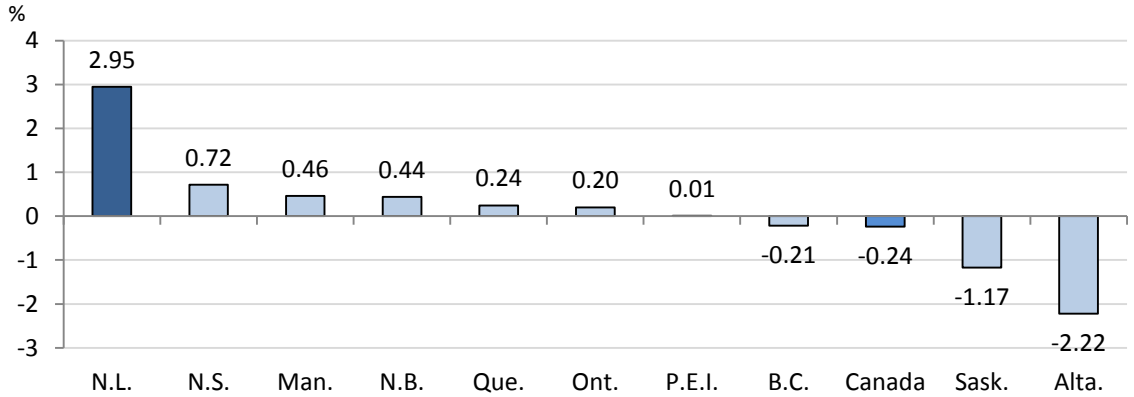
Source: CSLS Newfoundland and Labrador Productivity Database.

C. Multifactor Productivity

Multifactor productivity (MFP) represents output growth that is not accounted for by measured input growth. It captures the effect of a number of different factors, such as: disembodied technological growth, capacity utilization and returns to scale, among others, while also incorporating errors due to the mis-measurement of inputs.

During the 1997-2010 period, Newfoundland and Labrador experienced the fastest MFP growth among all the Canadian provinces (Chart 37). The province's MFP increased at a compound annual rate of 2.95 per cent, while actually falling 0.24 per cent per year at the national level. Nova Scotia had the second highest MFP growth (0.72 per cent per year), while Alberta came last (-2.22 per cent per year).

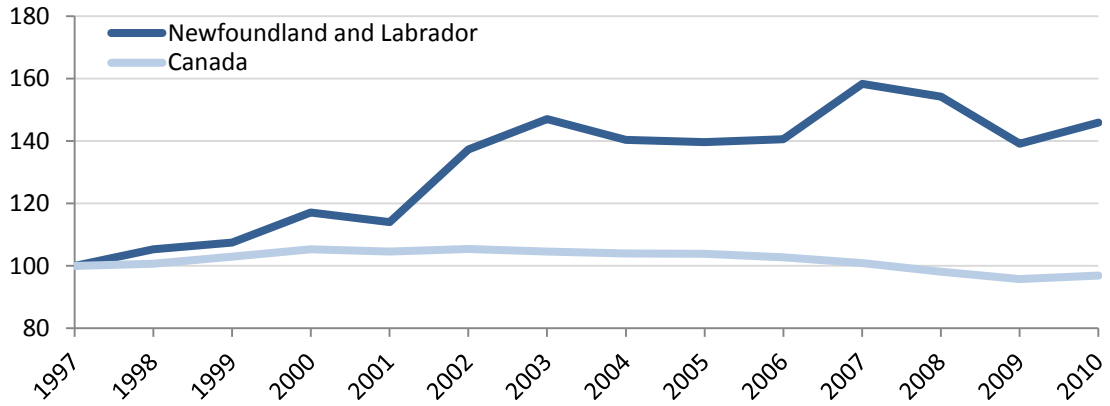
Chart 37: Multifactor Productivity Growth in Canada and Provinces, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database.

As a consequence of this rapid growth, Newfoundland and Labrador's MFP was 1.46 times higher in 2010 than in 1997, while Canada's MFP in 2010 was actually three per cent *lower* than in 1997 (Chart 38).

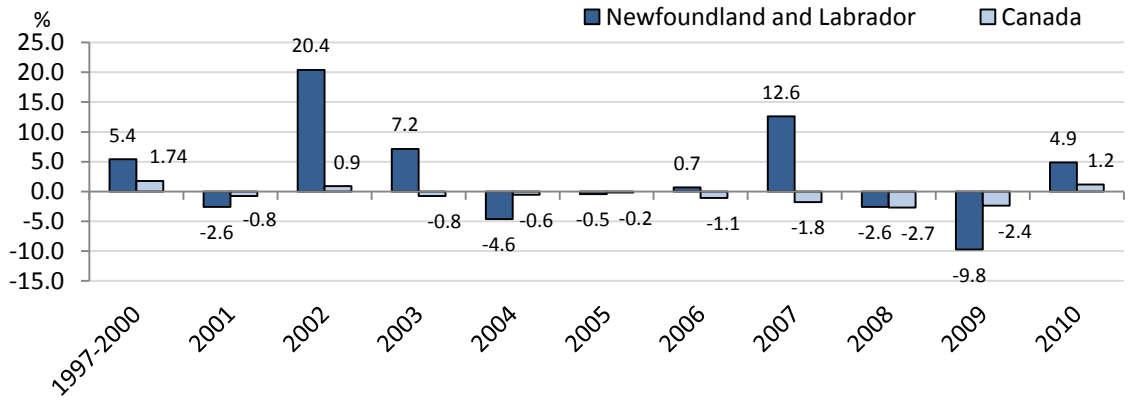
Chart 38: Multifactor Productivity Growth in Newfoundland and Labrador and Canada, Business Sector, 1997-2010 (1997=100)



Source: CSLS Newfoundland and Labrador Productivity Database.

A closer look at Newfoundland and Labrador's MFP growth during the 1997-2010 period shows a pattern that is very similar to the one provided by our analysis of labour and capital productivity growth. MFP grew at its highest rate in 2002, increasing 20.5 per cent. All three productivity measures also point to substantial MFP gains in 2000 (8.9 per cent) and 2007 (12.6 per cent). Finally, as with the other two indicators of productivity, MFP shows that Newfoundland and Labrador was more affected by the recession than Canada, with MFP declining at 9.8 per cent in the province versus a decline of only 2.4 per cent at the national level during that year.

Chart 39: Multifactor Productivity Growth in Newfoundland and Labrador and Canada, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database.

Table 20 provides MFP growth rates for all two-digit NAICS sectors in Newfoundland and Labrador and Canada. At the two-digit NAICS sector level, Newfoundland and Labrador outperformed Canada in 11 out of 15 sectors. The only exceptions were transportation and warehousing; professional, scientific and technical services; arts, entertainment and recreation; and other private services. It is interesting to note that, along with the FIRE sector, these were the only sectors in Newfoundland and Labrador that experienced negative MFP growth during the period. All the other ten sectors had positive MFP growth of at least 1.0 per cent per year.

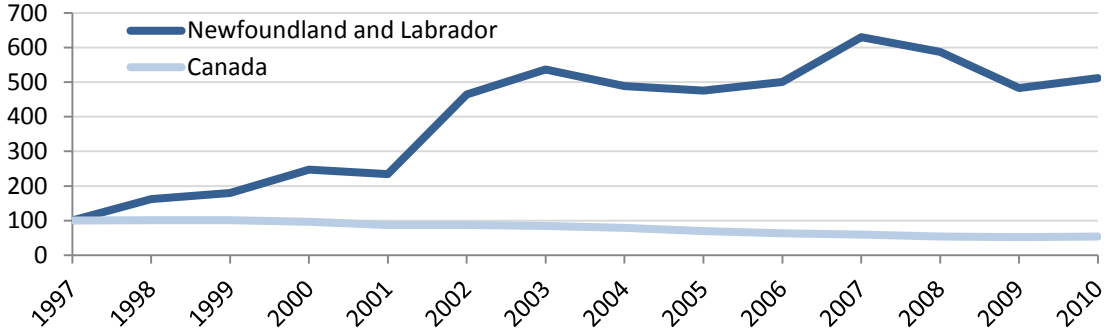
Table 20: Multifactor Productivity Growth in Newfoundland and Labrador and Canada by Two-Digit NAICS Sectors, Business Sector, 1997-2010

	Newfoundland and Labrador			Canada		
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
	(compound annual growth rates, per cent)					
Business sector	**2.95**	**5.39**	**2.23**	**-0.24**	**1.74**	**-0.82**
Agriculture, forestry, fishing and hunting	2.91	5.33	2.20	2.44	5.20	1.62
Mining and oil and gas extraction	13.38	35.27	7.53	-4.64	-1.18	-5.65
Utilities	1.13	0.55	1.30	-0.74	0.57	-1.14
Construction	1.28	1.24	1.30	-0.03	3.16	-0.97
Manufacturing	1.18	3.92	0.37	0.60	4.65	-0.59
Wholesale trade	3.45	6.83	2.46	1.49	3.61	0.87
Retail trade	2.12	1.41	2.33	1.41	3.45	0.80
Transportation and warehousing	-1.53	-5.51	-0.31	-0.22	-0.30	-0.19
Information and cultural industries	2.71	8.05	1.16	1.34	-0.26	1.83
FIRE	-0.61	-4.75	0.67	-0.11	-1.15	0.21
Professional, scientific and technical services	-1.33	-4.62	-0.33	-0.12	0.80	-0.39
ASWMRS	3.13	3.89	2.91	-0.52	2.72	-1.47
Arts, entertainment and recreation	-1.91	-9.58	0.52	-1.58	-1.90	-1.48
Accommodation and food services	1.47	5.19	0.38	0.39	2.21	-0.15
Other private services	-2.49	0.67	-3.42	-1.68	-1.41	-1.76

Source: CSLS Newfoundland and Labrador Productivity Database.

The mining and oil and gas extraction sector in Newfoundland and Labrador had the highest MFP growth among all of the province's two-digit NAICS sectors (13.38 per cent per year). At the national level, however, mining and oil and gas extraction actually had the *lowest* MFP growth of all two-digit NAICS sectors (-4.64 per cent per year). Chart 40 plots MFP growth in the mining and oil and gas sector for Newfoundland and Labrador and Canada, showing the massive gap that emerged in MFP during the 1997-2010 period.

Chart 40: Multifactor Productivity Growth in Newfoundland and Labrador and Canada, Mining and Oil and Gas Extraction Sector, 1997-2010 (1997=100)



Source: CSLS Newfoundland and Labrador Productivity Database

D. Sources of Labour Productivity Growth in Newfoundland and Labrador

The last three subsections have highlighted the important increases in labour, capital and multifactor productivity in the Newfoundland and Labrador business sector. More specifically, it showed that during the 1997-2010 period, Newfoundland and Labrador labour productivity, defined as 2007 chained dollar per hour worker, increased from 118 per cent to 162 per cent of Canada's. It also established that 12 of the 15 two-digit NAICS sectors in Newfoundland and Labrador experienced a higher growth in labour productivity than their Canadian counterparts during this period. What accounts for this productivity rate differential?

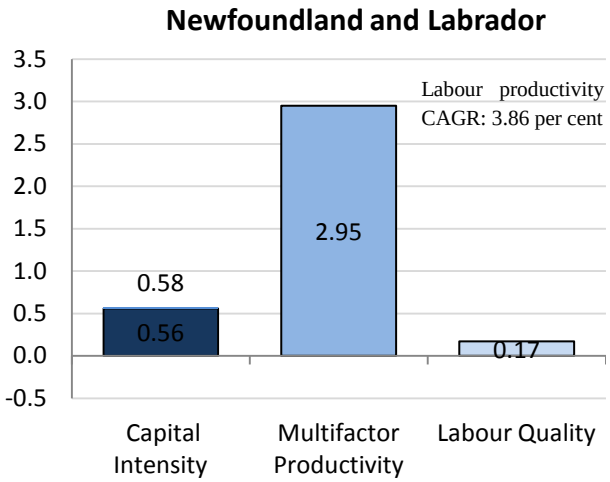
This report uses the standard growth accounting framework, which decomposes the growth in labour productivity into three broad factors: improvement in the quality of labour, capital deepening (increases in the amount of capital per labour input, or more precisely, per hour worked) and growth in multifactor productivity growth (MFP). MFP growth reflects output growth that is not accounted for by combined output growth. It 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 mis-measurement of inputs. In a value-added context, MFP is calculated as the ratio between an index of GDP growth and an index of combined labour or capital input growth.

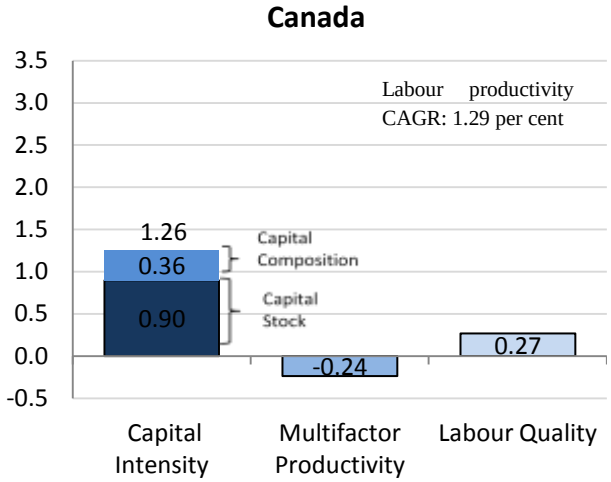
Chart 41 shows clearly that Newfoundland and Labrador's labour productivity growth outpaced Canada's due to a strong growth in multifactor productivity. MFP growth accounted for 2.95 percentage points of the overall 3.86 per cent annual labour productivity growth observed in the province between 1997 and 2010. This means than 79.7 per cent of the province's labour productivity growth was due to an increase in MFP. On the other hand, the contribution of capital intensity to labour productivity growth was much smaller; capital stock growth was responsible for 0.56 percentage points of labour productivity growth and capital composition

growth had a negligible impact. Finally, labour composition growth had a marginal impact, accounting for less than 5 per cent of labour productivity growth.

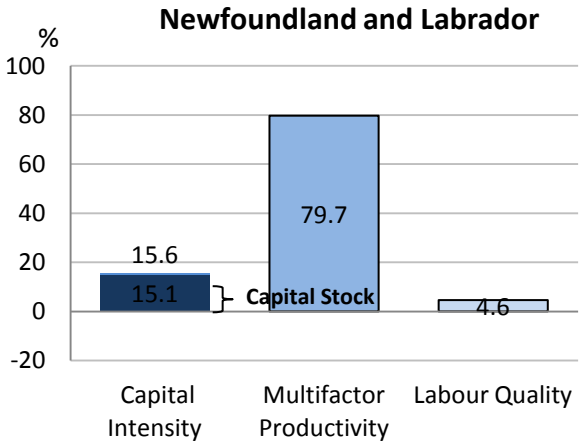
Chart 41: Percentage Point and Per cent Contribution to Labour Productivity Growth by Source in Newfoundland and Labrador and in Canada, Business Sector, 1997-2010

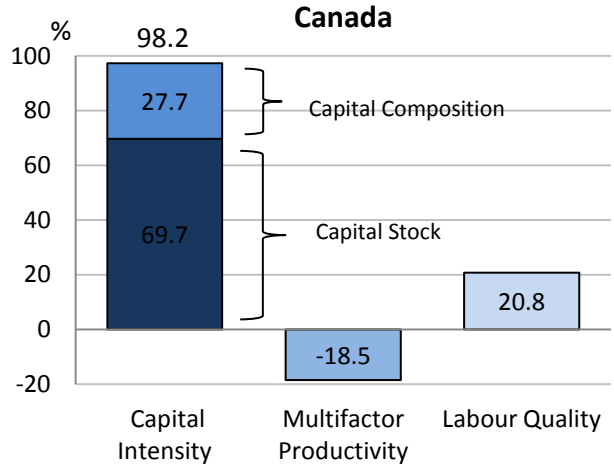
A) Percentage Point





B) Per Cent





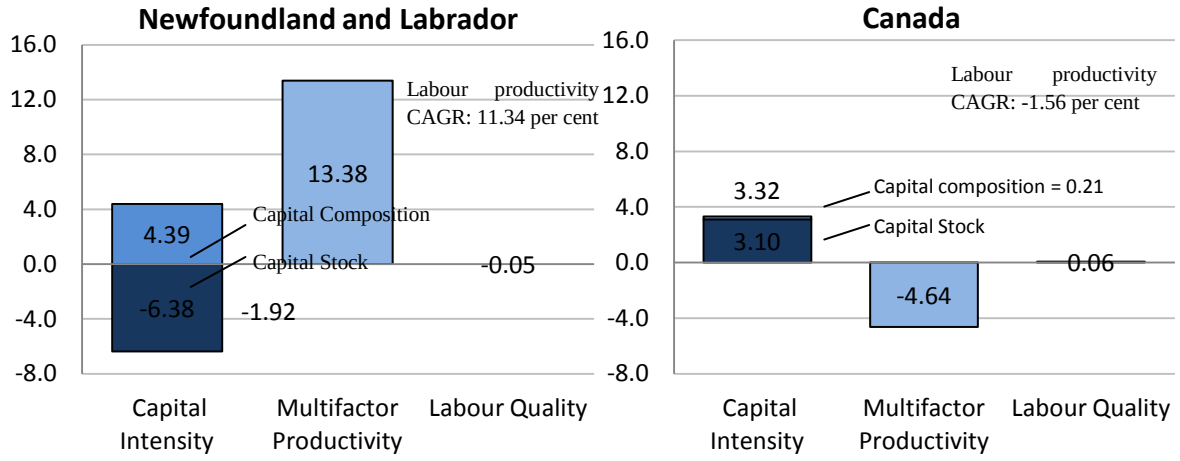
Source: CSLS Provincial Productivity Database
Note: Numbers may not sum up to 100 due to rounding.

The drivers of labour productivity growth in Canada were quite different. In stark contrast to Newfoundland and Labrador's business sector, MFP actually declined in Canada at 0.24 per cent per year. At the national level, it is growth in capital intensity that explained 98.2 per cent of labour productivity growth. The impact of capital intensity on labour productivity growth can be divided between capital stock growth (0.90 per cent per year) and capital

composition growth (0.36 per cent per year). Increases in labour quality also play an important part in explaining labour productivity growth, as they accounted for 20.8 per cent of the increase in national labour productivity.

Unfortunately, it is hard to pinpoint exactly why MFP growth in Newfoundland and Labrador represented such an important part of labour productivity growth and was higher than in Canada during the 1997-2010 period. By definition, MFP growth is a residual. It encapsulates the influence of a variety of factors. One of the most plausible explanations is related to the mining and oil and gas sector. Our period of study overlaps with the beginning of offshore oil production in Newfoundland and Labrador and the important increase in multifactor productivity does result from the increased production of oil, a natural resource industry associated with a high-productivity level. In fact, during the 1997-2010 period, this sector experienced an annual growth of 11.34 per cent in labour productivity, of which 118 per cent is attributable to an increase in MFP (Chart 42). As we will see in the next section, this sector was also responsible for most of Newfoundland and Labrador's labour productivity growth.

Chart 42: Percentage Point Contribution to the Mining and Oil and Gas Extraction Sector Labour Productivity Growth by the Source of Labour Productivity, Newfoundland and Labrador, 1997-2010



Source: CSLS Provincial Productivity Database

E. Industrial Structure and Intersectoral Shifts

The aggregate labour productivity level is (approximately) the weighted average of sectoral labour productivity levels, with the weights being equal to each sector's labour input

share. Using the framework developed by Sharpe and Thomson (2010b)[18], we can decompose the contributions of different sectors to aggregate labour productivity growth in Newfoundland and Labrador (the framework is formally derived in Appendix 2). Furthermore, the contribution of each sector can be broken down in 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 favored 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 overall effect is the aggregation of all the industry effects. According to CSLS calculations, Newfoundland and Labrador's mining and oil and gas extraction sector was responsible for 78.3 per cent of the province's overall labour productivity growth during the 1997-2010 period. It was followed by agriculture, forestry, fishing and hunting (4.6 per cent), retail trade (4.6 per cent), and manufacturing (4.3 per cent) (Table 21). On the other hand, professional, scientific and technical services; ASWMRS; arts, entertainment and recreation; and utilities made negative contributions to productivity growth in the province.

Table 22 decomposes the contribution of Newfoundland and Labrador two-digit NAICS sectors to aggregate labour productivity into within-sector, reallocation level, and reallocation growth effects. The within-sector effect was, by far, the most important, accounting for 82.1 per cent of total labour productivity growth in the province's business sector. Furthermore, Table 22 shows that changes in productivity within the mining and oil and gas extraction sector

[18] For an alternative decomposition methodology that works well with chained indexes, see Almon and Tang (2011) and de Avillez (2012).

contributed to 57.0 per cent of the overall labour productivity growth. Since this sector experienced the highest growth of all two-digit NAICS sectors, at 11.34 per cent per year, and because its share of hours worked increased from 3.6 per cent to 4.7 per cent, the reallocation growth effect in the mining and oil and gas extraction also contributed to 16.7 per cent of the labour productivity growth. Overall, the reallocation growth effect was responsible for 14.2 per cent of the growth in labour productivity while the reallocation level effect was responsible for only 3.7 per cent.[19]

Table 21: Sectoral Contribution to Business Sector Labour Productivity Growth in Newfoundland and Labrador, 1997-2010

	Hours Share, 1997	Hours Share, 2010	Δ Hours share	LP Level, 1997	LP Level 2010	Δ LP	Per Cent Sectoral Contribution to Overall LP Growth
	A	B	C=B-A	D	E	F=E-D	H
Business sector Industries	**100.0**	**100.0**	**0.0**	**45.4**	**74.3**	**28.9**	**100.0**
Agriculture, forestry, fishing and hunting	5.7	2.6	-3.1	23.4	50.1	26.7	5.7
Mining and oil and gas extraction	3.5	4.6	1.1	210.8	851.8	641.0	78.3
Utilities	1.7	1.4	-0.2	142.6	149.7	7.2	-0.1
Construction	11.1	12.0	0.8	30.9	43.5	12.6	2.9
Manufacturing	10.1	8.7	-1.4	34.5	43.3	8.8	3.3
Wholesale trade	5.8	4.8	-1.0	27.5	50.2	22.7	4.0
Retail trade	20.9	20.9	-0.1	14.3	22.5	8.2	4.4
Transportation and warehousing	7.3	6.5	-0.8	32.4	33.8	1.4	1.1
Information and cultural industries	2.8	2.5	-0.3	43.4	73.9	30.5	2.2
FIRE	5.4	4.8	-0.6	64.4	86.7	22.3	2.9
Professional, scientific and technical services	4.1	6.9	2.8	30.4	30.5	0.1	-3.1
ASWMRS	2.1	4.3	2.2	23.0	23.9	0.9	-2.7
Arts, entertainment and recreation	0.7	1.0	0.3	22.2	15.8	-6.4	-0.6
Accommodation and food services	8.3	8.1	-0.2	13.4	17.3	3.9	1.1
Other private services	10.4	10.8	0.5	21.8	25.8	3.9	0.5

Source: CSLS calculations based on CSLS Newfoundland and Labrador Database

[19] The decomposition of labour productivity growth for the 1997-2010 period showed in Table 22 is calculated using the data at the beginning and at the end of the period only. It is interesting to see that a year-by year analysis gives quite different values, notably for the reallocation level effect and the reallocation growth effect. When using a year-by-year analysis, the reallocation level effect accounted for 32.7 per cent of labour productivity growth while the reallocation growth effect accounted for -9.3 per cent of labour productivity growth. The fact that the reallocation growth effect was negative may seem counter-intuitive. However, it can be explained by the fact that, even if some sectors experienced an overall positive growth in both their share of hours worked and productivity level, the years where their share of hours increased coincided with declined in their productivity levels. For example, the mining and oil and gas extraction sector experienced a rapid growth in both labour productivity (from $210.8 to $851.8 chained 2007 dollar) and hours share (from 3.5 to 4.6 per cent) during the 1997-2010 period. However, most of the time, its hour share increased in years where labour productivity was on the decline. For example, between 2004 and 2005, labour productivity in the mining and oil and gas extraction sector decreased from $1,118.5 to $936.6 chained 2007 dollars while its hours share increased from 3.0 to 3.8 per cent, leading to an important negative reallocation growth effect. Overall, the reallocation growth effect of the mining and oil and gas sector extraction contributed to -4.9 per cent of the aggregate labour productivity growth according to the year-by year decomposition. Sectoral contribution to business sector labour productivity growth using a year-by-year analysis is shown in the Appendix Table 5.

Table 22: Sectoral Contribution to Business Sector Labour Productivity Growth Decomposed into Within-Sector, Reallocation Growth Effects, Newfoundland and Labrador, 1997-2010[20]

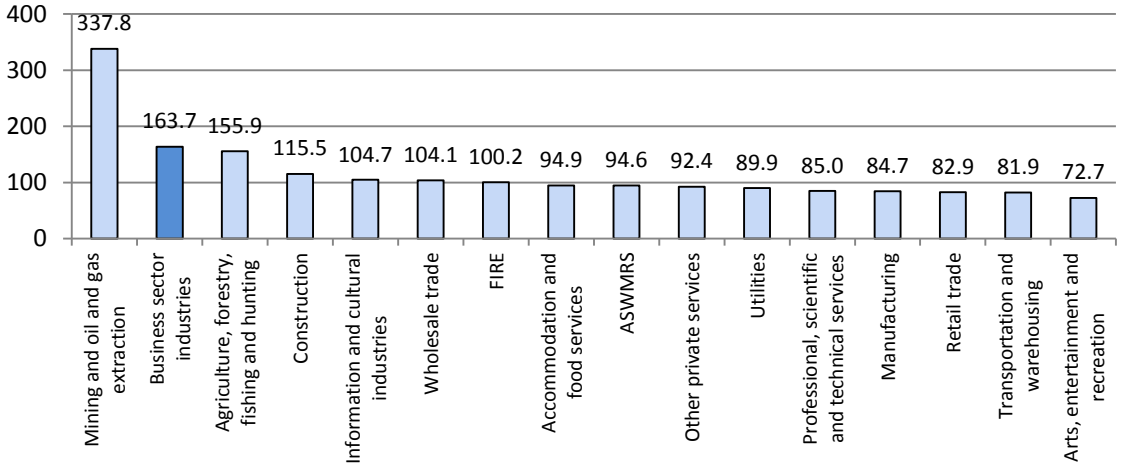
	Within-Sector Effect	Reallocation Level Effect	Reallocation Growth Effect	Total
	(as a share of total labour productivity change)			
Business sector Industries	**82.1**	**3.7**	**14.2**	**100.0**
Agriculture, forestry, fishing and hunting	3.9	1.7	0.2	5.7
Mining and oil and gas extraction	57.0	4.5	16.7	78.3
Utilities	0.3	-0.5	0.1	-0.1
Construction	3.6	-0.3	-0.3	2.9
Manufacturing	2.3	0.4	0.7	3.3
Wholesale trade	3.4	0.5	0.2	4.0
Retail trade	4.4	0.1	0.0	4.4
Transportation and warehousing	0.3	0.3	0.6	1.1
Information and cultural industries	2.2	0.0	0.0	2.2
FIRE	3.1	-0.3	0.1	2.9
Professional, scientific and technical services	0.0	-1.1	-2.0	-3.1
ASWMRS	0.0	-1.2	-1.6	-2.7
Arts, entertainment and recreation	-0.1	-0.2	-0.3	-0.6
Accommodation and food services	0.8	0.2	0.1	1.1
Other private services	1.0	-0.3	-0.3	0.5

Source: CSLS calculations based on CSLS Newfoundland and Labrador Database

One of the interesting fact about Newfoundland and Labrador's labour productivity is that, even if the labour productivity level of the business sector in general is much higher than Canada's, and even if most sectors (12 of 15) experienced a higher growth in labour productivity, in 2010, only six out of 15 sectors had a higher labour productivity in Newfoundland and Labrador than in Canada (Chart 43). As recently as 2008, only the mining and oil and gas sector and the agriculture, forestry, fishing and hunting sector had a higher labour productivity in Newfoundland and Labrador than in Canada.

[20] A similar analysis of the sectoral contributions to labour productivity growth was also made in Lee and Gu (2013), in which they found a negative reallocation effect for Newfoundland and Labrador, the within-sector, or as they call it, the direct contribution effect, explaining all of the growth in labour productivity, However, their results cannot be compared with those given here in this report since Lee and Gu calculate the direct effect by multiplying the change in labour productivity per sector by the output share of the given sector during the initial period whereas in this report, the within-sector effect is calculated by multiplying the change in labour productivity by the share of hours worked in the initial period. It is important to note that those two methods lead to largely different results.

Chart 43: Labour Productivity Levels in Newfoundland and Labrador as a percentage of Canada, Business Sector Industries, 2010 (Canada=100.0) (Chained 2007 dollars)



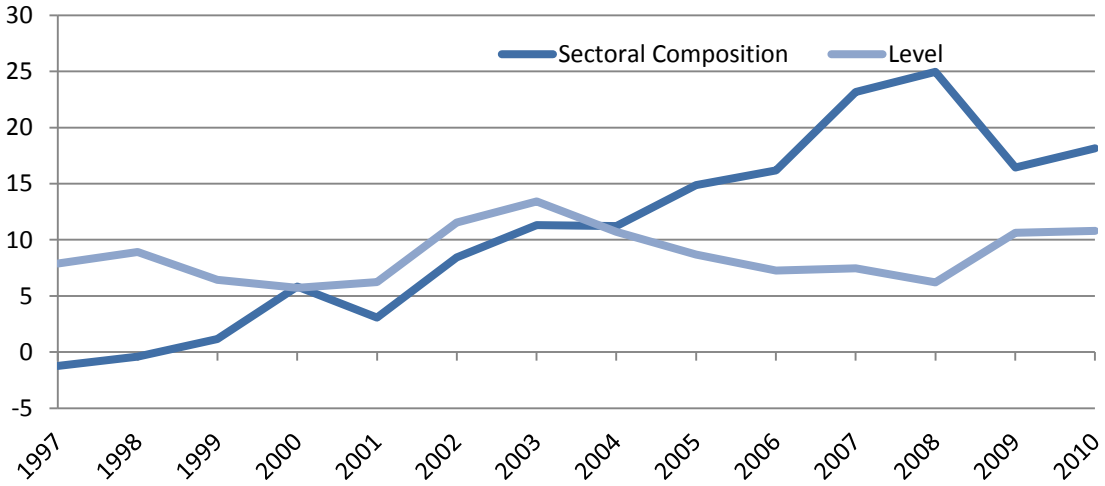
Source: CSLS calculations based on CSLS Newfoundland and Labrador Database

The disparity between the aggregate labour productivity level of Newfoundland and Labrador and Canada can be decomposed into two main components: differences in industry-specifics levels and differences in sectoral composition (in terms of shares of hours worked). Difference in industry-specific levels measures how, if the distribution of labour inputs would be exactly equal between sectors in Newfoundland and Labrador and Canada, the aggregate labour productivity would still differ due to industry-specific labour productivity level differences. On the other hand, the sectoral composition measures the extent to which labour productivity is higher in Newfoundland and Labrador than in Canada not because of higher levels of productivity per se, but because labour inputs (hours worked) are more concentrated in the most productive sectors of the economy. In other words, even if the labour productivity level in each sector was equal in Newfoundland and Labrador and Canada, there is still a possibility that the aggregate level of labour productivity would be higher in Newfoundland and Labrador if the province had a higher hour share in the most productive sectors of the economy, for example, the mining and oil and gas extraction industries.

Chart 44 and Table 23 show that while the higher level of labour productivity in Newfoundland and Labrador's was originally explained by difference in levels in 1997, it is mostly the changes in sectoral composition that explain why this productivity level differential increased in the last decade. In 1997, differences between Newfoundland and Labrador's and Canada's sectoral composition accounted for -$1.2 of the $6.6 difference between Newfoundland and Labrador's and Canada's level of labour productivity; in 2010, it accounted for $18.2 of the $29.0 differential, equivalent to 62.8 per cent of the gap between Newfoundland and Labrador's and Canada's labour productivity. Basically, this means that the gap between Newfoundland and Labrador's and Canada's level of labour productivity increased because labour input (hours worked) became more important in Newfoundland and Labrador's most productive sector of the

economy. For example, in 2010, if the sectoral distribution of labour, i.e. the hour share of each industry in Newfoundland and Labrador, would be the same as the hour share in Canada and the difference between Newfoundland and Labrador's and Canada's level of labour productivity would only be 10.8 chained 2007 dollar per worker. But, because labour inputs were more concentrated in the most productive sector in Newfoundland and Labrador, the Newfoundland and Labrador-Canada labour productivity differential was of $29.0 chained 2007 dollar per worker, of which $18.2 chained dollar is due to sectoral contribution.

Chart 44: Labour Productivity Level Gap Decomposition, Newfoundland and Labrador, 1997-2010



Source: CSLS Calculation from CSLS Newfoundland and Labrador Productivity Database

Table 23: Newfoundland and Labrador and Canada Labour Productivity Level Differential Decomposition, 1997-2010

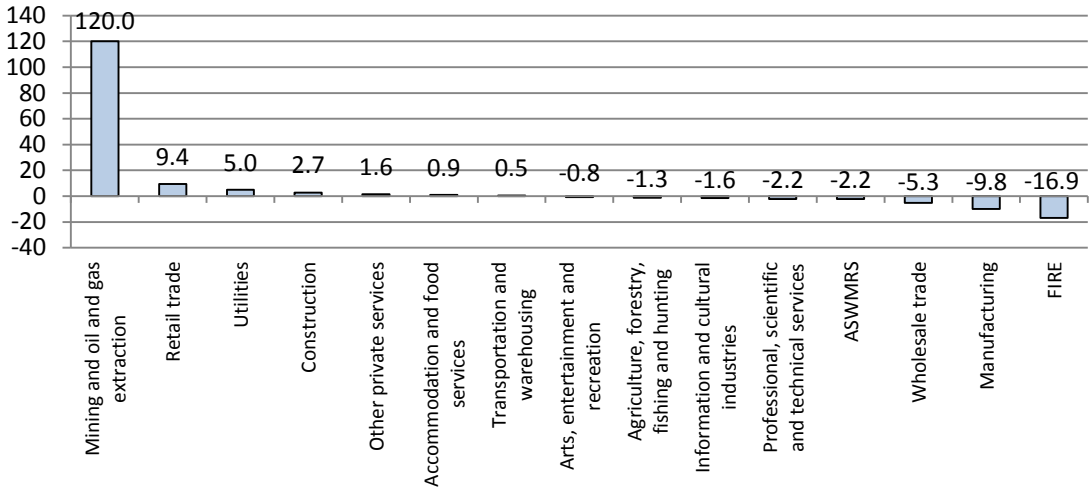
	Labour Productivity Level (2007 chained dollar)				Gap decomposition	
		Newfoundland and Labrador		Labour Productivity Gap	Sectoral Composition	Level
	Canada	Using Actual Hours Worked Share By Sector	Using Canada's Hours Worked Share By Sector			
	A	B	C	D=B-A	E=B-C	F=C-A
1997	38.8	45.4	46.7	6.6	-1.2	7.9
1998	39.4	48.0	48.4	8.5	-0.4	8.9
1999	40.6	48.2	47.0	7.6	1.2	6.4
2000	42.1	53.6	47.8	11.6	5.8	5.7
2001	42.5	51.8	48.7	9.3	3.1	6.2
2002	43.2	63.1	54.7	20.0	8.4	11.5
2003	43.4	68.1	56.8	24.7	11.3	13.4
2004	43.5	65.4	54.2	21.9	11.2	10.7
2005	44.6	68.2	53.3	23.6	14.9	8.7
2006	45.2	68.6	52.5	23.4	16.2	7.3
2007	45.2	75.8	52.6	30.6	23.2	7.5
2008	44.8	76.0	51.0	31.2	25.0	6.2
2009	44.7	71.8	55.3	27.1	16.5	10.6
2010	45.3	74.3	56.1	29.0	18.2	10.8
AVERAGE	**43.1**	**62.7**	**51.8**	**19.7**	**10.9**	**8.7**
	(as a percentage of Canada's labour productivity level, per cent)					
1997	100.0	117.1	120.3	17.1	-3.2	20.3
1998	100.0	121.6	122.6	21.6	-1.0	22.6
1999	100.0	118.7	115.8	18.7	2.9	15.8
2000	100.0	127.5	113.6	27.5	13.9	13.6
2001	100.0	121.9	114.7	21.9	7.3	14.7
2002	100.0	146.3	126.7	46.3	19.6	26.7
2003	100.0	157.0	130.9	57.0	26.1	30.9
2004	100.0	150.4	124.6	50.4	25.8	24.6
2005	100.0	152.8	119.5	52.8	33.4	19.5
2006	100.0	151.8	116.0	51.8	35.8	16.0
2007	100.0	167.8	116.5	67.8	51.3	16.5
2008	100.0	169.6	113.9	69.6	55.7	13.9
2009	100.0	160.6	123.8	60.6	36.8	23.8
2010	100.0	163.9	123.8	63.9	40.1	23.8
AVERAGE	**100.0**	**144.8**	**120.2**	**44.8**	**24.6**	**20.2**

Source: CSLS calculations based on CSLS Newfoundland and Labrador Database

Our previous discussion made it clear that the mining and oil and gas sector played an important part in the high level of labour productivity found in Newfoundland and Labrador. Chart 45 and Chart 46 strongly reinforce this view by showing that the differences between Newfoundland and Labrador's and Canada's labour productivity levels are almost uniquely caused by the mining and oil and gas extraction sector. Table 22 showed that 63.9 per cent of the difference between Newfoundland and Labrador's and Canada's level of labour productivity was caused by the specific sectoral composition of Newfoundland and Labrador's business sector. Chart 45 shows that the mining and oil and gas extraction sector accounted for 120.0 per cent of the sectoral composition effect on the Newfoundland and Labrador and Canada labour productivity differential. This is explained by the fact that the province has a larger share of its labour input (4.6 per cent) than Canada (1.9 per cent) going into the mining and oil and gas sector, a sector with an above average level of labour productivity. In comparison, the impact of the 14 other two-digit NAICS sectors looks minimal, accounting for between 9.4 and -16.9 per

cent of the sectoral composition component of the labour productivity component. If the contribution of a sector is negative, as in the case of the FIRE sector, then the sector accounted for a lower share of total hours worked than Canada in industries that have an above average labour productivity or it has a higher share of labour input than Canada on sectors that have below average labour productivity. In other words, in comparison to Canada, if the effect is negative, labour inputs are not allocated to the most productive sector of the economy.

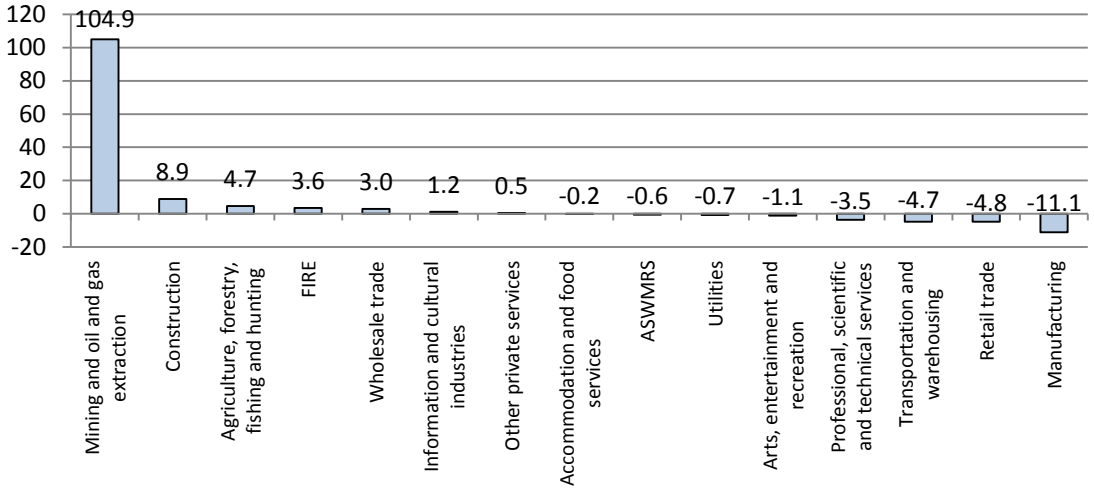
Chart 45: Contribution of Two-Digit NAICS Sectors to the Sectoral Composition component of the Newfoundland and Labrador and Canada Labour Productivity Level Differential, 2010 (per cent)



Source: CSLS calculations based on CSLS Newfoundland and Labrador Productivity Database

The importance of the mining and oil and gas extraction sector in explaining the differences between Newfoundland and Labrador's and Canada's labour productivity level is also striking when looking at the contribution of Newfoundland and Labrador's two-digit NAICS sector to the “within-sector component”, i.e. the part of the overall labour productivity level differential caused by higher productivity levels of industries in Newfoundland and Labrador, independently of the specific sectoral composition of the province. In 2010, when using the same hour shares as Canada for each sector to measure labour productivity, the mining and oil and gas extraction sector accounted for 104.9 per cent of the difference between Newfoundland and Labrador's and Canada's labour productivity level.

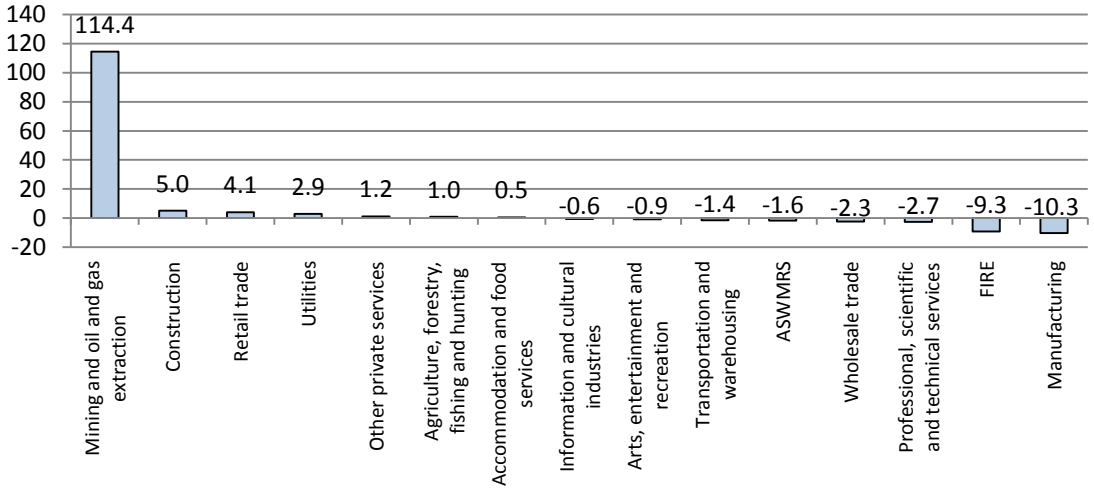
Chart 46: Contribution of Two-Digit NAICS Sectors to the Within-Sector Component of the Newfoundland and Labrador and Canada Labour Productivity Level Differential, 2010 (per cent)



Source: CSLS calculations based on CSLS Newfoundland and Labrador Productivity Database

In general, taking the within-sector effect and the sectoral composition effect together, the mining and oil and gas extraction sector was responsible for 114.4 per cent of the labour productivity level differential between Newfoundland and Labrador and Canada (Chart 47). The FIRE sector and the manufacturing sector have, on the contrary, prevented the Newfoundland and Labrador-Canada labour productivity differential from being even greater, as they were responsible for respectively -9.3 and -10.3 per cent of the labour productivity level differential.

Chart 47: Contribution of Two-Digit NAICS Sectors to the Overall Newfoundland and Labrador and Canada Labour Productivity Level Differential, 2010 (per cent)



Source: CSLS calculations based on CSLS Newfoundland and Labrador Productivity Database

The above decompositions raise several relevant questions, which are currently hard to answer appropriately due to lack of data. The main problem here is that differences in labour productivity levels can be caused by a variety of factors, including differences in the price *levels* of inputs and output. For a province such as Newfoundland and Labrador, where a large part of output comes from the oil production, a commodity that exhibits high variability in price, the year chosen for the calculation of real GDP and, indirectly, labour productivity, may influence considerably the comparisons between Canada's and Newfoundland and Labrador's respective levels of labour productivity. This issue was discussed in Box 4, at the end of the section on labour productivity.

G. Spill-over Effects from the Mining and Oil and Gas Extraction Industries

One of the most intriguing questions about the nature of aggregate labour productivity in Newfoundland and Labrador relates to the existence of productivity spillover from the oil industry to the rest of the economy. Has the productivity performance of the non-oil producing industries in Newfoundland and Labrador picked up since 1997, particularly relative to the national trends, and can such a development be related to the oil sector? In order to answer such a question, we need to examine a longer period to see if labour productivity growth accelerated in the province after the beginning of oil extraction in 1997. The following section analyses the labour productivity of Newfoundland and Labrador and Canada for the 1987-2010 period, with a focus on the 1987-1997 and 1997-2010 sub-periods.

Table 24: Labour Productivity Growth in Newfoundland and Labrador and Canada, Special Aggregation, 1987-2010 (compound annual growth rates)

		Newfoundland and Labrador			Canada		
		Total Economy	Mining and oil and gas	Total Economy, mining and oil and gas extraction excluded	Total Economy	Mining and oil and gas	Total Economy, mining and oil and gas extraction excluded
(1)	1987-1997	0.98	-1.41	0.96	1.04	1.80	1.02
(2)	1997-2010	3.01	11.37	1.61	1.25	-1.32	1.38
(3)	1997-2007	4.20	16.25	1.00	1.47	-1.70	1.58
(4)	2007-2010	-0.86	-3.47	3.66	0.52	-0.07	0.71
(5)	(2)-(1)	2.03	12.78	0.65	0.20	-3.12	0.36
(6)	(3)-(1)	3.22	17.66	0.04	0.42	-3.49	0.56
(7)	(4)-(1)	-1.84	-2.06	2.70	-0.52	-1.87	-0.31

Sources:
1. For real GDP CANSIM Table 379-0025 in which chained 2002 Fisher dollar series are available 1997-2010. These series were extended back (starting in 1996) using the growth rates of the corresponding constant-dollar series from the same CANSIM table.
2. For hours worked CANSIM Table 383-0011 for 1997-2010. Series were extended back using the growth rate of the corresponding series from the Labour Force Survey.
3. Real GDP without mining and oil and gas was calculated using a Törnqvist index. Nominal shares for 1984-2008 are from CANSIM Table 379-0025 for Newfoundland and Labrador and CANSIM Table 379-0022 for Canada. Series were extended to 2009 and 2010 using CANSIM Table 379-0028.

Table 24 breaks down between the growth of total economy labour productivity into the growth of the mining and oil and gas sector labour productivity and the growth of the total economy labour productivity excluding the mining and oil and gas sector. For the 1987-1997 period in Newfoundland and Labrador, there was virtually no difference in labour productivity growth when the mining and oil and gas extraction sector is excluded from the total economy (0.96 per cent annually for total economy and 0.98 per cent annually for total economy excluding mining and oil and gas). This is explained by the two following factors: mining and oil and gas accounted for only a small fraction of the province's output during this period and the growth rate of labour productivity in mining and oil and gas was fairly similar to that of the rest of the economy (0.98 per cent versus -1.41 per cent per year), as least compared to the post-1997 period.

This situation changed dramatically in the 1997-2010 period. Total economy labour productivity grew at an annual compound rate of 3.01 per cent.[21] But when the mining and oil and gas sector, which enjoyed an extremely robust labour productivity growth rate of 11.47 per cent per year, is removed from the total economy, labour productivity growth fell to 1.61 per cent per year.

An acceleration in labour productivity growth in Newfoundland and Labrador for the total economy excluding the mining and oil and gas sector after 1997, relative to the national trend, may represent prima facie evidence of productivity spillover effects from the oil sector developments. Such an acceleration did in fact take place. The 1.61 per cent average annual rate of labour productivity growth in the 1997-2010 period was 0.65 percentage points higher than the 0.96 per cent rate of increase in the 1987-1997 period. For Canada, the pick-up was only 0.36 points (1.02 per cent to 1.38 per cent). This suggests that the rise of the oil sector in Newfoundland and Labrador has been advantageous to the non-oil sectors of the economy in terms of labour productivity.

Table 25 also shows that the productivity spillover effect seems to have started only in recent years. Between 1997 and 2007, labour productivity growth in the total economy excluding mining and oil and gas in Newfoundland and Labrador was only 1.00 per cent a year, not much faster than in 1987-1997, at 0.96 per cent. But between 2007 and 2010, labour productivity grew 3.66 per cent per year, an impressive rate in comparison to its counterpart at the national level (0.52 per cent per year). Between the 1987-97 and 2007-2010 periods labour productivity growth in Newfoundland and Labrador accelerated 2.70 percentage points in the total economy excluding the mining and oil and gas sector, compared to a deceleration of 0.31 points in

[21] It is important to note that this productivity growth rate differs from the one given in the previous section since it refers to the total economy whereas the previous section refers to the business sector. Unfortunately, due to a lack of availability of data, we were unable to calculate business sector labour productivity growth before 1997.

Canada. This acceleration may constitute evidence of productivity spillovers from the oil sector to other sectors, although the spillover effect appears to have taken place with a considerable lag.

It is useful to identify which industries have experienced the largest acceleration of labour productivity growth in Newfoundland and Labrador since 1997 (Table 25). Of the 14 industries for which data are available, eight experienced an acceleration in labour productivity growth between the 1987-1997 and 1997-2010 periods in Newfoundland and Labrador. The very rapid growth of output from off-shore oil platforms meant that mining and oil and gas had by far the greatest labour productivity growth pick-up (12.78 percentage points). This was followed by retail trade (4.47 points), agriculture, forestry, fishing and hunting (3.66 points), construction (3.60 points), finance, insurance and real estate (2.48 points), manufacturing (1.52 points), professional, scientific and technical services (0.95 points), and transportation and warehousing (0.85 points). The other six industries experienced slower labour productivity growth after 1997. The overall acceleration in labour productivity growth of 0.65 percentage points after 1997 for the total economy excluding the mining and oil and gas sector, despite the fall-off in labour productivity growth in six of the 13 non-mining and oil and gas sectors, is explained by the greater size, in terms of nominal GDP, of the sectors that enjoyed faster productivity growth.

National trends may potentially explain faster labour productivity growth after 1997 at the industry level. Consequently, the change in labour productivity growth at the industry level in Newfoundland and Labrador between 1987-1997 and 1997-2010 must be compared with the change at the national level. Industries that enjoyed productivity spillovers are likely to be those that exhibited an improvement in labour productivity growth after 1997, relative to that which occurred at the national level. Table 2 identifies the eight of the 14 industries that fall into this category, and they are the same eight industries that experienced higher absolute labour productivity growth after 1997. This suggests that it is province-specific factors that account for the labour productivity accelerations in these sectors.

Table 25: Labour Productivity Newfoundland and Labrador and Canada, Business Sector Industries, 1987-2010 (compound annual growth rate)

	Newfoundland and Labrador			Canada			
	1987-1997	1997-2010	Difference	1987-1997	1997-2010	Difference	Comparison
	(1)	(2)	(3)= (2)-(1)	(4)	(5)	(6)=(5)-(4)	(7)= (6)-(3)
Agriculture, forestry, fishing and hunting	2.36	6.02	3.66	1.51	4.94	3.43	0.23
Mining and oil and gas extraction	-1.41	11.37	12.78	1.80	-1.32	-3.12	15.90
Utilities	1.98	0.43	-1.55	1.05	-0.41	-1.45	-0.09
Construction	-0.94	2.66	3.60	-0.32	0.82	1.14	2.46
Manufacturing	-0.11	1.41	1.52	2.13	1.79	-0.33	1.85
Wholesale trade	5.17	4.73	-0.44	3.40	3.29	-0.11	-0.33
Retail trade	-0.93	3.54	4.47	-0.29	2.75	3.03	1.44
Transportation and warehousing	-0.37	0.48	0.85	1.50	1.17	-0.33	1.18
Information and cultural industries	7.57	3.72	-3.85	3.19	1.49	-1.71	-2.14
FIRE	0.25	2.73	2.48	2.09	1.38	-0.71	3.19
Professional, scientific and technical services	-0.93	0.03	0.95	0.49	1.11	0.62	0.33
ASWMRS	4.21	0.40	-3.82	-3.02	-0.02	3.00	-6.82
Arts, entertainment and recreation	2.34	-2.48	-4.81	-1.13	-0.78	0.35	-5.16
Accommodation and food services	2.05	1.90	-0.15	-0.57	0.62	1.19	-1.34
Other Private Services	x	X	X	x	x	x	X

Sources:
1. For real GDP CANSIM Table 379-0025 in which chained 2002 Fisher dollar series are available 1997-2010. These series were extended back (starting in 1996) using the growth rates of the corresponding constant-dollar series from the same CANSIM table.
2. For hours worked CANSIM Table 383-0011 for 1997-2010. Series were extended back using the growth rate of the corresponding series from the Labour Force Survey.
3. Real GDP without mining and oil and gas was calculated using a Törnqvist index. Nominal shares for 1984-2008 are from CANSIM Table 379-0025 for Newfoundland and Labrador and CANSIM Table 379-0022 for Canada. Series were extended to 2009 and 2010 using CANSIM Table 379-0028.

The same exercise can be done in regards to multifactor productivity growth. Once again, we can see an acceleration of multifactor productivity after 1997 in Newfoundland and Labrador's total economy excluding the mining and oil and gas sector relative to the national trend. [22] In the province, the 1.68 per cent average annual rate of multifactor productivity growth in the 1997-2010 period was 0.59 percentage points higher than the 1.09 per cent rate of increase in the 1987-1997 period. For Canada, the pick-up was only 0.37 points (0.86 per cent to 1.24 per cent). This suggests that the rise of the oil sector in Newfoundland and Labrador has also been advantageous to the non-oil sectors of the economy in terms of multifactor productivity.

Once again, we can see that the productivity spillover effect has started only in the recent years. Multifactor productivity growth in the total economy, excluding mining and oil and gas in Newfoundland and Labrador, was of 1.36 per cent a year in the 1997-2007 period, a little bit faster than the 0.96 per cent annual growth between 1987 and 1997. However, between 2007 and 2010, multifactor productivity grew 2.74 per cent per year, an impressive rate in comparison to the rate the national level (-0.09 per cent per year).

[22] The multifactor productivity growth rates given in Table 26 are not comparable with official data on multifactor productivity measures. This is because the official data are based on capital services whereas the growth rates given here, due to the lack of data on capital services data at the provincial level before 1997, are calculated using capital stock. Since using capital stock as a capital input does not take into account changes in capital composition, Table 26 shows MFP growth rates that are considerably larger than MFP estimates where capital services is used as capital input. However, they can still be used to differentiate between the growth of MFP during the 1987-1997 period and the 1997-2010 period in both in Newfoundland and Labrador and Canada.

Table 26: Multifactor Productivity Growth in Newfoundland and Labrador and Canada, Special Aggregation, 1987-2010 (compound annual growth rates)

		Newfoundland and Labrador			Canada		
		Total Economy	Mining and oil and gas	Total Economy, mining and oil and gas extraction excluded	Total Economy	Mining and oil and gas	Total Economy, mining and oil and gas extraction excluded
(1)	1987-1997	0.63	-0.98	1.09	0.88	1.37	0.86
(2)	1997-2010	3.01	12.94	1.68	0.87	-3.64	1.24
(3)	1997-2007	4.46	19.21	1.36	1.26	-3.67	1.64
(4)	2007-2010	-1.68	-5.70	2.74	-0.41	-3.51	-0.09
(5)	(2)-(1)	2.39	13.92	0.59	-0.01	-5.01	0.37
(6)	(3)-(1)	3.84	20.19	0.27	0.38	-5.05	0.77
(7)	(4)-(1)	-2.31	-4.72	1.65	-1.29	-4.88	-0.95

Sources:
1. For real GDP CANSIM Table 379-0025 in which chained 2002 Fisher dollar series are available 1997-2010. These series were extended back (starting in 1996) using the growth rates of the corresponding constant-dollar series from the same CANSIM table.
2. For hours worked CANSIM Table 383-0011 for 1997-2010. Series were extended back using the growth rate of the corresponding series from the Labour Force Survey.
3. Real GDP without mining and oil and gas was calculated using a Törnqvist index. Nominal shares for 1984-2008 are from CANSIM Table 379-0025 for Newfoundland and Labrador and CANSIM Table 379-0022 for Canada. Series were extended to 2009 and 2010 using CANSIM Table 379-0028.
4. For Capital Stocks, CANSIM Table 031-0002 for Canada and CANSIM Table 031-0004 for Newfoundland and Labrador
5. For the labour compensation share, CANSIM Table 383-0011. Series were extended back using the growth rate of labour compensation share in the Provincial Economic accounts, CANSIM Table 384-0001.

We now turn to a brief discussion of possible channels by which the rise of the oil sector in Newfoundland and Labrador could have increased, either directly or indirectly, labour productivity growth in the other sectors of the economy. Possible mechanisms include: the productivity-augmenting effects of increased government spending financed by oil revenues; a tighter labour market; an increase in competition due to a more dynamic economy, leading to a reallocation of resources to more productive uses; and knowledge spillovers from the oil sector.

One of the most obvious ways by which the natural resources sector may affect productivity of the other sectors of the economy is through greater natural resources royalties and consequently government revenues, which can be spent in productivity-enhancing areas such as education, research, infrastructure, and programs to support business. This explanation appears consistent with the fact that the productivity growth acceleration only took place in the late 2000s, as the province only began to receive significant revenues from offshore royalties in 2006. While nominal government expenditures grew 2.43 per cent per year between 1997 and 2005, between 2005 and 2010, they grew 9.21 per cent per year.

Another plausible channel by which the oil sector may have fostered labour productivity growth was the sector's positive impact on the overall economic climate and in particular on unemployment. The unemployment rate decreased in the province from 18.1 per cent in 1997 to 14.4 per cent in 2010. This phenomenon was even more pronounced in St. John's, where the unemployment rate fell from 13.5 per cent in 1997 to 7.7 per cent in 2010. As a consequence of

this tighter labour market, which leads to higher wages and skill shortages, producers have greater incentive to substitute capital for labour, boosting labour productivity.

It is well known that the level of competitive intensity in an industry or economy is positively related to productivity growth (Sharpe and Currie, 2008). The rapid growth of the economy of Newfoundland and Labrador, fuelled by the oil boom, may have increased this competitive intensity in a number of sectors. With greater economic opportunities, more firms enter the market, compelling existing firms to be more productive to survive. Increased competition also encourages the reallocation of resources from less productive to more productive uses, a key driver of productivity growth. Greater competition can also provide an incentive for firms to develop new products and processes through R&D. In 2010, business R&D in Newfoundland and Labrador was $72 million, up from $14 million in 1997 and $7 million in 1987. During the 1997-2010 period, business sector R&D expenditures grew 13.42 per cent per year, considerably higher than the 1987-1997 period, when it grew 7.12 per cent per year.

Knowledge spillovers from the sophisticated oil and gas sector to others sectors may be an additional means by which the oil boom boosted productivity growth in the province. These spillover effects may result from workers moving from the oil and gas extraction sector to other sectors, such as the construction sector, and applying the skills they acquired in the oil and gas sector to their new sector of employment.[23] Equally, firms outside the oil sector can observe the technologies, techniques and organizational practices used in the oil sector and then adopt these technologies to their own sectors.

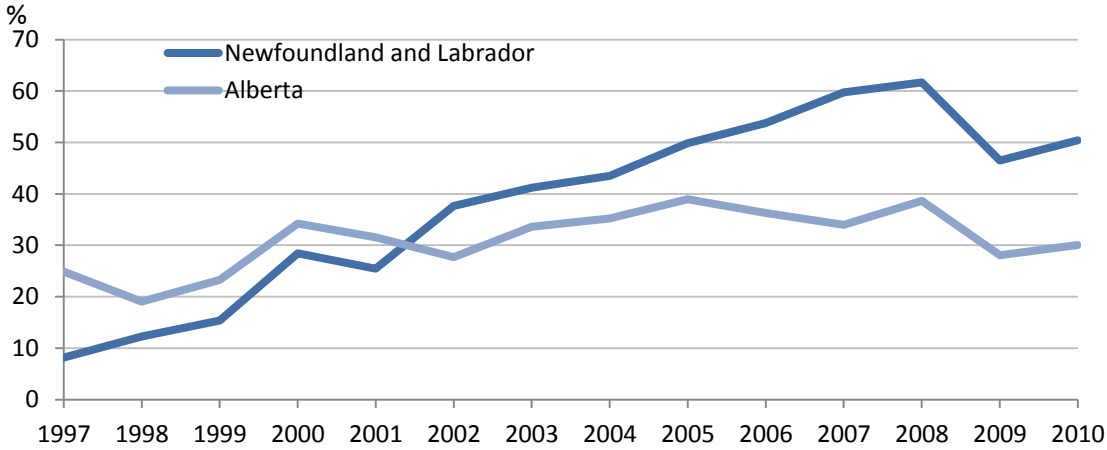
There is indeed empirical evidence, namely the acceleration of labour productivity growth outside the oil sector in Newfoundland and Labrador after 1997, and theoretical justification for a positive impact of the oil sector of the productivity performance of other sectors. However, the analysis of this phenomenon in this report is very preliminary and largely speculative in nature. More research is needed on this important topic.

[23] The construction sector was one of the sectors that experienced the largest productivity growth pick-up effect after the beginning of oil production in the province.

H. Comparison of Productivity Trends between Newfoundland and Labrador and Alberta

Newfoundland and Labrador and Alberta are both known for their substantial production of oil. In 2010, the mining and oil and gas extraction sector accounted for 50.6 per cent and 30.1 per cent of their respective provincial business sector value added[24] (Chart 48). The production of oil is characterized by a high value of output per worker and, because of that, Newfoundland and Labrador and Alberta are the two Canadian provinces with the highest level of labour productivity. Yet, during the 1997-2010 period, business sector labour productivity growth in Alberta was the slowest of all provinces at 0.57 per cent per year, while in Newfoundland and Labrador, the growth in labour productivity was the best in the country, at 3.86 per cent per year (Chart 49). The difference is even greater in terms of business sector multifactor productivity (MFP) as Alberta MFP decreased 2.22 per cent per year while Newfoundland and Labrador MFP was growing 2.95 per cent per year. What explains this important difference?

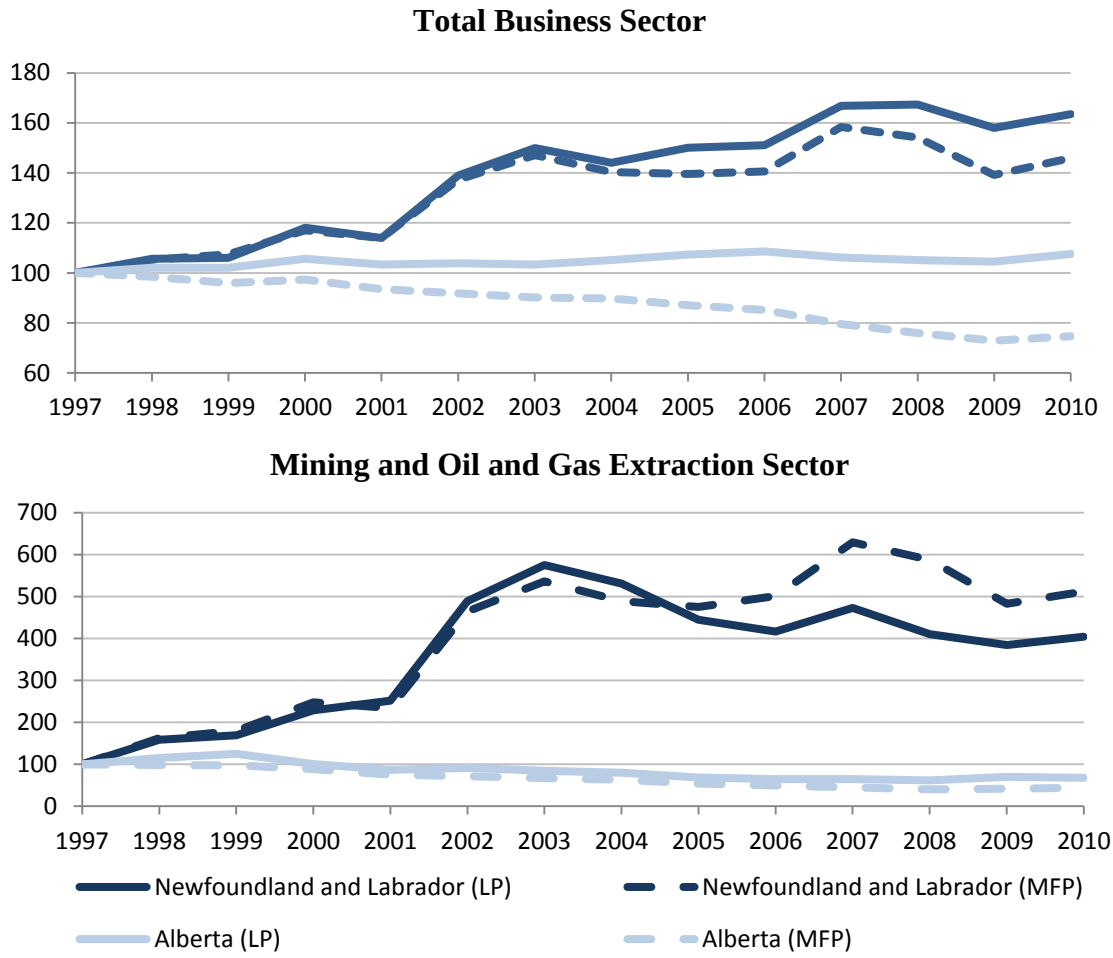
Chart 48: Mining and Oil and Gas Sector as a Share of Nominal Business Sector GDP, Newfoundland and Labrador and Alberta, 1997-2010



Source: CSLS Provincial Productivity Database

[24]According to Statistics Canada's data on provincial GDP, we can estimate, by taking the differential between total mining and oil and gas extraction output and mining output, that oil and gas extraction accounted for around 80 per cent of total mining and oil and gas extraction output in Newfoundland and Labrador in the last few years (80.4 per cent is the average share of oil and gas extraction activities between 2007 and 2009). This means that the oil and gas extraction activities in Newfoundland and Labrador accounted for around 44 per cent of nominal business sector GDP between 2007 and 2009.
For Alberta, separate GDP estimate for oil and gas only are available, but do not differ greatly from the output of mining and oil and gas since mining represents less than 3 per cent of the mining and oil and gas extraction sector in the province. Overall, oil and gas extraction activities accounted for around 30 per cent of nominal business sector GDP in Alberta in the last few years.

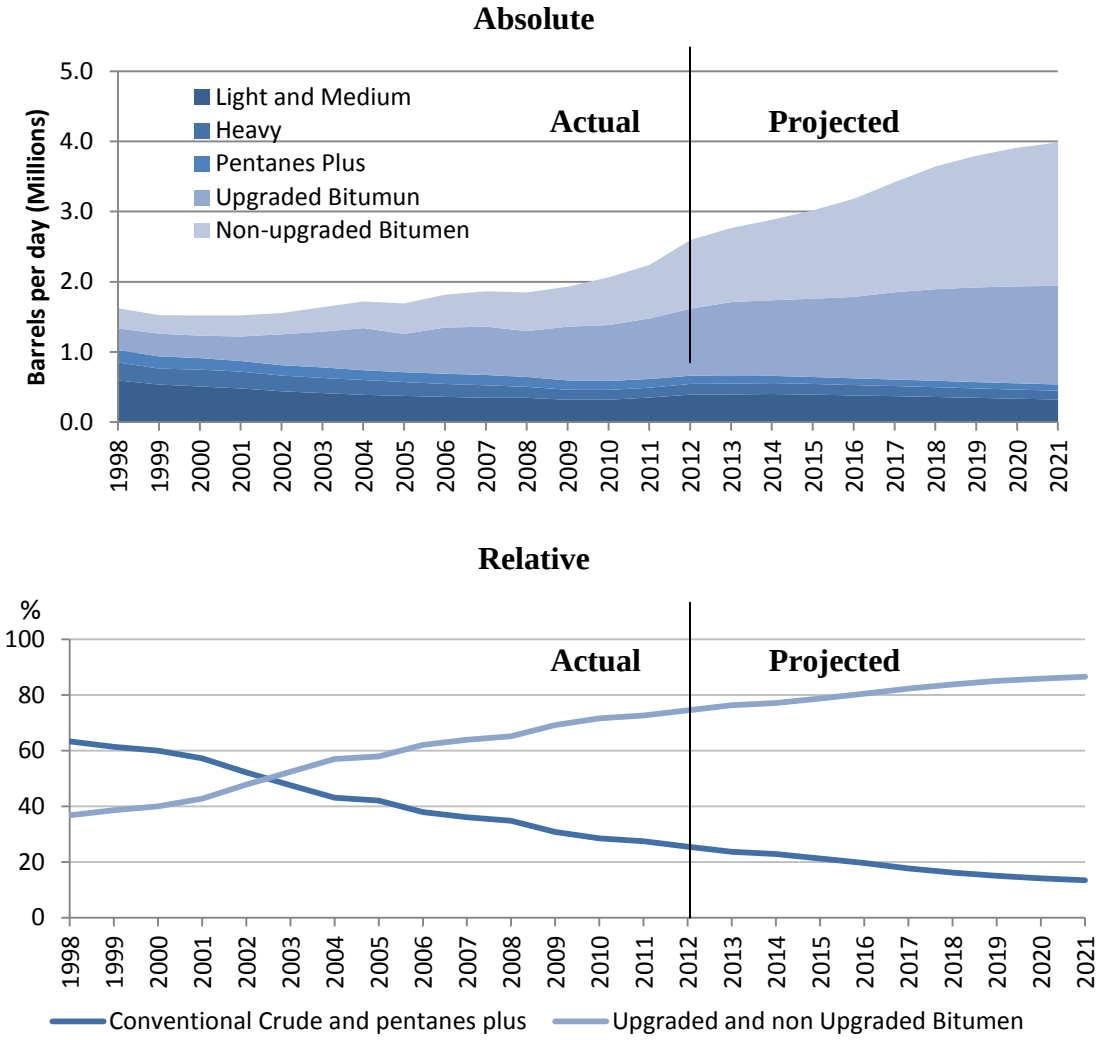
Chart 49: Labour and Multifactor Productivity Growth in Newfoundland and Labrador and Alberta, 1997-2010 (1997=100)



We already established earlier in the report that the increase in Newfoundland and Labrador labour productivity was mainly due to a shift from low-productivity non-oil extraction activities to the highly productive oil extraction in offshore platforms. The story is quite different for Alberta. In 1997, Alberta was already an important oil producer. Its mining and oil and gas extraction industries accounted for 24.9 per cent of nominal business sector GDP. Productivity growth did not slow because of a drop in oil production. On the contrary, the nominal share of mining and oil and gas in the business sector output increased to 30.1 per cent in 2010, with a peak at 38.6 per cent in 2008. It is the changes that happened within the mining and oil and gas industries that explain almost entirely the slow growth of labour productivity in the province (CSLS, 2012). The main reason for the decline in labour productivity is the decline of the production of the conventional oil fields. Chart 50 shows that between 1997 and 2010, the province's oil sector shifted to the less productive oil sands, in order to maintain, and even increase production. The production of oil from bitumen sands is considered as less productive

since it necessitates more capital and labour to extract and process a given amount of oil. From 36.7 per cent in 1998, the production of bitumen accounted for 74.5 per cent of the total oil production in 2012. The results of this is that the mining and oil and gas sector in Alberta experienced a massive decrease in multifactor productivity (-6.1 per cent per year), leading to an overall decline in aggregate labour productivity in the province.

Chart 50: Actual and Projected Oil Production in Alberta, 1998-2021[25]



Energy Resource Conservation Board, *Alberta's Energy Reserves & Supply/Demand Outlook*

To summarize, while Newfoundland and Labrador experienced a large increase in labour productivity because of a shift from low-productivity activities to the highly-productive extraction of crude oil, Alberta's slow labour productivity growth is due to a move in the opposite direction, as they shifted from the highly-productive extraction of conventional crude

[25] "Pentanes Plus" means a mixture mainly of pentanes and heavier hydrocarbons that ordinarily may contain some butanes and which is obtained from processing of raw gas, condensate or crude oil. (source: ECRB)

oil to the less-productive exploitation of oil sands. Yet, during that period, Alberta experienced robust productivity growth in all other sectors. When industries are equally weighted, Alberta ranked fourth in terms of labour productivity growth, not last. Newfoundland and Labrador also did very well when industries are equally weighted, ranking second in terms of labour productivity growth.

IV. Productivity Drivers

Part IV described in detail the productivity performance of Newfoundland and Labrador's business sector over the 1997-2010 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 improvements in the province.

In order to develop policies to improve productivity performance, it is important to first 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 total factor 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 which do not overlap between drivers, or driver-specific issues, and each are important to any explanation of productivity growth.

This leaves us with the cross-cutting issues, those which affect more than one of the productivity drivers through the general lens of 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 and conveniently, between microeconomic and macroeconomic issues, as well as taxation issues, which can have a large influence on

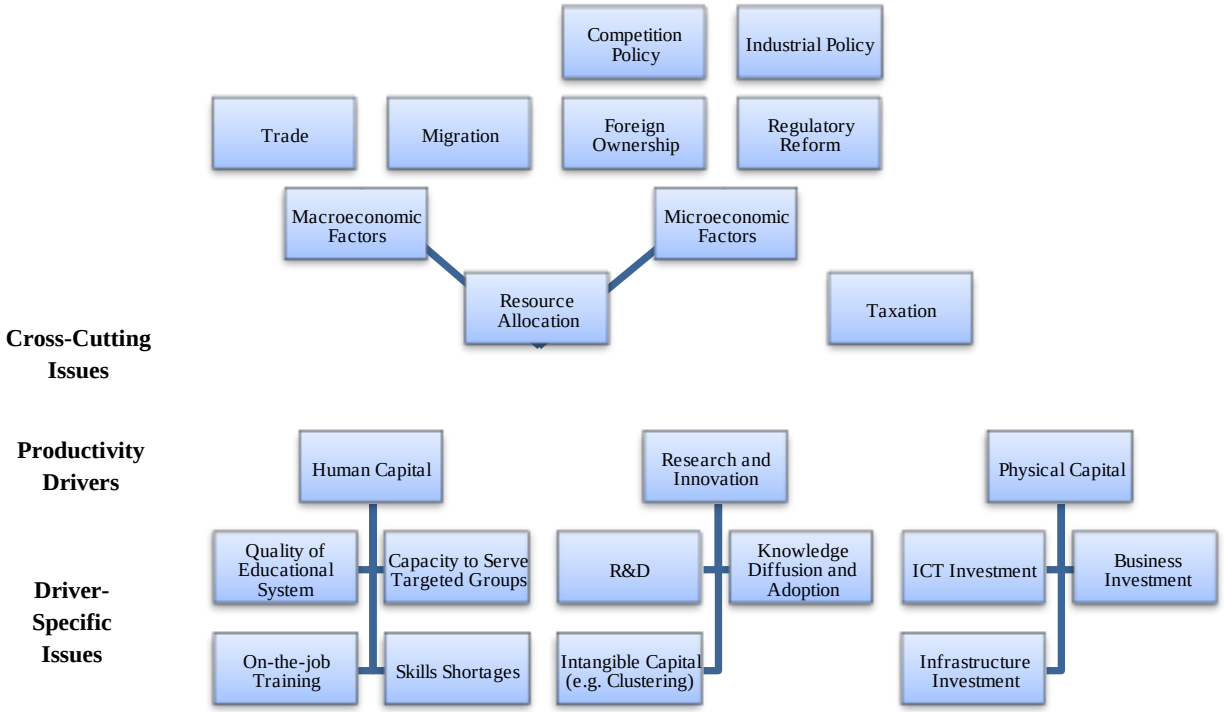
investment, the amount of R&D undertaken and educational decisions. We recognize that the differentiation between micro and macro factors in this fashion is somewhat artificial, but we believe that to deal with such an extensive issue as resource allocation, it is necessary to organize the issues in two distinct parts.

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, mostly trade and migration, are rich territory in the context of productivity. They benefit from some commonality as trade relates to the movement of goods and services while migration relates to the movement of individuals.

The section focuses mostly on the state of the three productivity drivers. As for the multiple cross-cutting issues, those will be mostly discussed in section IV on public policy.

Exhibit 3: CSLS Framework for Analyzing Productivity[26]



[26] 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. 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 mean by which technical changes 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 gain introduced by R&D will only affect productivity when these innovations will be embodied in the capital stock through investment.

i. Investment Intensity

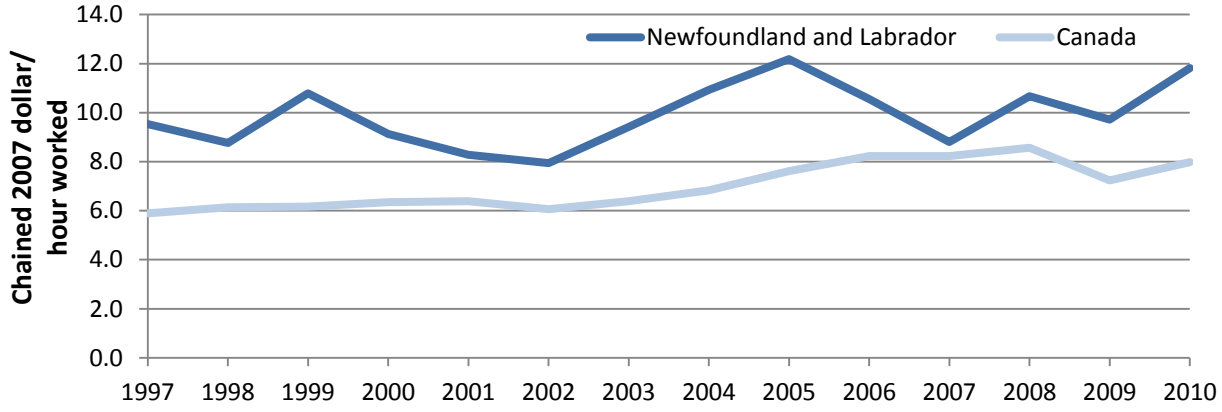
Fixed non-residential investment intensity (defined here as real gross investment per hour worked) in Newfoundland and Labrador's business sector grew at a compound annual rate of 1.66 per cent, below the national average of 2.36 per cent (Table 27). However, we can note that the absolute level of investment intensity in Newfoundland and Labrador was higher than Canada for the whole 1997-2010 period (Chart 51). Measured in chained 2007 dollars, from an initial investment of $9.54 per hour worked in 1997 (vs. $5.90 in Canada), the level of investment intensity reached $11.82 per hour in 2010 in the province (vs. $7.98 in Canada).

Table 27: Investment Intensity in Newfoundland and Labrador and Canada, Business Sector, 1997-2010

	Newfoundland and Labrador			Canada		
	1997	2000	2010	1997	2000	2010
	(chained 2007 dollars of gross investment per hour worked)					
Total Investment	**9.54**	**9.12**	**11.82**	**5.90**	**6.35**	**7.98**
Building	0.86	0.71	1.53	1.25	1.03	0.92
Engineering	6.28	3.80	3.91	1.67	1.71	2.64
Machinery and Equipment	2.23	3.55	4.30	2.26	2.52	3.12
IPP	0.58	0.77	2.12	0.86	1.11	1.29
ICT	0.46	0.50	1.23	0.58	0.81	1.44
Computers	0.06	0.07	0.49	0.07	0.17	0.50
Telecommunication Equipment	0.18	0.27	0.41	0.19	0.25	0.28
Software	0.22	0.16	0.33	0.32	0.39	0.66
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
	(compound annual growth rate, per cent)					
Total Investment	**1.66**	**-1.46**	**2.62**	**2.36**	**2.52**	**2.31**
Building	4.53	-6.01	7.91	-2.34	-6.25	-1.14
Engineering	-3.59	-15.40	0.27	3.59	0.80	4.45
Machinery and Equipment	5.18	16.83	1.92	2.51	3.69	2.16
IPP	10.47	9.61	10.73	3.14	8.77	1.51
ICT	7.82	2.78	9.38	7.28	11.87	5.94
Computers	17.91	8.15	21.01	16.42	35.71	11.18
Telecommunication Equipment	6.51	14.08	4.34	3.08	10.09	1.07
Software	2.94	-10.46	7.34	5.72	6.27	5.55

Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002

Chart 51: Fixed Non-Residential Investment Intensity in Newfoundland and Labrador and Canada, Business Sector, 1997-2010



Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002

Since the national investment intensity level grew at a higher rate than in Newfoundland and Labrador during the period, the disparity between Newfoundland and Labrador and Canada as a whole in terms of investment intensity decreased, from 61.7 to 48.1 percentage points (Table 28). It is interesting to note that investment intensity in engineering assets, in 1997, was 3.8 times higher in Newfoundland and Labrador than in Canada as a whole ($6.3 per hour vs. $1.7 per

hour). This is not as a surprise when we know that engineering assets are the principal type of asset used in the mining and oil and gas extraction sector. Still, as of 2010, Newfoundland and Labrador's investment intensity was higher than Canada's in all four types of assets defined in Statistics Canada's Fixed Capital Flows and Stocks Survey.

Table 28: Newfoundland and Labrador's Real Investment Intensity as a Percent of Canada's, Business Sector, 1997, 2000 and 2010

	1997	2000	2010
Total Investment	**161.7**	**143.6**	**148.1**
Building	68.8	69.4	166.7
Engineering	376.9	222.8	148.2
Machinery and Equipment	98.7	141.2	137.9
IPP	67.5	69.1	164.7
ICT	79.9	61.9	85.2
Computers	83.2	42.1	98.2
Telecommunication Equipment	96.1	106.9	147.0
Software	69.7	41.7	49.3

Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002

Yet, it is important to focus on specific capital assets that have a greater impact on productivity. At first, we can observe that Newfoundland and Labrador's investment intensity growth was much higher than Canada's in machinery and equipment assets (5.2 per cent vs. 2.5 per cent) as well as in intellectual property products assets (10.5 per cent vs. 3.1 per cent), two types of assets that economists believe to be strongly correlated with productivity growth. However, the investment intensity in information and communication technologies (ICTs) assets, even though it experienced a high rate of growth in Newfoundland and Labrador, at 7.4 per cent per year, grew at a slower pace than Canada's, where investment intensity in this type of asset grew at 8.4 per cent per year.

ICT assets are composed of computers, telecommunication equipments and software assets. Although computers and telecommunication equipments are also part of the M&E component of investment, ICT assets have been identified by the economic literature as an important driver of productivity growth that deserve additional attention.[27]

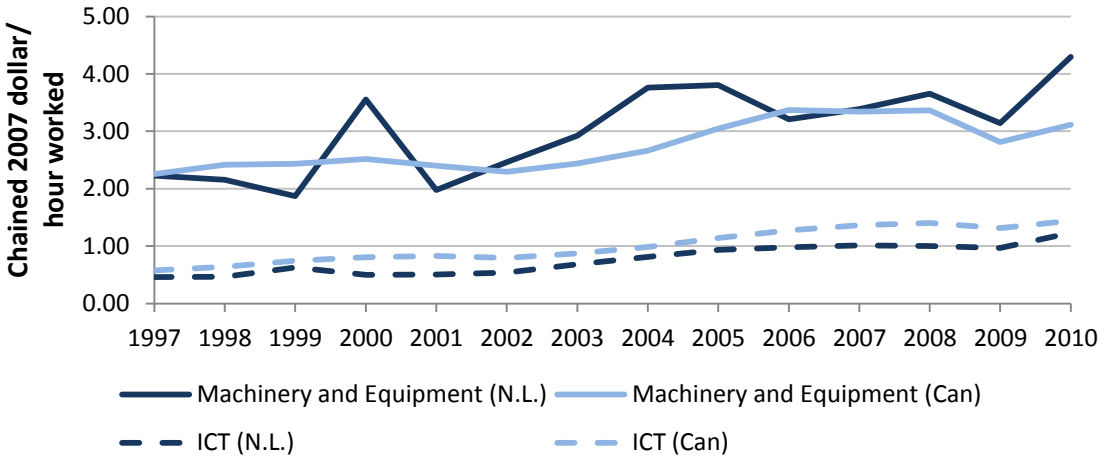
In recent years, the higher investment intensity in M&E assets in Newfoundland and Labrador has led to the creation of a gap between the province's level of investment intensity in M&E assets and the national level. In 1997, investment intensity in terms of M&E assets was similar in both regions. In 2010, investment intensity in Newfoundland and Labrador represented 137.9 per cent of Canada's (Chart 52). In terms of investment per hour, this represents an

[27] see Jorgenson (2001), Jorgenson et al. (2005), and Sharpe (2006) for detailed literature reviews

increase from $2.23 (2007 chained dollars) per hour in 1997 to $4.30 (2007 chained dollars) in 2010.

On the contrary, Newfoundland and Labrador's investment intensity in ICT assets as a share of Canada's experienced a slight decline during this period, from 79.6 per cent of Canada's in 1997 to 71.6 per cent in 2010. Yet, excluding any comparison to Canada, it is important to note that Newfoundland and Labrador's investment intensity in this type of assets enjoyed considerable growth during this period, going from $0.46 (2007 chained dollar) per hour in 1997 to $1.00 (2007 chained dollars) per hour in 2010.

Chart 52: M&E and ICT Investment Intensity Levels in Newfoundland and Labrador and Canada, Business Sector, 1997-2010



Source : CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0003 and CANSIM Table 031-0004

As mentioned previously, due to confidentiality issues, Statistics Canada releases investment data for only a few of all two-digit NAICS sectors in Newfoundland and Labrador, and for some sectors the data span only a very limited time period. Since the available data would provide only a very partial picture of investment intensity by sector in the province, we will not discuss these numbers in the report. We make them available, however, in the Appendix Table 7.

ii. Capital Intensity

Investment intensity growth is a good indicator of the pace at which technical change and innovation are introduced into the production process. But 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.

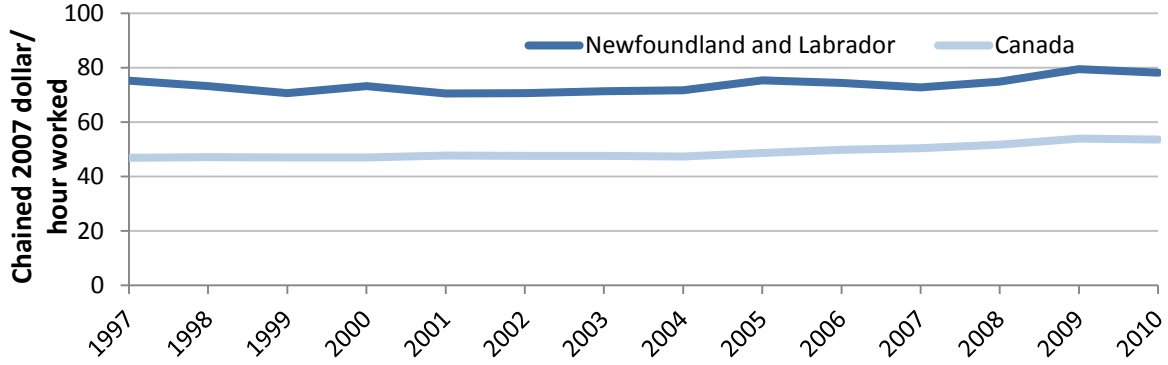
In regards to capital intensity, the performance of Newfoundland and Labrador is hard to compare vis-à-vis Canada as a whole. In terms of total net capital stock intensity growth, we can find similar trends to those seen in investment intensity. In terms of growth, during the 1997-2010 period, Newfoundland and Labrador's capital intensity increased by only 0.30 per cent per year and was outpaced by Canada, whose capital intensity grew at 1.04 per cent per year (Table 29). However, in terms of level, Newfoundland and Labrador's business sector capital intensity was noticeably higher than Canada's. In 1997, there was $75.20 (chained 2007 dollars) of capital for every hour worked in Newfoundland and Labrador's business sector. This number had increased to $78.15 (chained 2007 dollars) per hour worked in 2010 (Chart 53). In comparison, capital intensity in Canada went from $46.89 (chained 2007 dollars) in 1997 to $53.64 (chained 2007 dollars) in 2010.

Table 29: Capital Intensity in Newfoundland and Labrador and Canada, Business Sector, 1997-2010

	Newfoundland and Labrador			Canada		
	1997	2000	2010	1997	2000	2010
	(chained 2007 dollars of capital stock per hour worked, levels)					
Total Investment	**75.20**	**73.26**	**78.15**	**46.89**	**47.03**	**53.64**
Building	14.29	13.38	14.86	18.54	17.81	17.02
Engineering	47.36	44.00	39.99	16.56	15.93	19.54
Machinery and Equipment	10.75	11.60	15.39	9.44	9.97	11.76
IPP	3.73	4.73	7.91	3.03	3.59	5.31
ICT	1.37	1.50	2.38	1.54	1.91	3.28
Computers	0.08	0.12	0.76	0.10	0.25	0.87
Telecommunication Equipment	0.82	0.80	0.85	0.68	0.72	0.81
Software	0.47	0.57	0.77	0.75	0.94	1.61
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
	(compound annual growth rates, per cent)					
Total Investment	**0.30**	**-0.87**	**0.65**	**1.04**	**0.10**	**1.33**
Building	0.31	-2.15	1.05	-0.66	-1.32	-0.45
Engineering	-1.29	-2.43	-0.95	1.28	-1.30	2.07
Machinery and Equipment	2.80	2.59	2.87	1.70	1.82	1.67
IPP	5.96	8.31	5.26	4.39	5.74	3.99
ICT	4.34	2.98	4.75	6.02	7.51	5.58
Computers	18.80	15.37	19.85	17.90	35.15	13.17
Telecommunication Equipment	0.34	-0.54	0.60	1.30	1.88	1.13
Software	3.83	6.37	3.08	6.01	7.53	5.56

Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0003 and CANSIM Table 031-0004

Chart 53: Capital Intensity in Newfoundland and Labrador and Canada, Business Sector, 1997-2010

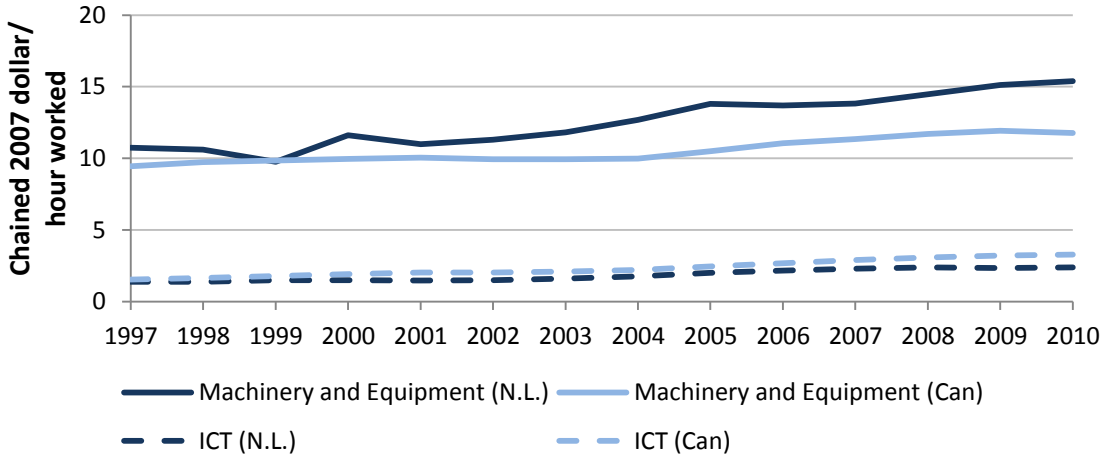


Source: CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0002

In the two components of capital stock most likely to improve productivity, Newfoundland and Labrador's performance was on par with Canada's in terms of levels and growth rates. In the M&E sector, the capital stock intensity grew at over one percentage point higher than Canada as a whole (2.80 per cent vs. 1.70 per cent). Therefore, whereas the difference between M&E capital stock intensity of Newfoundland and Labrador and Canada was only of $1.30 of output per $1,000 in 1997, it reached $3.63 of output per $1,000 in 2010 (Chart 54). In other words, as a share of Canada's, Newfoundland and Labrador's capital stock intensity increased from 113.8 per cent in 1997 to 130.9 per cent in 2010 (Table 30).

However, in the case of ICT capital stock intensity, Newfoundland and Labrador performed less well in comparison to Canada as a whole. During the 1997-2010 period, ICT capital stock intensity grew at 4.54 per cent versus 6.02 per cent for Canada as a whole, and Newfoundland and Labrador's level of ICT capital intensity declined from 89.3 per cent of Canada's in 1997 to 72.6 per cent in 2010.

Chart 54: M&E and ICT Capital Intensity Levels in Newfoundland and Labrador and Canada by types of Assets, Business Sector, 1997-2010



Source : CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0003 and CANSIM Table 031-0004

Table 30: Newfoundland and Labrador's Capital Intensity Levels as a Percent of Canada's, Business Sector, 1997, 2000 and 2010

	1997	2000	2010
Total Investment	**160.4**	**155.8**	**145.7**
Building	77.1	75.1	87.3
Engineering	285.9	276.2	204.6
Machinery and Equipment	113.8	116.4	130.9
IPP	122.8	132.0	149.0
ICT	89.3	78.5	72.6
Computers	78.7	49.0	86.9
Telecommunication Equipment	120.2	111.8	106.2
Software	62.9	60.9	48.0

Source : CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0003 and CANSIM Table 031-0004

Table 31 provides capital stock intensity levels and growth rates at the two-digit NAICS level for both Newfoundland and Labrador's and Canada's business sectors for the 1997-2010 period. Although the capital stock intensity growth of the total business sector was smaller in Newfoundland and Labrador than in Canada, Newfoundland and Labrador's business sector experienced a higher growth than Canada as a whole in 8 out of 13 sectors for which capital stock data were available. In fact, it is surprising to see that Newfoundland and Labrador's mining and oil and gas sector is the only sector, with arts, entertainment and recreation, that experienced a decline in capital stock intensity during the period. Yet, capital intensity in the mining and oil and gas extraction sector still increased to $1,171 chained 2007 dollars of capital stock per hour worked in 2004, before declining to its current level. The data show that the fall in capital intensity in this sector is therefore due to a significant increase in hours worked, as capital stock actually grew at a rate higher than the business sector average in the mining and oil and gas extraction sector. Given the important size of this sector in Newfoundland and Labrador's

economy, we can easily see that the decline in capital intensity in this sector is responsible for the slow growth of total business sector capital intensity in the province, as most of Newfoundland and Labrador's sectors performed relatively well.

Table 31: Capital Intensity in Newfoundland and Labrador and Canada, Business Sector, Sectoral Breakdown, 1997-2010

	Newfoundland and Labrador			Canada		
	1997	2000	2010	1997	2000	2010
	(chained 2007 dollars of capital stock per hour worked)					
Business sector industries	**75.2**	**73.3**	**78.1**	**46.9**	**47.0**	**53.6**
Agriculture, forestry, fishing and hunting	41.4	41.6	75.0	43.2	48.8	64.1
Mining and oil and gas extraction	993.0	914.9	817.7	428.2	518.7	656.2
Utilities	..	..	..	1073.5	1045.0	1012.1
Construction	7.1	8.3	11.2	7.3	8.2	9.0
Manufacturing	43.6	36.3	76.3	42.0	40.7	45.9
Wholesale trade	11.9	14.4	16.0	12.9	14.0	20.4
Retail trade	11.2	10.0	14.9	13.8	14.6	19.5
Transportation and warehousing	52.3	56.2	70.6	69.1	74.6	83.6
Information and cultural industries	100.1	109.2	105.2	97.0	84.3	85.7
FIRE	83.0	93.7	97.8	109.4	113.0	101.3
Professional, scientific and technical services	3.6	4.2	9.7	5.3	8.0	11.8
ASWMRS	..	..	..	3.5	3.0	5.4
Arts, entertainment and recreation	29.5	19.5	28.3	29.3	28.3	33.7
Accommodation and food services	6.6	6.6	10.0	14.1	12.9	16.1
Other private services	8.6	8.0	8.2	5.3	5.4	6.2
	1997-2010	1997-2000	2000-2010	1997-2010	1997-2000	2000-2010
	(compound annual growth rates, per cent)					
Business sector industries	**0.30**	**-0.87**	**0.65**	**1.04**	**0.10**	**1.33**
Agriculture, forestry, fishing and hunting	4.68	0.15	6.08	3.09	4.17	2.77
Mining and oil and gas extraction	-1.48	-2.69	-1.12	3.34	6.60	2.38
Utilities	n.a.	n.a.	n.a.	-0.45	-0.89	-0.32
Construction	3.59	5.26	3.09	1.57	3.97	0.86
Manufacturing	4.40	-5.96	7.72	0.68	-1.05	1.21
Wholesale trade	2.29	6.49	1.06	3.59	2.90	3.80
Retail trade	2.21	-3.61	4.03	2.70	1.89	2.95
Transportation and warehousing	2.34	2.43	2.31	1.47	2.55	1.15
Information and cultural industries	0.38	2.94	-0.38	-0.95	-4.59	0.16
FIRE	1.27	4.14	0.43	-0.59	1.08	-1.09
Professional, scientific and technical services	7.92	5.26	8.73	6.31	14.49	3.98
ASWMRS	n.a.	n.a.	n.a.	3.25	-4.96	5.85
Arts, entertainment and recreation	-0.31	-12.90	3.81	1.08	-1.20	1.77
Accommodation and food services	3.25	-0.06	4.26	1.06	-2.78	2.24
Other private services	-0.36	-2.45	0.28	1.13	0.80	1.23

Source : CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0003 and CANSIM Table 031-0004

When we compare the level of capital intensity between Newfoundland and Labrador's and Canada's business sectors, we can identify an interesting pattern: capital intensity tends to be higher in Newfoundland and Labrador than Canada for the goods sector and it tends to be higher in Canada for the services sector. Since capital data are not available for utilities and ASWMRS, we do not have the capital intensity for the goods sector and services sector per se. However, in

2010, in Newfoundland and Labrador's goods sector, all sectors for which capital stock data were available had a higher capital stock intensity than their Canadian counterpart (Table 32). On the contrary, in the service sectors, seven out of the nine sectors for which capital stock data were available had a higher capital intensity in Canadian industries than in Newfoundland and Labrador's.

Table 32: Newfoundland and Labrador's Capital Intensity as a Percent of Canada's, Sectoral Breakdown, 1997, 2000 and 2010

	1997	2000	2010
	(province's capital intensity level as a percent of Canada's)		
Business sector industries	**160.4**	**155.8**	**145.7**
Agriculture, forestry, fishing and hunting	95.9	85.3	117.0
Mining and oil and gas extraction	231.9	176.4	124.6
Utilities	n.a.	n.a.	n.a.
Construction	96.7	100.4	125.0
Manufacturing	103.7	89.0	166.2
Wholesale trade	92.7	102.7	78.7
Retail trade	81.1	68.7	76.2
Transportation and warehousing	75.6	75.4	84.5
Information and cultural industries	103.2	129.6	122.8
FIRE	75.8	82.9	96.6
Professional, scientific and technical services	67.7	52.6	82.3
ASWMRS	n.a.	n.a.	n.a.
Arts, entertainment and recreation	100.5	68.8	83.9
Accommodation and food services	47.0	51.1	62.0
Other private services	161.8	146.6	133.3

Source : CSLS Newfoundland and Labrador Productivity Database, based on Statistics Canada, Fixed Capital Flows and Stocks, CANSIM Table 031-0003 and CANSIM Table 031-0004

B. Human Capital

We start this section with an overview of average years of schooling in Newfoundland and Labrador, comparing them to the trends observed at the national level. Next we discuss Statistics Canada's measure of labour composition and analyze the difference between Newfoundland and Labrador's and Canada's labour quality. This is followed by a general analysis of other measures of human capital, including managerial skills, apprenticeship training, employer-supported training, adult literacy, early childhood education, and PISA scores.

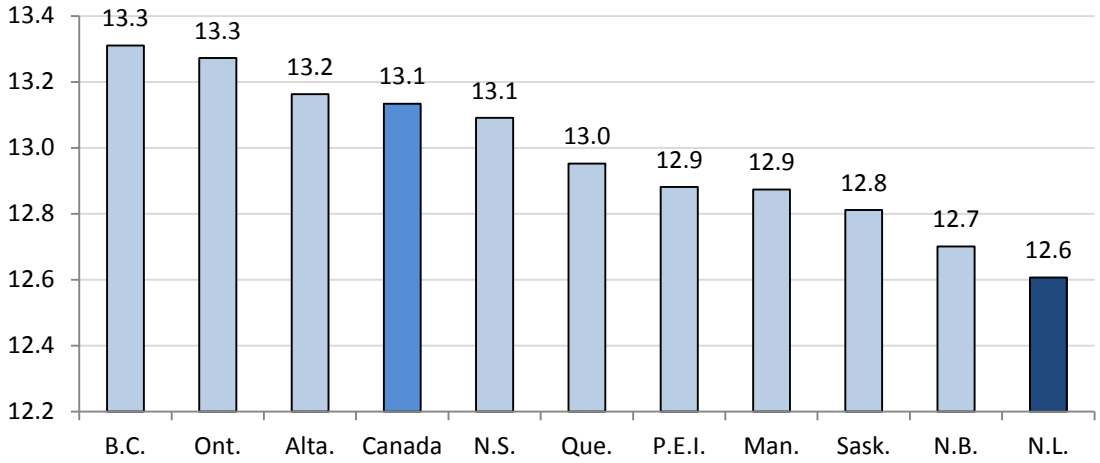
i. Average Years of Schooling[28]

During the 1990-2010 period, the average years of schooling among Newfoundland and Labrador's total population was consistently below the national average. In 2010, a working-age resident of Newfoundland and Labrador had, on average, 12.6 years of schooling while the

[28] Note: 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.

working-age Canadian had, on average, 13.1 years of schooling. This means that Newfoundland and Labrador had the least educated population in terms of average years of schooling of all Canadian provinces in 2010 (Chart 55). Yet, during the 1990-2010 period, the average years of schooling grew at a slightly faster rate in Newfoundland and Labrador than in Canada (0.50 per cent vs. 0.47 per cent respectively).

Chart 55: Average Years of Schooling in Canada and the Provinces, Total Population, 2010

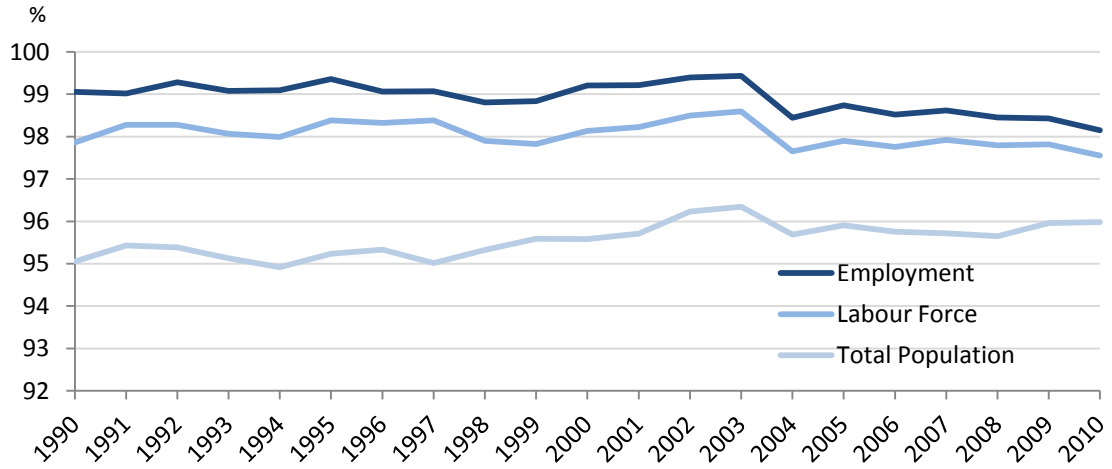


Source: CSLS calculations based on Statistics Canada data, Labour force survey estimates, by educational attainment, sex and age group, annually (CANSIM Table 282-0004).

However, looking only at the employed population, the gap between Newfoundland and Labrador's and Canada's average years of schooling was significantly smaller. In general, the employed population tends to be better educated than the total population. In the case of Newfoundland and Labrador, this difference is particularly stark. An employed individual had, on average, 13.7 years of schooling while the average resident of Newfoundland and Labrador had 13.5 years of schooling in 2010, a difference of only 0.2 years compared to 0.5 years for total population. As a consequence, when we compare Newfoundland and Labrador's performance to Canada's in terms of employed population (instead of total population), the province shows a smaller years-of-education gap, at 98.8 per cent of the national average in 2010 (vs. 96.7 per cent for the total population) (Chart 56). Instead of ranking last in terms of average year of schooling, Newfoundland and Labrador ranked sixth when we looked at the employed population instead of the total population (Chart 57).

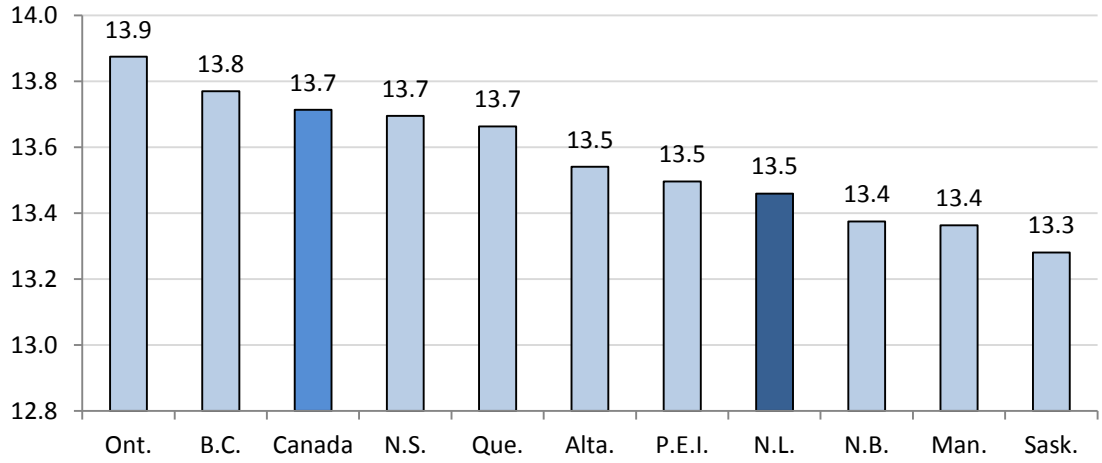
Therefore, it is important to keep in mind that the difference between the average years of schooling between the employed population and total population is much smaller at the national level, amounting to only half a year of studies (13.1 years for the total population vs. 13.7 for the employed population), than in Newfoundland and Labrador, where it amounts to nearly one full year of study (12.6 years for the total population vs. 13.5 for the employed population).

Chart 56: Newfoundland and Labrador's Average Years of Schooling as a percent of Canada, Employed, Labour Force and Total Population, Total Economy, 1990-2010



Source: CSLS calculations based on Statistics Canada data, Labour force survey estimates, by educational attainment, sex and age group, annually (CANSIM Table 282-0004).

Chart 57: Average Years of Schooling in Canada and the Provinces, Employed Population, 2010



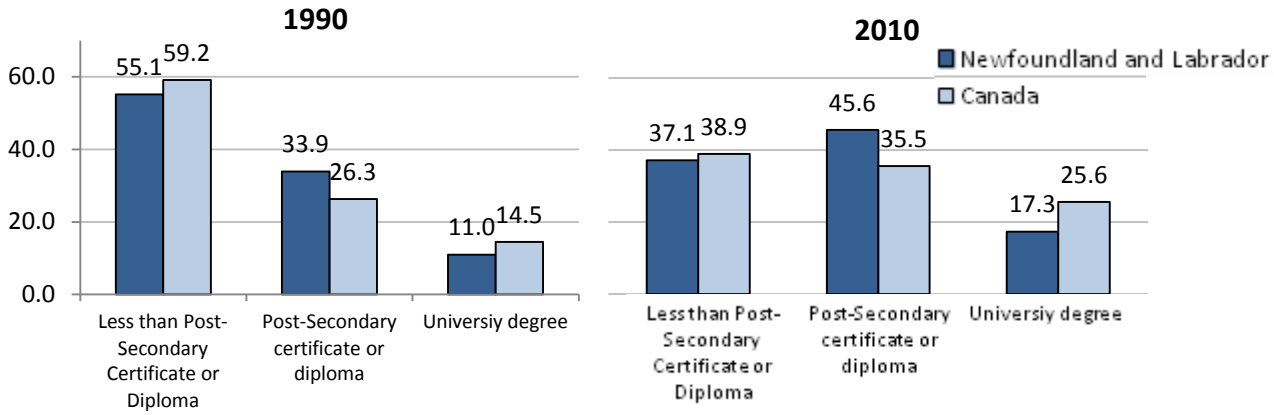
Source: CSLS calculations based on Statistics Canada data, Labour force survey estimates, by educational attainment, sex and age group, annually (CANSIM Table 282-0004).

Another way to gauge the level of human capital in the workforce is to look at the highest level of educational attainment in the employed population. Chart 58 illustrates how, in both Newfoundland and Labrador and Canada, the percentage of the working population that had less than post-secondary education decreased substantially between 1990 and 2010, as the percentage of those holding post-secondary certificates[29] and university degrees[30] increased substantially. In

[29] Completed a certificate (including a trade certificate) or diploma from an educational institution beyond the secondary level. This includes certificates from vocational schools, apprenticeship training, community college,

2010, although the proportion of the employed population with less than post-secondary education was fairly similar between Newfoundland and Labrador and Canada (36.0 per cent vs. 38.9 per cent), the proportions were hardly the same for those with post-secondary diploma and university degree. The percentage of Newfoundland and Labrador's employed population with post-secondary certificates or diploma reached 44.7 per cent in 2010, more than 11.7 percentage points higher than Canada, at 26.3 per cent. On the contrary, Canada had a much higher proportion of workers with a university degree (25.6 percent) than Newfoundland and Labrador (19.3 per cent). Although this pattern (highest proportion of workers holding a post-secondary certificate or diploma in Newfoundland and Labrador coupled with a higher proportion of workers holding a university degree in Canada) existed in 1990, it was accentuated during the 1990-2010 period.

Chart 58: Workers aged 15+ by Highest Level of Educational Attainment as a Share of Total Workers, Newfoundland and Labrador and Canada, 1990 and 2010



Source: CSLS calculations based on Statistics Canada data, Labour force survey estimates, by educational attainment, sex and age group, annually (CANSIM Table 282-0004).

Collège d'Enseignement Général et Professionnel (CEGEP), and school of nursing. Also included are certificates below a Bachelor's degree obtained at a university

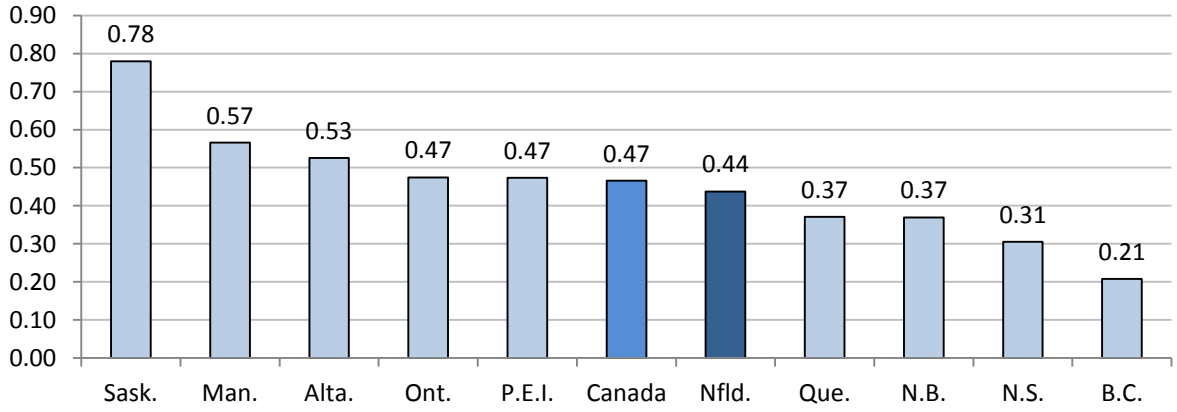
[30] Attained at least a university bachelor's degree.

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, 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 hours 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 0.44 per cent during the 1997-2010 period, slightly below the national average of 0.47 per cent (Chart 59). In comparison to other provinces, Newfoundland and Labrador ranked 6th in terms of labour composition growth.[31]

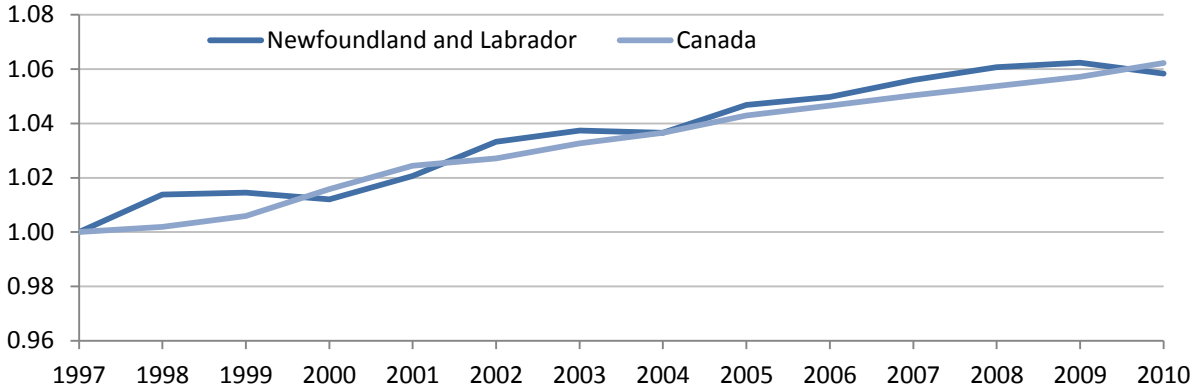
Chart 59: Labour Composition Growth in Canada and the Provinces, 1997-2010



Source: CSLS Provincial Productivity Database

[31] It is important to note that Newfoundland and Labrador's quality of labour experienced a certain stagnation between 2007 and 2010, as illustrated in Chart 53. Between 2007 and 2010, Newfoundland and Labrador's labour composition experienced the worst growth rate of all provinces, at 0.07 per cent. If we only look at the labour composition growth for the 1997-2007 period, Newfoundland and Labrador's labour composition grew at an annual compound rate of 0.55 per cent, 3rd among Canadian provinces.

Chart 60: Labour Composition in Newfoundland and Labrador and Canada, 1997-2010



Source : CSLS Provincial Productivity Database

At the two digit NAICS levels, labour composition growth in Newfoundland and Labrador during the 1997-2010 period was higher than the national average in the retail sector (0.74 per cent vs. 0.22 per cent) and the agriculture, forestry, fishing and hunting sector (1.35 per cent vs. 0.80 per cent) (Table 33). On the other hand, Newfoundland and Labrador labour quality growth was outpaced by Canada's in sector like utilities (-0.51 per cent vs. 1.18 per cent) and mining and oil and gas extraction (-0.30 per cent vs. 0.29 per cent), among others. Overall, the growth in labour composition could not explain any significant divergence in productivity growth during this period.

Table 33: Labour Composition Growth in Newfoundland and Labrador and Canada, Two-Digit NAICS sectors, 1997-2010

	Newfoundland and Labrador			Canada		
	1997-2010	1997-2007	2007-2010	1997-2010	1997-2007	2007-2010
	(annual compound growth rate- per cent)					
Business sector industries	0.44	0.55	0.07	0.47	0.49	0.38
Agriculture, forestry, fishing and hunting	1.35	2.00	-0.79	0.80	0.97	0.24
Mining and Oil and Gas Extraction	-0.30	-0.19	-0.70	0.29	0.31	0.21
Utilities	-0.51	0.32	-3.22	0.21	0.18	0.30
Construction	0.09	0.14	-0.11	0.08	0.14	-0.10
Manufacturing	0.63	0.57	0.81	0.44	0.48	0.29
Wholesale Trade	-0.28	-0.45	0.30	0.20	0.30	-0.13
Retail Trade	0.74	1.02	-0.18	0.22	0.11	0.58
Transportation and Warehousing	0.19	0.11	0.47	0.35	0.46	0.01
Information and Cultural Industries	-0.06	-0.19	0.35	0.31	0.38	0.06
FIRE	-0.05	-0.23	0.57	0.38	0.30	0.63
Professional, Scientific and Technical Services	0.70	0.49	1.41	0.51	0.67	-0.03
ASWMRS	0.16	-0.03	0.81	0.04	-0.03	0.26
Arts, Entertainment and Recreation	-0.39	-0.70	0.64	-0.02	-0.11	0.27
Accommodation and Food Services	0.11	-0.02	0.52	0.22	0.22	0.25
Other private services	0.23	0.30	-0.01	0.41	0.35	0.60

Source: CSLS Provincial Productivity Database

iii. Adult Literacy

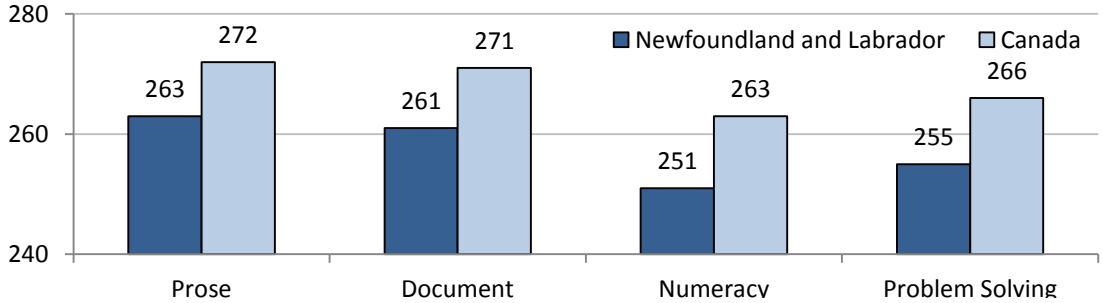
Another important indicator of human capital is adult literacy. In general, the ability of workers to understand written text and draw inferences from it has a direct bearing on the quality of the work being performed. The 2003 International Adult Literacy Survey (IALS) conducted by Statistics Canada measures competencies of persons 16 or older in four domains:
prose literacy, document literacy, numeracy, and problem solving.

The mean scores in Newfoundland and Labrador were considerably below the national average in all four domains (at a minimum of nine points below the national average in all indicators) (Chart 61). Furthermore, when compared to the other provinces, Newfoundland and Labrador ranked last in all categories.

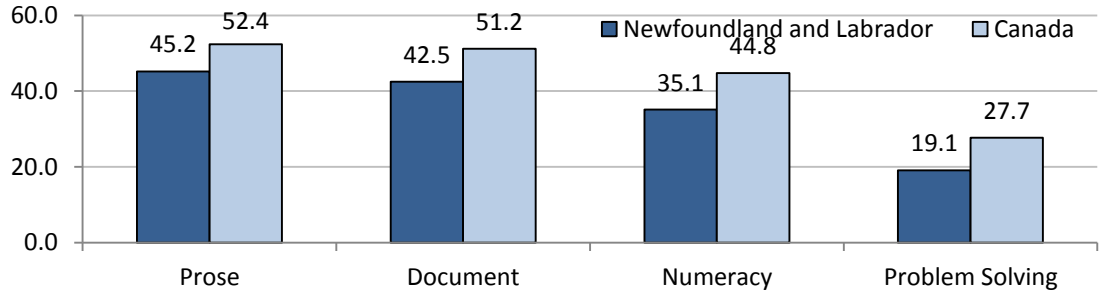
The IALS defines five competency levels and considers Level 3 (scores between 276 and 325) to be the minimum desirable level of literacy. In Newfoundland and Labrador, 45.2 per cent of the population aged 16 and over met the desired threshold in prose literacy, 42.2 per cent in document literacy, 35.1 per cent in numeracy, and 19.1 per cent in problem solving. Compared to the other provinces, those proportions are the second lowest after New Brunswick.

Chart 61: IALS Literacy score in Canada and Newfoundland and Labrador, 2003

A) Average IALS Score



B) Population Aged 16 and over with IALS Score of Level 3



Source : Source: Statistics Canada (2005). "Build on our Competencies. Canadian Results of the International Adult Literacy and Skills Survey 2003", Annex A, Table 1.1

iv. 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 registration and completion broken down by age, gender, trade group, and province.

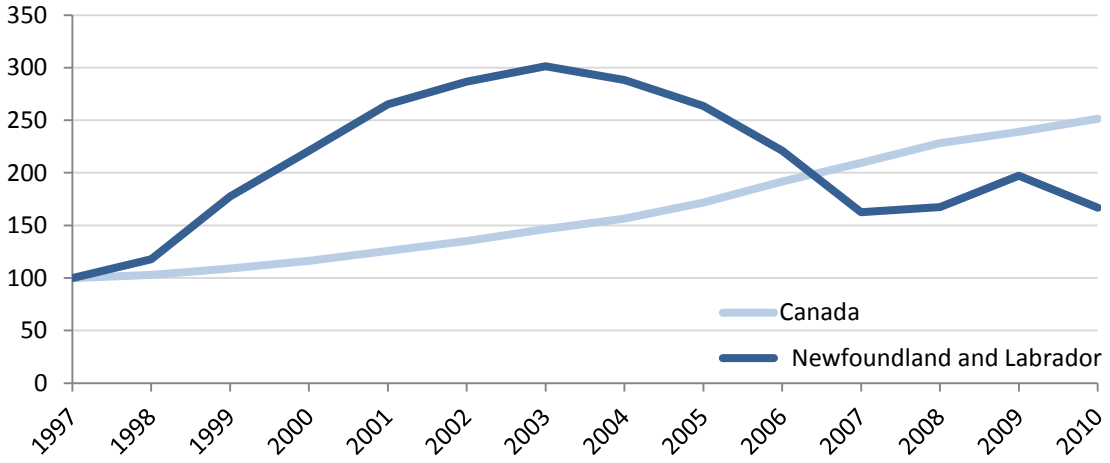
The number of apprenticeship registrations in Newfoundland and Labrador experienced an unusual progression during the 1997-2010 period. From 3,531 registrations in 1997, the number of registrations reached 10,641 in 2003, and tumbled to 5,889 in 2010 (Table 34). On the other hand, apprenticeship registrations in Canada as a whole experienced a more linear increase, growing at a compound annual rate of 4.31 per cent during the period. Chart 62 illustrates the unusual expansion (from 1997 to 2003) and regression (from 2003 to 2007) of apprenticeship registrations in Newfoundland and Labrador.

Table 34: Apprenticeship Registrations in Canada and the Provinces, 1991-2010

	1997	2000	2010
	(persons)		
Canada	**171,180**	**199,074**	**430,452**
Newfoundland and Labrador	3,531	7,803	5,889
Prince Edward Island	408	444	930
Nova Scotia	4,257	4,824	6,405
New Brunswick	3,939	4,329	5,289
Quebec	30,483	37,179	87,159
Ontario	63,987	66,675	160,815
Manitoba	3,627	5,343	10,320
Saskatchewan	5,637	6,969	11,859
Alberta	34,215	43,428	89,190
British Columbia	20,241	21,297	51,321
	(share of national apprenticeship)		
Canada	**100.0**	**100.0**	**100.0**
Newfoundland and Labrador	2.1	3.9	1.4
Prince Edward Island	0.2	0.2	0.2
Nova Scotia	2.5	2.4	1.5
New Brunswick	2.3	2.2	1.2
Quebec	17.8	18.7	20.2
Ontario	37.4	33.5	37.4
Manitoba	2.1	2.7	2.4
Saskatchewan	3.3	3.5	2.8
Alberta	20.0	21.8	20.7
British Columbia	11.8	10.7	11.9
	1997-2010	**1997-2000**	**2000-2010**
	(compound annual growth rates, per cent)		
Canada	**7.35**	**5.16**	**8.02**
Newfoundland and Labrador	4.01	30.25	-2.77
Prince Edward Island	6.54	2.86	7.67
Nova Scotia	3.19	4.26	2.88
New Brunswick	2.29	3.20	2.02
Quebec	8.42	6.84	8.89
Ontario	7.35	1.38	9.20
Manitoba	8.38	13.78	6.80
Saskatchewan	5.89	7.33	5.46
Alberta	7.65	8.27	7.46
British Columbia	7.42	1.71	9.19

Source: CSLS calculations based on Statistics Canada data, Registered Apprenticeship Information System (CANSIM Table 477-0053).

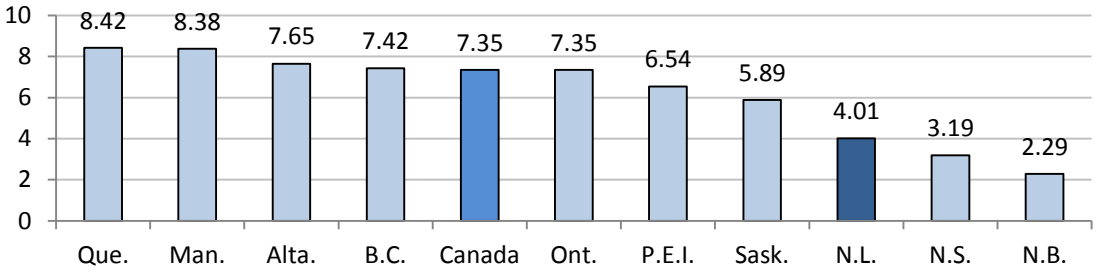
Chart 62: Apprenticeship Registrations in Newfoundland and Labrador and Canada, 1997-2010, 1997=100



Source: CSLS calculations based on Statistics Canada data, Registered Apprenticeship Information System (CANSIM Table 477-0053)

Compared to other provinces, Newfoundland and Labrador ranked 8th in terms of apprenticeship registration growth between 1997 and 2010, at 4.01 per cent, 3.34 percentage points below the Canadian average (Chart 63). However, we must note that, due to the non-linear progression of apprenticeship registration in Newfoundland and Labrador, these data lose much of their usefulness as a measure of comparison.

Chart 63: Apprenticeship Registrations Growth in Canada and the Provinces 1997-2010



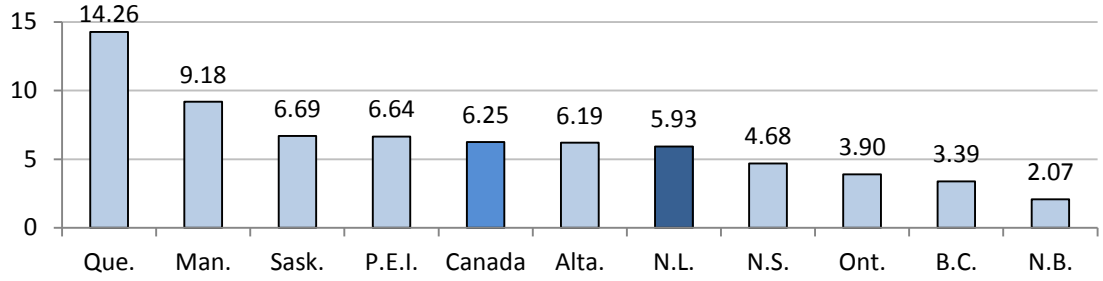
Source: CSLS calculations based on Statistics Canada data, Registered Apprenticeship Information System (CANSIM Table 477-0053)

In terms of apprenticeship completions, during the 1997-2010 period they increased at a lower rate in Newfoundland and Labrador (5.93 per cent) than in Canada as a whole (6.25 per cent) (Chart 64). Completed apprenticeships rose from 354 in 1991 to 444 in 2010.

If we take a look at Chart 65, we notice that between 2000 and 2004, apprenticeship completion declined under its 1997 level and, after that, experienced an important increase

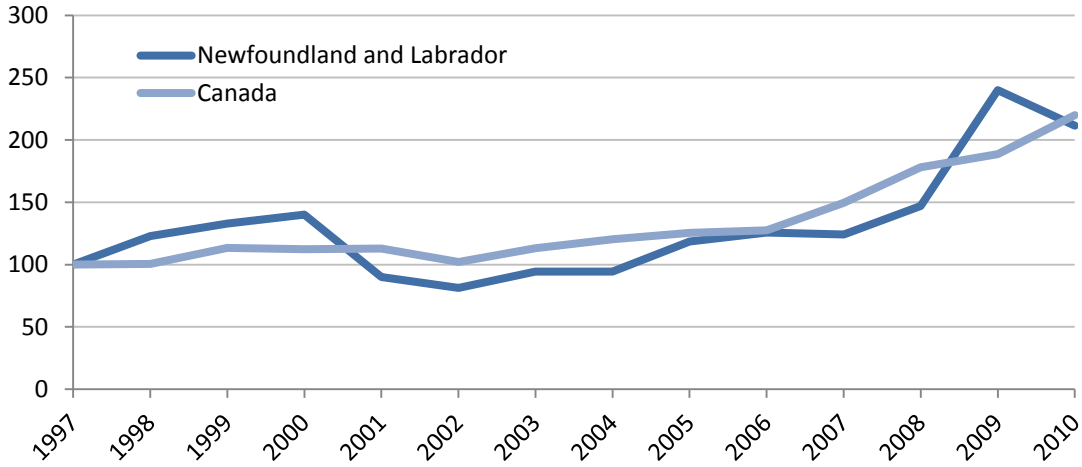
between 2007 and 2010. Therefore, the positive growth rate of apprenticeship completion in Newfoundland and Labrador for the 1997-2010 is only due to a recent upsurge.

Chart 64: Apprenticeship Completions Growth in Canada and the Provinces 1997-2010



Source: CSLS calculations based on Statistics Canada data, Registered Apprenticeship Information System (CANSIM Table 477-0053)

Chart 65: Apprenticeship Completions Newfoundland and Labrador and Canada, 1997-2010, 1997=100



Source: CSLS calculations based on Statistics Canada data, Registered Apprenticeship Information System (CANSIM Table 477-0053)

Table 35: Apprenticeship Completions in Canada and the Provinces, 1991-2010

	1997	2000	2010
	(persons)		
Canada	**16,368**	**18,396**	**36,009**
Newfoundland and Labrador	210	294	444
Prince Edward Island	39	60	90
Nova Scotia	288	432	522
New Brunswick	462	420	603
Quebec	1,518	2,289	8,586
Ontario	5,562	6,186	9,150
Manitoba	366	537	1,146
Saskatchewan	552	750	1,281
Alberta	4,290	4,509	9,369
British Columbia	3,021	2,859	4,662
	(share of national apprenticeship)		
Canada	**100.0**	**100.0**	**100.0**
Newfoundland and Labrador	1.3	1.6	1.2
Prince Edward Island	0.2	0.3	0.2
Nova Scotia	1.8	2.3	1.4
New Brunswick	2.8	2.3	1.7
Quebec	9.3	12.4	23.8
Ontario	34.0	33.6	25.4
Manitoba	2.2	2.9	3.2
Saskatchewan	3.4	4.1	3.6
Alberta	26.2	24.5	26.0
British Columbia	18.5	15.5	12.9
	1997-2010	**1997-2000**	**2000-2010**
	(compound annual growth rates, per cent)		
Canada	**6.25**	**3.97**	**6.95**
Newfoundland and Labrador	5.93	11.87	4.21
Prince Edward Island	6.64	15.44	4.14
Nova Scotia	4.68	14.47	1.91
New Brunswick	2.07	-3.13	3.68
Quebec	14.26	14.67	14.13
Ontario	3.90	3.61	3.99
Manitoba	9.18	13.63	7.88
Saskatchewan	6.69	10.76	5.50
Alberta	6.19	1.67	7.59
British Columbia	3.39	-1.82	5.01

Source: CSLS calculations based on Statistics Canada data, Registered Apprenticeship Information System (CANSIM Table 477-0053)

A sufficient supply of well-trained trades persons are needed to ensure skilled labour shortages do not impede production and hence productivity growth. Although there was a massive increase in the number of apprenticeship registrations during the 1997-2003 period (annual growth of 20.2 per cent), they have since gone down to a point where, in 2010, Newfoundland and Labrador's apprenticeship registrations represented a lower share of Canadian apprenticeship registration than they did in 1997 (2.1 per cent in 1997 to 1.4 per cent in 2010).

Furthermore, those additional registrations did not affect the number of completed apprenticeships.[32] During the 1997-2010 period, apprenticeship completion represented on

[32] Since most apprenticeships take three to five years to complete, the ratio of completions to total registrations is an imperfect estimation of the completion rate of apprenticeship. Still, by dividing the number of completions found in Table 34 by the number of registrations found in Table 34, it is interesting to see that during the 1997-2010 period,

average 1.25 per cent of national apprenticeship completions. While there have been no massive changes during that period, it is important to highlight that before 1997, this share used to be fairly higher. Between 1991 (the first year for which data is available) and 1997, Newfoundland and Labrador's apprenticeship completions represented on average 1.64 per cent of Canada's.

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 trainings, 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 a proportion of respectively 39.9 and 37.2 per cent of the population who participated in job-related training in 2008.

On the other hand, of the workers that do participate in job-related training, Newfoundland and Labrador employers are among the most generous in regard 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 a great improvement in comparison to 2002, when only 86.7 per cent of job-related trainings were sponsored by employers in the province.

Newfoundland and Labrador had the lowest ratio of all provinces. In 2002, Newfoundland and Labrador's apprenticeship completion-registration ratio reached its lowest point, at 1.64 per cent. In comparison, the national completion to registration ratio was of 7.21 per cent. However, Newfoundland and Labrador's low completion-registration ratio seems to be unique to the 1997-2010 period. Before 1997, Newfoundland and Labrador ratio of apprenticeship completion to registration used to be higher than the national average and in 2010, the ratio had nearly caught up with the national average (7.54 per cent vs. 8.37 per cent).

Chart 66: Training-related Statistics for Canadian and Employed Canadian aged 25-64, 2002 and 2008

	Proportion of Canadian who participated in job-related training		Proportion of job-related training taken by employed Canadian 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

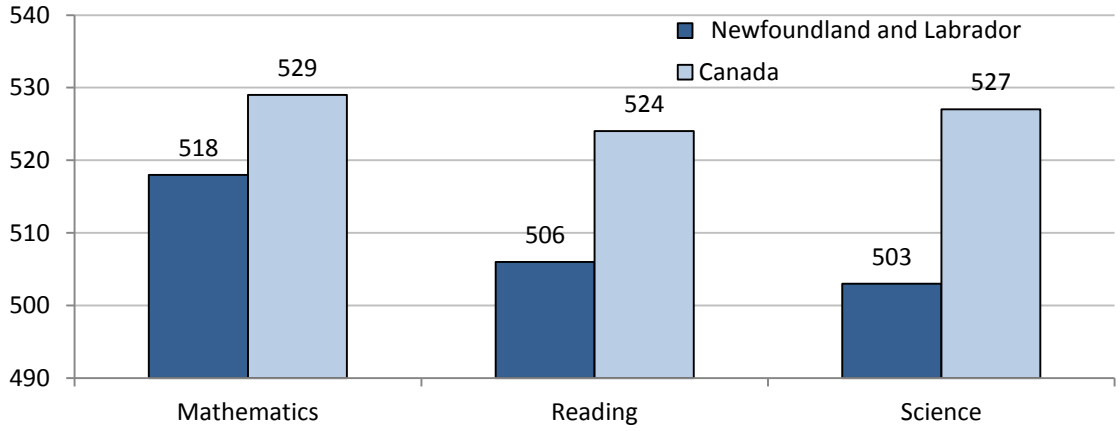
Note: data for 2002 represent activities undertaken between January and December 2002 while data for 2008 represents activities undertaken between July 2007 and July 2008.

vi. PISA

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 market productivity. After all, if current high school students are now receiving a better education, it will only be reflected in labour productivity 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.

Newfoundland and Labrador's scores were considerably below the national averages in all three categories (Chart 67, Chart 68). Compared to other provinces, Newfoundland and Labrador ranked sixth in reading and mathematics, and eighth in science. Although the province's performance within Canada is not impressive, it is important to note that Newfoundland and Labrador, like most Canadian provinces, outperformed the OECD average performance in all three areas (501 in science, 493 in reading, and 496 in mathematics).

Chart 67: Average Scores of Canadian 15-Year Old Students on the PISA Test by Subject Area, Canada and the Provinces, 2009



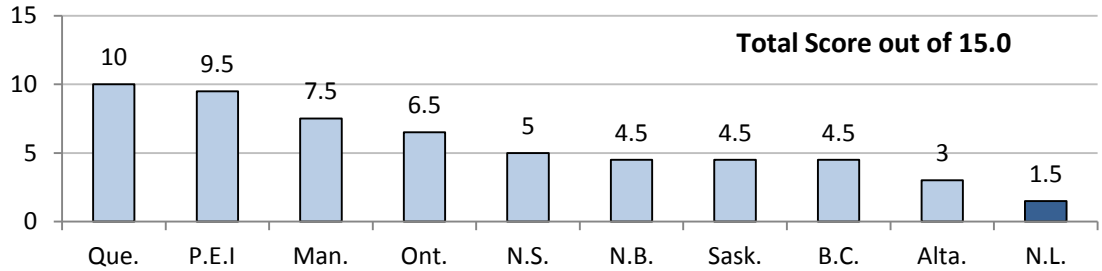
Source: Statistics Canada (2010). The Performance of Canada's Youth in Reading, Mathematics and Science. PISA 2009, First Results for Canadians Aged 15

vii. 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. The index is based on 19 benchmarks organized under five categories: governance, funding, access, learning environment, and accountability. Each category is assigned 3 points out of a total of 15 points.

In 2011, Newfoundland and Labrador ranked last among all Canadian provinces with a meager score of 1.5 points (Chart 68). Details on how Newfoundland and Labrador fared on the 19 benchmarks are found in Appendix Table 7. This very poor performance indicates that there are significant opportunities for Newfoundland and Labrador to improve the quality of early childhood education.

Chart 68: Early Childhood Education Index 2011



Source: Early Childhood Education Report 2011

viii. Summary of Human Capital Indicators

In 2011, the Center for the Study of Living Standards issued a study that examined human capital development in British Columbia (Murray and Sharpe, 2011). Included in the study was a ranking of all Canadian provinces according to numerous human capital indicators. Those variables included some that have already been discussed in this report, such as results from the *adult literacy standardized test*, and other variables such as real capital investment in the education service industry per person. A few important points can be highlighted:

- Newfoundland and Labrador performs badly in terms of educational expenditures, ranking 9th for provincial and local government expenditure on education as a share of nominal GDP and for per-student provincial and local government expenditure on education in public elementary and secondary schools.
- Quite paradoxically, although Newfoundland and Labrador has the lowest high school completion rate (per cent of population aged 25-64 with a high school diploma), the province has the second lowest drop-out rate of all Canadian provinces, at 8.0 per cent (vs. the national average of 10.1).
- The province ranks third in terms of its university enrolment rate (in the population 18-29), but last in the both the proportion of the population with a university degree and in average number of years of education.
- The province ranks first for the unemployment rate of recent immigrants with post-secondary education, relative to the overall unemployment rate for persons with post secondary education.

The average rank of Newfoundland and Labrador in the 25 indicators was 6.8, putting it in 9th place. This reflects the overall finding of this section: in terms of human capital, Newfoundland and Labrador is the weakest province of Canada after New Brunswick. Considering that, when data for a certain indicator was unavailable, the province was credited with the fifth rank, the overall ranking of the province would probably be worse if more data were available. The rankings can be found in Appendix Table 8.

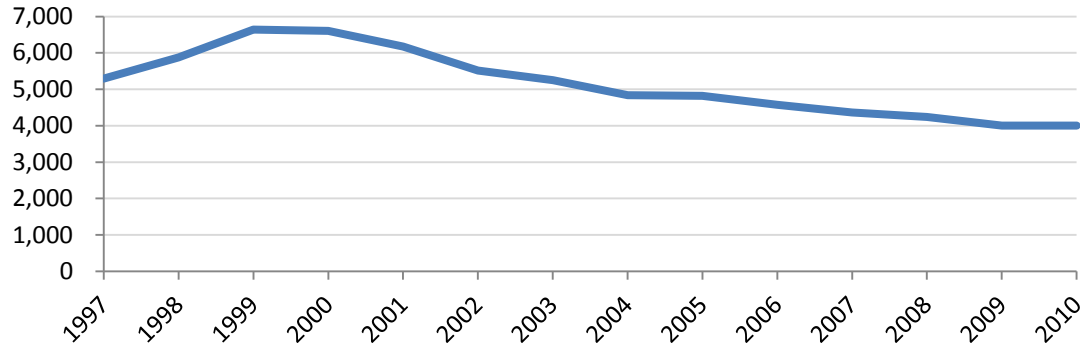
ix. Workplace Injuries and Fatalities

The quality of the work environment can affect the productivity performance of the workers in that location. One aspect of work environment 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 morale commitment and morale 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.

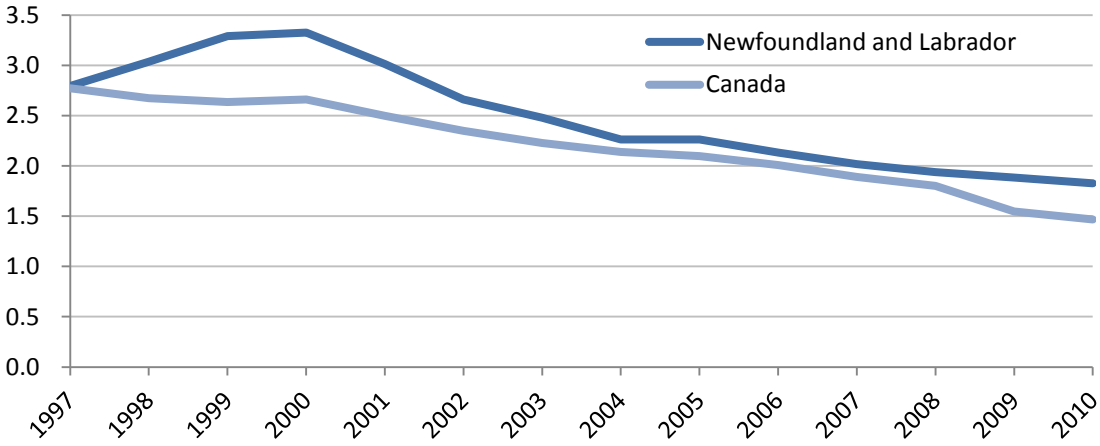
Chart 69 shows that 4,006 time-loss injuries were compensated by Newfoundland and Labrador's Workplace Health Safety and Compensation Commission in 2010, down from 5,295 compensated time-loss injuries in 1997. In 2010, in comparison to Canada as a whole, the incidence of workplace time-loss injuries was slightly higher in the province, with an incidence of 1.8 per cent versus 1.5 per cent in Canada (Chart 70). In Newfoundland and Labrador, in terms of time-loss injuries, the number of injuries dropped by 42.8 per cent and the incidence dropped by 56.6 per cent. Similar declines took place at the national level. Conclusively, Newfoundland and Labrador workplaces, like Canadian workplaces in general, are becoming much less prone to injuries.

Chart 69: Number of Workplace Time-Loss Injuries in Newfoundland and Labrador, 1997-2010



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

Chart 70: Incidence of Workplace Time-Loss Injuries (per 100 Workers) in Newfoundland and Labrador and Canada, 1993-2010

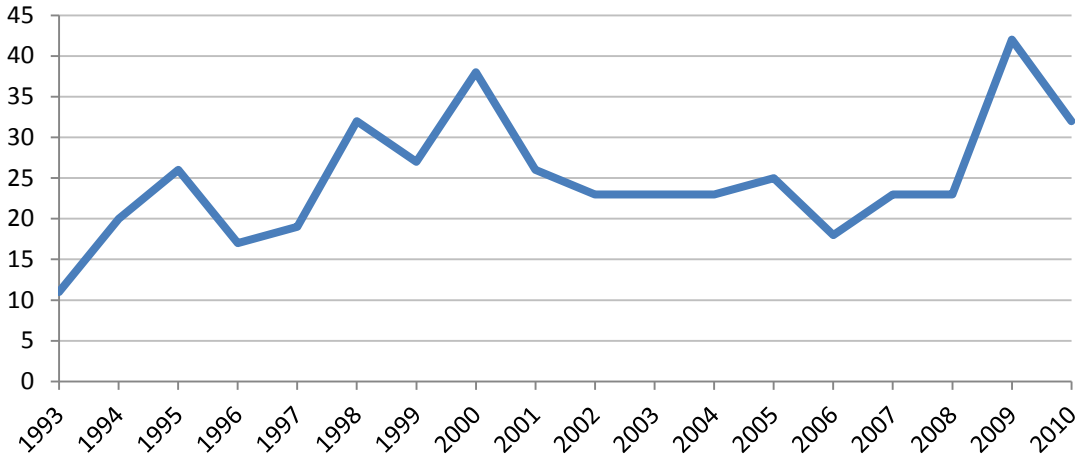


Source: Association of Workers' Compensation Boards of Canada (AWCBC)

However, the portrait is less encouraging when we look at the numbers on workplace fatalities. In 2010, there were 32 workplace fatalities in Newfoundland and Labrador, 291 per cent higher than the 11 fatalities in 1993. Chart 71 clearly demonstrates that this upward trend in the number of workplace fatalities in Newfoundland and Labrador is not due to one exceptional year. It is even more evident when we look at the incidence of workplace fatalities. From 5.7 fatalities per 100,000 workers in 1993, the incidence of workplace fatalities reached 14.6 in 2010 in Newfoundland and Labrador (Chart 72). Furthermore, Newfoundland and Labrador's incidence of workplace fatalities was far higher than the one experienced in Canada; in 2010, the incidence of workplace fatalities in Canada as a whole was around 6.0 per 100,000 workers.

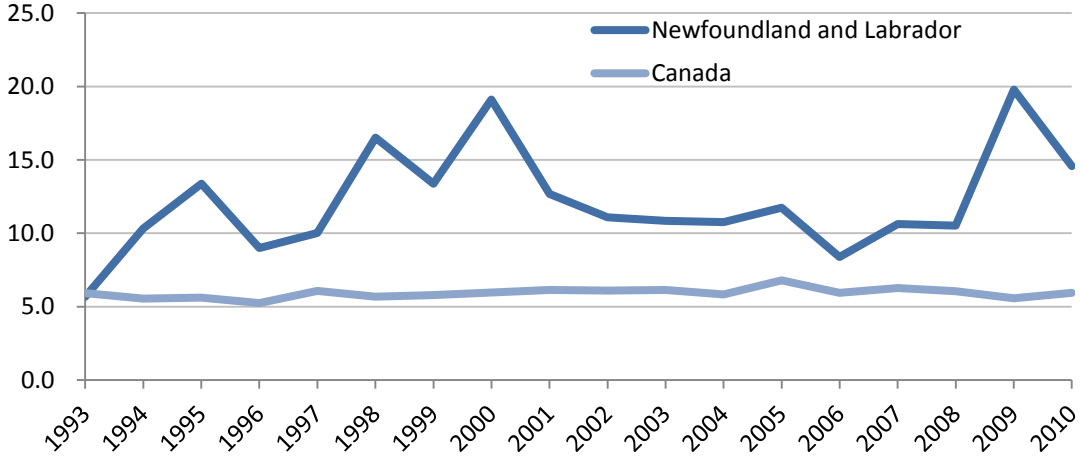
Newfoundland and Labrador's rising incidence of workplace fatalities represents a disturbing development for workers in the province, while the falling incidence of workplace injuries certainly represents a happier one. However, the productivity implications are likely minor. Compared to the main drivers of productivity growth – human capital, investment and innovation – fewer injuries and fatalities have limited effects on output and productivity.

Chart 71: Number of Workplace Fatalities in Newfoundland and Labrador, 1993-2010



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

Chart 72: Incidence of Workplace Fatalities per 100,000 Workers in Newfoundland and Labrador and Canada, 1993-2010



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

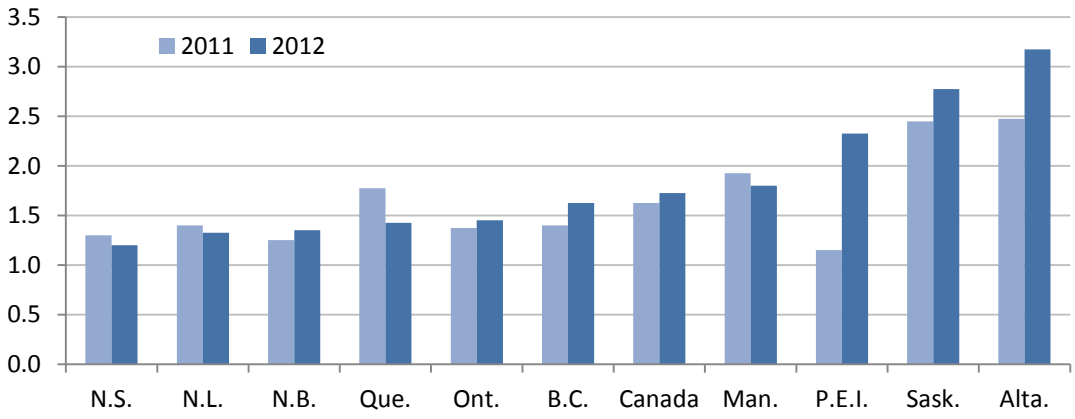
x. Labour Shortages

The existence of labour shortages is often seen as evidence that supply of labour is inadequate to meet demand and may indicate that policies related to the 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 these shortages for productivity growth.

The best measure of labour shortages is job vacancies. Fortunately, starting from January 2011, Statistics Canada has begun to gather and provide statistics on job vacancies. Given this is a new data series, trends are not yet available and the data has to be interpreted with caution. Yet, those data show no evidence of any general labour shortage in Newfoundland and Labrador. On the contrary, the province has one of the lowest job vacancy rates, i.e. the number of vacant positions divided by total labour demand (vacant positions plus occupied positions). In 2012, this rate was of 1.3 per cent in Newfoundland and Labrador, down from 1.4 per cent in 2011 (Chart 73). This represents around 2,500 vacancies. In comparison, at the national level, this rate was of 1.7 per cent in 2012 and 1.6 in 2011.[33]

[33] Although job vacancies are not available by sector at the provincial level, it is interesting to note that, at the national level, the mining and oil was by far the sector with the highest job vacancy rate, at 3.05 in 2012, nearly twice the average of all other sector combined. Other sector with high job vacancy rate was the information and cultural industries (2.30 per cent) and health care and social assistance (2.20 per cent). In 2011, the mining and oil and gas extraction sector was also the sector with the highest job vacancy rate, at 3.13 per cent.

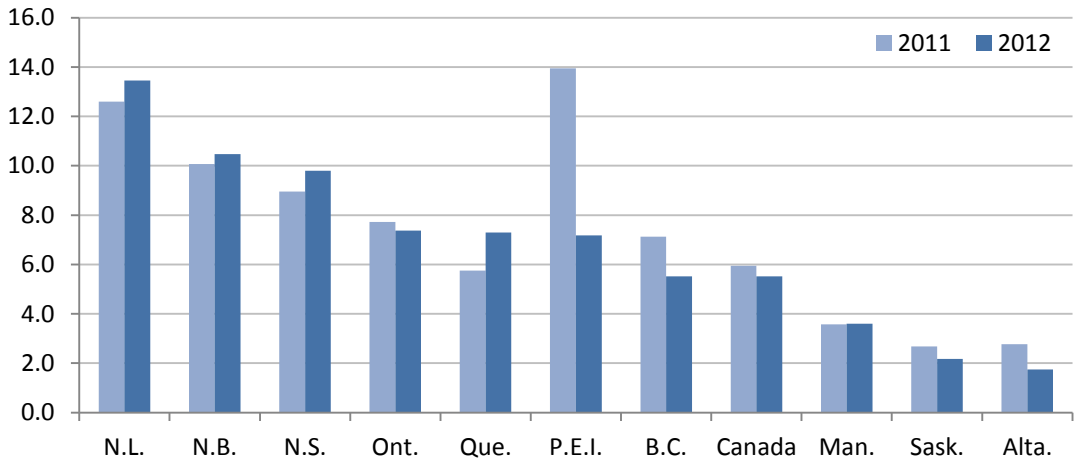
Chart 73: Job Vacancy Rate, by Province, 2011 and 2012.



Source: Statistics Canada, CANSIM TABLE 284-0002

Another useful indicator of labour shortage 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. In 2012, the province had the highest ratio of all provinces, at 13.5. In other words, there were around 13.5 unemployed persons looking for a job in Newfoundland and Labrador for each job vacancy. In 2011, Newfoundland and Labrador had an unemployment-to-job vacancies ratio of 12.6. In comparison, the national unemployment-to-job vacancies ratio was 6.0 in 2011 and 5.5 in 2012.

Chart 74: Unemployment-to-Job Vacancies Ratio, All Unemployed, by Province, 2011 and 2012



Source: Statistics Canada, CANSIM TABLE 284-0004

There are, however, some worries of labour shortages in specific industries or specific areas of the province. For example, Vale, the firm building the $4.2 billion nickel processing

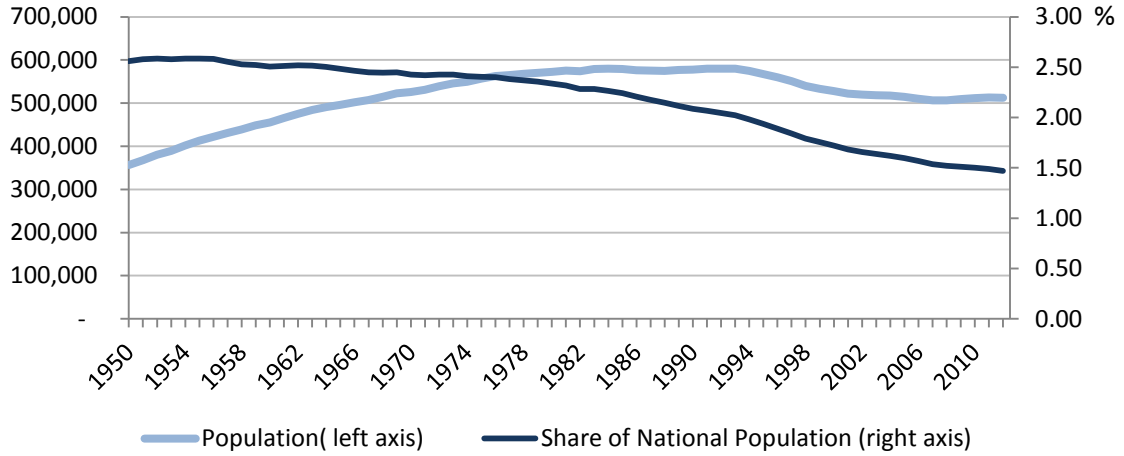
plant in Long Harbour, had to spend a significant sum of money on cross-country job advertising as well as hire workers outside of Newfoundland and Labrador and Canada. The skilled workers needed are mostly ironworkers and pipe-fitters, but also include welders, electricians and plumbers. It is also unsure if enough specialized workers will be available in order to complete other major capital projects in the province. For example, “Hebron and Muskrat Falls (see section on major capital projects) would require some 5,700 workers, the large majority of them skilled trades people"(McCarthy 2011). All things considered, it is more accurate to speak of a labour shortage for certain types of skills than a generalized labour shortage.

An increase in the number of apprenticeships could be a solution, but the province worries that many employers appear reluctant to take on trainees. The fact that many companies in Newfoundland and Labrador are not willing to compete with the wages and benefits of other comparable industries in other provinces, like Alberta's oil sands, is also a factor. Such a shortage of specific type of skills could lead to the delay or even the cancellation of specific projects. However, it should not necessarily be considered as a problem. In fact, it could help stretch the economic growth of the province over a longer period, avoiding a boom and bust cycle that now seems inevitable with the currently record-high amount of investment.

xi. Interprovincial Migration and Demographic Developments

The story of Newfoundland and Labrador's population is one of decline. When the province joined the Canadian federation in 1949, its population accounted for 2.57 per cent of the Canadian population. Since then, the population share of the province has declined to 1.47 per cent of Canada's in 2012 (Chart 75). In 2010, the province had a population of 513,000 persons, roughly the same population it had in the mid-1960s, meaning that the province experienced no population growth in the last half-century. After reaching a peak of 580,109 in 1993, the population of Newfoundland and Labrador has been declining at an alarming rate. If Newfoundland and Labrador had maintained its 1949 share of the national population, its population in 2012 would be 894,000 persons, not 513,000. Both the declining fertility rate and the large interprovincial out-migration explain this very significant decline.

Chart 75: Newfoundland and Labrador's Population, 1949-2012

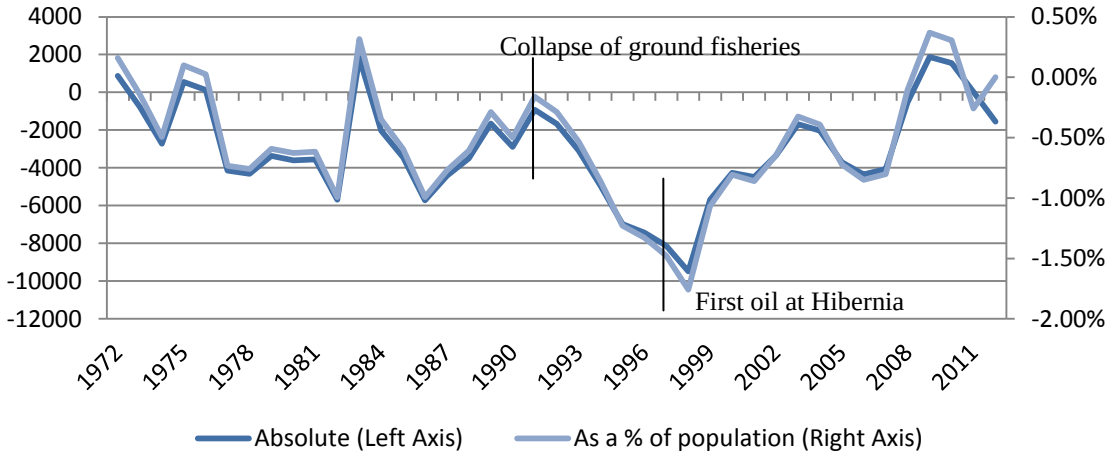


Source: CANSIM Table 051-0001 linked to CANSIM Table 051-0023 for years before 1971

Chart 76 illustrates the net interprovincial migration in the province between 1972 and 2012. It is interesting to see that most trends in Newfoundland and Labrador's net migration can be related to important macroeconomic events. As related by Lynch, "there were two national recessions, 1981-1982 and 1990-1991 and again, in-migration increased and out-migration decreased. The collapse of the ground fishery in the late 1980s and 1990s had a significant negative impact on the Newfoundland and Labrador economy. Beginning in 1992 there was a massive exodus of people and outmigration was at its highest level in 1998 with a net loss of 9,490 individuals" (2007: p.11). From 1998 onward, the beginning of oil production diminished the amount of outgoing net-migration from the province, although the production of oil sands in Alberta pulled many workers out of the province, as can be seen by the increase in out-migration between 2004 and 2007. As jobs in Western Canada dried up during the recent downturn, the net migration became positive in the recent years. We can estimate the net cumulative loss in population due to out-going interprovincial migration to be approximately 123,000 individuals for the 1972-2012 period, around one quarter of the actual provincial population. Of those, nearly 74 000, or 60 percent, left between 1993 and 2007. [34]

[34] Cumulatively, most of the gross out-migrants during 1972-2012 migrated either to Ontario (40.6 per cent), Alberta (21.7 per cent) or Nova Scotia (14.6 per cent). However, in the last two decades, the number of out-migrants who choose Alberta as their province of destination has increased sharply. From 11.9 per cent in 1992, Newfoundlanders who migrated to Alberta accounted for 49.7 per cent of all out-migrants in 2012.

Chart 76: Net Interprovincial Migration in Newfoundland and Labrador, 1980-2010



Source: CANSIM Table 051-0012

The impact that such a decline can have on productivity is ambiguous. From the Canadian perspective, Sharpe, Arseneault and Ershov (2007) showed that interprovincial migration provides significant output gain for Canada as a whole. In 2006, they estimate those gains to be of $883.1 million (1997 constant prices). 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 takes place if an unemployed person in one province finds a job in another province where the 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 Ershoy (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 seems insignificant, 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 help 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, the fact that most of those who out-migrated from Newfoundland and Labrador are young and well-educated residents is an important problem when looking at current and future productivity. 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 dampen growth in human capital and can ultimately slow the growth in labour productivity or even reduce the aggregate level of labour productivity. Second, increased investment in education has little benefit to Newfoundland and Labrador if the people who receive this additional education leave the province. Therefore, policy planners in Newfoundland and Labrador will find it crucial for the province's economy to create meaningful employment opportunities for the 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.

C. Innovation

In the introduction to this section, we established that increases in productivity come from three sources: the quality of labour, or human capital; the amount of physical capital per worker, or capital intensity; and the pace of technological progress, also called 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 higher levels of 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 innovative 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. As developments before 1997 are crucial for understanding trends since then, this section will discuss developments in R&D expenditures since 1984.

In 2010, nominal R&D expenditures in Newfoundland and Labrador reached $260 million, up from $59 million in 1984 and growing at a compound annual rate of 5.87 per cent for the whole 1984-2010 period (Table 36). R&D expenditures increased at a higher rate in Canada as a whole, where it grew at 6.21 per cent per year. Compared to other provinces, Newfoundland and Labrador ranked eighth in terms of R&D expenditure growth during the 1984-2010 period. However, if we look only at the 1997-2010 period, it ranked fourth, with a compound annual growth rate of 7.38 per cent (vs. 5.69 per cent for Canada as a whole).

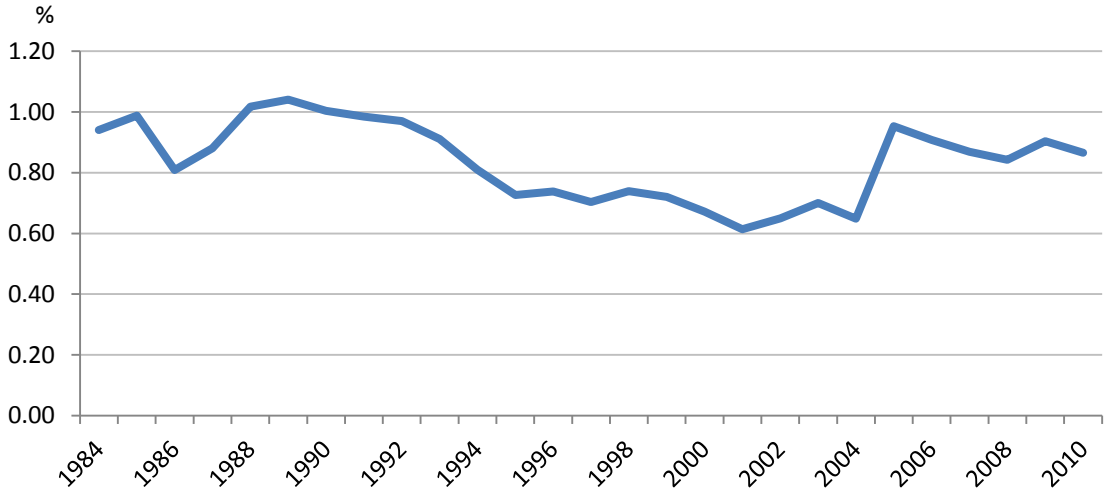
Table 36: Total Nominal R&D Expenditures Levels and Growth in Canada and the Provinces, 1984-2010

	1984	1997	2000	2010
	(Current Dollar)			
Canada	**6,273**	**14,635**	**20,556**	**30,048**
Newfoundland and Labrador	59	103	138	260
Prince Edward Island	10	18	37	67
Nova Scotia	160	257	362	524
New Brunswick	49	127	158	293
Quebec	1,240	3,953	5,717	7,957
Ontario	2,483	7,525	10,383	13,645
Manitoba	204	271	393	678
Saskatchewan	135	288	376	597
Alberta	511	1,051	1,319	2,850
British Columbia	380	1,038	1,606	3,025
	1984-2010	**1997-2010**	**1997-2000**	**2000-2010**
	(compound annual growth rates, per cent)			
Canada	**6.21**	**5.69**	**11.99**	**3.87**
Newfoundland and Labrador	5.87	7.38	10.24	6.54
Prince Edward Island	7.59	10.64	27.15	6.12
Nova Scotia	4.67	5.63	12.1	3.77
New Brunswick	7.12	6.64	7.55	6.37
Quebec	7.41	5.53	13.09	3.36
Ontario	6.77	4.68	11.33	2.77
Manitoba	4.73	7.31	13.19	5.6
Saskatchewan	5.88	5.77	9.29	4.73
Alberta	6.83	7.98	7.87	8.01
British Columbia	8.31	8.58	15.66	6.54

Source: CSLS calculations based on Statistics Canada data, Research and Development in Canadian Industry, CANSIM Table 358-001

These differences between Newfoundland and Labrador's R&D expenditure growth rate in each period translate into changes in its share of national R&D spending, as illustrated in Chart 77. From 1984 to 2001, Newfoundland and Labrador's R&D share in national R&D declined from 0.94 per cent to 0.61 per cent. However, during the 2000-2010 period, due to a higher growth of R&D expenditures in Newfoundland and Labrador than in Canada (6.54 per cent per year vs. 3.87 per cent per year), Newfoundland and Labrador's share increased to 0.87 per cent of Canada's in 2010.

Chart 77: Total Nominal R&D Expenditures in Newfoundland and Labrador as a Share of Canada's, 1984-2010

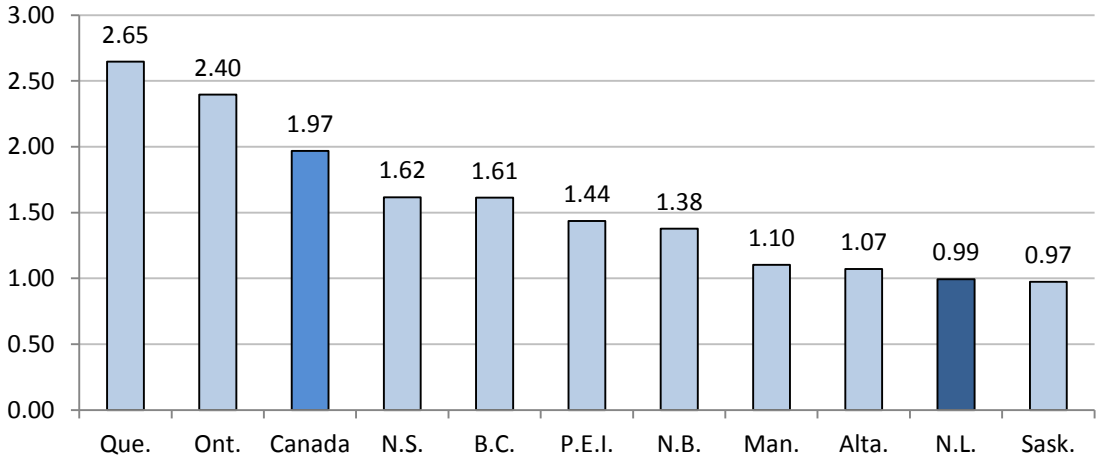


Source: CSLS calculations based on Statistics Canada data, Research and Development in Canadian Industry, CANSIM Table 358-001

Since R&D expenditure levels do not take into account the fluctuation in the economic performance of each region, R&D intensity, defined here as the ratio of R&D expenditures to nominal GDP, is more than often considered as a better indicator of R&D effort. Nevertheless, Newfoundland and Labrador performance in terms of R&D intensity is not any better by this measure. On the contrary, in 2010, R&D intensity in Newfoundland and Labrador was at 0.99 per cent, well below the national average at 1.97 per cent (Chart 78). Compared to the other provinces, Newfoundland and Labrador ranked 9th in terms of R&D intensity, outperforming only Saskatchewan, where 0.97 per cent of Nominal GDP is directed to R&D expenditures.

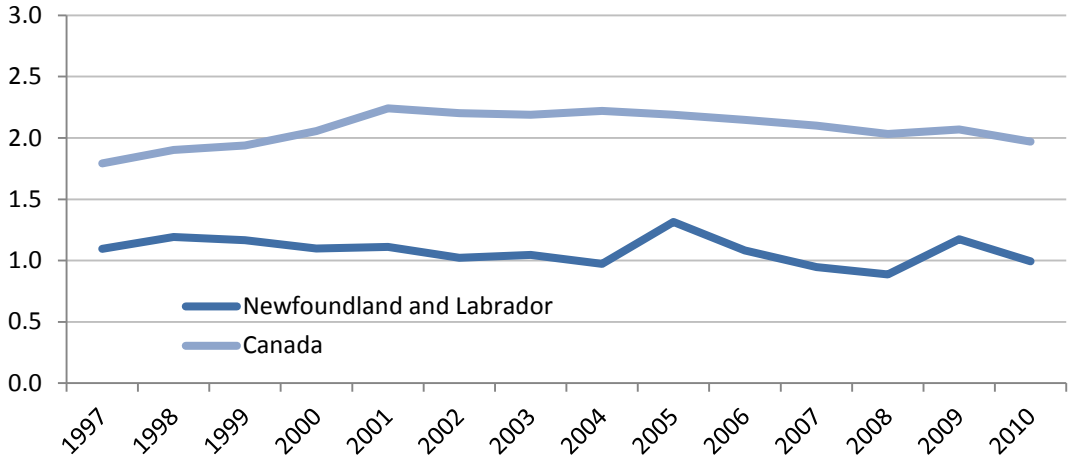
Furthermore, Newfoundland and Labrador's under-spending in R&D is not unique to 2010. Chart 79 illustrates how, during the whole 1997-2010 period, R&D intensity was much higher in Canada than in Newfoundland and Labrador. The difference was less pronounced in 1997 (0.98 per cent in Newfoundland and Labrador vs. 1.47 per cent in Canada), but the gap between Newfoundland and Labrador's and Canada's R&D intensity increased during the 1997-2010 period as R&D intensity was falling in Newfoundland and Labrador and increasing in Canada.

Chart 78: Total R&D Intensity (R&D as a percentage of GDP) in Canada and the Provinces, 2010



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).

Chart 79: Total R&D Intensity (R&D as a percentage of GDP) in Newfoundland and Labrador and Canada, 1984-2010



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 assume that the province's business sector does not benefit from R&D even when it is not conducted by the business sector.

Newfoundland and Labrador's BERD increased at an impressive compound annual rate of 10.80 per cent during the 1984-2010 period (vs. an increase of 6.39 per cent per year in the nation-wide BERD), from $5 million in 1984 to $72 million in 2010. The province's R&D expenditure growth also outpaced Canada's in the R&D performed by the high education sector (8.92 per cent vs. 7.76 per cent) but regressed in term of R&D performed by the government sector with R&D expenditures in this sector declining at an annual rate of 1.88 per cent (vs. an increase of 2.92 per cent for Canada as a whole).

Table 37: Total R&D Expenditures by Performing Sector, Newfoundland and Labrador and Canada, 1984-2010

	Newfoundland and Labrador				Canada			
	1984	1997	2000	2010	1984	1997	2000	2010
	(millions, Current dollars)							
Total R&D Expenditures	**59**	**103**	**138**	**260**	**6,273**	**14,635**	**20,556**	**30,048**
Government Sector	36	27	35	22	1,595	1,934	2,310	3,367
Business Sector	5	14	20	72	3,022	8,739	12,395	15,116
Higher Education Sector	18	62	83	166	1,656	3,961	5,851	11,564
	1984	1997	2000	2010	1984	1997	2000	2010
	(as a share of total R&D expenditures)							
Total R&D Expenditures	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Government Sector	61.0	26.2	25.4	8.5	25.4	13.2	11.2	11.2
Business Sector	8.5	13.6	14.5	27.7	48.2	59.7	60.3	50.3
Higher Education Sector	30.5	60.2	60.1	63.8	26.4	27.1	28.5	38.5
	1984	1997	2000	2010	1984	1997	2000	2010
	(as a share of total economy nominal GDP)							
Total R&D Expenditures	0.98	1.09	1.1	0.89	1.47	1.79	2.06	1.99
Government Sector	0.60	0.29	0.28	0.08	0.38	0.24	0.23	0.22
Business Sector	0.08	0.15	0.16	0.25	0.71	1.07	1.24	1.00
Higher Education Sector	0.30	0.66	0.66	0.57	0.39	0.48	0.59	0.77
	1984-2010	1997-2010	1997-2000	2000-2010	1984-2010	1997-2010	1997-2000	2000-2010
	(compound annual growth rates, per cent)							
Total R&D Expenditures	**5.87**	**7.38**	**10.24**	**6.54**	**6.21**	**5.69**	**11.99**	**3.87**
Government Sector	-1.88	-1.56	9.04	-4.54	2.92	4.36	6.10	3.84
Business Sector	10.80	13.42	12.62	13.67	6.39	4.31	12.36	2.00
Higher Education Sector	8.92	7.87	10.21	7.18	7.76	8.59	13.89	7.05

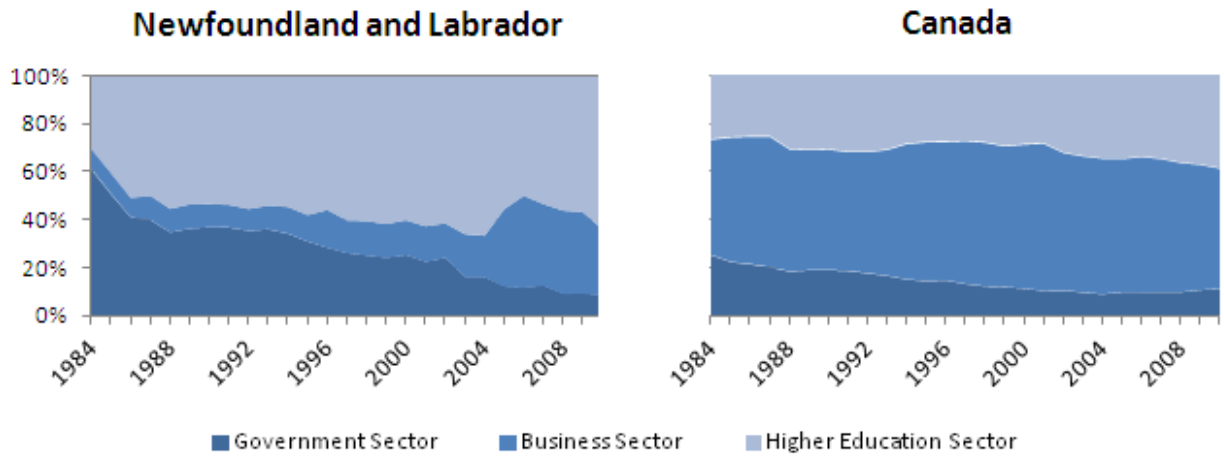
Source: CSLS calculations based on Statistics Canada data, 1) Input-Output Structure of the Canadian Economy in Current Prices (CANSIM Tables 379-0024 and 379-0025); 2) Research and Development in Canadian Industry (CANSIM Table 358-0001).

In 2010, the Canadian business sector played a much larger role than Newfoundland and Labrador's in performing R&D. More specifically, the business sector in Canada performed 50.3 per cent of all R&D expenditures, while in Newfoundland and Labrador, it performed only 27.7 per cent. Yet, this difference is far smaller than in 1984, when Newfoundland and Labrador's business sector was responsible for only 8.7 per cent of all R&D expenditures (vs. 48.2 per cent in Canada). Although R&D performed by the business sector has a more marginal role in Newfoundland and Labrador, it is interesting to note the important increase in nominal expenditures of R&D performed by the Newfoundland and Labrador' business sector since 2005,

when business sector R&D nearly tripled in one year (from $30 million in 2004 to $86 million in 2005). [35]

Chart 80 illustrates the decline of government as a performer of R&D in both Newfoundland and Labrador and Canada. From 61.0 per cent of all R&D expenditures in 1984, Newfoundland and Labrador's government sector performed only 8.5 per cent of all R&D expenditures in the province in 2010. In Canada, the share of R&D expenditures performed by the government sector declined from 25.4 percent in 1984 to 11.2 per cent in 2010. As a consequence of the decline in R&D performed by the government sector coupled with an important increase in R&D expenditures performed by the higher education sector, the higher education sector replaced the government sector as the main performer of R&D in Newfoundland and Labrador in 2010, performing 63.8 per cent of all nominal R&D expenditures.

Chart 80: R&D Expenditures by Performer, Newfoundland and Labrador and Canada, 1984-2010 (as a per cent of total)

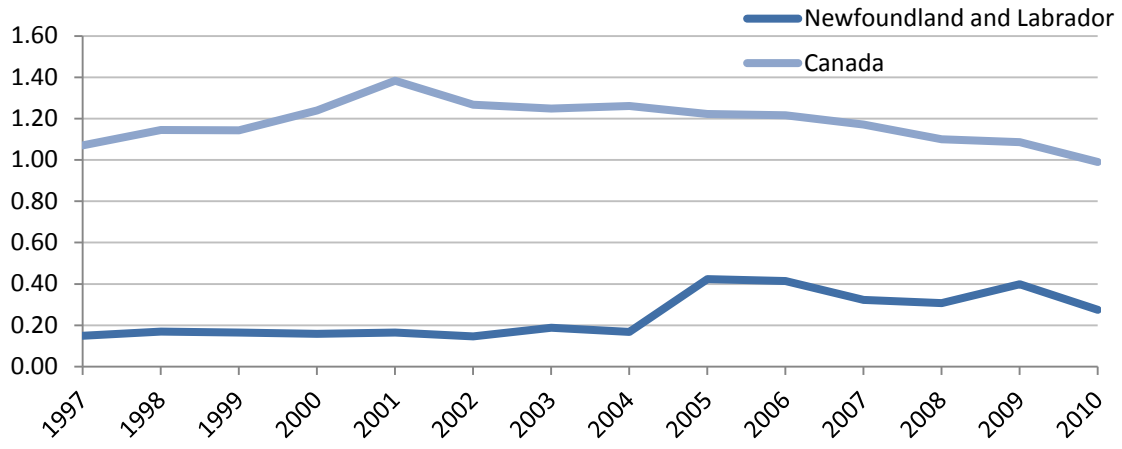


Source: CSLS calculations based on Statistics Canada, Research and Development in Canadian Industry, CANSIM Table 358-00

[35] The sudden increase in business sector R&D and in the share of total R&D performed by the business sector in 2005 was due to the pilot plant and demonstration plant associated with the Voisey's Bay project. However, in 2010, R&D expenditures related to that project had ended but BERD intensity still remained higher than its 1997 level, mostly due to increased R&D in the mining and oil and gas sector and in the private services sector.

Looking specifically at BERD intensity (defined here as BERD as a share of nominal business sector GDP), although it experienced an important increased after 2004, we can see that Newfoundland and Labrador's R&D performance in the business sector has been well below Canada's during the 1997-2010 period (Chart 81). In 2010, BERD intensity in Newfoundland and Labrador was 0.28 per cent, around a quarter of Canada's, at 0.99 per cent.

Chart 81: BERD Intensity in Newfoundland and Labrador and Canada, 1997-2010



Source: CSLS calculations based on Statistics Canada Research and Development in Canadian Industry (CANSIM Table 358-0001).

To conclude, although additional efforts in education would be valuable in order to increase the quality of labour and reach the Canadian average in most human capital indicators, one of the most important ways to assure sustainable productivity in Newfoundland and Labrador is through additional efforts in R&D. In comparison to Canada, R&D intensity in Newfoundland and Labrador is half of the national average, and the role played by the business sector in Newfoundland and Labrador's R&D is only around one quarter that of Canada.

V. Public Policy and Productivity in Newfoundland and Labrador

This section explores the relationship between public policy and productivity in Newfoundland and Labrador. It first examines the impact of public policy on the productivity performance of the province, and then discusses the implications of the findings of the report for public policy. The report also acknowledges the efforts already put in place by the Newfoundland and Labrador government to increase labour productivity in the province.

A. The Impact of Public Policy on Productivity

As noted earlier, sound public policy sets the scene for solid business sector productivity performance. Bad public policy dampens productivity growth, or even leads to declines in

productivity. Good public policy is a necessary, but not sufficient, condition for strong productivity growth. Can public policy in Newfoundland and Labrador explain the faster labour productivity growth in Newfoundland and Labrador relative to Canada in the 1997-2010 period? To a certain extent, the answer is yes. The decision in the early 1980s by the federal government to show economic leadership by taking an equity stake in the development of the offshore Hibernia oil field is an example of a public policy that has proven to have been effective, indeed prescient. If this public policy had not been implanted, it is very possible that the affected oil deposits would have developed at a much slower pace, or not at all.

In retrospect, government participation in the offshore oil development was an excellent policy decision that greatly contributed to the economic development of the province and to the increase in productivity growth. To recall, 78.2 per cent of the increase in labour productivity in Newfoundland and Labrador between 1997 and 2010 is attributable to the mining and oil and gas extraction sector. Therefore, the government has a share of the credit for the growth of productivity in Newfoundland and Labrador. In addition to the growth in the labour productivity of the mining and oil and gas sector, it is also important to remember that a higher growth in labour productivity was also reported for the province in 12 of the 15 two-digit NAICS sectors. To ascertain if this growth was caused by public policies or only spill-over effects of the oil production would require an evaluation of the productivity impacts of all economic-related policies and programs of the Newfoundland and Labrador government. Although a highly desirable initiative, it is well beyond the scope of this project.

B. Implications of the Findings for Public Policy

The key finding of this report is that the majority of Newfoundland and Labrador's productivity growth that occurred after 1997 has been due to the increased production of oil and gas in the province offshore. To refresh, the section on industrial structure and intersectoral shifts established that 78.3 per cent of the growth in labour productivity in the last decade and a half was caused by the mining and oil and gas industries. It is clear that an economy whose major source of income comes from non-renewable natural resources will have to prepare for when these natural resources will be exhausted. Newfoundland and Labrador's high productivity growth and high productivity level are not likely to continue given the outlook for oil production from proven reserves. Therefore, the province has to find a way to assure sustainable labour productivity growth and level for the years to come.

In resource economics, this principle has been established as a rule of thumb called the Hartwick's rule. This rule implies that, in order to maintain its actual level of consumption, a society should invest the totality of the resources rent, i.e. the difference between the market price of oil and its cost of production, in reproducible capital. In its analysis of productivity trends in Canada, Serge Coulombe makes it very clear that "if the accumulation of capital (both

physical and human capital) is not sufficient to compensate for the exhaustion of the resource, then the exhaustible resource economy's living standards will inexorably decline" (2011, p.14).

The Hartwick's rule was defined as a rule of thumb by the economist Robert Solow as a way to guarantee the intergenerational allocation of natural resources. In the case of Newfoundland and Labrador's labour productivity, it is quite easy to understand how, if all the rent extracted from the production of oil and gas is consumed instead of reinvested in reproducible capital, the aggregate level of labour productivity in the province will go down. When all the oil reserves will be exhausted, labour will be redirected to the other sectors of the economy, characterized by a lower level of labour productivity than the mining and oil and gas sector and, all other things being equal, the province's level of labour productivity will inexorably decrease. The Hartwick's rule implies that it is possible to prevent this from happening, if the decrease in the output of the mining and oil sector is balanced by an increase in the labour productivity of the other sectors of the economy.[36]

This rule of thumb raises one relevant question: how to make sure the rent is re-invested properly. It is inevitable that the government has a great role to play due to the important amount it receives in royalties. This statement raises two other important issues: 1) How much of the economic rent from the production of oil is appropriated by the government and 2) how effectively does government uses the increased revenue from oil royalties to create a sustainable productivity level in the province.

In order to answer the first question, while the choice of a taxation system goes well beyond the scope of this report, it is important to acknowledge that there is an important debate surrounding the effectiveness of the royalty system currently in use in Newfoundland and Labrador. In their 2010 report, researchers Jack Mintz and Duanjie Chen founded that Newfoundland and Labrador has a negative marginal effective tax and royalty rate, that the royalty system is needlessly complex and that it distorts investment in oil and gas projects. To resume, Mintz and Chen believe that Newfoundland and Labrador is a poor rent collector and should simplify its system to adopt a 25 per cent flat rate. However, those findings are challenged by Professor Wade Locke (2010) of the Memorial University, who believes that there is insuffient evidence to justify changing the royalty system. Locke believes that many assumptions made in the Mintz and Chen report are false, and that the solution proposed in this report would have a disastrous effect on the province's prosperity.

[36] The Hartwick's rule proposes that it is possible to maintain a maximal level of consumption if all the rent from the extraction of a non-renewable natural resource is invested in the form of capital (either physical of human). However, one of the main assumptions of this model is that the elasticity of substitution between natural resources and reproducible capital/labour-and-capital good is no less than unit elastic. In other word, it is relatively easy to replace a unit of natural capital with a unit of human or physical capital and maintain the same level of production. It is unclear if such an assumption holds true for Newfoundland and Labrador's economy. However, the Hartwick's rule remains relevant, as investing the rent of natural capital in human and physical capital would moderate the decrease in labour productivity following the end of oil production.

Nevertheless, it is estimated that, with the actual system of royalties, $42 billion are to be received by the Newfoundland and Labrador government in the next two decades, adding to the $10 billion already received during the last decade.

Now let's turn to the second question: how can government effectively use the increased revenue from oil royalties in order to create sustainable productivity level in the province. If we agree with the Hartwick rule that those revenues should be reinvested in reproducible capital, the question becomes what type of investment should be done for meeting this recommendation?

Investing in human capital would be one of the first options. Although we cannot say that Newfoundland and Labrador lagged greatly behind the national average in terms of educational attainment, improvements can be made. In the section on human capital, we established that Newfoundland and Labrador had, in 2010, the least educated population over 15 years old (12.6 years vs. 13.1 years for Canada) and was the province with the lowest ratio of the population holding a university degree, at 12.0 per cent (vs. 20.9 per cent in Canada). According to an important OECD report published in 2003, a 1 year increase in average years of education increases GDP per capita by 4 to 7 per cent (see Appendix Table 5). The sole action of reducing the gap between Canada's and Newfoundland and Labrador's average years of schooling could therefore increase the province's GDP per capita by 2 to 3.5 per cent.

However, it is important to understand that any policy aimed at increasing human capital should be linked to a policy aimed at limiting the "brain drain", or the emigration of educated residents of the province. We already discussed the extent of this brain drain in Newfoundland and Labrador in the section on demographic developments, and established that the brain drain is real and represents a threat to the accumulation of human capital in the province. In 2007, the Newfoundland and Labrador Skills Task Force released a report called: *All the Skills to Succeed,* in which they recommended several policy recommendations for the retention and recruitment of skilled workers in Newfoundland and Labrador.[37] They recommended the development of common messages on the benefits of staying in Newfoundland and Labrador for use in promotional materials, the introduction of financial initiatives to encourage post-secondary students to live in the province, the maintenance or enhancement of the federal funding support for student employment initiatives and the support of initiatives in the provincial Immigration Strategy that speak to the improved recognition of foreign credentials and the successful integration of immigrants into the workforce.

Whether the policy that is adopted by the Newfoundland and Labrador government is aimed at retaining workers who already live in the province or at increasing the immigration of

[37] This report also contains many policy recommendations on how to ensure an appropriate and responsive training, education and support system to meet labour market demands, both now and in the coming years. This includes how to improve the access to, as well as the performance and outcome of skilled trades and technical professions and how to improve apprenticeship programs and opportunities for journeypersons.

skilled workers, it is important to remember that migration decisions are almost always family decisions. The objective of attracting professionals to Newfoundland and Labrador will be a success if it can offer a diversified set of professional opportunities and adequate recreational and educational facilities. The establishment of regional service centres, with easy access by road, is one recommendation that would provide a basis for this strategy and that has been previously suggested for Newfoundland and Labrador (Brett, 2003).

Turning back to the productivity drivers identified in the 2003 OECD report, it identified that a 1 percentage point increase in private non-residential investment as a share of GDP will raise GDP per capita by 1.3 per cent. Investment as a share of GDP was highly variable during the 1997-2010 period in Newfoundland and Labrador, ranging from 35.0 per cent in 1997 to 11.6 per cent in 2007. Unfortunately, since much of the investment data are confidential at the provincial level, it is impossible to know what proportion of those investments went into the mining and oil and gas industries and in the other sectors of the economy, and it therefore hard to say if the level of investment in the non-mining and oil and gas sector during the 1997-2010 period was sufficient to assure a sustainable level of labour productivity.

At last, the key to sustaining the high level of productivity and standards of living in Newfoundland and Labrador relies on innovation. In 2010, business sector R&D as a share of total economy GDP was 0.28 per cent compared to 0.99 per cent in Canada. Total R&D was not significantly better, with R&D intensity (defined as the ratio of R&D expenditures to nominal GDP) representing half of the Canadian average, good for the 9th position among all Canadian provinces.

The need for Newfoundland and Labrador to increase the amount of R&D is recognized by professor Wade Locke (2003:197) of the Memorial University: "While local businesses can benefit via the diffusion of technology from elsewhere, the benefits that result from adopting research and development performed in other jurisdictions is tied to the capacity of the receptor companies to absorb that research and development, [...] which is tied directly to their own capacity to undertake research and development". In order to correct this lack of innovation in the province, Locke makes some recommendations in order to optimize the benefits flowing from knowledge-based activities in the province's economy. Among them, he recommended that the degree of collaboration between Memorial University, businesses, labour and provincial and federal governments increases, particularly in relation to the problems that are important for the local economy. He also suggested that federal innovation funding programs should be designed so that provinces such as Newfoundland and Labrador capture a greater share of these funds, that the federal government alter the eligibility criteria utilized for its investment tax credit so that more local companies can qualify for the tax credit, and that the provincial government should focus on the retention of high-knowledge workers.

Nevertheless, even though the Newfoundland and Labrador government could increase its expenditures in R&D, the business sector needs to take a greater place in innovation, as shown by the low level of BERD intensity in the province. Yet, it is not an easy task for government to incent businesses to increase spending on innovation. A recent article by Kevin Lynch, former Clerk of the Privy Council, and Munir Sheikh, former Chief Statistician of Canada (Lynch and Sheikh, 2011) suggests some general principles for fostering productivity growth through innovation and the limitations of the role of government in this process. They write:

> We need a stronger culture of innovation in our business community, with greater managerial focus on continual innovation and productivity and less risk aversion to change. There are clear limits to the effectiveness of policy support by government unless corporate management teams understand and value innovation as a key business strategy for competitiveness and growth.

On this account, it is important to acknowledge that the government of Newfoundland and Labrador (through the Department of Innovation, Trade and Rural Development) made a step in the right direction when they launched, in 2006, their new innovation strategy called *Innovation, Newfoundland and Labrador: A Blueprint for Prosperity*. It identifies the four following strategic directions to increase innovation in the province:

- Fostering a culture of innovation that encourages new ideas and collaboration among business, labour, government, educational institutions and other stakeholders throughout the province
- Positioning Newfoundland and Labrador as a competitive economy with internationally-recognized strengths and advantages
- Broadening education and skills development and aligning them with the future economic direction and labour market development needs of the province
- Supporting enhanced R&D capacity, and improving financing and investment tools to facilitate commercialization

In order to achieve those goals, the government's economic development department was renamed the Department of Innovation, Trade and Rural Development, a new Innovation, Research and Advanced Technologies Branch was created and the government created a Crown corporation, the Research & Development Corporation (RDC), which provides leadership, strategic focus and investments in order to strengthen and improve the research system throughout the province. While it is beyond the scope of this report to assess the effectiveness of this new strategy, some important points regarding innovation, education and productivity growth can be highlighted from the 2013 budget of the province:

- An additional $5.2 million in order to help increase the number of certified apprentices and tradespersons.

- The continuation of the early childhood learning strategy, a three-year $4.8 million investment. Early childhood education is a component of human capital that we highlighted as deficient in the province during the 1997-2010 period.

- The consolidation of more than 20 programs that help businesses diversify and grow under two umbrella funds: the Business Investment Fund and a Regional Development Fund.

- $1.3 million investment by the Research & Development Corporation (RDC) to complete the construction of two new facilities, the Suncor Energy Offshore Innovation Centre and C-CORE's Centre for Arctic Resource Development. The government of Newfoundland and Labrador estimates that the RDC's total investment of $8.8 million will leverage $14.5 million from industry partners.

- Over $200 million to support innovation and development of traditional and emerging industries such as aquaculture, ocean technology, and tourism.

- Important investment in public infrastructures, notably on the completion of the Trans Labrador Highway, one of the largest infrastructure projects in the province's history.

It is also important to highlight that, with its 2013 budget, the government of Newfoundland and Labrador also issued a 10 year sustainability plan. The objective of year 1 (Budget 2013) is to keep the deficit under control. The objective of year 2 is to review post-secondary education and pensions in order to make them as efficient and cost-effective as possible. Finally, the return to surplus is planned in year 3 (budget 2015) while the government plans for year 4 to 10 are continued focus on innovation, economic diversification and debt reduction.

The productivity data provided and analyzed in this report only go up to 2010. However, Statistics Canada recently released data for labour productivity by province up to 2012. It is important to note that their dataset only covers the 2007-2012 period and that overlapping data for the 2007-2010 period are not comparable to the data covered in this report since it uses a different methodology in the calculation of labour productivity, as they reflect recent revisions to the Systems of National Accounts.

According to Statistic Canada, labour productivity declined 5.0 per cent per year between 2010 and 2012 in Newfoundland and Labrador, compared to a 0.5 increase in Canada. The mining and oil and gas extraction sector is the sector that experienced the highest decrease in

labour productivity in the last few years in the province, with its labour productivity decreasing by nearly 40 per cent between 2010 and 2012. Other sectors of the economy experienced important increases in labour productivity, such as the construction and the manufacturing sectors, respectively increasing at 10.0 per cent and 7.6 per cent per year, while the services sector in general experienced a slight decrease in its labour productivity, declining at 0.6 per cent per year between 2010 and 2012.

VI. Further Research

This report answered many questions about trends in Newfoundland and Labrador productivity. However, in doing so, it also highlighted many different topics that would benefit from additional research. Below, we draw attention to some of those topics:

- In this report, we found initial evidences of productivity spill-over effects from the mining and oil and gas sector to the other sectors of the economy. A more in-depth study of this phenomenon would be substantially beneficial to our understanding of the role played by the oil sector in the Newfoundland and Labrador's economy. An analysis of the productivity impacts of all economics-related policies and programs of the Newfoundland and Labrador government would also help in understanding how the government can make sure that such spill-over effects can be maximized.

- It would be interesting to understand the underlying reasons behind the very low ratio of apprenticeship completion to registration ratio during the 1997-2010 period. Although the low ratio could be the consequence of the rapid growth that happened in apprenticeship registration between 1997 and 2002, it does not seem to have affected the completion rate in any way.

- There seems to be a strong relationship between the real gross domestic income per capita relative to Canada and the price of energy. It would be interesting to further study the relationship between advantageous terms of trade for Newfoundland and Labrador (higher price for oil and gas products) and the relative purchasing power of the province within Canada.

- The construction sector is the sector that experienced the largest acceleration in labour productivity growth in Newfoundland and Labrador in comparison to Canada after the beginning of oil production in the province. It is also one of the few sectors where the labour productivity level is higher in the province than in Canada as whole. A more comprehensive study of those developments is needed.

- Although not highly related to labour productivity, it would be interesting to know the underlying causes of the increased incidence of workplace fatalities in the province relative to Canada.

VII. Conclusion

This report has provided a detailed analysis on the trends of labour productivity in Newfoundland and Labrador as well as on the trends in capital and multifactor productivity. As the mining and oil and gas sector has become the dominant industry of the province during the 1997-2010 period, labour productivity has increased at an impressive rate of 3.86 per cent per year and Newfoundland and Labrador has become the most productive province in terms of real GDP per hour worked. During this period, 12 of the 15 sectors identified in this study experienced higher growth in labour productivity in Newfoundland and Labrador than in Canada.

Yet, to say that the mining and oil and gas sector played an important role is an understatement. Growth in the labour productivity of this sector explains 78.2 per cent of the aggregate labour productivity growth in the provinces, and explained 114.4 per cent of the difference between the province's and Canada's level of labour productivity.

The challenge for the Newfoundland and Labrador government is to identify and develop policies that will assure prosperity and a high level of productivity in the post-oil production period. If we look at the drivers of productivity, Newfoundland and Labrador, without having a bad performance *per se*, still has place for improvement. This report highlighted that the province has the population with the lowest average years of education and that business R&D intensity is one of the lowest in the country, at only a quarter of the national average. Fortunately, it is encouraging to see that those challenges have been recognized by the Newfoundland and Labrador government in their 2006 innovation plan, and that investment in education and innovation were important parts of their recent budgets.

The data series used for productivity estimates in this report only go to 2010. More recent data from other Statistics Canada series show that Newfoundland and Labrador's productivity performance deteriorated significantly in 2011 and 2012, driven mostly by the mining and oil and gas sector where labour productivity dropped by 40 per cent between 2010 and 2012 due to an important fall in oil production.[38] From this perspective, productivity continues to represent a major challenge for the province. With the falling labour productivity in the mining and oil and gas extraction sector, the enactment of public policies that would allow the creation of a sustainable level of labour productivity is fundamental.

[38] A detailed table containing labour productivity growth rates for all two-digit NAICS sectors in Newfoundland and Labrador and Canada between 2010 and 2012 can be found in the appendix tables.

Bibliography

Almon, Michael-John and Tang, Jianmin (2011) "Industrial structural change and the post-2000 output and productivity growth slowdown: a Canada-U.S. comparison," *International Productivity Monitor*, No. 22, Fall, pp. 44-81.

Atlantic Provinces Economic Council (2013) Major Projects 2013: Atlantic Investment Potential Continues to Improve

Brett, Craig (2003) Demographic Trends and Implications for Public Policy, Royal Commission on Renewing and Strengthening Our Place in Canada

CBC News (2012, June 22), Mizzen oil discovery far from a sure thing, *CBC News*, Retrived from http://www.cbc.ca

Center for The Study of Living Standards (2012), The Alberta Productivity Story, 1997-2010

Conference Board of Canada (2013) Provincial Outlook Long-Term Economic Forecast for Newfoundland and Labrador: 2013, 36 p.

Coulombe, Serge (2011). Lagging Behind: Productivity and the Good Fortune of Canadian Provinces, *Commentary No 331*, C.D.Howe Institute, Toronto, http://www.cdhowe.org/pdf/Commentary_331.pdf

Coulombe, Serge and Jean-François Tremblay (2009) Migration and skills disparities across the Canadian provinces, *Regional Studies*, 43:1: 5-18

Department of Finance. Economic Review 2009. (2012) St. John's: Government of Newfoundland and Labrador

Department of Finance. Economic Review 2012. (2012) St. John's: Government of Newfoundland and Labrador

Department of Finance. Productivity and Productivity Growth: Newfoundland and Labrador Government of Newfoundland and Labrador, 2003

Department of Innovation, Business and Rural Development, Innovation (2006) Newfoundland and Labrador: A Blueprint for Prosperity, Newfoundland and Labrador's government, Saint John

Diewert, Erwin (2008) "The measurement of nonmarket sector outputs and inputs using cost weights," Discussion Paper 08-03, Department of Economics, University of British Columbia.

Jorgenson, Dale W. (2001) "Information technology and the U.S. economy," *American Economic Review*, Vol. 91, No. 1, pp. 1-32.

Jorgenson, Dale W., Mun S. Ho, and Kevin J. Stiroh. (2005) "Growth of U.S. industries and investments in information technology and higher education," in *Measuring capital in the new economy*, C. Corrado, J. Haltiwanger, D. Sichel (eds.) (Chicago, IL: University of Chicago Press).

Krugel, Lauren (2013, 18 February) "Fracking fears rise in Newfoundland as junior explorers hunt for shale oil",*National Post*, Retrieved from http://business.financialpost.com

Fusco, Leah (2007), "Offshore Oil: An Overview of Development in Newfoundland and Labrador", *Oil, Power and Dependency*, Memorial University

Lee, Beatrix and Wulong Gu (2013), "Productivity and Economic Growth in the Canadian Provinces, 1997 to 2010", The Canadian Productivity Review. 30

Locke, Wade and Scott Lynch (2003) What Does Newfoundland and Labrador Need to Know About the Knowledge-Based Economy to Strengthen Its Place in Canada?, Royal Commission on Renewing and Strengthening Our Place in Canada

Locke, Wade (2010). Do Newfoundland and Labrador royalties subsidize offshore oil and gas investments? : an independent assessment of the claims made in Mintz and Chen (2010) and Mintz (2010), St John's, N.L. : Leslie Harris Centre of Regional Policy and Development, Memorial University

Locke, Wade (2011) "Newfoundland and Labrador, from Austerity to Prosperity –and Back to Austerity (?): Planning to Avoid a Financial Crisis", *Newfoundland Quarterly*, 104.2, p.39-41

Locke, Wade and Strategic Concepts, Inc. (2012) " Economic Impact Analysis of Iron Ore Mining Industry in Labrador 2011-2031", Prepared for Department of Natural Resources, Government of Newfoundland and Labrador

Lynch, Scott (2007) "The Absence of Opportunity and the Prospect of Prosperity: Understanding the Dynamics of Out-Migration within Newfoundland and Labrador", The Harris Centre

Natural Resources Canada (June 2012), "Capital Investment in the Mining Sector Reaches a Record $12.5 Billion in 2011 and Is Expected to Climb in 2012", *Information Bulletin*, retrieved from http://www.nrcan.gc.ca/minerals-metals/publications-reports/4479

Newfoundland and Labrador Skill Task Force (2007) All The Skills To Succeed

Marshall, Thomas.W. (2012) "Newfoundland and Labrador Budget Speech 2012 - People and Prosperity: Responsible Investments for a Secure Future" delivered by honourable Thomas

W. Marshall, Minister of Finance and President of Treasury Board, in the house of the assembly, Tuesday, 24th April, 2012

Mintz, Jack.M. and Duanjie Chen (2010). Taxing Canada's Cash Cow: Tax and Royalty Burdens on Oil and Gas Investments, University of Calgary, School of Public Policy, 19 p.

Murray, Alexander and Andrew Sharpe (2011) "Human Capital and Productivity in British Columbia" CSLS Research Report 2011-10 (Ottawa: Centre for the Study of Living Standards).

OECD (2001) *Measuring productivity – Measurement of aggregate and industry-level productivity growth* (Paris: OECD).

Office of Immigration and Multiculturalism (2007) "Diversity – Opportunity and Growth", Newfoundland and Labrador department of Human Resources, Labour and Employment, St John's, NL

Osberg, Lars and Andrew Sharpe (2011), "Beyond GDP: measuring economic well-being in Canada and the provinces,1981-2010", CSLS Research Report 2011-11 (Ottawa: Centre for the Study of Living Standards)

Sharpe, Andrew (2006) "The relationship between ICT investment and productivity in the Canadian economy: a review of the evidence," CSLS Research Report 2006-05 (Ottawa: Centre for the Study of Living Standards).

Sharpe, Andrew, Jean-Francois Arsenault and Daniel Ershov (2007) "The Impact of Interprovincial Migration on Aggregate Output and Labour Productivity in Canada, 1987-2006", *International Productivity Monitor*, No. 15, Fall, pp. 25-40.

Sharpe and Currie (2008) "Competitive Intensity as a Driver of Innovation and Productivity Growth: A Synthesis of the Literature". CSLS Research Report 2008-03 (Ottawa: Centre for the Study of Living Standards).

Sharpe, Andrew and Eric Thomson (2010a) "New estimates of labour, capital and multifactor productivity growth and levels for Canadian provinces at the three-digit NAICS level, 1997-2007," CSLS Research Report 2010-06 (Ottawa: Centre for the Study of Living Standards).

Sharpe, Andrew and Eric Thomson (2010b) "Insights into Canada's abysmal post-2000 productivity performance from decompositions of labour productivity growth by industry and province," *International Productivity Monitor*, No. 20, Fall, pp. 48-67.

Sharpe, Andrew and Ricardo de Avillez (2010) "Canada-U.S. ICT investment in 2009: the ICT investment per worker gap widens," CSLS Research Report 2010-08 (Ottawa: Centre for the Study of Living Standards).

Solow, Robert M. (1986) "On the Intergenerational Allocation of Natural Resources" Scandinavian Journal of Economics, 141-149

Statistics Canada (2007) *North American Industry Classification System (NAICS) – Canada*, Cat. No. 12-501-XIE (Ottawa: Statistics Canada).

Statistics Canada (2008) *Guide to the income and expenditure accounts*, Cat. No. 13-017-X, (Ottawa: Statistics Canada).

Statistics Canada (2011) *Literacy for life: further results from the Adult Literacy and Life Skills Survey*, Cat No. 89-604-X (Ottawa: Statistics Canada).

Van Ark, Bart (2002) "Understanding productivity differentials among OECD countries: a survey," in *The Review of Economic Performance and Social Progress – Towards a Social Understanding of Productivity*, Vol. 2, A. Sharpe, F. St-Hillaire, K. Banting (eds.) (Ottawa: Institute for Research and Public Policy and The Centre for the Study of Living Standards).

Yu, Kam. (2004) "Measurement of government output", forthcoming in *Essays on price and productivity measurement*, Vol. 3, W.E. Diewert, B. Balk, D. Fixler, K. Fox, and A.O. Nakamura (eds.) (Victoria: Trafford Publishing).

Appendix 1: Labour Productivity and Living Standards

In part I, we noted that there is a link between labour productivity and living standards. In this subsection, we explain the nature of this link. According to van Ark (2002:69), labour productivity affects social progress on two fronts:

> The first and more obvious reason is that, together with a greater use of labour, productivity positively contributes to per capita income, which is a reasonable proxy for living standards in a country. The second reason is that labour productivity growth often reflects the accumulation of intangible capital, which itself contributes to social progress, as workers become equipped with more human capital, more knowledge and access to networks, and which may ultimately even lead to the creation of more social capital.

Our main focus here is the first reason highlighted by van Ark: the relationship between GDP per capita and labour productivity.[39] Using a simple growth accounting framework, GDP per capita can be decomposed into a number of determinants:

Exhibit 1: Decomposition of GDP per Capita into Labour Productivity and Labour Supply Components

$$\frac{GDP}{Population} = \frac{GDP}{Hours\ Worked} \times \frac{Hours\ Worked}{Employment} \times \frac{Employment}{Labour\ Force} \times \frac{Labour\ Force}{Working\ Age\ Population} \times \frac{Working\ Age\ Population}{Total\ Population}$$

GDP per Capita	Labour Productivity (LP)	Hours Worked per Person Employed (HWPE)	1-Unemployment Rate (1-UR)	Labour Force Participation Rate (LFPR)	Working Age Population Share (WAPS)

Note: The definition of working age population used here encompasses persons fifteen years and older.
Source: Adapted from The Conference Board of Canada, 2009.

According to Exhibit 1, GDP per capita is driven by labour productivity (LP) and labour supply, which affects GDP per capita through four different terms (HWPE, UR, LFPR, and WAPS).[40] Exhibit 1 shows the factors that contribute to the *levels* of GDP per capita. To see how each of these factors contribute to the *growth rate* of GDP per capita, we take the log of both sides and differentiate with respect to time, which leads to:

$$\Delta GDP\ per\ Capita = \Delta LP + \Delta HWPE + \Delta(1 - UR) + \Delta LFPR + \Delta WAPS$$

[39] For a detailed discussion on how labour productivity affects the accumulation of intangible capital, refer to van Ark (2002).
[40] The reader should bear in mind that this is one of many possible GDP per capita decompositions. In the end, GDP per capita is determined by a number of different factors that are not highlighted here, such as terms of trade.

where Δ denotes percentage point changes.

Note that four out of the five factors shown above have an upper bound, i.e. there is a clear limit as to how much hours worked per person employed, per cent employed in the labour force, labour force participation rate, and working age population share can rise. Labour productivity, on the other hand, can grow indefinitely, driven on the long-run by innovation and technological change, and therefore plays a vital role in increasing GDP per capita.

We estimated the contribution of the different factors to GDP per capita in Newfoundland and Labrador over the 1997-2010 period.[41] In 2010, Newfoundland and Labrador had a GDP per capita of $50,812 (chained 2007 dollars), up from $30,307 (chained 2007 dollars) in 1997, which entails an average growth rate of 4.12 per cent per year.[42] As Table 38 and Chart 82 show, labour productivity growth accounted for 2.72 percentage points of GDP per capita growth over the entire period, 66.1 per cent of total growth. Of the four labour supply terms, hours worked per person employed was the only one that had a negative contribution (-0.29 percentage points), while the unemployment rate, the labour force participation rate, and the demographic participation rate all had positive contributions. The increase in the labour participation rate had a significant impact on the growth of GDP per capita, contributing to 23.8 per cent of this growth.

Table 38: Sources of GDP per Capita Growth in Newfoundland and Labrador, 1997-2010

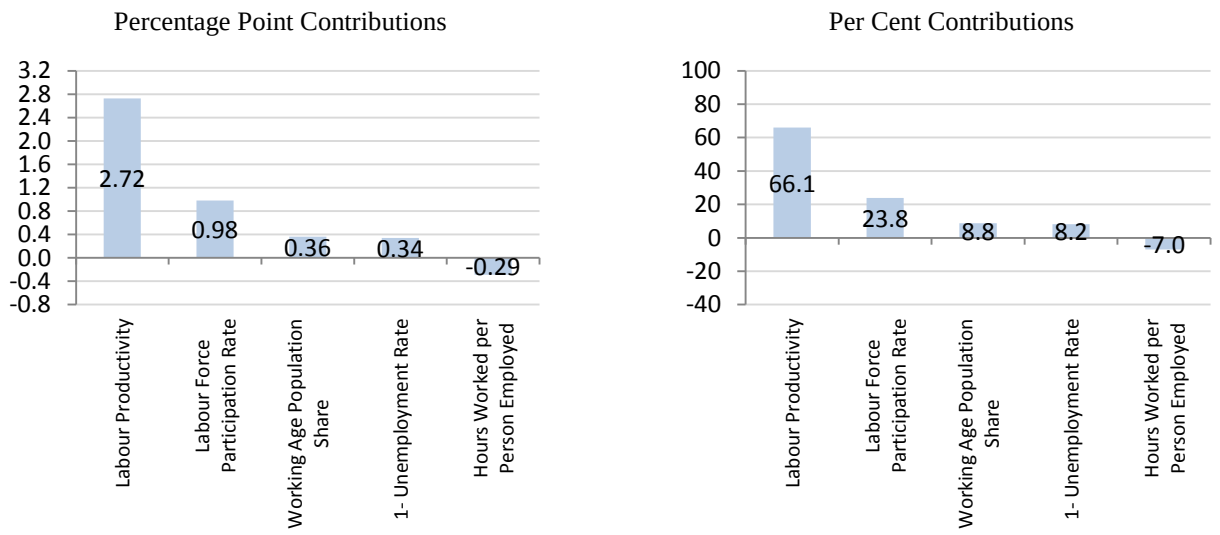
	1997-2010	1997-2000	2000-2010
	(percentage point contribution)		
GDP per Capita	4.12	6.65	3.37
Labour Productivity	2.72	3.39	2.52
Hours Worked per Person Employed	-0.29	0.26	-0.45
1- Unemployment Rate	0.34	0.60	0.26
Labour Force Participation Rate	0.98	1.73	0.76
Working Age Population Share	0.36	0.64	0.28
	(per cent contribution)		
GDP per Capita	100.0	100.0	100.0
Labour Productivity	66.1	51.0	74.9
Hours Worked per Person Employed	-7.0	3.9	-13.4
1- Unemployment Rate	8.2	9.1	7.7
Labour Force Participation Rate	23.8	26.1	22.4
Working Age Population Share	8.8	9.6	8.4

Source: CSLS calculations

[41] The numbers in this section refer to total economy, not business sector, and hence are slightly different from the numbers used in the rest of the report, which refer to the business sector (either at the provincial level or at the national level). The main reason for this is that it is very hard to talk about a "business sector labour force", and using business sector employment numbers to calculate participation rates would lead to an understatement of the labour force participation rate term. A second difference is that GDP estimates in this section refer to GDP at market prices estimates, instead of GDP at basic prices.

[42] In order to be consistent with Exhibit 1, continuous time growth rates were calculated (as opposed to growth rates that are compounded in discrete time periods).

Chart 82: Sources of GDP per Capita Growth in Newfoundland and Labrador, 1997-2010



Source: CSLS calculations based on Statistics Canada data: 1) GDP (at basic prices) estimates from CANSIM Table 379-0030 linked to CANSIM Table 379-0025; 2) Total population estimates from CANSIM Table 051-0001; 3) Employment, Labour Force and working age population estimates from CANSIM Table 282-0002; 4) Hours worked estimates from CANSIM Table 383-0011.

In 2010 GDP per capita in Canada was $43,568 (chained 2007 dollars), 18.9 per cent lower than in Newfoundland and Labrador. Exhibit 1 can also be used to decompose the sources of the GDP per capita gap between the province and Canada as a whole. Taking the log of the ratio between GDP per capita in Newfoundland and Labrador and Canada gives us the sources of this difference in GDP per capita.

$$ln\left(\frac{GDP\ per\ Capita_{NL}}{GDP\ per\ Capita_{CAD}}\right) = ln\left(\frac{LP_{NL}}{LP_{CAD}}\right) + ln\left(\frac{HWPE_{NL}}{HWPE_{CAD}}\right) + ln\left(\frac{(1-UR)_{NL}}{(1-UR)_{CAD}}\right) + ln\left(\frac{LFPR_{NL}}{LFPR_{CAD}}\right) + ln\left(\frac{WAPS_{NL}}{WAPS_{CAD}}\right)$$

Table 39 and Chart 83 show the results of the above decomposition for 2010. Higher labour productivity levels in Newfoundland and Labrador accounted for $15,822 (chained 2007 dollars) of the $8,234 gap, or 191.9 per cent of the difference between the province's and Canada's level of GDP per Capita. The only other factor that contributed positively to the larger GDP per Capita of Newfoundland and Labrador is the working age population share, accounting for 18.1 per cent of the Newfoundland and Labrador-Canada GDP per capita differential. The other three labour supply factors contributed to reducing the distance between the province's GDP per Capita and the national average. The low labour participation rate and the high unemployment in the province prevented Newfoundland and Labrador's GDP per Capita from being even higher than Canada's, contributing to respectively -64.7 per cent and -41.6 per cent of the difference between their respective level of GDP per capita.

Table 39: Sources of the Newfoundland and Labrador-Canada GDP per Capita Differential, 2010

A) Data

	GDP per Capita	Labour Productivity	Hours Worked per Persons Employed	1 - Unemployment Rate	Labour Force Participation Rate	Working Age Population Share
	(chained 2007 dollars per person)	(chained 2007 dollars per hour worked)			(per cent)	
Newfoundland and Labrador	51,811	70.27	1,720.24	85.6	59.9	83.6
Canada	43,567	50.39	1,731.60	92.0	67.0	81.0

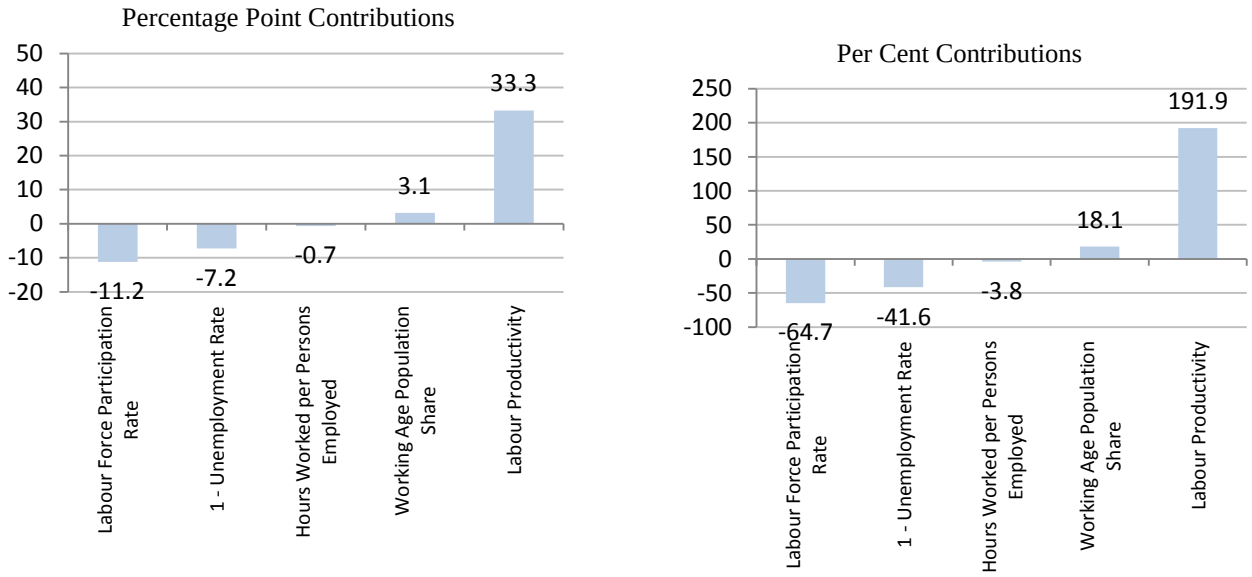
Source: CSLS calculations based on Statistics Canada data.

B) Gap Decomposition

	GDP per Capita	Labour Productivity	Hours Worked per Persons Employed	1 - Unemployment Rate	Labour Force Participation Rate	Working Age Population Share
Gap (chained 2007 dollars)	8,243.89	15,822.11	-313.01	-3,430.00	-5,337.51	1,494.89
Gap (percentage points)	17.3	33.3	-0.7	-7.2	-11.2	3.1
Gap (per cent)	100.0	191.9	-3.8	-41.6	-64.7	18.1

Source: CSLS calculations based on Statistics Canada data.

Chart 83: Sources of the Newfoundland and Labrador-Canada GDP per Capita differential, 2010



Source: CSLS calculations based on Statistics Canada data.

Finally, another element that may increase living standards in a way that is similar to productivity growth is an improvement in terms of trade. By increasing exports prices relative to import prices, a larger quantity of imports can be purchased for a given quantity of exports and

the purchasing power of domestic income rise. Between 1997 and 2010, for the province of Newfoundland and Labrador, improvements in the terms of trade have contributed to a 2.18 per cent annual increase in living standards.[43] This represents a 36 per cent cumulative increase in income over our period of study, a significant increase in living standards. The question that remains surrounding this issue is to what extent Newfoundland and Labrador purchasing power relative to Canada is dependent on the price of oil. In fact, preliminary evidence seems to show that Newfoundland and Labrador is the province whose purchasing power within the federation is the most correlated with energy price.[44]

Personal Income and Gross Domestic Product

Our previous discussion assumed that GDP per capita is a reasonable proxy for living standards. GDP measures the market value of all final goods and services produced within an economy. On the other hand, personal disposable income measures the total income that can be use by individuals for either consumption expenditures or saving. Therefore, disposable income may be closer to the concept of income as commonly understood than the traditional measure of GDP and serve as a better proxy of living standards. In the case of Newfoundland and Labrador, it is interesting to differentiate between the two measures since they grew at different rates during the 1997-2010 period.

First, it is important to notice that measures of income grew faster in Newfoundland and Labrador than in Canada. During the 1997-2010 period, personal disposable income (PDI) per capita grew at 3.12 per cent per year in the province versus only 1.81 per cent per year at the national level. The same trend can be noticed with personal income (3.04 per cent per year vs. 1.52 per cent per year).

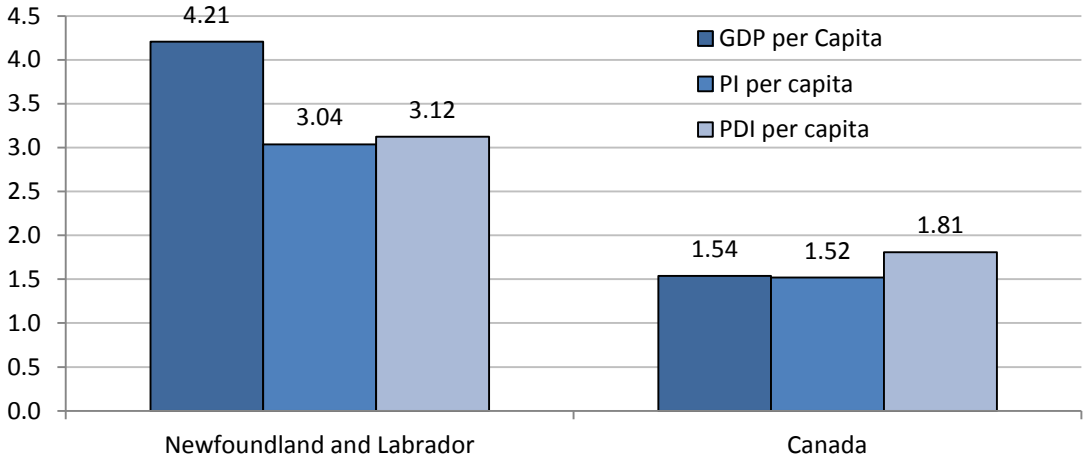
Second, personal disposable income per capita grew at a much slower rate than GDP in Newfoundland and Labrador. Personal income does not measure incomes that are earned but not received such as corporate profits. In the case of Newfoundland and Labrador, where most of the output comes from the production of mining and oil and gas extraction, the amount of those corporate profits are far more important than in any other Canadian province. From 1997 to 2010, corporate profits in Newfoundland and Labrador went from 6.0 per cent to 25.2 per cent of GDP, peaking in 2008 at 36.4 per cent. The Canadian national average for the same period was 11.9 per cent (CANSIM Table 384-0001). Increases in corporate profits would then be a reasonable hypothesis for the important difference between GDP and PDI growth. Yet,

[43] The terms-of-trade changes are estimated here by subtracting the growth of provincial real GDP from the growth of a CPI-deflated provincial nominal GDP. This procedure yields results that are good estimations in comparison to more sophisticated approaches (Coulombe, 2011, p.5).

[44] The coefficient of correlation between Newfoundland and Labrador Real GDI per capita relative to the national average and the Bank of Canada's commodity price index (BCPI) energy subcomponent is of 0.88, the highest of all provinces. The correlation coefficient for Alberta was 0.74.

Newfoundland and Labrador still had the highest growth rate of all provinces in terms of personal disposable income per capita.[45]

Chart 84 : Real GDP, Personal Income and Personal Disposable Income Growth on a per Capita Basis ($2007), Newfoundland and Labrador and Canada, Total Economy, 1997-2010[46]

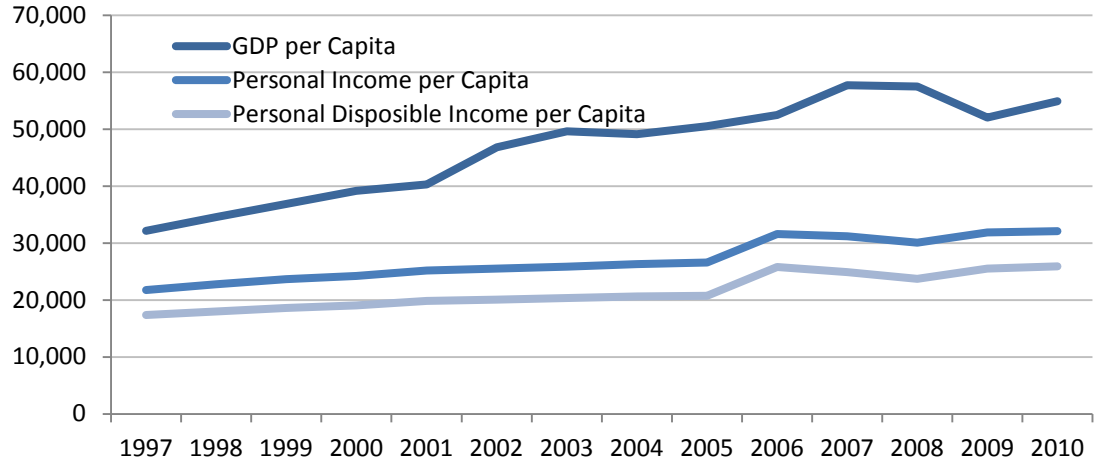


Source: CANSIM Table 384-0012, CANSIM Table 051-000 and CANSIM Table 028-0004
Note: CPI GDP per capita is adjusted using the GDP deflator from CANSIM TABLE 384-0013 while income measurer are adjusted using the CPI from CANSIM Table 326-0021.

[45] Another reason that would explain the difference between the growth in PI and GDP is that personal income is calculated from GNP, which, unlike GDP, defines its scope according to ownership and not location. Therefore, if a firm in Newfoundland and Labrador is owned by foreign citizens, its production counts in GDP but income that leaves the province as dividends are excluded from GNP.

[46] This chart uses the national GDP deflator and CPI for Canada and the provincial GDP deflator and CPI for Newfoundland and Labrador. It is interesting to note that if we use the national GDP deflator and CPI for the province, the real growth rate of GDP is considerably bigger, at 6.17 per cent (vs. 4.21). Measures of personal income growth are virtually the same (2.93 per cent for PI and 3.02 per cent for PDI).

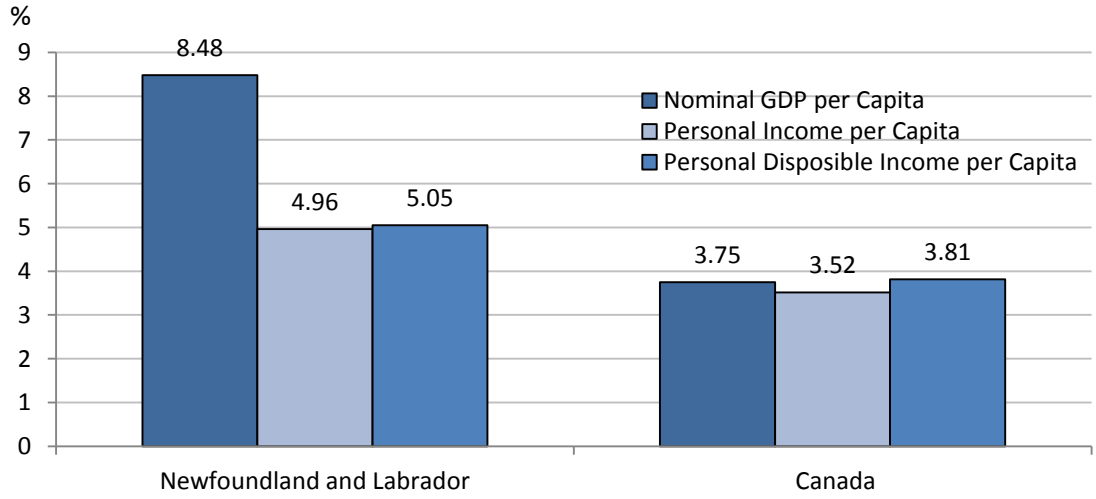
Chart 85 : Real GDP, Personal Income and Personal Disposable Income Growth on a per Capita Basis ($2007), Newfoundland and Labrador, Total Economy, 1997-2010



Source: CANSIM Table 384-0012 and CANSIM Table 051-000

The difference between the GDP and PDI growth rate is even bigger if we look only at nominal values. In this case, personal disposable income per capita grew 5.05 per cent per year in the province, 3.75 percentage points lower than the growth in nominal GDP per capita.

Chart 86 : Nominal GDP per Capita and Personal Disposable Income per Person Growth in Newfoundland and Labrador and Canada, Total Economy, 1997-2010



Source: CANSIM Table 384-0012, CANSIM Table 051-000 and CANSIM Table 384-0001

Although personal income growth is a better measure of improvement in living standards than gross domestic product growth, it is still seen by many as a poor way to measure the evolution of the broadest concept of economic well-being in an economy. Two recent CSLS reports showed that economic well-being have increased in a substantial way in Newfoundland

and Labrador. The first one showed that Newfoundland and Labrador is the province that experienced the highest growth in the Index of Economic Well-being (IEWB) during the 1997-2010 periods, at 3.95 per cent per year (Osberg and Sharpe, 2011). The IEWB is an economic index that comprises the four following domains of economic well-being: consumption flows, stocks of wealth, economic equality and economic security. Newfoundland and Labrador experienced considerable increases in consumption flows, stock of wealth and economic equality, but also experienced a considerable decrease in economic security in comparison to all other Canadian provinces. In 2010, Newfoundland and Labrador had the second highest value of the overall IEWB among Canadian provinces, just behind Alberta. This was an impressive increase if we consider that from 1981 to 2001, Newfoundland and Labrador was the province with the lowest index of economic well-being.

Secondly, the other report showed the evolution of the Human Development Index (HDI) in Canada, a well-known index of human well-being that combines three dimensions: income, education and life expectancy. A 2012 CSLS report showed that between 2000 and 2011, Newfoundland and Labrador was the province that experienced the highest HDI growth, at 0.48 per cent per year (Hazell, Gee and Sharpe, 2012). However, the increase in HDI seems to be driven mostly by an increase in income.

Appendix 2: Decomposing Labour Productivity Growth by Sector[47]

To begin we note that at any given point in time

$$P \equiv \frac{Q}{H} = \frac{\sum Q_i}{H} = \frac{\sum H_i P_i}{H} = \sum P_i \, h_i \qquad (1)$$

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 (1) 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.

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 (2) expresses the absolute change in aggregate labour productivity from period 0 to period 1, $\boldsymbol{\Delta P = P^1 - P^0}$ where superscripts denote the period.

$$\Delta P = \sum h_i^0 \Delta P_i + \sum P_i^0 \Delta h_i + \sum \Delta h_i \Delta P_i \qquad (2)$$

In equation (2) 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 (2) 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 $\Delta\bar{P}$ $\boldsymbol{\Delta\bar{P}}$ from the change in labour productivity in each sector, ΔP_i $\boldsymbol{\Delta P_i}$. 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

[47] This appendix is an extract from Sharpe and Thomson (2010).

makes a negative contribution to aggregate labour productivity growth. The result of these adjustments is equation (3):

$$\Delta P = \sum h_i^0 \Delta P_i + \sum (P_i^0 - \bar{P}^0)\Delta h_i + \sum \Delta h_i (\Delta P_i - \Delta \bar{P}) \qquad (3)$$

We are able to subtract $\bar{P}^0$ from equation (2) 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 sum to zero across sectors.

The three terms in equation (3) 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 12 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.

Data Appendix

Appendix Table 1 : Nominal GDP by Two-Digit NAICS Sectors and Special Industry Aggregations, Newfoundland and Labrador and Canada, 1997, 2000, and 2010

	1997	2000	2010
Business sector industries	**5,858**	**8,591**	**19,919**
Agriculture, forestry, fishing and hunting	301	383	342
Mining and oil and gas extraction	478	2,446	10,041
Utilities	439	435	583
Construction	579	581	1,531
Manufacturing	653	854	958
Wholesale trade	373	419	688
Retail trade	575	701	1,243
Transportation and warehousing	421	404	604
Information and cultural industries	330	410	525
FIRE	765	776	1,186
Professional, scientific and technical services	222	308	616
ASWMRS	88	121	280
Arts, entertainment and recreation	39	33	44
Accommodation and food services	208	242	397
Other private services	388	476	879

Source: CSLS Newfoundland and Labrador Productivity Database.

Appendix Table 2: Nominal GDP Shares by Two-Digit NAICS Sectors, Excluding the Mining and Oil and Gas Extraction Sector, Newfoundland and Labrador and Canada, 1997, 2000 and 2010

	Newfoundland and Labrador			Canada		
	1997	2000	2010	1997	2000	2010
	(as a share of total business sector, per cent)					
Business sector industries	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Agriculture, forestry, fishing and hunting	5.6	6.2	3.5	3.4	3.1	2.4
Utilities	8.2	7.1	5.9	4.4	3.7	3.3
Construction	10.8	9.5	15.5	7.4	7.0	10.4
Manufacturing	12.1	13.9	9.7	24.7	26.5	16.0
Wholesale trade	6.9	6.8	7.0	7.6	7.2	7.9
Retail trade	10.7	11.4	12.6	7.3	7.2	8.4
Transportation and warehousing	7.8	6.6	6.1	6.6	6.2	6.5
Information and cultural industries	6.1	6.7	5.3	4.5	4.5	5.2
FIRE	14.2	12.6	12.0	15.9	15.3	17.3
Professional, scientific and technical services	4.1	5.0	6.2	5.2	6.2	7.5
ASWMRS	1.6	2.0	2.8	2.7	2.9	3.7
Arts, entertainment and recreation	0.7	0.5	0.4	1.0	1.0	1.1
Accommodation and food services	3.9	3.9	4.0	3.4	3.3	3.3
Other private services	7.2	7.8	8.9	6.1	6.0	7.2

Source: Statistics Canada, 1) GDP at basic prices in current dollars, SNA benchmark values, by NAICS, annually (CANSIM Tables 379-0023 and 379-0024; 2) GDP at basic prices, by NAICS and provinces, annually (CANSIM Table 379-0025); 3) LPM- Provinces and Territories (annual) (CANSIM Tables 383-0011).

Appendix Table 3: Nominal GDP Breakdown, Excluding the Mining and Oil and Gas Extraction Sector, Newfoundland and Labrador and Canada, 1997, 2000 and 2008 (as a share of total economy)

	Newfoundland and Labrador			Canada		
	1997-2008	1997	2008	1997-2008	1997	2008
	(as a share of the total economy, per cent)					
Total Economy	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Business Sector Industries*	60.2	60.3	61.9	74.8	73.9	74.0
Owner-Occupied Dwellings	9.3	10.0	9.3	8.1	8.6	8.1
Other Private Services (Non-Business Sector component) **	17.9	16.8	16.7	9.8	9.9	10.4
Public Administration	11.0	11.3	10.5	6.1	6.3	6.3
Other ***	1.7	1.6	1.6	1.2	1.3	1.2

* Unlike Statistics Canada's general definition of the business sector, the CPA's definition of the business sector, which is used here, excludes owner-occupied dwellings.
** Includes non-business establishment classified under education services (NAICS code 61), health care and social assistance (NAICS code 62), and other services (except public administration) (NAICS code 81).
*** Includes non-business establishments classified under NAICS code 11-56, 71, and 72.
Source: Statistics Canada, 1) GDP at basic prices in current dollars, SNA benchmark values, by NAICS, annually (CANSIM Tables 379-0023 and 379-0024; 2) GDP at basic prices, by NAICS and provinces, annually (CANSIM Table 379-0025); 3) LPM- Provinces and Territories (annual) (CANSIM Tables 383-0011).

Appendix Table 4: Average Weekly Hours Worked By Two-Digit NAICS Sectors, Newfoundland and Labrador and Canada, 1997, 2000, and 2010

	1997	2000	2010
Business sector industries	**36.4**	**36.4**	**35.6**
Agriculture, forestry, fishing and hunting	44.4	49.3	49.3
Mining and oil and gas extraction	44.9	44.1	43.0
Utilities	35.8	34.7	34.4
Construction	43.6	43.7	44.8
Manufacturing	38.8	37.3	37.9
Wholesale trade	39.2	39.0	38.0
Retail trade	33.7	32.7	31.3
Transportation and warehousing	36.7	40.5	38.9
Information and cultural industries	34.5	32.1	32.8
FIRE	34.2	36.2	33.9
Professional, scientific and technical services	37.1	35.4	38.9
ASWMRS	29.3	35.4	33.1
Arts, entertainment and recreation	30.3	32.1	30.6
Accommodation and food services	34.3	33.6	32.8
Other private services	58.7	59.6	66.5

Source: CSLS Newfoundland and Labrador Productivity Database.

Appendix Table 5: Sectoral Contribution to Business Sector Labour Productivity Growth Decomposed into Within-Sector, Reallocation Growth Effects, Newfoundland and Labrador, Year-by-Year Calculation, 1997-2010

	Within-Sector Effect	Reallocation Level Effect	Reallocation Growth Effect	Total
	(as a share of total labour productivity change)			
Business sector Industries	76.6	32.7	-9.3	100.0
Agriculture, forestry, fishing and hunting	3.1	2.3	-0.7	4.6
Mining and oil and gas extraction	51.7	31.4	-4.9	78.2
Utilities	0.7	0.1	-1.0	-0.2
Construction	3.4	-1.5	0.6	2.4
Manufacturing	2.6	2.3	-0.5	4.3
Wholesale trade	3.1	0.8	-0.2	3.7
Retail trade	4.5	0.5	-0.4	4.6
Transportation and warehousing	0.2	0.9	-0.1	1.0
Information and cultural industries	2.4	0.4	-0.9	1.8
FIRE	2.8	-0.2	-0.4	2.2
Professional, scientific and technical services	0.1	-2.1	0.0	-2.1
ASWMRS	0.2	-2.0	-0.2	-1.9
Arts, entertainment and recreation	-0.1	-0.2	-0.1	-0.3
Accommodation and food services	0.9	0.4	-0.1	1.1
Other private services	1.1	-0.3	-0.2	0.6

Source: CSLS Calculations based on Newfoundland and Labrador Productivity Database.

Appendix Table 6: Investment Intensity by Two-Digit NAICS Sectors and Special Industry Aggregations, Newfoundland and Labrador and Canada, 1997, 2000, 2009 and 2010

	1997	2000	2009	2010
Business sector industries	**9.54**	**9.12**	**9.71**	**11.82**
Agriculture, forestry, fishing and hunting	2.60	3.80	6.64	..
Mining and oil and gas extraction	..	..	..	..
Utilities	..	..	..	..
Construction	1.12	1.60	2.81	3.45
Manufacturing	5.13	4.61	..	..
Wholesale trade	1.88	3.15	2.18	..
Retail trade	1.49	1.03	1.59	2.07
Transportation and warehousing	..	..	..	..
Information and cultural industries	12.87	..	..	..
FIRE	5.03	..	..	..
Professional, scientific and technical services	..	..	..	..
ASWMRS	..	..	..	..
Arts, entertainment and recreation	..	..	..	..
Accommodation and food services	0.58	0.68	..	..
Other private services	..	..	..	..

Source: CSLS Newfoundland and Labrador Productivity Database.

Appendix Table 7: Early Childhood Education Index, 2011

BENCHMARKS	Value	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC
Integrated Governance											
ECE under common department/ ministry	0.5		0.5		0.5		0.5		0.5		
Common ECE supervisory unit	0.5						0.5				
Common ECE policy framework	1		1			1		1			
Common local authority for ECE management and administration	1										
Funding											
At least two-thirds of child care funding goes to program operations*	1		1	1		1		1		1	
Mandated salary and fee scale	1		1			1		1			
At least 3% of budget devoted to early childhood education	1					1					
Access											
Full day kindergarten offered	1		1	1	1	1	1*				1
50% of 2-4-year-olds regularly attend an ECE program	1					1	1				
Funding is conditional on including children with special needs	1		1**					1			
Learning Environment											
Early childhood curriculum/framework	0.5		0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5
Alignment of early childhood framework with kindergarten	0.5		0.5		0.5	0.5	0.5				0.5
Programs for 2-4-year-olds require at least two-thirds of staff to have ECE qualifications	0.5			0.5		0.5	0.5	0.5			
Kindergarten educators require ECE qualifications	0.5		0.5				0.5				
Salaries for Early childhood educators are at least two-thirds of teacher salaries	0.5					0.5					
ECE professional certification and/or professional development required	0.5	0.5	0.5	0.5			0.5	0.5	0.5	0.5	0.5
Accountability											
Annual progress reports are current and posted (2008 or later)	1		1	1	1	1***		1	1	1	1
Program standards for ECE programs (including kindergarten)	1										
EDI or population measure for preschool leaning collected and reported	1	1	1	1	1	1	1	1	1	1	1
Total	**15**	**1.5**	**9.5**	**5**	**4.5**	**10**	**6.5**	**7.5**	**4.5**	**3**	**4.5**

* Includes special needs funding.

** In Early Years Centres only.

*** Quebec was not a signatory to the federal/provincial/territorial early childhood development agreements where the parties agreed to regular standardized reporting. Quebec has its own mechanisms for public reporting.

Source: http://earlyyearsstudy.ca/en/report/chapter-6-where-are-we-how-far-do-we-have-go/chapter-6-figures/

.

Appendix Table 8: Summary Indicators of Human Capital Performance for the Canadian Provinces, 2010 or Most Recent Year

	N.L.	P.E.I.	N.S	N.B.	Que	Ont.	Man.	Sask.	Alta	B.C.
Input Indicators										
Physical Investment										
1. Real capital investment in the educational services industry, per person aged 5-24 (2002 chained dollars)	5	5	3	9	2	8	10	5	1	4
2. Total real capital stock in the educational services industry, per person aged 5-24 (2002 chained dollars)	8	1	4	9	5	7	10	6	2	3
3. Investment in the educational services industry as a share of total investment (per cent)	5	5	1	10	2	4	9	5	8	3
Educational Expenditure										
4. Total provincial and local government expenditure on education as a share of nominal GDP (per cent)	9	1	2	3	4	6	5	8	10	7
5. Per-student provincial and local government expenditure on education in public elementary and secondary schools (current dollars)	9	10	8	7	6	4	1	2	5	3
6. Per-student provincial and local government expenditure on education at the post-secondary level (current dollars)	7	2	5	9	10	8	4	1	3	6
Output and Outcome Indicators										
High-School Performance and Completion										
7. Mean score (among students aged 15) on the Program for International Student Assessment (PISA) test -- Science	5	9	7	10	4	3	6	8	1	2
8. Mean score (among students aged 15) on the Program for International Student Assessment (PISA) test -- Reading	6	9	8	10	4	2	5	7	1	3
9. Mean score (among students aged 15) on the Program for International Student Assessment (PISA) test -- Mathematics	6	10	8	9	1	3	5	7	2	4
10. High school drop-out rate (per cent of persons aged 20-24 without a high school diploma and not attending school)	2	6	5	4	8	3	10	7	9	1
11. High school completion rate (per cent of population aged 25-64)	10	9	7	8	6	2	5	4	3	1
12. On-reserve aboriginal high school completion rate (per cent of population aged 20-64)	5	1	3	2	7	6	10	8	9	4

	N.L.	P.E.I.	N.S	N.B.	Que	Ont.	Man.	Sask.	Alta	B.C.
Output and Outcome Indicators (continued)										
Post-secondary Enrolment and Completion										
13. Proportion of the population aged 18-29 enrolled in community college or in a university undergraduate program (per cent)	6	7	2	4	1	3	8	10	9	5
14. Graduate university enrolment rate (per cent of population aged 18-29)	3	10	2	8	1	4	7	9	6	5
15. Registered apprenticeship enrolment rate (per cent of population aged 18-29)	2	8	10	9	4	5	7	6	1	3
16. Proportion of the population aged 25-64 with a post-secondary degree or certificate (per cent)	6	7	5	8	2	1	10	9	3	4
17. Proportion of the population aged 25-64 with a university degree (per cent)	10	8	6	9	4	1	5	7	3	2
18. Proportion of the population aged 25-64 with a university degree above a bachelor's degree (per cent)	10	7	3	8	5	1	6	9	4	2
19. Average Number of Years of Education	10	8	4	9	5	2	6	7	3	1
Adult Literacy Standardized Tests										
20. Proportion of the population (aged 16 and over) with at least a Level 3 literacy score in the International Adult Literacy and Skills Survey (per cent) -- Prose literacy	9	7	4	10	8	6	5	3	1	2
21. Proportion of the population (aged 16 and over) with at least a Level 3 literacy score in the International Adult Literacy and Skills Survey (per cent) -- Document literacy	9	7	4	10	8	6	5	3	1	2
22. Proportion of the population (aged 16 and over) with at least a Level 3 literacy score in the International Adult Literacy and Skills Survey (per cent) -- Numeracy	9	8	6	10	7	4	5	3	1	2
23. Proportion of the population (aged 16 and over) with at least a Level 3 literacy score in the International Adult Literacy and Skills Survey (per cent) -- Problem solving	9	8	6	10	7	4	5	3	2	1
Performance of Recent Immigrants with Post Secondary Education										
24. Unemployment Rate of recent immigrants with post-secondary education relative to the overall unemployment rate for persons with post secondary education (per cent)	1	3	4	5	10	9	8	2	6	7
Average Rank										
Input Indicators:	***7.7***	***4.0***	***3.5***	***7.5***	***4.7***	***6.2***	***6.5***	***4.5***	***5.3***	***4.2***
Output and Outcome Indicators:	***6.6***	***7.3***	***5.2***	***7.9***	***5.1***	***3.6***	***6.6***	***6.2***	***3.6***	***2.8***
All Indicators:	***6.8***	***6.5***	***4.8***	***7.8***	***5.0***	***4.3***	***6.5***	***5.8***	***4.0***	***3.2***

Source: Murray and Sharpe, 2011

Appendix Table 9: Quantifying Some Key Growth Drivers*

Impact on level of GDP per capita in steady state

Driving Factor	Definition	Change	Impact	Typical Change over 80s and 90s in OECD
Human Capital	Average years of education	+ 1 Year	4% - 7%	+ 1.5 years in G-7
Physical Capital	Private non-res. Invest. as % GDP	+ 1 pct. pt.	1.3%	Variable
R&D	Business R&D % GDP	+ 0.1 pct. pt.	> 1.2%	About 0.1 pct. pt.
Trade Exposure	Ave of Exp/Imp % GDP	+ 10 pct. pt.	4%	About 10 pct. pts
Tax Burden	Govt. Revenue % GDP	+ 1 pct. pt. (0.6%)	- (0.7%)	About 1.5 pct. pts
Inflation Level	Final Consumption Deflator	- 1 pct. pt.	0.4% - 0.5%	About 4 pct. pts.
Inflation Variability	Standard Deviation	- 1 pct. pt.	2%	About 2/3 pct. pts

* Based on regression analysis of 21 OECD countries over 1971-98.

Source: Nicholson (2003), p. 11.

Appendix Table 10: Recent Developments in Labour Productivity Growth

	Newfoundland and Labrador			Canada		
	2011	2012	2010-2012	2011	2012	2010-2012
Business sector industries	**-2.12**	**-7.72**	**-4.96**	**1.06**	**0.00**	**0.53**
Agriculture, forestry, fishing and hunting	10.69	-9.31	0.19	3.93	1.58	2.75
Mining and oil and gas extraction	-15.59	-28.09	-22.09	-0.39	-7.78	-4.16
Utilities	5.51	-3.44	0.94	1.80	1.30	1.55
Construction	0.88	14.78	7.61	-0.52	-0.52	-0.52
Manufacturing	-3.42	25.24	9.98	1.42	0.60	1.01
Wholesale trade	1.87	3.91	2.89	1.55	1.27	1.41
Retail trade	-0.38	1.52	0.56	1.52	1.49	1.50
Transportation and warehousing	-0.51	-0.77	-0.64	1.92	-0.71	0.60
Information and cultural industries	-3.47	-2.64	-3.06	-0.69	0.93	0.11
Finance and insurance, and holding companies	-13.08	-0.87	-7.18	2.25	-0.26	0.99
Real estate, rental and leasing	3.85	-6.44	-1.43	5.57	-4.73	0.29
Professional, scientific and technical services	-0.98	2.30	0.65	-1.14	1.85	0.34
ASWMRS	-2.87	0.37	-1.26	0.00	-0.36	-0.18
Arts, entertainment and recreation	-7.30	1.82	-2.85	-1.52	-2.31	-1.91
Accommodation and food services	0.51	-1.52	-0.51	0.89	-1.76	-0.45
Other private services	-3.19	-1.23	-2.22	0.61	-0.61	0.00

Source: CANSIM Table 383-0029