April 2011

111 Sparks Street, Suite 500
Ottawa, Ontario K1P 5B5
613-233-8891, Fax 613-233-8250
csls@csls.ca

CENTRE FOR THE STUDY OF LIVING STANDARDS

An Analysis of British Columbia's Productivity, 1997-2007: Manufacturing Shines, despite Overall Sub-Par Performance

CSLS Research Report 2011-03j

Ricardo de Avillez

April 2011

An Analysis of British Columbia's Productivity, 1997-2007: Manufacturing Shines, despite Overall Sub-Par Performance

Executive Summary

The report, based on the CSLS Provincial Productivity Database, provides an overview of British Columbia's productivity performance over the 1997-2007 period. The key findings are the following:

- British Columbia experienced weak labour productivity growth in the market sector from 1997 to 2007, with an average growth rate of only 1.2 per cent per year, significantly below the national average of 1.7 per cent per year. This was due to weak capital intensity growth compared to the national average (1.6 per cent vs. 2.3 per cent), as well as weak labour quality growth (0.1 per cent vs. 0.5 per cent). In terms of labour productivity growth, British Columbia's performance ranks 9th among the provinces, only above Alberta.
- Labour productivity growth in the province was driven mainly by capital intensity growth, which accounted for 52.2 per cent of the increase experienced over the 1997-2007 period. Multifactor productivity growth also played an important role, accounting for 40.6 per cent of labour productivity growth. Finally, a small but steady increase in labour quality was responsible for 6.5 per cent of the labour productivity growth experienced in the province.
- Despite low labour productivity growth overall, the manufacturing and utilities industries in British Columbia had the highest growth rates compared to equivalent industries in the other provinces over the 1997-2007 period (2.9 and 2.1 per cent per year, respectively).
- British Columbia's labour productivity level in 2007 was $32.50 (1997 dollars) per hour, which represents 90.1 per cent of the Canadian level (which implies a labour productivity gap of -9.9 percentage points), down from 95.0 per cent in 1997. The province had the 6th highest labour productivity level among the ten provinces in 2007.
- British Columbia had a negative labour productivity gap relative to Canada in eight of the 15 two-digit NAICS industries. In most cases, the below average capital intensity level was the main culprit.
- Capital productivity in British Columbia's market sector fell at a rate of 0.5 per cent per year during the 1997-2007 period. Declining capital productivity was by no means unique to British Columbia, having happened in six of the ten provinces. Canada's capital productivity declined 0.6 per cent per year over the period. For this reason, the province's capital productivity growth in the market sector ranked 5th in Canada.
- Multifactor productivity in British Columbia's market sector grew at an average rate of 0.5 per cent per year during the 1997-2007 period, slightly above the national average of 0.4 per cent per year. The province ranked 6th in Canada.

An Analysis of British Columbia's Productivity, 1997-2007: Manufacturing Shines, despite Overall Sub-Par Performance

Productivity is the key factor that determines living standards in the long run. If the amount of output each worker produces does not increase, real wages and incomes cannot rise (Sharpe, 2010a). Since 2000, Canada's labour productivity growth has been abysmal, both from an historical and an international perspective (Sharpe and Thomson, 2010b).[1] Improving this poor performance must be a key objective of Canada's economic agenda. To develop policies with this goal in mind, it is important to understand the nature of labour productivity at both the national and provincial levels, including the sources of growth at the market sector and industry levels.

This report analyzes British Columbia's productivity performance over the 1997-2007 period. It is based on the CSLS Provincial Productivity Database. Level and growth rate estimates of labour, capital and multifactor productivity are discussed, with an emphasis on British Columbia's market sector. Two-digit NAICS industry level estimates are also presented.[2]

This report is divided into ten sections. The first section provides a brief overview of basic concepts related to productivity, along with the methodology and the data sources used. Section two discusses British Columbia's industry composition by nominal GDP and total hours worked. Sections three through nine detail British Columbia's productivity performance, focusing on the following topics: labour productivity, capital productivity, multifactor productivity, capital intensity, labour quality, sources of labour productivity growth in the market sector, and sources of labour productivity gap by industry. Section ten concludes. An appendix provides details on the growth accounting framework used in the report.

I. Basic Concepts, Methodology and Data Sources

In this section, we first define the main concepts used in this report, as well as explain important topics related to productivity analysis – such as the difference between partial and total productivity measures, and the distinction between productivity growth rates and levels. This is followed by a brief discussion on methodology and data sources. Although the basics of the growth accounting framework used in the report are presented in this section, its details are only discussed in the Appendix.

---

[1] From 1981 to 2000, labour productivity in Canada's business sector grew at an average annual rate of 1.6 per cent. In the 2000-2009 period, labour productivity growth dropped sharply to a mere 0.7 per cent per year in Canada. This slowdown in labour productivity growth in Canada was not experienced in the United States, which grew at an average annual rate of 2.5 per cent during the same period (up from 2.0 per cent during the 1981-2000 period).

[2] This report builds on and extends earlier CSLS work on provincial productivity. The CSLS Provincial Productivity Database is available at http://www.csls.ca/data/mfp_new.asp. Previous CSLS articles on this topic include Sharpe and Arsenault (2009), Sharpe (2010) and Sharpe and Thomson (2010a, 2010b). A detailed discussion about productivity drivers in British Columbia can be found in Sharpe and Arsenault (2008).

Basic Concepts

Productivity is, broadly speaking, a measure of how much output is produced per unit of input used. The output and input measures used will affect, however, the productivity estimates. In this sub-section, we define the input, output and productivity measures used throughout this paper:

- The **labour services input** is defined as total *quality adjusted* hours worked in a particular sector or in the market sector as a whole. It is the weighted sum of hours worked across different categories of workers, with the weights being equal to relative labour compensation shares.

- **Labour quality** (also known as **labour composition**) is defined residually as the difference between growth in labour services and growth in hours worked (*unadjusted* by quality). In Canada, the variables used to differentiate labour quality 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.[3]

- The **capital services input** represents the flow of services provided by the capital stock. The difference between capital stock and capital services stems from the fact that not all forms 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 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 provide relatively more services per dollar of capital stock (i.e. short lived assets).

- **Capital intensity** is defined as capital services per hour worked.

- **Gross domestic product (GDP)** measures the value of all *final* goods and services produced in a defined geographic region during a certain time period, typically a year or a quarter.

- **Labour productivity** is defined as real GDP per hour worked.

- **Capital productivity** is real GDP per unit of capital services.

- **Multifactor Productivity (MFP)**[4] growth is measured as the difference between real output growth and combined input growth. In other words, MFP reflects output growth that is not accounted for by input growth. The inputs that are taken into account to construct a combined input aggregate vary whether we are calculating MFP using a gross output basis or a value

[3] For more information on how Statistics Canada calculates labour quality, see Gu *et al* (2002).
[4] Also known as total factor productivity (TFP).

added basis. The gross output basis takes into consideration labour, capital, and intermediate inputs, while the value added basis takes into account only capital and labour (because intermediate consumption is already subtracted from value added). Thus, MFP captures the residual effects of several elements of the production process, such as improvements in technology and organizations, capacity utilization, increasing returns to scale, mismeasurement, etc. In this report, MFP growth is calculated on a value added basis.

When discussing productivity, there are two important dimensions to consider. The first is whether productivity is measured using a partial productivity approach or a multifactor productivity approach. The second is whether the focus is on growth rates, levels, or both.

There is a fundamental distinction between partial and multifactor productivity (MFP). Partial productivity measures refer to the relationship between output and a single input, such as labour or capital. Multifactor productivity, on the other hand, attempts to measure how efficiently all factors of production are used in the production process. This report provides estimates for two partial productivity measures – labour productivity (the most commonly used measure of productivity) and capital productivity –, as well as multifactor productivity.

Productivity can be expressed either in growth rates or in levels. The economics literature largely focuses on productivity growth rates, which reflect increases in *real* output per hour or per unit of capital. In this report we are also interested in making level comparisons between provinces. Ideally, productivity level comparisons are done in current dollars (i.e. using *nominal* GDP), as these estimates capture changes in relative prices. However, at the time the CSLS Provincial Productivity Database was constructed, nominal GDP figures at the industry level were available only up to 2005. As a consequence, the productivity levels were calculated using real GDP. One advantage of using real GDP instead of nominal GDP for the level comparisons is that the growth rates and changes in levels are consistent with each other. Regardless of whether nominal or real GDP figures are used for 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.

As mentioned above, this report makes provincial comparisons of both productivity levels and growth rates. These comparisons are done both at the **market sector level** and at the **two-digit NAICS industry level**.[5] The North American Industry Classification System (NAICS) breaks down the economy into 20 sectors:

[5] The words *industry* and *sector* are used interchangeably in this report.

Exhibit A: The North American Industry Classification System (NAICS) at the Two-Digit Level

Sector Number	Description
11	Agriculture, Forestry, Fishing and Hunting
21	Mining, and Oil and Gas Extraction
22	Utilities
23	Construction
31-33	Manufacturing
42	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
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

The market sector is comprised by 17 of the 20 sectors, all of which have been highlighted in Exhibit A. The only three sectors that are not included in the market sector are: education services, health care and social assistance, and public administration. For practical purposes, we have grouped the finance and insurance, real estate, rental and leasing, and management of companies and enterprises sectors into only one sector, which will be referred to as the finance, insurance, real estate, rental and leasing (FIRE) sector. Since this change is only a slight departure from the standard NAICS breakdown, we will still refer to these 15 sectors as NAICS sectors.

The provincial comparisons are done by ranking the productivity growth rates and levels of different provinces from 1 (highest) to 10 (lowest). Each province has two market sector ranks: an **equally-weighted rank** and an **industry composition weighted rank**. The industry composition weighted market sector rank, which will be referred throughout this report simply as the market sector rank, takes into account the province's market sector output, labour input and capital input, which are basically a sum of the outputs and inputs of the 15 two-digit NAICS industries in the province. Thus, it gives more weight to the sectors that comprise a more significant part of the province's economy. The equally-weighted market sector rank, as the name implies, attributes equal weights to all industries. Comparing the two ranks allows for important characteristics of the province's productivity performance to be identified. For instance, a province with a high market sector rank and a low equally-weighted market sector rank in labour productivity growth will most likely have strong labour productivity growth in its largest industries, but low productivity growth in most of the fifteen two-digit NAICS industries.

Lastly, we also perform **growth accounting** exercises in order to measure how different factors contributed to labour productivity growth. Contributions to labour productivity growth were broken

down into three factors: 1) capital intensity[6]; 2) labour quality; and 3) multifactor productivity.[7] Formally, this decomposition is a consequence of the growth accounting framework adopted in this report. However, it is also quite intuitive:

- Workers that have access to more capital (i.e. higher capital intensity) tend to have, *ceteris paribus*, higher labour productivity. Imagine, for example, two teams with two workers each. In the first team, one worker has a shovel and the other has a snow blower. In the second team, both workers have snow blowers. The second team uses capital more intensively than the first, and thus is able to clear much more snow in the same period of time.

- Improvements in labour quality tend to increase the amount of output a worker can produce in a given time period. Thus, an experienced coal miner will normally be able to extract more coal than a novice miner during a given timeframe.

- Technological progress can substantially increase output per worker. A logger with a chainsaw, for instance, is much more productive than one with an axe. This is an example of productivity growth driven by MFP. It should be noted, however, that technological progress is only one of the several possible factors to drive MFP growth.

Methodology and Data Sources

Statistics Canada has detailed the methodologies and data sources used in the preparation of its estimates of multifactor productivity (MFP) at the national level in Baldwin *et al*. (2007). The provincial estimates used in this report have been prepared by Statistics Canada for the Centre for the Study of Living Standards (CSLS) and largely follow the methodologies used for the national estimates. There are, however, certain differences between the national and provincial estimates which are discussed in detail in Sharpe and Arsenault (2009). CSLS supplemented Statistics Canada data by calculating multifactor productivity level estimates for the provinces relative to the Canadian average.[8]

The growth accounting framework used in this report is the same as the one used in Sharpe and Thomson (2010a). It assumes a Cobb-Douglas production function such that:

$$Y = AK^{\alpha}L^{1-\alpha}$$

where *Y* is real output, *K* stands for capital services, *L* for labour input (quality adjusted hours), *A* for multifactor productivity and α is the share of output that takes the form of capital compensation. For more information, refer to the Appendix.

[6] Note, once again, that capital intensity has been defined here as capital services per hour worked, *not* capital stock per hour worked.
[7] To understand the reasons behind this decomposition, refer to the Appendix.
[8] For more details, see Appendix.

II. Industry Composition by Nominal GDP and Total Hours Worked

In order to understand British Columbia's overall productivity performance, it is essential to understand how each of the 15 two-digit NAICS industries contributed to the province's market sector in terms of nominal GDP and actual hours worked. Table 1 details these contribution shares for 1997 and 2007. In British Columbia, the industries that had the highest GDP shares in 2007 were FIRE (finance, insurance, real estate, rental and leasing) (15.9 per cent of the province's nominal GDP in the market sector), manufacturing (12.1 per cent), and construction (10.4 per cent). In terms of total hours worked, the three industries that had the highest contributions in 2007 were retail trade (13.3 per cent of total hours worked), construction (11.6 per cent), and manufacturing (10.8 per cent).

Table 1: Industry Share of Nominal GDP and Total Hours Worked in British Columbia

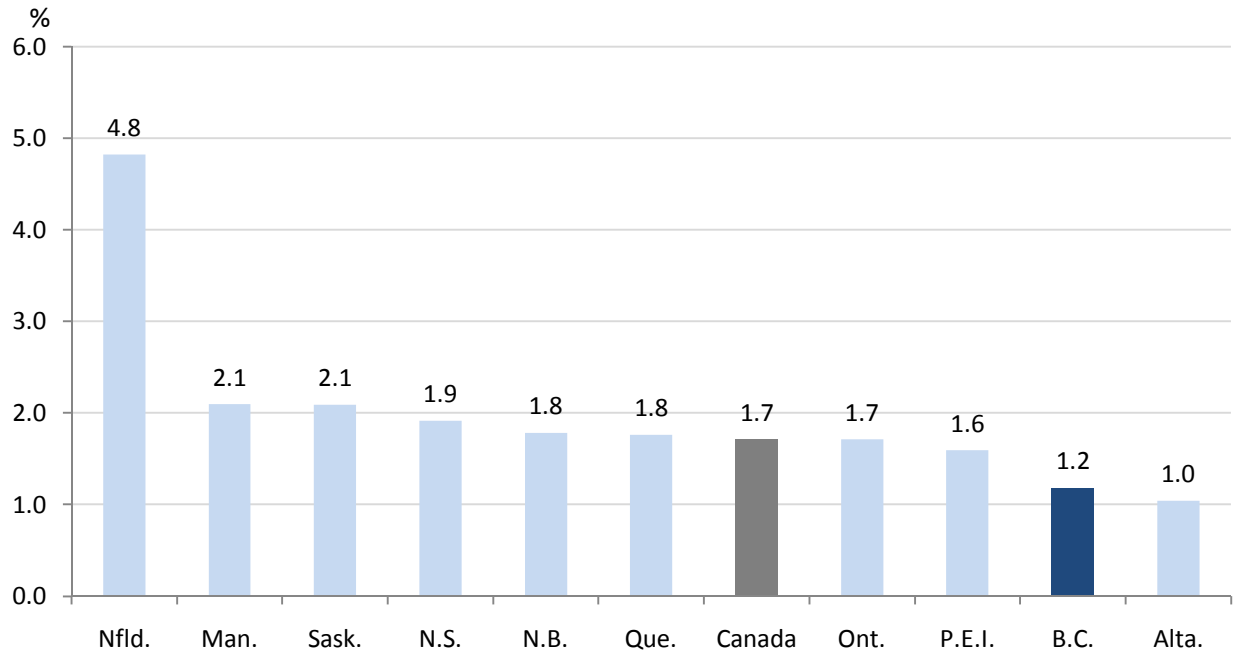
	1997				2007			
	GDP		Hours Worked		GDP		Hours Worked	
	Canada	British Columbia	Canada	British Columbia	Canada	British Columbia	Canada	British Columbia
Market Sector	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Agriculture, Forestry, Fishing and Hunting	3.2	6.0	5.4	5.2	2.1	3.2	3.4	3.8
Mining, and Oil and Gas Extraction	5.5	3.5	1.7	1.2	11.1	7.2	2.0	1.3
Utilities	4.2	3.1	0.9	0.5	3.0	2.5	0.8	0.4
Construction	7.0	8.5	7.9	9.4	9.0	10.4	10.1	11.6
Manufacturing	23.2	15.1	18.3	12.4	16.8	12.1	14.8	10.8
Wholesale Trade	7.1	6.5	7.4	7.0	7.1	6.2	6.9	6.4
Retail Trade	6.9	8.0	13.1	13.9	7.4	8.5	12.9	13.3
Transportation and Warehousing	6.2	8.2	6.3	7.4	5.6	7.5	6.6	7.6
Information and Cultural Industries	4.3	4.6	2.5	2.8	4.3	4.8	2.7	2.5
FIRE*	15.0	16.3	7.5	7.9	14.6	15.9	7.8	7.4
Professional, Scientific and Technical Services	4.9	5.2	6.3	6.7	6.2	6.6	7.9	8.1
ASWMR**	2.5	2.6	4.0	3.8	3.3	3.1	5.7	5.6
Arts, Entertainment and Recreation	0.9	1.1	1.5	1.7	0.9	1.2	1.9	2.5
Accommodation and Food Services	3.2	4.7	7.8	9.6	2.8	4.0	7.0	8.7
Other Services (Except Public Administration)	5.7	6.8	9.4	10.3	5.8	6.8	9.5	9.9

Source: Shares calculated by the CSLS, based on Statistics Canada data (Cansim Table 383-0011).
*Finance, insurance, real estate, rental and leasing **Administrative and support, waste management and remediation services

III. Labour Productivity

Labour productivity, defined as real GDP per hour worked,[9] grew at an average rate of 1.2 per cent per year in British Columbia's market sector during the 1997-2007 period, which is significantly below the national average of 1.7 per cent per year. British Columbia ranks 9th among the provinces in terms of labour productivity growth, only above Alberta (Chart 1).

Chart 1: Labour Productivity Growth in Canada and the Provinces, Market Sector, 1997-2007
(Average Annual Growth Rates)



Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.

During the period in question, the industry that experienced the highest labour productivity growth rate in British Columbia was the information and cultural industry (4.2 per cent per year), followed by wholesale trade (4.0 per cent), manufacturing, and retail trade (both of which grew at an average annual rate of 2.9 per cent) (Table 2). The industry that had the lowest labour productivity growth rate was arts, entertainment and recreation (-3.9 per cent per year), followed by administrative and support, waste management and remediation services (-2.5 per year), and construction (-0.7 per cent).

In terms of labour productivity growth, the province ranked 7th or below in eight of the 15 two-digit NAICS industries. This widespread low labour productivity growth across several industries explains why the province had both the second worst market sector rank (only above Alberta) and the second worst equally-weighted market sector rank (only above Newfoundland). In particular, agriculture, forestry, fishing and hunting, and administrative and support, waste management and remediation services in British Columbia had the lowest labour productivity growth rates among all provinces. Notable

[9] Note that the total hours worked figures used to calculate labour productivity are unadjusted for labour quality.

exceptions were the utilities and manufacturing industries, in which British Columbia had the highest labour productivity growth among the ten provinces.

British Columbia's labour productivity level in 2007 was $32.50 (1997 dollars) per hour, which represents 90.1 per cent of the Canadian level, down from 95.0 per cent in 1997. The province had the 6th highest labour productivity level in Canada in 2007.

In 2007, seven of the 15 two-digit NAICS industries in British Columbia had labour productivity levels above Canada's. In particular the industries with the highest relative levels in the province were utilities (161.9 per cent of the Canadian level), agriculture, forestry, fishing and hunting (143.0 per cent), and mining, and oil and gas extraction (115.5 per cent). The industries that had the lowest relative levels in the province were arts, entertainment and recreation (74.4 per cent of the Canadian level), construction (74.7 per cent), and administrative and support, waste management and remediation services (77.1 per cent).

The three industries that had the lowest relative labour productivity levels in British Columbia in 2007 still managed to have higher levels than equivalent industries in other provinces. Arts, entertainment and recreation, and administrative and support, waste management and remediation services ranked 7th, while construction ranked 8th. Meanwhile, British Columbia's FIRE industry, with a labour productivity level that was 93.1 per cent of Canada's, had the lowest level among all the ten provinces. This might seem surprising, given that its relative level was not as low as that of other industries in British Columbia. However, it is important to keep in mind that the dispersion of labour productivity levels can vary widely between different industries.

Table 2: Labour Productivity Levels and Growth Rates in British Columbia, 1997-2007

	Compound Annual Growth Rate, 1997-2007	Provincial Ranking	Province's Labour Productivity Level Relative to Canada's, 1997	Province's Labour Productivity Level Relative to Canada's, 2007	Labour Productivity Level, 2007	Provincial Ranking, 2007
	(per cent)		(Canada=100)	(Canada=100)	(1997 Dollars)	
Market Sector	**1.2**	**9**	**95.0**	**90.1**	**32.5**	**6**
Agriculture, Forestry, Fishing and Hunting	1.7	10	182.1	143.0	38.8	2
Mining, and Oil and Gas Extraction	0.5	4	87.3	115.5	90.9	4
Utilities	2.1	1	119.4	161.9	217.9	1
Construction	-0.7	9	95.5	74.7	23.8	8
Manufacturing	2.9	1	90.7	96.7	46.2	4
Wholesale Trade	4.0	3	91.3	94.1	39.4	4
Retail Trade	2.9	10	102.8	98.1	21.6	4
Transportation and Warehousing	1.0	3	106.0	109.3	34.7	3
Information and Cultural Industries	4.2	5	90.8	101.4	69.6	7
FIRE*	1.1	9	97.3	93.1	65.5	10
Professional, Scientific and Technical Services	0.5	7	94.4	86.6	23.4	4
ASWMR**	-2.5	10	102.6	77.1	15.3	7
Arts, Entertainment and Recreation	-3.9	6	98.2	74.4	12.0	7
Accommodation and Food Services	0.5	8	113.6	107.4	14.8	2
Other Services (Except Public Administration)	1.3	9	108.9	100.8	16.4	5
Absolute Equally-Weighted Average Rank		6.3				4.8
Equally-Weighted Market Sector Rank		**9**				**5**

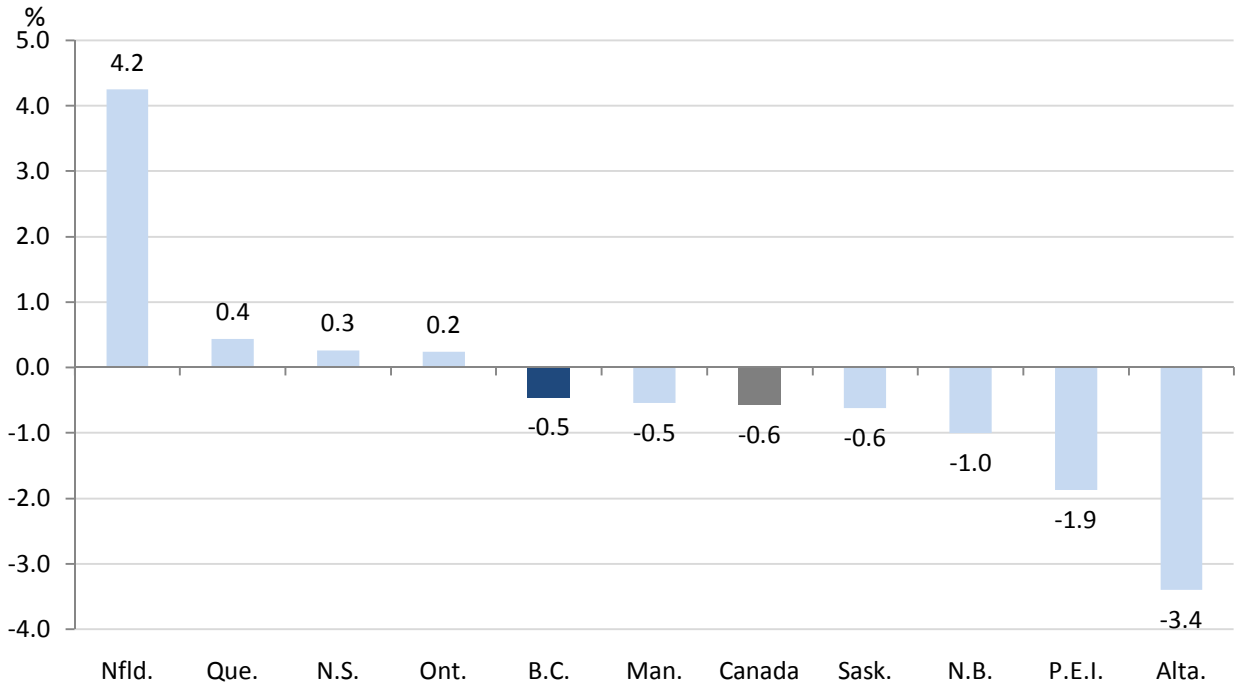
Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.
*Finance, insurance, real estate, rental and leasing **Administrative and support, waste management and remediation services

IV. Capital Productivity

Capital productivity, defined as real GDP per unit of capital services, fell at a rate of 0.5 per cent per year in British Columbia's market sector during the 1997-2007 period. Declining capital productivity was by no means unique to British Columbia, having happened in six of the ten provinces. Canada's capital productivity declined 0.6 per cent per year over the period. The province's capital productivity growth in the market sector ranked 5th in Canada (Chart 2).

In British Columbia, 10 of the 15 two-digit NAICS industries had negative capital productivity growth rates during the period. The industries that had the worst performances were arts, entertainment and recreation industry (-12.1 per cent per year), professional, scientific and technical services industry (-6.9 per cent), and administrative and support, waste management and remediation services (-5.7 per cent) (Table 3). Of the few industries that had positive growth rates, the ones that performed better were manufacturing (5.3 per cent per year), agriculture, forestry, fishing and hunting industry (1.6 per cent), and information and cultural industries (1.5 per cent).

Chart 2: Capital Productivity Growth Rates in Canada and the Provinces, Market Sector, 1997-2007
(Average Annual Growth Rates)



Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.

Compared to the rest of Canada, British Columbia had mediocre capital productivity growth rates at the industry level during the period, with six of the 15 two-digit NAICS industries at 7th place or lower. Arts, entertainment and recreation, and accommodation and food services had the worst capital productivity growth rates among all provinces. In contrast, manufacturing in British Columbia had the highest capital productivity growth in Canada.

British Columbia's capital productivity level in the market sector in 2007 was 115.9 per cent of the Canadian level, up from 114.6 per cent in 1997. In 2007, 10 of the 15 two-digit NAICS industries in the province had capital productivity levels above the Canadian average. The industries with highest capital productivity levels were manufacturing (178.6 per cent of the Canadian level), wholesale trade (146.5 per cent), and mining, and oil and gas extraction (143.6 per cent). The five industries that had capital productivity levels lower than Canada's in 2007 were arts, entertainment and recreation (50.8 per cent of the Canadian level), administrative and support, waste management and remediation services (61.3 per cent), accommodation and food services (78.5 per cent), FIRE (89.0 per cent), and utilities (92.2 per cent).

British Columbia's market sector had the 4th highest capital productivity level in Canada in 2007. The province's equally-weighted market sector rank was even higher, 2nd, only behind Ontario. This reflects the high overall capital productivity level in the province, which ranked 3rd or above in six of the 15 two-digit NAICS industries. British Columbia had the highest capital productivity level in Canada in manufacturing, as well as in wholesale trade and in professional, scientific and technical services.

Table 3: Capital Productivity Levels and Growth Rates in British Columbia, 1997-2007

	Compound Annual Growth Rate, 1997-2007	Provincial Ranking	Province's Capital Productivity Level Relative to Canada's, 1997	Province's Capital Productivity Level Relative to Canada's, 2007	Capital Productivity Level, 2007	Provincial Ranking, 2007
	(per cent)		(Canada=100)	(Canada=100)	(1997 Dollars)	
Market Sector	**-0.5**	**5**	**114.6**	**115.9**	**2.66**	**4**
Agriculture, Forestry, Fishing and Hunting	1.6	7	118.1	113.5	2.38	4
Mining, and Oil and Gas Extraction	-3.2	6	111.1	143.6	1.11	7
Utilities	-0.3	6	94.8	92.2	1.19	6
Construction	1.4	3	113.2	112.8	7.71	3
Manufacturing	5.3	1	125.0	178.6	4.86	1
Wholesale Trade	1.0	4	130.9	146.5	4.65	1
Retail Trade	-1.3	7	117.9	114.6	5.25	5
Transportation and Warehousing	-0.9	3	106.9	119.1	2.87	3
Information and Cultural Industries	1.5	3	108.6	119.4	2.30	2
FIRE*	-2.0	7	99.6	89.0	1.46	6
Professional, Scientific and Technical Services	-6.9	4	119.2	116.9	2.86	1
ASWMR**	-5.7	8	83.1	61.3	1.89	8
Arts, Entertainment and Recreation	-12.1	10	117.0	50.8	1.05	9
Accommodation and Food Services	-4.3	10	117.2	78.5	3.38	9
Other Services (Except Public Administration)	-1.2	4	107.4	103.2	5.49	5
Absolute Equally-Weighted Average Rank		5.5				4.7
Equally-Weighted Market Sector Rank		**7**				**2**

Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.
*Finance, insurance, real estate, rental and leasing **Administrative and support, waste management and remediation services

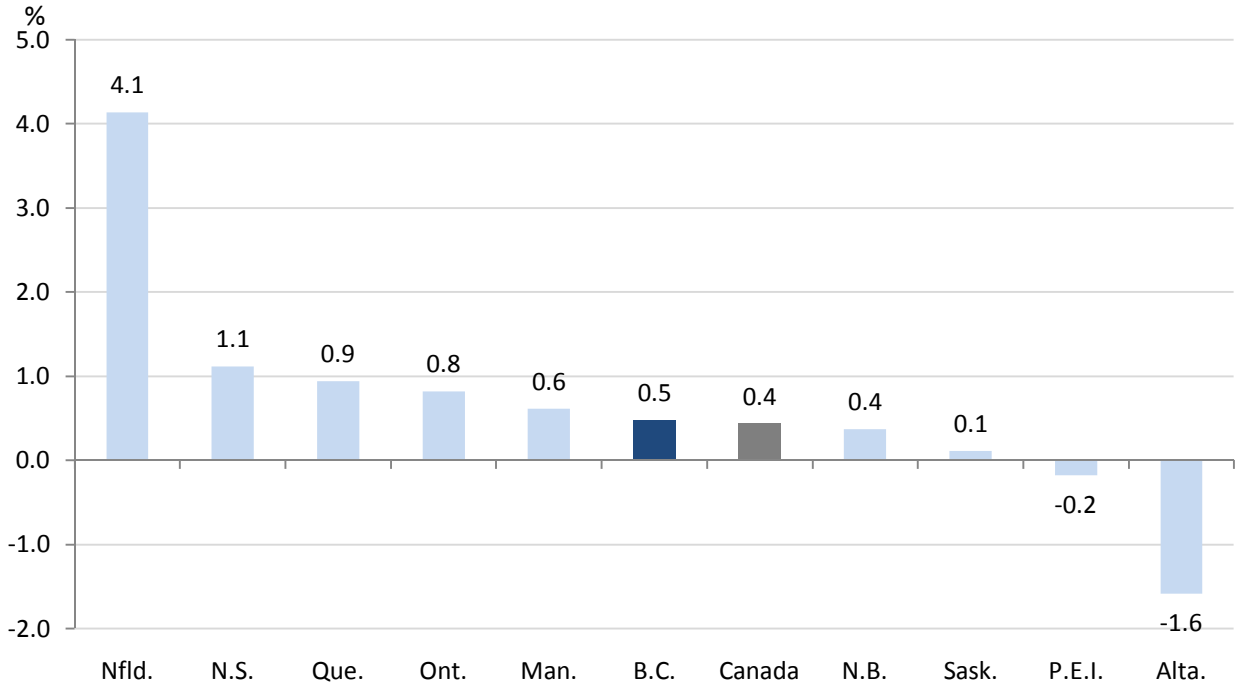
V. Multifactor Productivity

British Columbia's multifactor productivity in the market sector grew at an average rate of 0.5 per cent per year during the 1997-2007 period, slightly above the national average of 0.4 per cent per year. The province ranked 6th in Canada (Chart 3).

The industry that experienced the highest multifactor productivity growth rate in British Columbia was manufacturing (4.0 per cent per year), followed by wholesale trade (3.3 per cent) and information and cultural industries (2.3 per cent) (Table 4). The industries that had the lowest multifactor productivity growth rates were arts, entertainment and recreation (-5.7 per cent per year), administrative and support, waste management and remediation services (-2.6 per cent), and mining, and oil and gas extraction (-2.1 per cent).

In terms of multifactor productivity growth, the province ranked 6th in Canada according to the market sector ranking (it did marginally worse in the equally-weighted market sector rank, 7th place). Of the 15 two-digit NAICS industries, seven were ranked at 7th place or lower. Administrative and support, waste management and remediation services, and accommodation and food services had the worst multifactor productivity growth rates among all provinces. Conversely, manufacturing in British Columbia had the highest multifactor productivity growth in Canada when compared to equivalent industries in the other provinces.

Chart 3: Multifactor Productivity Growth in Canada and the Provinces, Market Sector, 1997-2007
(Average Annual Growth Rates)



Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.

The province's multifactor productivity level in 2007 was 102.5 per cent of the Canadian level, up from 101.5 per cent in 1997. In 2007, 10 of the 15 two-digit NAICS industries in British Columbia had multifactor productivity levels above those of Canada. The industries with highest multifactor productivity levels were mining, and oil and gas extraction (140.2 per cent of the Canadian level), agriculture, forestry, fishing and hunting (137.6 per cent), and manufacturing (125.5 per cent). In contrast, the industries with lowest multifactor productivity levels were arts, entertainment and recreation (68.0 per cent of the Canadian level), accommodation and food services (76.2 per cent), and construction (83.3 per cent).

In terms of multifactor productivity levels, British Columbia's market sector ranked 4th in Canada in 2007 (the province was also 4th place according to the equally-weighted market sector rank). Overall, the province had high levels of multifactor productivity, with five of the 15 two-digit NAICS industries ranking 3rd or above. In 2007, British Columbia had the highest multifactor productivity levels among all industries in manufacturing, as well as in transportation and warehousing and wholesale trade.

Table 4: Multifactor Productivity Levels and Growth Rates in British Columbia, 1997-2007

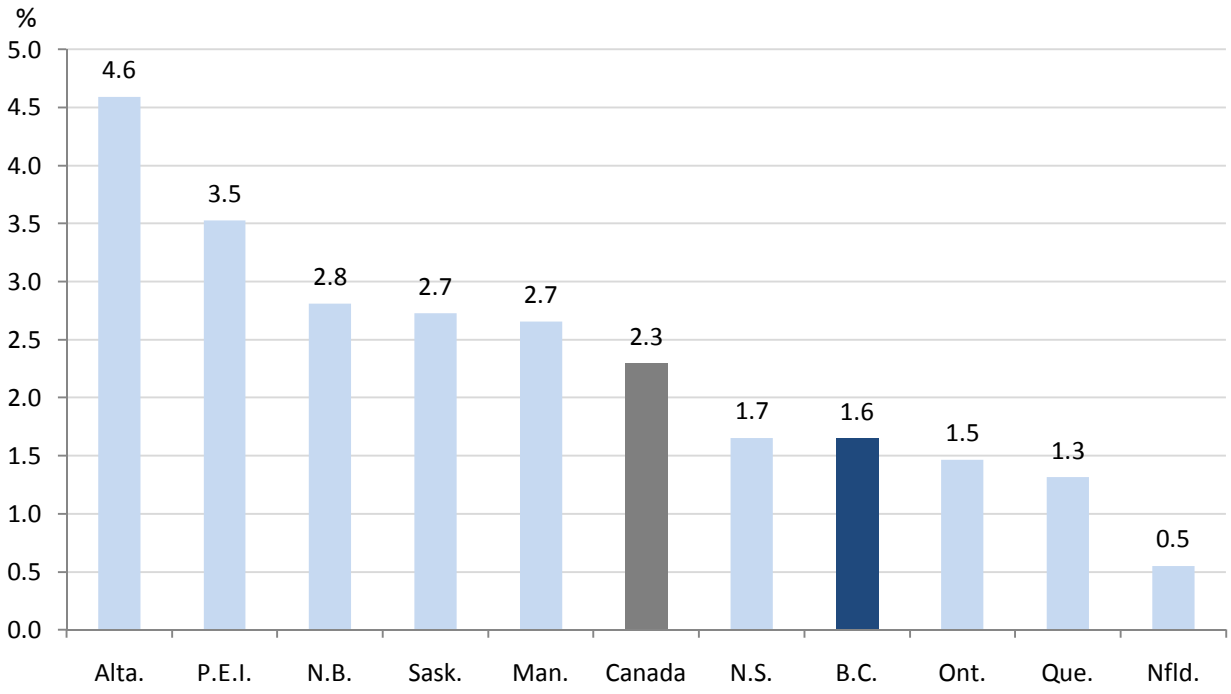
	Compound Annual Growth Rate, 1997-2007	Provincial Ranking	Province's Multifactor Productivity Level Relative to Canada's, 1997	Province's Multifactor Productivity Level Relative to Canada's, 2007	Provincial Ranking, 2007
	(per cent)		(Canada=100)	(Canada=100)	
Market Sector	**0.5**	**6**	**102.1**	**102.5**	**4**
Agriculture, Forestry, Fishing and Hunting	1.9	8	147.0	137.6	3
Mining, and Oil and Gas Extraction	-2.1	5	106.6	140.2	6
Utilities	0.3	5	100.4	106.2	4
Construction	-0.2	9	99.9	83.3	7
Manufacturing	4.0	1	101.7	125.5	1
Wholesale Trade	3.3	2	100.3	111.1	1
Retail Trade	2.0	6	104.3	103.4	4
Transportation and Warehousing	0.4	2	106.3	116.4	1
Information and Cultural Industries	2.3	3	100.1	108.2	2
FIRE*	-0.8	7	98.6	90.7	7
Professional, Scientific and Technical Services	-0.8	6	95.6	94.4	4
ASWMR**	-2.6	10	95.0	76.2	9
Arts, Entertainment and Recreation	-5.7	8	99.6	68.0	8
Accommodation and Food Services	-0.5	10	113.6	102.1	2
Other Services (Except Public Administration)	0.6	7	107.6	102.1	4
Absolute Equally-Weighted Average Rank		5.9			4.2
Equally-Weighted Market Sector Rank		**7**			**3**

Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.
*Finance, insurance, real estate, rental and leasing **Administrative and support, waste management and remediation services

VI. Capital Intensity

Capital intensity, defined as capital services per hour worked (unadjusted for labour quality), grew at an average rate of 1.6 per cent per year in British Columbia's market sector during the 1997-2007 period, which is below the national average of 2.3 per cent per year. British Columbia ranked 7th among the ten provinces in terms of capital intensity (Chart 4).

Chart 4: Capital Intensity Growth in Canada and the Provinces, Market Sector, 1997-2007
(Average Annual Growth Rates)



Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.

During this period, the industries that experienced the highest capital intensity growth rates were arts, entertainment and recreation (9.4 per cent per year), professional, scientific and technical services (7.9 per cent), and accommodation and food services (5.0 per cent) (Table 5). Conversely, the industries that had the lowest growth rates were manufacturing (-2.3 per cent per year), construction (-2.1 per cent), and agriculture, forestry, fishing and hunting (0.1 per cent).

In terms of capital intensity growth, the province ranked 7th or below in eight of the 15 two-digit NAICS industries. In particular, agriculture, forestry, fishing and hunting, and manufacturing had the worst capital intensity growth rates among all the provinces. On the other hand, arts, entertainment and recreation, along with accommodation and food services, had the strongest capital intensity growth rates in Canada.

Table 5: Capital Intensity Levels and Growth Rates in British Columbia, 1997-2007

	Compound Annual Growth Rate, 1997-2007	Provincial Ranking	Province's Capital Intensity Level Relative to Canada's, 1997	Province's Capital Intensity Level Relative to Canada's, 2007	Capital Intensity Level, 2007	Provincial Ranking, 2007
	(per cent)		(Canada=100)	(Canada=100)	(1997 Dollars)	
Market Sector	**1.6**	**7**	**82.8**	**77.7**	**12.2**	**6**
Agriculture, Forestry, Fishing and Hunting	0.1	10	154.1	125.9	16.3	2
Mining, and Oil and Gas Extraction	3.9	5	78.5	80.5	81.8	3
Utilities	2.4	2	125.9	175.5	183.2	2
Construction	-2.1	9	84.4	66.2	3.1	7
Manufacturing	-2.3	10	72.6	54.2	9.5	7
Wholesale Trade	3.0	5	69.7	64.2	8.5	9
Retail Trade	4.2	6	87.2	85.6	4.1	6
Transportation and Warehousing	1.9	7	99.1	91.8	12.1	4
Information and Cultural Industries	2.6	8	84.8	86.2	30.7	9
FIRE*	3.1	7	97.7	104.6	44.8	8
Professional, Scientific and Technical Services	7.9	7	79.2	74.0	8.2	9
ASWMR**	3.4	5	123.6	125.8	8.1	3
Arts, Entertainment and Recreation	9.4	1	84.0	146.5	11.5	2
Accommodation and Food Services	5.0	1	97.0	136.8	4.4	2
Other Services (Except Public Administration)	2.6	7	101.4	97.7	3.0	4
Absolute Equally-Weighted Average Rank		6.0				5.1
Equally-Weighted Market Sector Rank		**7**				**3**

Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.
*Finance, insurance, real estate, rental and leasing **Administrative and support, waste management and remediation services

British Columbia's capital intensity level in 2007 was 77.7 per cent of the Canadian level, down from 82.8 per cent in 1997. According to the market sector rank the province had the 6th highest capital intensity level in Canada in 2007, even though it ranked 3rd according to the equally-weighted market sector rank.

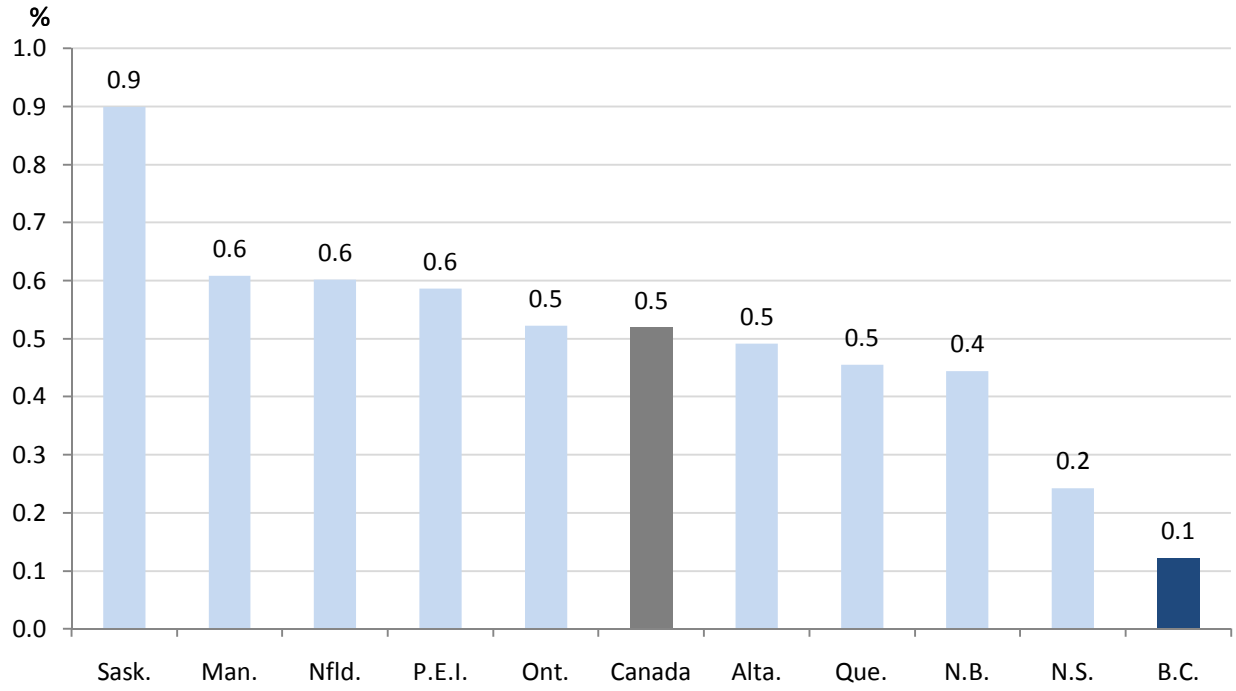
In 2007, six of the 15 two-digit NAICS industries had capital intensity levels above the Canadian levels. Industries with high relative levels included: utilities (175.5 per cent of the Canadian level), arts, entertainment and recreation (146.5 per cent), and accommodation and food services (136.8 per cent). The industries that had the lowest relative levels were manufacturing (54.2 per cent of the Canadian level), wholesale trade (64.2 per cent), and construction (66.2 per cent).

As mentioned before, British Columbia's capital intensity level in 2007 ranked 6th according to the market sector ranking, but ranked 3rd according to the equally-weighted market sector ranking. This disparity is caused by the fact that relative capital intensity levels in British Columbia were either significantly above the Canadian level (six of the 15 two-digit industries are ranked 3rd or above, although none of the industries are ranked 1st in Canada) or significantly below (six industries are ranked 7th or below).

VII. Labour Quality

British Columbia experienced very slow labour quality growth in the market sector during the 1997-2007 period. The province grew at an average rate of 0.1 per cent per year, while the national average was 0.5 per cent per year. The province ranks 10th in Canada in terms of labour quality growth (Chart 5).

Chart 5: Labour Quality Growth in Canada and the Provinces, Market Sector, 1997-2007
(Average Annual Growth Rates)



Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.

During the period in question, the industries that experienced the highest labour quality growth rates were information and cultural industries (0.9 per cent per year), FIRE (0.5 per cent), and other services (0.3 per cent) (Table 6). The industries that had the lowest labour quality growth rates were agriculture, forestry, fishing and hunting, administrative and support, waste management and remediation services (both of which grew at -0.4 per cent per year), mining, and oil and gas extraction, and utilities (both of which grew at -0.3 per cent per year).

In terms of labour quality growth, the province ranked 7th or below in 10 of the 15 two-digit NAICS industries. The worst comparative performances were in agriculture, forestry, fishing and hunting, manufacturing, and transportation and warehousing, all of which earned the province the last place in the provincial ranking.

Table 6: Labour Quality Levels and Growth Rates in British Columbia, 1997-2007[10]

	Compound Annual Growth Rate, 1997-2007	Provincial Ranking
	(per cent)	
Market Sector	**0.1**	**10**
Agriculture, Forestry, Fishing and Hunting	-0.4	10
Mining, and Oil and Gas Extraction	-0.3	8
Utilities	-0.3	9
Construction	0.1	4
Manufacturing	-0.2	10
Wholesale Trade	-0.1	7
Retail Trade	0.0	7
Transportation and Warehousing	-0.1	10
Information and Cultural Industries	0.9	2
FIRE*	0.5	5
Professional, Scientific and Technical Services	0.2	7
ASWMR**	-0.4	9
Arts, Entertainment and Recreation	-0.1	9
Accommodation and Food Services	0.0	7
Other Services (Except Public Administration)	0.3	5
Absolute Equally-Weighted Average Rank		7.3
Equally-Weighted Market Sector Rank		**10**

Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.
*Finance, insurance, real estate, rental and leasing **Administrative and support, waste management and remediation services

[10] Labour quality levels are not shown here because they are assumed to be the same (and equal to 100.0) across all provinces and in Canada in the base year, 1997 (Sharpe and Thomson, 2010a). They differ after 1997, incorporating the different labour quality growth rates experienced by the provinces and Canada. For example, labour quality in British Columbia's market sector grew at an average annual rate of 0.1 per cent over the 1997-2007 period, while Canada's labour quality grew at an average annual rate of 0.5 per cent. As a consequence, British Columbia's labour quality level was 96.1 per cent of the Canadian level in 2007.

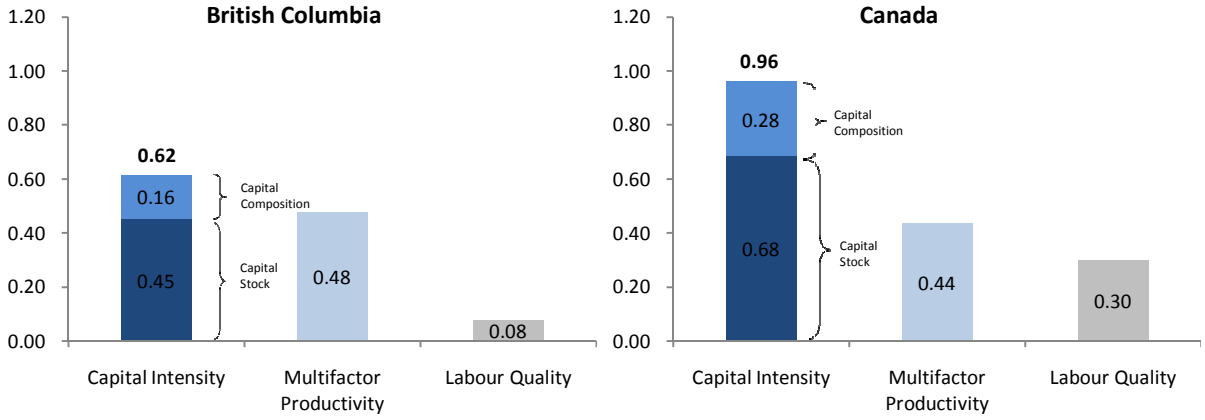
VIII. Sources of Labour Productivity Growth in the Market Sector

British Columbia's labour productivity grew at an average rate of 1.2 per cent per year during the 1997-2007 period, significantly below the national average of 1.7 per cent per year. Charts 6 and 7 show both the percentage point and per cent contributions to labour productivity growth by the sources of growth for British Columbia and Canada over the 1997-2007 period.

British Columbia's labour productivity growth was driven mainly by capital intensity growth, which accounted for 0.62 percentage points of the overall labour productivity growth (or, alternatively, 52.2 per cent of total growth). The contribution of capital intensity to labour productivity growth can be broken down into two components: capital composition growth, which was responsible for 0.16 percentage points of labour productivity growth (13.6 per cent), and capital stock growth, which accounted for 0.45 percentage points (38.6 per cent). Multifactor productivity growth also played an important role in labour productivity growth in British Columbia, accounting for 0.48 percentage points of the latter (40.6 per cent). Finally, a small but steady increase in labour quality was responsible for 0.08 percentage points of the labour productivity growth experienced in the province (6.5 per cent).

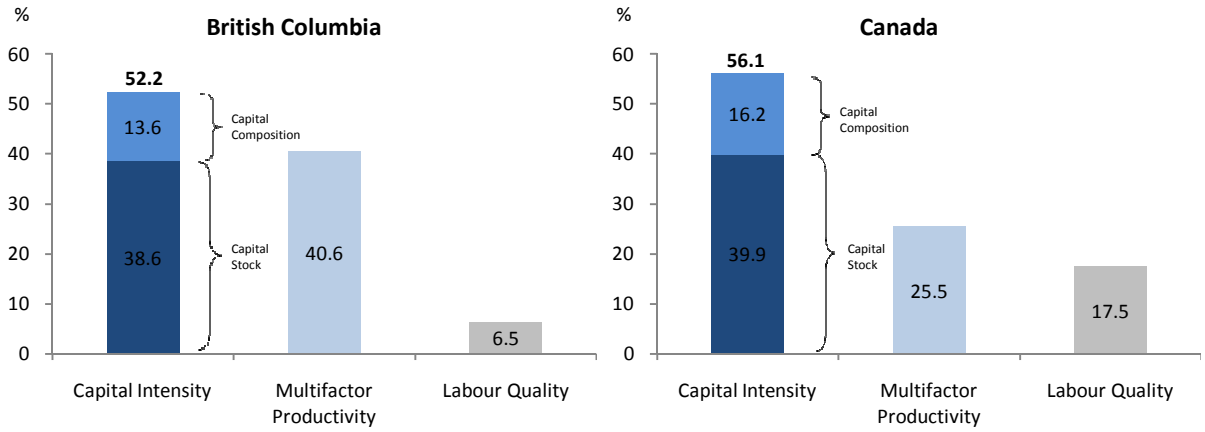
Comparing the two charts, it can be seen that capital intensity had approximately the same contribution in British Columbia and in Canada (albeit slightly higher in Canada). The main difference between the two was in the roles of multifactor productivity and labour quality. Whereas multifactor productivity explained only 25.5 per cent of the labour productivity growth in Canada, it explained 40.6 per cent of British Columbia's labour productivity growth. Conversely, labour quality explained 17.5 per cent of labour productivity growth in Canada, but only 6.5 per cent in British Columbia.

Chart 6: Percentage Point Contribution to Labour Productivity Growth by the Source of Labour Productivity Growth in the Market Sector in British Columbia and in Canada, 1997 to 2007



Source: CSLS Provincial Productivity Database, Appendix Table 17, http://www.csls.ca/data/mfp_new.asp.

Chart 7: Per Cent Contribution to Labour Productivity Growth by the Source of Labour Productivity Growth in the Market Sector in British Columbia and in Canada, 1997 to 2007



Source: CSLS Provincial Productivity Database, Appendix Table 17, http://www.csls.ca/data/mfp_new.asp.
Note: Numbers may not sum to 100 due to rounding.

Table 7 details the contributions in absolute and per cent terms of capital intensity, MFP, and labour quality growth to labour productivity growth in British Columbia over the 1997-2007 period at the two-digit NAICS industry level.

Table 7: Contributions to Labour Productivity Growth at the Industry Level by Source in British Columbia, 1997-2007

	Labour Productivity	Capital Intensity			MFP	Labour Quality
		Total	Capital Composition	Capital Stock		
		Percentage Point Contributions to Labour Productivity Growth				
Market Sector	**1.2**	**0.6**	**0.2**	**0.5**	**0.5**	**0.1**
Agriculture, Forestry, Fishing and Hunting	1.7	0.2	0.0	0.2	1.9	-0.3
Mining, and Oil and Gas Extraction	0.5	2.9	0.1	2.7	-2.1	-0.1
Utilities	2.1	1.9	1.1	0.7	0.3	-0.1
Construction	-0.7	-0.6	-0.1	-0.5	-0.2	0.1
Manufacturing	2.9	-0.9	0.3	-1.2	4.0	-0.1
Wholesale Trade	4.0	0.8	0.1	0.7	3.3	-0.1
Retail Trade	2.9	0.8	0.2	0.7		0.0
Transportation and Warehousing	1.0	0.6	0.3	0.3	0.4	0.0
Information and Cultural Industries	4.2	1.4	0.4	1.0	2.3	0.5
FIRE*	1.1	1.7	0.5	1.2	-0.8	0.2
Professional, Scientific and Technical Services	0.5	1.1	0.1	1.0	-0.8	0.2
ASWMR**	-2.5	0.4	0.0	0.4	-2.6	-0.3
Arts, Entertainment and Recreation	-3.9	2.0	0.2	1.7	-5.7	-0.1
Accommodation and Food Services	0.5	1.0	0.0	1.0	-0.5	0.0
Other Services (Except Public Administration)	1.3	0.4	0.1	0.3	0.6	0.3
		Per Cent Contributions to Labour Productivity Growth				
Market Sector	**100.0**	**52.6**	**13.6**	**38.6**	**40.6**	**6.5**
Agriculture, Forestry, Fishing and Hunting	100.0	9.1	-1.4	10.5	109.3	-18.2
Mining, and Oil and Gas Extraction	100.0	529.8	22.6	505.8	-396.3	-22.0
Utilities	100.0	87.7	52.8	34.5	14.6	-2.5
Construction	100.0	86.7	13.3	73.2	27.7	-14.4
Manufacturing	100.0	-30.4	10.9	-41.0	136.5	-4.7
Wholesale Trade	100.0	19.9	3.5	16.2	81.3	-1.7
Retail Trade	100.0	29.2	6.0	22.9		-1.0
Transportation and Warehousing	100.0	61.7	28.1	33.0	41.8	-3.8
Information and Cultural Industries	100.0	33.0	9.1	23.6	55.0	10.9
FIRE*	100.0	161.3	50.3	109.3	-79.1	19.0
Professional, Scientific and Technical Services	100.0	239.6	18.1	219.6	-180.7	42.9
ASWMR**	100.0	-14.1	0.0	-14.1	103.2	10.8
Arts, Entertainment and Recreation	100.0	-49.9	-6.3	-42.7	145.7	1.5
Accommodation and Food Services	100.0	194.8	-2.9	197.8	-94.0	0.1
Other Services (Except Public Administration)	100.0	33.2	10.3	22.5	47.6	18.8

Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.
Note: Per cent contributions may not sum to 100 due to rounding.
*Finance, insurance, real estate, rental and leasing **Administrative and support, waste management and remediation services

IX. Sources of Labour Productivity Level Gap by Industry

British Columbia's labour productivity level in 2007 was 90.1 per cent of the Canadian level, which implies a labour productivity gap of 9.9 percentage points. Table 8 makes it clear that the gap was caused predominantly by the market sector's below average capital intensity level, which was responsible for -10.1 percentage points of the gap. The multifactor productivity and labour quality levels accounted for 2.3 and -2.2 percentage points of the gap respectively.[11]

British Columbia had labour productivity gaps in eight of the 15 two-digit NAICS industries. In most cases, the below average capital intensity level was the main culprit. In fact, in industries where British Columbia had higher labour productivity levels than those of Canada, the higher levels were achieved mostly due to the above average multifactor productivity levels, which were able to offset the below average capital intensity levels. Notable exceptions were the agriculture, forestry, fishing and hunting industry and the utilities industry, which had positive contributions from both multifactor productivity and capital intensity levels.

Table 8: Sources of the Labour Productivity Gap Relative to Canada for British Columbia at the Two-Digit Industry Level, 2007

			Percentage Point Contributions to Labour Productivity Gap			Percent Contributions to Labour Productivity Gap			
	Labour Productivity Relative Level	Labour Productivity Gap	Capital Intensity	Multifactor Productivity	Labour Quality	Labour Productivity	Capital Intensity	Multifactor Productivity	Labour Quality
Market Sector	**90.1**	**-9.9**	**-10.1**	**2.3**	**-2.2**	**100.0**	**101.5**	**-23.4**	**21.9**
Agriculture, Forestry, Fishing and Hunting	143.0	43.0	13.0	38.4	-8.4	100.0	30.2	89.4	-19.6
Mining, and Oil and Gas Extraction	115.5	15.5	-20.3	36.4	-0.5	100.0	-130.6	233.9	-3.3
Utilities	161.9	61.9	55.3	7.8	-1.3	100.0	89.5	12.6	-2.0
Construction	74.7	-25.3	-9.4	-15.9	0.0	100.0	37.4	62.8	-0.2
Manufacturing	96.7	-3.3	-21.8	22.4	-3.8	100.0	671.6	-687.5	115.9
Wholesale Trade	94.1	-5.9	-13.5	10.2	-2.6	100.0	228.2	-172.8	44.6
Retail Trade	98.1	-1.9	-4.1	3.3	-1.1	100.0	212.6	-171.3	58.7
Transportation and Warehousing	109.3	9.3	-3.2	15.9	-3.4	100.0	-33.8	170.3	-36.4
Information and Cultural Industries	101.4	1.4	-8.0	8.0	1.5	100.0	-556.7	551.9	104.9
FIRE*	93.1	-6.9	2.3	-9.5	0.2	100.0	-33.8	136.3	-2.5
Professional, Scientific and Technical Services	86.6	-13.4	-4.6	-5.4	-3.5	100.0	34.3	40.0	25.8
ASWMR**	77.1	-22.9	3.8	-23.9	-2.9	100.0	-16.7	104.2	12.6
Arts, Entertainment and Recreation	74.4	-25.6	8.2	-33.3	-0.5	100.0	-32.0	130.0	1.9
Accommodation and Food Services	107.4	7.4	6.9	2.1	-1.7	100.0	94.2	28.7	-22.9
Other Services (Except Public Administration)	100.8	0.8	-0.5	2.1	-0.8	100.0	-66.2	262.3	-96.1

Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.
*Finance, insurance, real estate, rental and leasing **Administrative and support, waste management and remediation services

[11] Again, it is important to bear in mind that labour quality levels were assumed to be equal to 100.0 in all provinces and in Canada for the base year of 1997. They differ after 1997, incorporating the different labour quality growth rates experienced by the provinces and Canada.

X. Conclusion

During the 1997-2007 period, British Columbia experienced a slow but steady decline in capital productivity (-0.5 per cent per year) and unimpressive labour and multifactor productivity growth rates (1.2 and 0.5 per cent, respectively). Although the province had multifactor and capital productivity growth rates slightly above the national average, labour productivity grew significantly less than the national average (1.2 per cent vs. 1.7 per cent). This was due to weak capital intensity growth relative to the national average (1.6 per cent vs. 2.3 per cent), as well as weak labour quality growth (0.1 per cent vs. 0.5 per cent). Despite low labour productivity growth overall, the manufacturing and utilities industries in British Columbia had the highest growth rates compared to equivalent industries in the other provinces over the 1997-2007 period (2.9 and 2.1 per cent per year, respectively).

British Columbia's capital and multifactor productivity levels in 2007 were above national levels. The labour productivity level, however, was below Canada's, with the labour productivity gap between British Columbia's market sector and Canada's reaching 9.9 percentage points. This was due mainly to the below average capital intensity level in British Columbia, which explains 101.5 per cent of the gap.

Table 9 provides a summary of both levels (in 1997 and 2007) and growth rates (for the 1997-2007 period) for the productivity measures discussed in this report, along with rankings that show how British Columbia fared in comparison to the other provinces. A key observation is that British Columbia's growth rate performance was significantly worse than its level performance. On the one hand, growth rates were either close to the average (as was the case of capital productivity, multifactor productivity and capital intensity) or near the bottom of the distribution (labour productivity and labour quality). On the other hand, British Columbia's levels relative to the Canadian levels were either above the average (capital productivity, multifactor productivity) or close to it (labour productivity and capital intensity). It should be noted, however, that the weak growth rates, often below the national average, implied an overall deterioration of British Columbia's relative levels in 2007 compared to its 1997 values.

Table 9: Summary of British Columbia's Productivity Performance in the Market Sector

	Market Sector Growth, 1997 to 2007			Per Cent of the Canadian Level		Level Rankings, 2007	
	Compound Annual Growth Rate	Market Sector Rank	Equally-Weighted Market Sector Rank	1997	2007	Market Sector Rank	Equally-Weighted Market Sector Rank
Labour Productivity	1.2	9	9	95.0	90.1	6	5
Capital Productivity	-0.5	5	7	114.6	115.9	4	2
Multifactor Productivity	0.5	6	7	102.1	102.5	4	3
Capital Intensity	1.6	7	7	82.8	77.7	6	3
Labour Quality	0.1	10	10	n.a.	n.a.	n.a.	n.a.

Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.

References

Baldwin, John R., Wulong Gu and Beiling Yan (2007) "User Guide for Statistics Canada's Annual Multifactor Productivity," Cat. 15-206-XOE- No.14. Statistics Canada, December. http://www.statcan.gc.ca/pub/15-206-x/15-206-x2007014-eng.pdf.

Gu, Wulong, Mustapha Kaci, jean-Pierre Maynard and Mary-Anne Sillamaa (2002) "The Changing Composition of the Canadian Workforce and Its Impact on Productivity Growth," Cat. 15-204, Chapter, Statistics Canada, December. http://www.statcan.gc.ca/pub/15-204-x/15-204-x2001000-eng.pdf.

Sharpe, Andrew (2010a) "Unbundling Canada's Weak Productivity Performance: The Way Forward," CSLS Research Report 2010-02, February. http://www.csls.ca/reports/csls2010-02.pdf.

Sharpe, Andrew (2010b) "Can Sectoral Reallocations of Labour Explain Canada's Abysmal Productivity Performance?," *International Productivity Monitor*, Vol. 19, Spring, pp. 40-45. http://www.csls.ca/ipm/19/IPM-19-sharpe.pdf.

Sharpe, Andrew and Jean François Arsenault (2008) "Productivity Drivers in British Columbia: Strategic Areas for Improvement", CSLS Research Report 2008-9, December. http://www.csls.ca/reports/csls2008-9.pdf.

Sharpe, Andrew and Jean François Arsenault (2009) "New Estimates of Labour, Capital and Multifactor Productivity for Canadian Provinces by Industry, 1997-2007," *International Productivity Monitor*, Number 18, Spring, pp. 25-37. http://www.csls.ca/ipm/18/IPM-18-Sharpe-Arsenault.pdf.

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, June. http://www.csls.ca/reports/csls2010-06.pdf.

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*, Number 20, Fall, pp. 48-67. http://www.csls.ca/ipm/20/IPM-20-Sharpe-Thomson.pdf.

Appendix – A Growth Accounting Framework

The growth accounting framework used in this report assumes a Cobb-Douglas production function such that

$$Y = AK^{\alpha}L^{1-\alpha} \tag{1}$$

where *Y* is real output, *K* stands for capital services, *L* for labour input (quality adjusted hours), *A* for multifactor productivity and α is the share of output that takes the form of capital compensation. The labour input *L* can be decomposed into hours (*H*) and labour quality (*QL*):

$$L = H * QL \tag{2}$$

Capital services can be decomposed into capital stock (*SK*) and capital composition (*QK*):

$$K = SK * QK \tag{3}$$

Capital intensity (*KI*) is defined as:

$$KI = \frac{K}{H} \tag{4}$$

Using (1), (2), and (4), the components of labour productivity *growth* can be decomposed as follows:

$$\Delta LP = \Delta Y - \Delta H = [\Delta QL * (1-\alpha)] + [\Delta KI * \alpha] + \Delta A \tag{5}$$

where *LP* stands for labour productivity and Δ is the percentage change. This equation was used in section eight.

The province's MFP levels relative to the Canadian levels (*Relative MFP*$_{p,i}$) were calculated using the equation below:

$$\ln\left(Relative\ MFP_{p,i}\right) = \ln\left(\frac{A_{p,i}}{A_{c,i}}\right) = \ln\left(\frac{Y_{p,i}}{Y_{c,i}}\right) - k_{p,c} * \ln\left(\frac{K_{P,i}}{K_{c,i}}\right) - \left(1-k_{p,c}\right) * \ln\left(\frac{L_{p,i}}{L_{c,i}}\right) \tag{6}$$

where $k_{p,c}$ is the average share of capital input between Canada and the province, and the subscripts *c, p* and *i* stand for Canada, province and industry, respectively.

Finally, the contributions to the relative labour productivity levels between the province and Canada (*Relative LP*$_{p,i}$) can be found using the following formula:

$$\ln\left(Relative\ LP_{p,i}\right) = \ln\left(\frac{A_{p,i}}{A_{c,i}}\right) + k_{p,c} * \ln\left(\frac{KI_{P,i}}{KI_{c,i}}\right) + \left(1-k_{p,c}\right) * \ln\left(\frac{QL_{p,i}}{QL_{c,i}}\right) \tag{7}$$

This equation was used in section nine. For a detailed discussion about the growth accounting framework used here, refer to Sharpe and Thomson (2010a).