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

CENTRE FOR THE STUDY OF LIVING STANDARDS

An Analysis of Manitoba's Productivity, 1997-2007: Above Average Labour Productivity Growth Lead to Convergence Towards the National Level

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Christopher Ross

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An Analysis of Manitoba's Productivity, 1997-2007: Above Average Labour Productivity Growth Lead to Convergence Towards the National Level

Executive Summary

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

- Manitoba's labour productivity growth in the market sector was above the national average during the 1997-2007 period, with an average growth rate of 2.1 per cent compared to the Canadian rate of 1.7 per cent per year. In terms of labour productivity growth, Manitoba's performance ranked 2nd among the provinces.
- As with Canada, labour productivity growth was driven mainly by capital intensity growth. Capital intensity was responsible for 52.9 per cent of growth in labour productivity in Manitoba over the 1997-2007 period.
- Manitoba's labour productivity level in 2007 was $31.40 (1997 dollars) per hour, which represents 87.1 per cent of the Canadian level. This, in turn, implies a labour productivity gap of 12.9 percentage points. This gap was caused by low levels of both multifactor productivity and capital intensity compared to the national average.
- Manitoba had a labour productivity gap in 10 of the 15 two-digit NAICS industries. In most cases, the low multifactor productivity level was the main culprit. The exception was transportation and warehousing, which had a labour productivity gap caused by a capital intensity level levels.
- Capital productivity in Manitoba's market sector declined at a rate of 0.5 per cent per year during the 1997-2007 period. The national average was even lower, declining by 0.6 per cent per year. Manitoba ranked 6th in Canada in terms of capital productivity growth.
- Manitoba's multifactor productivity grew at an average rate of 0.6 per cent per year during the 1997-2007 period, above the national average of 0.4 per cent per year. The province ranked 5th in Canada in terms of multifactor productivity.
- Over the 1997-2007 period, Manitoba experienced higher growth in every metric – labour, capital and multifactor productivities, capital intensity and labour quality – than the national average.

An Analysis of Manitoba's Productivity, 1997-2007: Above Average Labour Productivity Growth Lead to Convergence Towards the National Level

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 Manitoba'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 Manitoba'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 Manitoba's industry composition by nominal GDP and total hours worked. Sections three through nine detail Manitoba'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.

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[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).

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 Manitoba'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 Manitoba, the industries that had the highest GDP shares in 2007 were manufacturing (18.9 per cent of the province's nominal GDP in the market sector), FIRE (finance, insurance, real estate, rental and leasing) (12.9 per cent), and retail trade (8.6 per cent). In terms of total hours worked, the three industries that had the highest contributions in 2007 were manufacturing (16.4 per cent of total hours worked), retail trade (12.9 per cent), and transportation and warehousing (9.5 per cent).

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

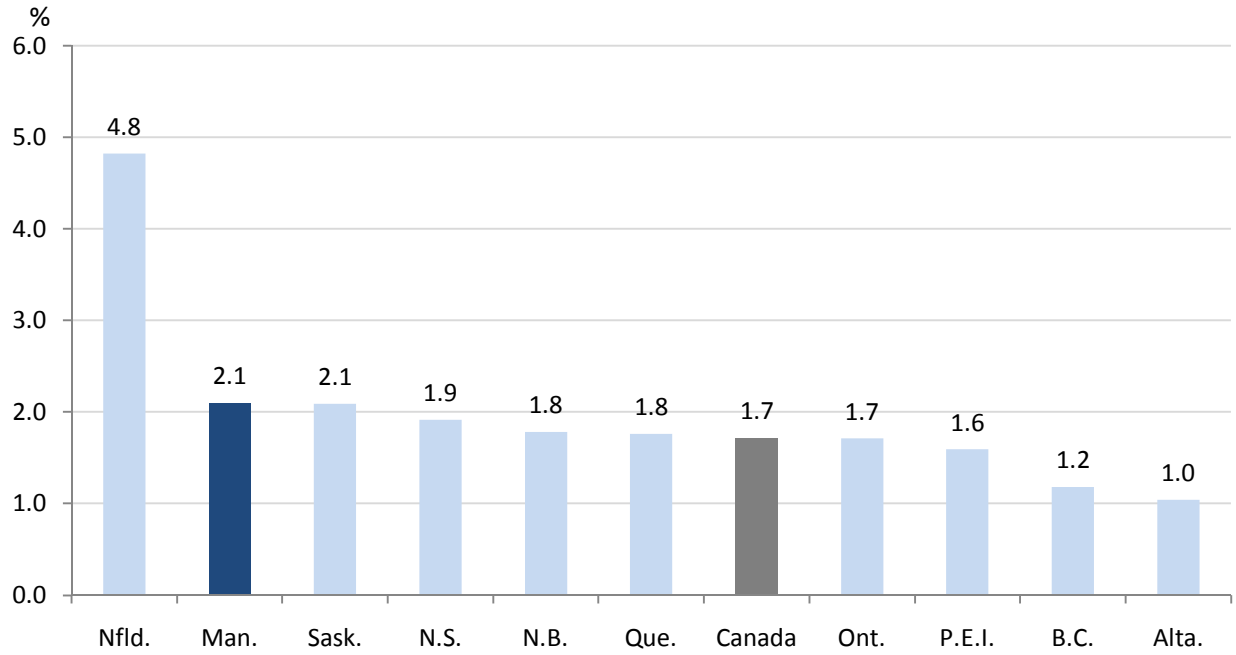
	1997				2007			
	GDP		Hours Worked		GDP		Hours Worked	
	Canada	Manitoba	Canada	Manitoba	Canada	Manitoba	Canada	Manitoba
Market Sector	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Agriculture, Forestry, Fishing and Hunting	3.2	6.7	5.4	12.5	2.1	5.0	3.4	8.7
Mining, and Oil and Gas Extraction	5.5	3.2	1.7	1.5	11.1	7.2	2.0	1.1
Utilities	4.2	5.5	0.9	1.0	3.0	4.8	0.8	1.3
Construction	7.0	6.7	7.9	7.5	9.0	6.8	10.1	8.3
Manufacturing	23.2	19.1	18.3	15.7	16.8	18.9	14.8	16.4
Wholesale Trade	7.1	8.3	7.4	7.2	7.1	8.0	6.9	6.0
Retail Trade	6.9	7.6	13.1	12.6	7.4	8.6	12.9	12.9
Transportation and Warehousing	6.2	9.5	6.3	8.6	5.6	8.0	6.6	9.5
Information and Cultural Industries	4.3	3.9	2.5	2.0	4.3	4.4	2.7	2.2
FIRE*	15.0	14.2	7.5	6.4	14.6	12.9	7.8	6.5
Professional, Scientific and Technical Services	4.9	3.3	6.3	4.3	6.2	3.8	7.9	5.4
ASWMR**	2.5	1.7	4.0	2.8	3.3	2.4	5.7	4.2
Arts, Entertainment and Recreation	0.9	0.8	1.5	2.1	0.9	0.8	1.9	1.6
Accommodation and Food Services	3.2	3.4	7.8	7.1	2.8	2.8	7.0	7.1
Other Services (Except Public Administration)	5.7	6.0	9.4	8.9	5.8	5.6	9.5	8.8

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 2.1 per cent per year in Manitoba's market sector during the 1997-2007 period, which is above the national average of 1.7 per cent. Manitoba ranked 2nd among the provinces in terms of labour productivity growth (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 period in question, the industry that experienced the highest labour productivity growth rate in Manitoba was mining, oil and gas extraction (6.1 per cent per year), followed by arts, entertainment and recreation (5.7 per cent), and agriculture, forestry, fishing and hunting (4.9 per cent) (Table 2). The industry that had the lowest labour productivity growth rate was utilities (-2.7 per cent per year), professional, scientific and technical services (-0.8 per cent), and accommodation and food services (0.4 per cent).

Compared to the other provinces, Manitoba had strong labour productivity growth rates at the industry level during this period. The province ranked 7th or below in only six of the 15 two-digit NAICS industries, including a 10th place ranking in accommodation and food services. At the same time, it ranked 4th or above in six industries, including 1st place rankings in arts, entertainment and recreation and administrative and support, waste management and remediation services.

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

Manitoba's labour productivity level in 2007 was $31.40 (1997 dollars) per hour, which represents 87.1 per cent of the Canadian level, significantly better than the 83.9 per cent the province had in 1997. Manitoba had the 7th highest labour productivity level in Canada in 2007.

In 2007, five of the 15 two-digit NAICS industries in Manitoba had a labour productivity level above the national level. The industries with the highest relative labour productivity levels in the province were: mining and oil and gas extraction (127.8 per cent of the Canadian level), retail trade (106.5 per cent), and arts, entertainment and recreation (103.6 per cent). The industries that had the lowest levels in the province were: professional, scientific and technical services (67.8 per cent of the Canadian level), manufacturing (70.3 per cent), and utilities (75.9 per cent).

Compared to the other provinces, Manitoba had high labour productivity levels in several industries, with seven of the 15 two-digit NAICS industries ranking 4th or above. On the other hand, Manitoba ranked 7th or lower in four industries, including a 10th place ranking in professional, scientific and technical services.

Table 2: Labour Productivity Levels and Growth Rates in Manitoba, 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	**2.1**	**2**	**83.9**	**87.1**	**31.4**	**7**
Agriculture, Forestry, Fishing and Hunting	4.9	4	76.3	81.2	22.1	8
Mining, and Oil and Gas Extraction	6.1	3	56.1	127.8	100.5	2
Utilities	-2.7	9	91.2	75.9	102.2	7
Construction	2.1	5	84.5	87.2	27.8	5
Manufacturing	0.9	7	80.5	70.3	33.6	7
Wholesale Trade	3.2	7	100.6	95.6	40.1	3
Retail Trade	4.3	2	96.8	106.5	23.5	2
Transportation and Warehousing	0.4	6	95.6	93.0	29.6	6
Information and Cultural Industries	3.3	8	100.2	102.9	70.6	6
FIRE*	2.0	3	93.1	98.1	69.0	4
Professional, Scientific and Technical Services	-0.8	8	83.9	67.8	18.3	10
ASWMR**	2.0	1	80.0	94.2	18.7	4
Arts, Entertainment and Recreation	5.7	1	52.6	103.6	16.8	3
Accommodation and Food Services	0.4	10	98.9	92.4	12.7	6
Other Services (Except Public Administration)	2.8	5	94.5	101.0	16.4	3
Absolute Equally Weighted Average Rank		5.3				5.1
Equally Weighted Market Sector Rank		**3**				**6**

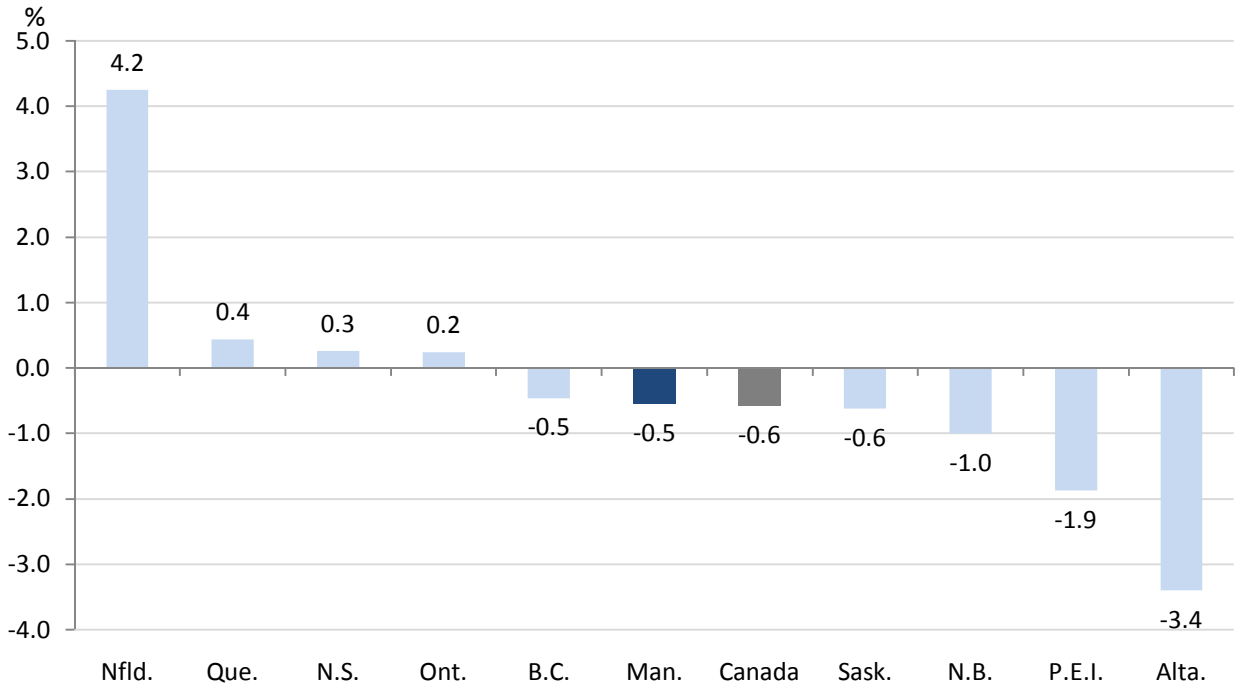
Source: CSLS Provincial Productivity Database, Appendix Tables, http://www.csls.ca/data/mfp_new.asp.
*Finance, insurance, real estate, rental and leasing **Administrative and support, waste management and remediation services

IV. Capital Productivity

Capital productivity, defined as real GDP per unit of capital services, declined by 0.5 per cent per year in Manitoba's market sector during the 1997-2007 period. The national average, in contrast, declined by 0.6 per cent per year. Manitoba ranked 6th in Canada in terms of capital productivity growth (Chart 2).

In Manitoba, 11 of the 15 two-digit NAICS industries had negative capital productivity growth rates during the period. The industries that experienced the worst performances were: professional, scientific and technical services (-7.2 per cent per year), administrative and support, waste management and remediation services (-4.1 per cent), and construction (-3.4 per cent) (Table 3). The industries that had the best performances were: agriculture, forestry, fishing and hunting (2.7 per cent per year), other services (2.0 per cent), and mining, and oil and gas extraction (1.1 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 the provinces, Manitoba had higher capital productivity growth rates in most industries. In Manitoba, seven of the 15 two-digit NAICS industries at 4th place or above and six industries ranked 7th place or below. While Manitoba did not have the highest capital productivity growth in any industry, there were two industries where the province ranked 2nd: transportation and warehousing and mining, oil and natural gas extraction. There was also one industry in which Manitoba had the lowest capital productivity growth of any province, manufacturing.

Manitoba's capital productivity level in the market sector in 2007 was 99.4 per cent of the Canadian level, up slightly from 99.1 per cent in 1997. In five of the 15 two-digit NAICS industries in the province

had capital productivity levels above the national level. The industries with highest relative capital productivity levels in the province were: mining, and oil and gas extraction (288.7 per cent of the Canadian level), arts, entertainment and recreation (167.4 per cent), and retail trade (126.4 per cent). The ten industries that had capital productivity levels lower than the national level in 2007 were: professional, scientific and technical services (97.6 per cent), agriculture, forestry, fishing and hunting (94.7 per cent), and accommodation and food services (93.4 per cent).

Manitoba's market sector ranked 7th highest in terms of the capital productivity level in Canada in 2007. The province's equally weighted market sector rank was higher, 5th. The province ranked 4th or above in seven of the 15 two-digit NAICS industries, but 7th or below in six industries. Manitoba did not have the highest capital productivity level in any industry, but attained the 2nd highest ranking in transportation and warehousing and arts, entertainment and recreation. Manitoba had the lowest capital productivity level in Canada in wholesale trade.

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

	Compound Annual Growth Rate, 1997-2007	Provincial Ranking	Province's Capital Productivity Level Relative to Canada's		Capital Productivity Level, 2007	Provincial Ranking, 2007
	(per cent)		(Canada=100)		(1997 Dollars)	
Market Sector	**-0.5**	**6**	**99.1**	**99.4**	**2.28**	**7**
Agriculture, Forestry, Fishing and Hunting	2.7	3	88.5	94.7	1.99	7
Mining, and Oil and Gas Extraction	1.1	2	144.1	288.7	2.23	3
Utilities	-1.6	7	99.9	85.1	1.10	7
Construction	-3.4	9	111.3	68.4	4.67	8
Manufacturing	-0.7	10	100.4	79.6	2.17	9
Wholesale Trade	-0.5	6	75.9	73.4	2.33	10
Retail Trade	0.1	3	113.1	126.4	5.79	3
Transportation and Warehousing	-0.1	2	101.2	121.9	2.94	2
Information and Cultural Industries	-0.9	8	102.0	88.4	1.70	7
FIRE*	-1.9	6	98.5	89.0	1.46	6
Professional, Scientific and Technical Services	-7.2	5	102.7	97.6	2.39	4
ASWMR**	-4.1	7	106.7	93.0	2.87	6
Arts, Entertainment and Recreation	-3.3	4	147.8	167.4	3.45	2
Accommodation and Food Services	-1.7	7	106.5	93.4	4.02	4
Other Services (Except Public Administration)	2.0	2	82.1	108.7	5.79	4
Absolute Equally Weighted Average Rank		5.4				5.5
Equally Weighted Market Sector Rank		**6**				**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

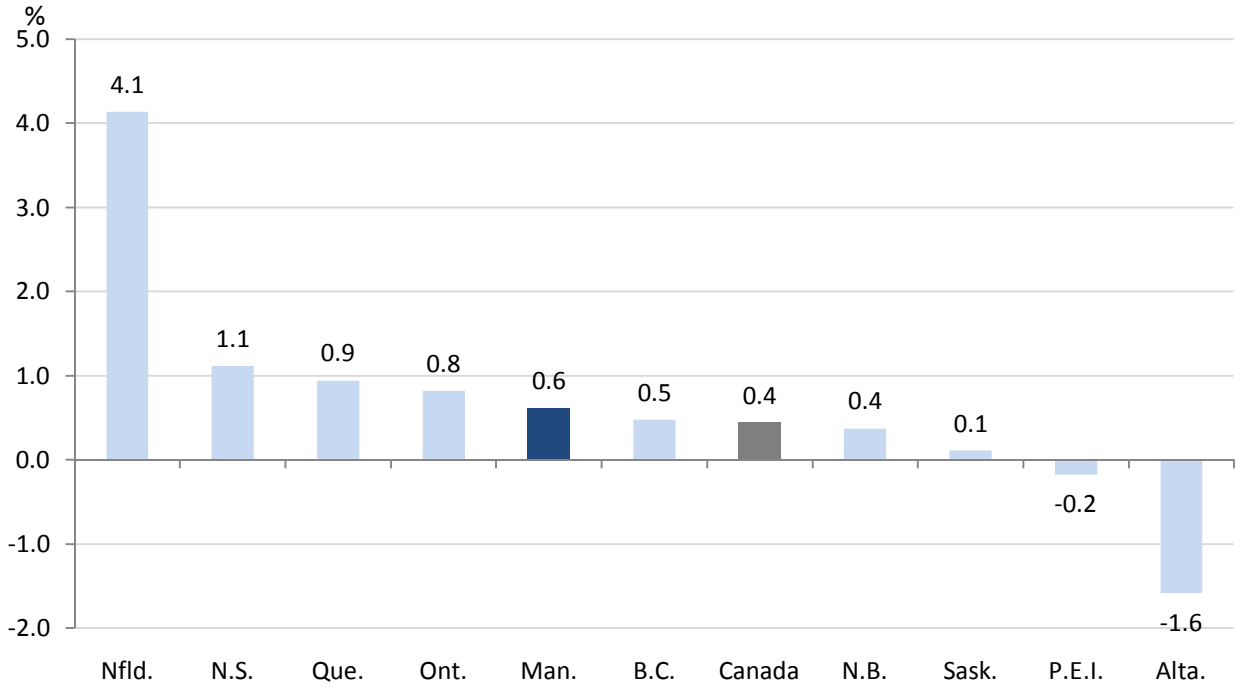
V. Multifactor Productivity

Manitoba's multifactor productivity in the market sector grew at an average annual rate of 0.6 per cent during the 1997-2007 period, above the national average of 0.4 per cent per year. The province ranked 5th in Canada in terms of multifactor productivity (Chart 3).

The industries that experienced the highest multifactor productivity growth rates in Manitoba were agriculture, forestry, fishing and hunting (3.1 per cent), mining, and oil and gas extraction (3.1 per cent), and retail trade (3.1 per cent) (Table 4). The industry that had the lowest multifactor productivity growth rates were professional, scientific and technical services (-2.1 per cent per year), utilities (-1.9 per cent), and finance, insurance, real estate, rental and leasing (-0.4 per cent).

Compared to the other provinces, Manitoba had above average multifactor productivity growth rankings in most industries over the 1997-2007 period. Of the 15 two-digit NAICS industries, only six were ranked at 7th place or lower. The information and cultural industries had the worst multifactor productivity growth rate in Canada when compared to equivalent industries in the other provinces. In contrast, Manitoba's arts, entertainment and recreation had the highest multifactor productivity growth rate in Canada.

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 91.9 per cent of the Canadian level, up from 90.2 per cent in 1997. In 2007, five of the 15 two-digit NAICS industries in Manitoba had multifactor productivity levels above Canada's. The industries with the highest multifactor productivity levels in the

province were mining, and oil and gas extraction (248.5 per cent of the Canadian level), retail trade (113.0 per cent), and other services (except public administration) (110.4 per cent). In contrast, the industries with the lowest multifactor productivity levels in the province were manufacturing (74.3 per cent of the Canadian level), professional, scientific and technical services (76.6 per cent), and construction (82.0 per cent).

In terms of multifactor productivity levels, Manitoba's market sector ranked 6th in Canada in 2007. Manitoba experienced multifactor productivity such that five of the 15 two-digit NAICS industries ranked 3rd or above, but eight ranked 7th or below. In 2007, Manitoba did not have the highest multifactor productivity level in any industry, but attained the 2nd highest ranking in mining, oil and gas extraction, retail trade and other services (excluding public administration). Manitoba had the lowest multifactor productivity level of any province in information and cultural industries.

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

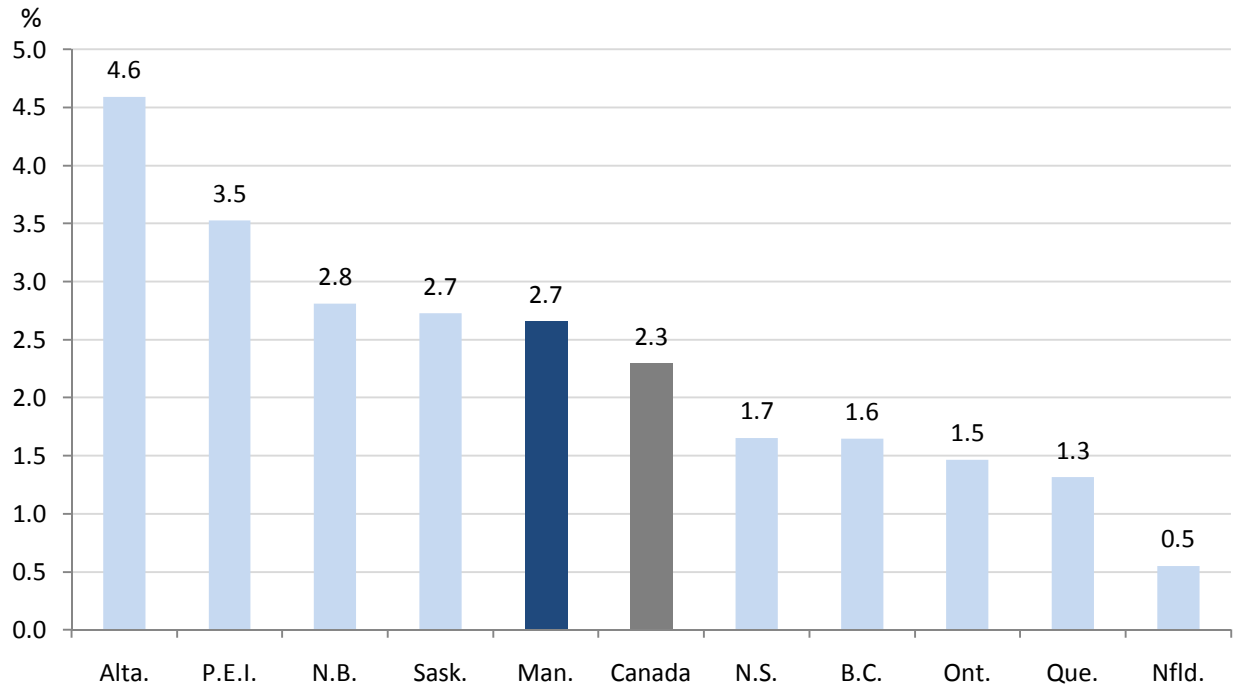
	Compound Annual Growth Rate, 1997-2007	Provincial Ranking	Province's Multifactor Productivity Level Relative to Canada's, 1997	Province's Multifactor Productivity Level Relative to Canada's, 2007	Provincial Ranking, 2007
	(per cent)		(Canada=100)	(Canada=100)	
Market Sector	**0.6**	**5**	**90.2**	**91.9**	**6**
Agriculture, Forestry, Fishing and Hunting	3.1	4	85.6	90.3	7
Mining, and Oil and Gas Extraction	3.1	3	112.2	248.5	2
Utilities	-1.9	7	97.6	82.7	7
Construction	0.9	7	88.2	82.0	8
Manufacturing	0.0	8	88.8	74.3	9
Wholesale Trade	1.5	6	93.1	86.7	8
Retail Trade	3.1	3	102.8	113.0	2
Transportation and Warehousing	0.1	3	97.8	103.8	3
Information and Cultural Industries	0.5	10	101.2	91.8	10
FIRE*	-0.4	5	96.1	92.4	5
Professional, Scientific and Technical Services	-2.1	8	88.3	76.6	8
ASWMR**	0.4	4	82.7	89.6	7
Arts, Entertainment and Recreation	2.3	1	68.9	106.2	3
Accommodation and Food Services	-0.2	9	102.1	94.3	5
Other Services (Except Public Administration)	3.0	3	92.3	110.4	2
Absolute Equally Weighted Average Rank		5.4			5.7
Equally Weighted Market Sector Rank		**5**			**6**

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 2.7 per cent per year in Manitoba's market sector during the 1997-2007 period, above the national average of 2.3 per cent per year. Manitoba ranked 5th 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 in the province were: arts, entertainment and recreation (9.3 per cent per year), professional, scientific and technical services (6.8 per cent), and administrative and support, waste management and remediation services (6.3 per cent). Conversely, the industries that had the lowest growth rates in the province were: utilities (-9.0 per cent per year), transportation and warehousing (0.5 per cent), and other services (except public administration) (0.8 per cent).

Compared to the other provinces, Manitoba had strong capital intensity growth rates at the industry level during the 1997-2007 period. The province ranked 7th or below in only three of the 15 two-digit NAICS industries, but ranked 3rd or above in six industries. In particular, utilities had the best capital intensity growth in Canada when compared to equivalent industries in the other provinces. None of Manitoba's industries ranked last in terms of capital intensity.

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

	Compound Annual Growth Rate, 1997-2007	Provincial Ranking	Province's Capital Intensity Level Relative to Canada's		Capital Intensity Level, 2007	Provincial Ranking, 2007
	(per cent)		1997 (Canada=100)	2007 (Canada=100)	(1997 Dollars)	
Market Sector	**2.7**	**5**	**84.7**	**87.7**	**13.8**	**5**
Agriculture, Forestry, Fishing and Hunting	2.1	6	86.1	85.8	11.1	7
Mining, and Oil and Gas Extraction	5.0	3	38.9	44.3	45.0	6
Utilities	-1.1	6	91.3	89.2	93.1	6
Construction	5.7	2	75.9	127.4	5.9	3
Manufacturing	1.6	1	80.1	88.4	15.5	6
Wholesale Trade	3.7	3	132.9	130.3	17.2	2
Retail Trade	4.2	5	85.7	84.2	4.1	7
Transportation and Warehousing	0.5	9	94.8	76.3	10.1	6
Information and Cultural Industries	4.3	4	99.2	118.1	42.0	4
FIRE*	4.1	5	94.1	110.2	47.2	5
Professional, Scientific and Technical Services	6.8	9	82.1	69.5	7.7	10
ASWMR**	6.3	3	75.4	101.4	6.5	5
Arts, Entertainment and Recreation	9.3	2	35.6	61.9	4.9	8
Accommodation and Food Services	2.2	6	92.6	98.9	3.2	6
Other Services (Except Public Administration)	0.8	8	114.9	92.9	2.8	5
Absolute Equally Weighted Average Rank		4.8				5.7
Equally Weighted Market Sector Rank		**4**				**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

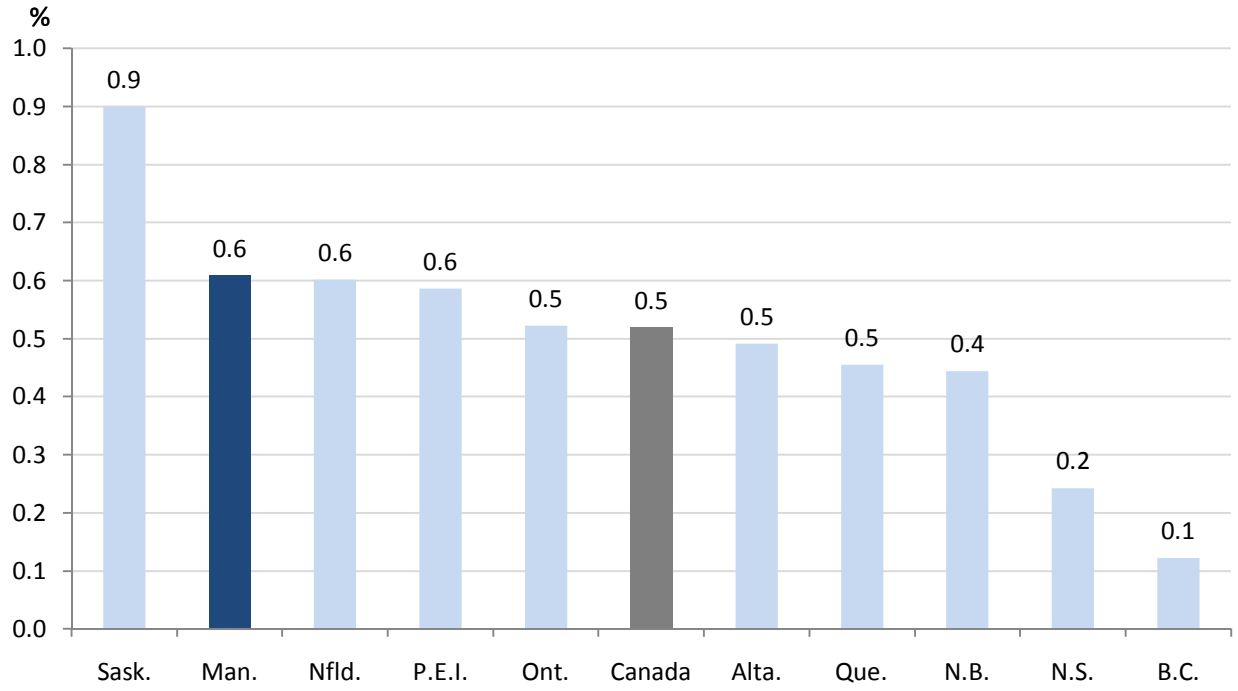
Manitoba's capital intensity level in 2007 was 87.7 per cent of the Canadian level in 2007, up from 84.7 per cent in 1997. Of the 15 two-digit NAICS industries, five had levels above the national average in 2007. The industries with the highest capital intensity levels in the province in 2007 were: wholesale trade (130.3 per cent of the Canadian level), construction (127.4 per cent), and information and cultural industries (118.1 per cent). The industries with the lowest capital intensity levels in the province were: mining, and oil and gas extraction (44.3 per cent), arts, entertainment and recreation (61.9 per cent), and professional, scientific and technical services (69.5 per cent).

In terms of capital intensity levels, Manitoba's market sector ranked 5th in Canada in 2007. Manitoba had the lowest capital intensity level in professional, scientific and technical services. None of the province's industries ranked 1st.

VII. Labour Quality

Manitoba's labour quality grew at an average rate of 0.6 per cent per year during the 1997-2007 period, above the national average of 0.5 per cent. The province ranks 3rd 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 in the province were: arts, entertainment and recreation (1.4 per cent per year), information and cultural industries (1.1 per cent) and agriculture, forestry, fishing and hunting (0.7 per cent). The industries that had the lowest labour quality growth rates were: other services (excluding public administration) (-0.5 per cent per year), accommodation and food services (0.0 per cent) and professional, scientific and technical services (0.0 per cent).

Manitoba ranked well in terms of labour quality growth. In fact, the province ranked 1st in four of the 15 two-digit NAICS industries: information and cultural industries, finance, insurance, real estate, rental and leasing, administrative and support, waste management and remediation services and arts, entertainment and recreation. In contrast, professional, scientific and technical services ranked last among the provinces.

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

	Compound Annual Growth Rate, 1997-2007	Provincial Ranking
	(per cent)	
Market Sector	**0.6**	**2**
Agriculture, Forestry, Fishing and Hunting	0.7	5
Mining, and Oil and Gas Extraction	0.0	5
Utilities	0.2	5
Construction	0.1	5
Manufacturing	0.3	5
Wholesale Trade	0.2	5
Retail Trade	0.0	6
Transportation and Warehousing	0.2	9
Information and Cultural Industries	1.1	1
FIRE*	0.6	1
Professional, Scientific and Technical Services	0.0	10
ASWMR**	0.6	1
Arts, Entertainment and Recreation	1.4	1
Accommodation and Food Services	0.0	8
Other Services (Except Public Administration)	-0.5	9
Absolute Equally Weighted Average Rank		5.1
Equally Weighted Market Sector Rank		**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

[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 Manitoba's market sector grew at an average annual rate of 0.61 per cent over the 1997-2007 period, while Canada's labour quality grew at an average annual rate of 0.51 per cent. As a consequence, Manitoba's labour quality level was 100.89 per cent of the Canadian level in 2007.

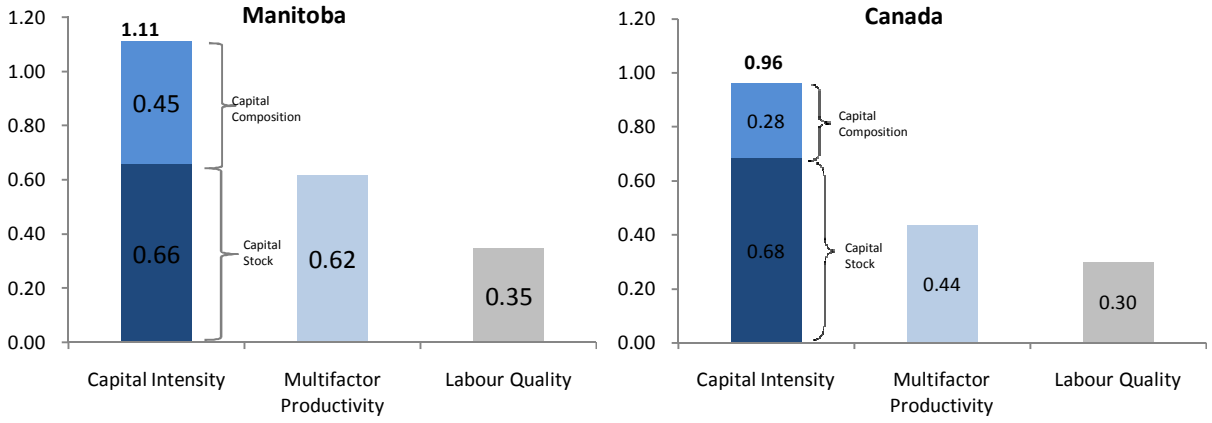
VIII. Sources of Labour Productivity Growth in the Market Sector

Manitoba's labour productivity grew at an average rate of 2.1 per cent per year during the 1997-2007 period, above the national average. Charts 6 and 7 show both the percentage point and per cent contributions to labour productivity growth by the sources of growth for Manitoba and Canada over the 1997-2007 period.

Manitoba's labour productivity growth was driven mainly by capital intensity growth, which accounted for 1.1 percentage points of the overall labour productivity growth (or, alternatively, 52.9 per cent of total growth), of which 0.66 percentage points (31.3 per cent) were due to growth in capital stock and 0.45 percentage points (21.6 per cent) caused by capital composition. Multifactor productivity growth contributed with 0.62 percentage points (29.4 per cent). Labour quality was responsible for 0.35 percentage points of the labour productivity growth experienced in the province (16.6 per cent).

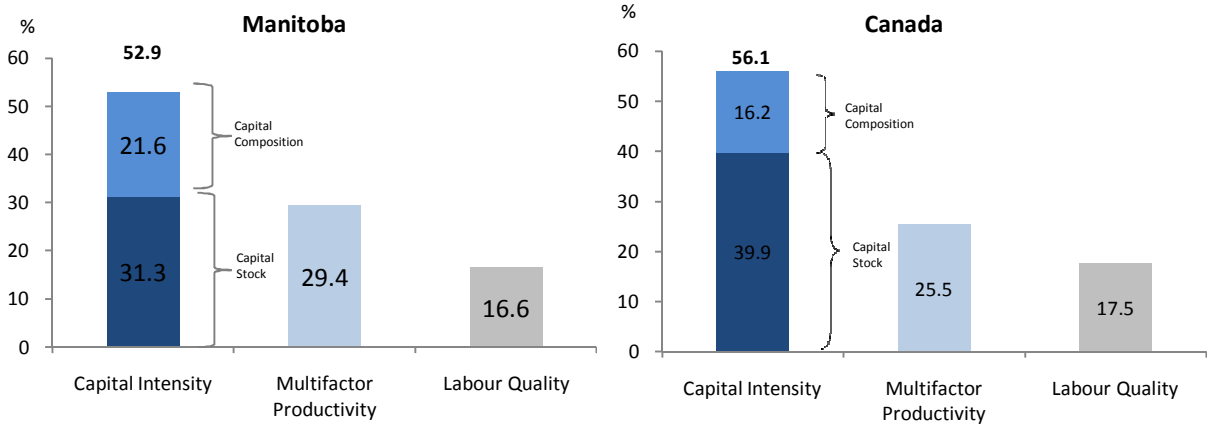
Comparing the two charts, it can be seen that the causes of growth in Manitoba and Canada were essentially the same. Capital intensity was the main driver in both jurisdictions, but slightly less important in Manitoba having explained 52.9 per cent of growth compared to 56.1 in Canada. Multifactor productivity of slightly higher significance in Manitoba, explaining 29.4 per cent of growth compared to 25.5 per cent in Canada. Labour quality was responsible for slightly less of Manitoba's growth (16.6 per cent) compared to national growth (17.5 per cent).

Chart 6: Percentage Point Contribution to Labour Productivity Growth by the Source of Labour Productivity Growth in the Market Sector in Manitoba 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 Manitoba 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 Manitoba 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 Manitoba, 1997-2007

	Labour Productivity	Capital Intensity			MFP	Labour Quality
		Total	Capital Composition	Capital Stock		
	Percentage Point Contributions to Labour Productivity Growth					
Market Sector	**2.1**	**1.1**	**0.5**	**0.7**	**0.6**	**0.3**
Agriculture, Forestry, Fishing and Hunting	4.9	1.5	-0.2	1.7	3.1	0.2
Mining, and Oil and Gas Extraction	6.1	2.9	0.4	2.5	3.1	0.0
Utilities	-2.7	-0.9	-0.4	-0.5	-1.9	0.0
Construction	2.1	1.1	0.1	1.0	0.9	0.0
Manufacturing	0.9	0.7	0.1	0.6	0.0	0.2
Wholesale Trade	3.2	1.6	0.3	1.3	1.5	0.1
Retail Trade	4.3	1.2	0.0	1.1		0.0
Transportation and Warehousing	0.4	0.2	0.1	0.1	0.1	0.1
Information and Cultural Industries	3.3	2.3			0.5	0.5
FIRE*	2.0	2.2	0.8	1.3	-0.4	0.3
Professional, Scientific and Technical Services	-0.8	1.3	0.1	1.2	-2.1	0.0
ASWMR**	2.0	1.1			0.4	0.5
Arts, Entertainment and Recreation	5.7	2.3			2.3	1.0
Accommodation and Food Services	0.4	0.6	0.0	0.6	-0.2	0.0
Other Services (Except Public Administration)	2.8	0.2	0.2	0.0	3.0	-0.4
		Per Cent Contributions to Labour Productivity Growth				
Market Sector	**100.0**	**53.4**	**21.6**	**31.3**	**29.4**	**16.6**
Agriculture, Forestry, Fishing and Hunting	100.0	31.1	-3.5	34.6	63.3	4.4
Mining, and Oil and Gas Extraction	100.0	47.4	7.3	40.0	50.6	0.5
Utilities	100.0	31.3	13.5	17.7	70.7	-1.5
Construction	100.0	52.6	3.6	48.8	44.5	2.4
Manufacturing	100.0	76.1	12.6	63.1	1.3	22.5
Wholesale Trade	100.0	48.9	9.2	39.4	47.8	2.5
Retail Trade	100.0	26.8	0.7	26.1		0.5
Transportation and Warehousing	100.0	37.5	22.3	14.9	33.0	29.4
Information and Cultural Industries	100.0	68.8			15.0	15.4
FIRE*	100.0	105.8	40.1	64.4	-18.7	13.0
Professional, Scientific and Technical Services	100.0	-159.0	-7.6	-150.6	253.9	1.8
ASWMR**	100.0	57.4			18.0	24.1
Arts, Entertainment and Recreation	100.0	40.0			40.6	17.7
Accommodation and Food Services	100.0	156.7	8.6	147.8	-49.9	-6.5
Other Services (Except Public Administration)	100.0	7.7	7.2	0.4	107.1	-14.6

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

Manitoba's labour productivity level in 2007 was 87.1 per cent of the Canadian level, which implies a labour productivity gap of 12.9 percentage points. Table 8 makes it clear that this differential was caused mostly by the market sector's low multifactor productivity level, which was responsible for 7.9 percentage points of the gap (61.4 per cent of the gap). The capital intensity and labour quality levels accounted for 5.4 and -0.5 percentage points of the gap, respectively (42.2 and -3.6 per cent of the gap).[11]

Manitoba had a labour productivity gap relative to Canada in 10 of the 15 two-digit NAICS industries. In most cases, the low multifactor productivity was the main culprit. The exception was transportation and warehousing, which had labour productivity gap caused by a low multifactor productivity level.

Table 8: Sources of the Labour Productivity Gap Relative to Canada for Manitoba 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	**87.1**	**-12.9**	**-5.4**	**-7.9**	**0.5**	**100.0**	**42.2**	**61.4**	**-3.6**
Agriculture, Forestry, Fishing and Hunting	81.2	-18.8	-9.0	-9.2	-0.6	100.0	47.8	49.1	3.1
Mining, and Oil and Gas Extraction	127.8	27.8	-75.4	103.2	0.0	100.0	-271.7	371.7	0.0
Utilities	75.9	-24.1	-7.5	-16.6	0.1	100.0	31.3	69.1	-0.4
Construction	87.2	-12.8	6.0	-18.5	-0.4	100.0	-47.0	144.2	2.8
Manufacturing	70.3	-29.7	-4.4	-25.0	-0.2	100.0	14.9	84.4	0.8
Wholesale Trade	95.6	-4.4	10.4	-14.0	-0.8	100.0	-239.7	321.1	18.6
Retail Trade	106.5	6.5	-5.4	12.6	-0.7	100.0	-83.5	194.7	-11.2
Transportation and Warehousing	93.0	-7.0	-8.8	3.6	-1.7	100.0	127.2	-51.1	23.9
Information and Cultural Industries	102.9	2.9	9.0	-8.7	2.6	100.0	310.8	-301.8	91.0
FIRE*	98.1	-1.9	5.1	-7.8	0.8	100.0	-265.6	407.7	-42.1
Professional, Scientific and Technical Services	67.8	-32.2	-5.6	-22.1	-4.6	100.0	17.3	68.6	14.1
ASWMR**	94.2	-5.8	0.3	-10.7	4.7	100.0	-4.8	185.7	-81.0
Arts, Entertainment and Recreation	103.6	3.6	-13.1	6.1	10.6	100.0	-358.6	168.4	290.2
Accommodation and Food Services	92.4	-7.6	-0.2	-5.6	-1.8	100.0	3.0	73.3	23.7
Other Services (Except Public Administration)	101.0	1.0	-1.7	10.0	-7.2	100.0	-164.3	956.9	-692.6

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

Over the 1997-2007 period, Manitoba experienced higher growth in every metric – labour, capital and multifactor productivities, capital intensity and labour quality – than the national average. Labour productivity grew at a rate of 2.1 per cent per year, compared to the national rate of 1.7 per cent. Growth in labour productivity was primarily driven by capital intensity growth, which was responsible for 52.9 per cent of growth, while multifactor productivity was responsible for 29.4 per cent and labour quality contributed 16.6 per cent.

Manitoba's labour, capital, and multifactor productivity levels in 2007 were below the national levels. The province's labour productivity level, in particular, was only 87.1 per cent of the Canadian level, which implies a labour productivity gap of 12.9 percentage points. This gap was caused by both low overall multifactor productivity and capital intensity levels. Like the labour productivity gap, all gaps shrank over the 1997-2007 period, reflecting faster growth rates than observed nationally in each domain.

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 Manitoba fared in comparison to the other provinces. A key observation is that Manitoba outpaced national growth rates in each domain, but starting from a lower base. Manitoba has thus experienced convergence in each variable, though a sizable gap remains.

Table 9: Summary of Manitoba'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	Provincial Rank	Provincial Equally Weighted Rank	1997	2007	Provincial Rank	Provincial Equally Weighted Rank
Labour Productivity	2.1	2	3	83.9	87.1	7	6
Capital Productivity	-0.5	6	6	99.1	99.4	7	5
Multifactor Productivity	0.6	5	5	90.2	91.9	6	6
Capital Intensity	2.7	5	4	84.7	87.7	5	5
Labour Quality	0.6	2	3	n.a.	n.a.	n.a.	n.a.

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

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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).