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CENTRE FOR THE STUDY OF LIVING STANDARDS

A DETAILED ANALYSIS OF THE PRODUCTIVITY PERFORMANCE OF CANADIAN FOOD MANUFACTURING

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A Detailed Analysis of the Productivity Performance of the Canadian Food Manufacturing Subsector

Abstract

This report analyzes labour productivity, multifactor productivity and input trends in Canadian food manufacturing since 1961, with a focus on the entire time period and developments since 2000. It is found that the subsector experienced labour productivity growth stronger than the business sector over both the long and short term, but has outperformed manufacturing only in the more recent period. Labour productivity growth is decomposed into capital intensity and multifactor productivity growth, which are found to have contributed to growth almost equally, and labour composition growth accounted for less than 15 per cent over the 1961-2007 period. Underlying drivers of growth are identified and trends in technology, capacity utilization, human capital, economies of scale, machinery and equipment, international trade, and regulation are explored. Policy implications for fostering labour productivity growth based on the drivers are outlined. Finally, a conclusion summarizes the key findings of the paper.

A Detailed Analysis of the Productivity Performance of the Canadian Food Manufacturing Subsector

Table of Contents

A Detailed Analysis of the Productivity Performance of the Canadian Food Manufacturing Subsector

Executive Summary

Productivity is the key determinant of living standards in the long run as it determines wages and income. Since 2000, there has been a slowdown in productivity growth in the Canadian business sector and also in manufacturing, but not in food manufacturing. Food manufacturing has actually seen accelerated productivity growth in the post-2000 era. This report provides an overview of the productivity performance of the Canadian food manufacturing subsector since 1961.

Output Trends

Real GDP growth in the food manufacturing subsector was significantly weaker than that of the Canadian business sector for the 1961-2007 period (2.22 vs. 3.81 per cent per year, respectively). In the 2000-2007 period, real GDP growth in both the food manufacturing and the business sectors continued to advance, but at a lower rate (1.83 vs. 2.59 per cent per year), although the fall in the growth rate was much steeper in the business sector.

Labour Productivity Levels and Trends

The labour productivity level in 2007 was $51.81 per hour worked (in current prices) in the food manufacturing subsector, slightly ahead of manufacturing at $51.14 and also ahead of the average for total economy at $48.20. There is a wide variation in productivity levels among industry groups within the food processing sub-sector in 2007; animal food manufacturing had the highest productivity ($72.71 in current dollars per hour worked), followed by miscellaneous food manufacturing ($59.53), sugar and confectionary product manufacturing ($55.30), dairy product manufacturing ($54.32), fruit and vegetable preserving and specialty food manufacturing ($53.60) and meat product manufacturing ($50.74). Seafood product preparation and packaging ($20.25) had the lowest productivity by far.

Labour productivity, defined as real GDP per hour worked, in the food processing subsector grew at an average annual rate of 2.37 per cent over the 1961-2007 period. This was above the growth experienced by the business sector at 2.07 per cent but below the manufacturing growth rate of 2.92 per cent. During the more recent 2000-2007 period, food manufacturing labour productivity growth accelerated to 2.63 per cent, more than double the rates registered in manufacturing or the business sector.

Over the entire 1961-2007 period, growth in capital services intensity and multifactor productivity growth were responsible for 1.05 and 0.97 percentage points of the 2.37 per cent labour productivity growth rate experienced by the food manufacturing industry (alternatively, 44.8 and 41.5 per cent of growth). Changes in labour mix towards more skilled workers were responsible for 0.32 percentage points or 13.7 per cent of labour productivity growth. Food manufacturing experienced much stronger multifactor productivity growth (0.97 per cent per year) than the business sector (0.35 per cent), but much less than manufacturing (1.59 per cent) over the 1961-2007 period. The more recent 2000-2007 period witnessed an acceleration of multifactor productivity growth for food manufacturing (to a growth rate of 1.06 per cent growth per year), but declines in manufacturing (to -0.30 per cent) and the business sector (to -0.30 per cent). Canada experienced faster labour productivity growth than the United States in the food manufacturing industry over the 1987-2008 period (1.57 per cent vs. 1.08 per cent), despite experiencing a slower growth rate in both the business sector and manufacturing.

Drivers of Growth

The economic literature suggests several important drivers of labour productivity growth in the food manufacturing subsector, including: research and development, human capital, investment in physical capital, increases in capital intensity and scale economies.

- Innovation in both products offered and production processes are important in increasing productivity. Total business enterprise research and development intramural expenditures as a share of value added in the food manufacturing subsector has increased from 0.56 per cent in 1994 to 0.72 per cent in 2007. Another measure of research intensity is employment in food manufacturing research and development, which almost tripled from 1,007 in 1994 to 2,857 in 2008. This is likely a contributing factor to the subsector having outperformed others sectors in terms of productivity growth in recent years.

- Higher rates of capacity utilization are essentially the more efficient use of resources, a direct contributor to multifactor productivity. In 2010, capacity utilization in the food manufacturing subsector stood at 80.8 per cent, well above manufacturing (76.2 per cent) and total industrial capacity utilization (75.8 per cent). Capacity utilization fell by only 0.1 percentage points from 2000 to 2010, while the total industrial rate fell by 11.2 percentage points and the manufacturing rate fell by 9.9 percentage points. Capacity utilization, therefore, cannot explain the acceleration of growth in food processing productivity in the post 2000 period, though it certainly contributed to the strong performance of the subsector relative to manufacturing and the industrial total.

- Trends in education attainment from 1990 through 2007 were very favourable to the food manufacturing industry and fostered labour productivity growth. Growth in average years of education attained by workers was faster in the food manufacturing subsector (0.55 per cent per year) than in the total economy (0.39 per cent), and more than doubles the growth rate in the manufacturing sector (0.23 per cent). The proportion of workers with a university degree increased at an average annual rate of 4.73 per cent in food manufacturing, above the 4.03 per cent attained in manufacturing and well above the 2.89 per cent increase in the total economy.

- There is evidence that business establishments in the food manufacturing subsector strived to attain economies of scale given that the average number of employees per firm increased in food manufacturing over the three periods for which data are available (1990-1999, 2000-2003 and 2004-2008). The data from each time period are not comparable, but the trend towards larger firms is clear.

- Increases in the stock of capital combined with changes in the composition of capital towards assets with shorter service lives have increased capital intensity, which has increased labour productivity. Capital services intensity increased at an average annual rate of 2.68 per cent per year in food manufacturing from 1961 through 2007, a rate faster than manufacturing (2.57 per cent), but slower than the business sector (3.29 per cent). During the more recent 2000-2007 period, food manufacturing experienced average annual growth in capital intensity of 2.60 per cent, above both the business sector (2.54 per cent) and manufacturing (2.37 per cent).

- International trade allows for domestic firms to increase output by selling in foreign markets and attain a larger size, leading to economies of scale. Increased import competition has been found to improve innovation. Export intensity of food manufacturing, the value of domestically produced exports as a proportion of gross output, increased from 14.6 per cent in 1992 to 26.1 per cent in 2008, and import intensity of food manufacturing rose to 22.1 per cent up from 14.6 per cent in 1992.

Government Role

Government also plays an important role in determining productivity levels and trends in a given sector through regulation as well as investments in public infrastructure. Investments in public infrastructure lower production costs for food manufacturers, but public investment is an exogenous variable from the firm's perspective. Public capital stock has increased at half the speed of business sector capital stock in the last three decades, which has acted as an important supplement to private sector investment. While there have been many drivers of growth, there are also clear opportunities for advancing productivity. Slow processing times by Health Canada for applications to make health claims signaling health and well-being attributes of food products, and to attaining approval of new additives and foods act as a significant regulatory hurdle to innovation in the food manufacturing industry.

Policy

Longer-term productivity performance of the sector is mainly determined by the private sector investments in innovation and innovation adoption, and the size and pace of economic adjustment by producers to rapidly changing market conditions. Federal and provincial governments can play an important role in improving the sector's productivity performance and competitiveness by supporting and fostering innovation and innovation adoption, improving access to export markets, removing inter-provincial barriers to trade, reducing regulatory burden, providing adequate and state-of the art transportation and telecommunication infrastructure and facilitating the market driven structural changes and economic adjustment.

List of Charts and Summary Tables

Charts

Summary Tables

A Detailed Analysis of the Productivity Performance of the Canadian Food Manufacturing Subsector[1]

I. Introduction

Productivity is the key factor that determines living standards in the long run. If the amount of real output per hour worked, i.e. labour productivity, 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).[2] Labour productivity in the Canadian food manufacturing sector, however, was unaffected by this slowdown, continuing to grow at a very robust pace during the 2000-2007 period.

In 2009, the food manufacturing subsector is responsible for 12.8 per cent of Canadian manufacturing employment and was the second largest manufacturing industry in Canada in terms of labour input. Given the prominence of food manufacturing to the economy, productivity trends in the subsector are an important contributor to productivity trends in the wider economy, and productivity is the major determinant of living standards.

Over the 1961-2007 period, labour productivity in the food manufacturing subsector increased at a rate of 2.37 per cent per year. This was above the business sector growth rate of 2.07 per cent, but below the manufacturing labour productivity growth rate of 2.92 per cent. Between 2000 and 2007 productivity advanced at 2.63 per cent, more than double the rates experienced by the business and manufacturing sectors. During the post-2000 period, with six of the seven food manufacturing industry groups for which information are available experienced higher labour productivity growth than both manufacturing and the total economy. This report aims to explain in relation to the food manufacturing subsector:

[1] This report was written by Christopher Ross, under the supervision of Andrew Sharpe. The section on policy directions received major input from Someshwar Rao. The author would like to thank the participants of the AAFC discussion session on agricultural productivity on Feb 25, 2011, and the participants of the CEA session on June 4, 2011, at the University of Ottawa for their feedback. Special thanks go to Professor Serge Nadeau (University of Ottawa) and Bruce Phillips (AAFC). The CSLS would like to thank Agriculture and Agri-Food Canada for financial support.

[2] From 1981 to 2000, labour productivity in Canada's business sector grew at an average annual rate of 1.63 per cent. In the 2000-2009 period, labour productivity growth dropped sharply to a mere 0.71 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 2.54 per cent during the same period (up from 1.96 per cent during the 1981-2000 period).

- What have been the underlying trends in variables related to labour productivity, such as real multifactor productivity, price trends relative to other industries, capital input and multifactor productivity?

- How has the Canadian experience differed from that of other major nations, especially the United States?

- Have labour productivity trends differed across provinces?

- To what degree have the traditional productivity drivers, such as, technical progress, capacity utilization, human capital of workers, capital intensity, machinery and equipment, international trade, industry regulations and public infrastructure, contributed to the sector's productivity performance since 2000?

- What are the policy implications for Canadian policy makers wishing to pursue greater productivity?

The report is organized as follows. Section two discusses definitions, concepts, and measurement issues related to productivity analysis, as well as data sources. Section three reviews literature describing the state and trends of the food manufacturing subsector. Section four outlines trends in labour, capital, and multifactor productivity in the seven industries that make up the Canadian food manufacturing subsector and have data available. The fifth section provides a comparison between food manufacturing trends in Canada and the United States. Section six identifies factors that influence productivity growth in the food manufacturing subsector and discusses the role these factors have played in the recent evolution of productivity in the sector in Canada. Section seven discusses policy directions for fostering labour productivity growth in the subsector. Section eight summarizes and concludes.

II. Definitions, Concepts, Measurement Issues, and Data Sources

This section discusses definitions and concepts relevant for productivity analysis in the food manufacturing subsector. It then addresses general issues in productivity measurement and outlines the data sources utilized in this report.

A. Definitions

Statistics Canada classifies establishments[3] according to the North American Industry Classification System (NAICS). NAICS classifies establishments into industries

[3] "The establishment is the level at which all accounting data required to measure production are available. The establishment, as a statistical unit, is defined as the most homogeneous unit of production for which the business

based on the similarity of their production processes. NAICS has a hierarchical structure that divides the economy into 20 sectors, identified by 2-digit codes. Below the sector level, establishments are classified into 3-digit subsectors, 4-digit industry groups, and 5-digit industries. At all levels the first two digits always indicate the sector, the third digit the subsector, the fourth digit the industry group, and the fifth digit the industry.

Exhibit 1: The Food Manufacturing Subsectors and Industry Groups by North American Industry Classification System

31-33 Manufacturing

311 Food Manufacturing

3111 Animal Food Manufacturing
3112 Grain and Oilseed Milling
3113 Sugar and Confectionery Product Manufacturing
3114 Fruit and Vegetable Preserving and Specialty Food Manufacturing
3115 Dairy Product Manufacturing
3116 Meat Product Manufacturing
3117 Seafood Product Preparation and Packaging
3118 Bakeries and Tortilla Manufacturing
3119 Other Food Manufacturing
311A Miscellaneous Food Manufacturing*

Source: Statistics Canada, 2007.

B. Productivity Concepts[4]

Productivity is, broadly speaking, a measure of how much output is produced per unit of input used. It is the key factor that determines living standards in the long run, because if the amount of output each worker produces does not increase, real wages and incomes cannot rise (Sharpe, 2010a). There are several different concepts of productivity, each based on different measures of output and inputs. In this subsection, we define input, output, and productivity measures used throughout this report:

- The **labour services input** is defined as *quality adjusted* total hours worked in a particular sector or in the market sector as a whole. It is the weighted sum of

maintains accounting records from which it is possible to assemble all the data elements required to compile the full structure of the gross value of production (total sales or shipments, and inventories), the cost of materials and services, and labour and capital used in production. Provided that the necessary accounts are available, the statistical structure replicates the operating structure of the business. In delineating the establishment, however, producing units may be grouped. An establishment comprises at least one location but it can also be composed of many. Establishments may also be referred to as profit centres." (Statistics Canada, 2007)

[4] This section draws on CSLS (2003), CSLS (2004), and Sharpe (2007).

hours worked across different categories of workers, with the weights being equal to their relative labour compensation shares.

- **Labour quality** (also known as **labour composition**) is derived residually as the difference between growth in labour services and growth in hours worked (*unadjusted* by quality). 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.[5]

- 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 **composition** of capital stock and their rates of earnings and depreciation.

- **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 sector or a geographic region during a certain time period, typically a year or a quarter.

- **Labour productivity** is defined as real GDP per hour worked when a value added approach is taken, though it could also be defined on a gross output basis whereby gross output is divided by labour hours. Productivity can be measured on a gross output basis or on a value added basis, and both methods have advantages. The OECD (2001) notably recommends the use of value added labour productivity for "analysis of micro-macro links, such as the industry contribution to economy-wide labour productivity and economic growth" because the value added labour productivity of each industry weighed by the proportion of total hours worked would sum to labour productivity in the economy. Furthermore, "value-added based labour productivity forms a direct link to a widely used measure of living standards, income per capita. Productivity translates directly into living standards." Labour productivity as measured by

[5] For more information on how Statistics Canada calculates labour quality, see Gu *et al* (2002).

gross output, in contrast, can be increased without any true efficiency gain. The OECD (2001) notes, for instance, that outsourcing "implies substitution of primary factors of production, including labour, intermediate inputs"; as gross output remains the same, but labour input falls, outsourcing increases gross output labour productivity measures. This holds even if the outsourced production is done the exact same way as was done previous to outsourcing. As an example, imagine a company that makes frozen dinners and has advertising and legal departments. If this firm outsourced advertising and legal services, productivity increases *because the value added of outsourced production is embedded in the final good* but not part of the value added of the firm. Growth rates in value added productivity and gross output productivity are the same only if the ratio of intermediate goods to gross output are constant. For these reasons, the analysis that follows uses a value-added approach.

- **Multifactor Productivity (MFP)**[6] growth is measured as the difference between real output growth and combined input growth. In other words, MFP measures growth in output 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 added concept. The gross output concept takes into consideration labour, capital, and intermediate inputs, while the value added concept takes into account only capital and labour (because intermediate consumption is already subtracted from value added). Thus, MFP captures the effects of several elements of the production process, such as the adoption and diffusion of new and improved technologies and work-place organizations, capacity utilization, economies of scale and scope, measurement issues, 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 a value added basis, on the other hand, attempts to measure how efficiently labour and capital are used in the production process (the gross output measure also includes the use of intermediate goods, along with labour and capital). This report provides estimates for one partial productivity measures – labour productivity (the most commonly used measure of productivity) – as well as multifactor productivity.

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[6] Also known as total factor productivity (TFP).

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 industry groups. Ideally, productivity level comparisons across industries are done in current dollars (i.e. using *nominal* GDP), as these estimates capture changes in relative prices. However, this frequently leads to confusion as the growth rates (calculated using real output per hour), would not be consistent with the levels (calculated using nominal output per hour).

C. Labour Productivity and Living Standards

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

> The first and more obvious reason is that, together with a greater use of labour, productivity positively contributes to per capita income, which is a reasonable proxy for living standards in a country. The second reason is that labour productivity growth often reflects the accumulation of intangible capital, which itself contributes to social progress, as workers become equipped with more human capital, more knowledge and access to networks, and which may ultimately even lead to the creation of more social capital (p. 69).

Our main focus here is the first reason highlighted by van Ark, the relationship between GDP per capita and labour productivity.[7] Using a simple growth accounting framework, GDP per capita can be decomposed into a number of determinants:

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

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

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

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

[7] For a detailed discussion on how labour productivity affects the accumulation of intangible capital, refer to van Ark (2002).

According to Exhibit 2, GDP per capita is driven by labour productivity (LP) and labour supply, which affects GDP per capita through four different terms (HWPE, UR, LFPR, and WAPS). Exhibit 2 shows the factors that contribute to the *levels* of GDP per capita. To see how each of these factors contribute to the *growth rate* of GDP per capita, we take the log of both sides and differentiate with respect to time, which leads to:

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

where Δ denotes percentage point changes.

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

Summary Table 1: Sources of GDP per Capita Growth in Canada, 1981-2010

	1981-2010	1981-2000	2000-2010
	(percentage point contribution)		
GDP per Capita	1.37	1.68	0.80
Labour Productivity	1.19	1.31	0.96
Hours Worked per Person Employed	-0.14	0.08	-0.54
1 - Unemployment Rate	-0.02	0.04	-0.13
Labour Force Participation Rate	0.08	0.04	0.18
Demographic Participation Rate	0.25	0.21	0.33
	(per cent contribution)		
GDP per Capita	100.0	100.0	100.0
Labour Productivity	86.8	78.4	120.4
Hours Worked per Person Employed	-10.0	4.5	-67.9
Employment Rate	-1.1	2.6	-16.0
Labour Force Participation Rate	6.2	2.1	22.2
Demographic Participation Rate	18.1	12.3	41.2

Source: CSLS calculations based on Statistics Canada data.

We estimated the contribution of the different factors to GDP per capita in Canada over the 1981-2010 period.[8] In 2010, Canada had a GDP per capita of $38,849 (chained 2002 dollars), up from $26,081 (chained 2002 dollars) in 1981, which entails an average growth rate of 1.37 per cent per year.[9] As Summary Table 1 shows, labour productivity growth accounted for 1.19 percentage points of GDP per capita growth over the entire period, 87 per cent of total growth. Of the four labour supply terms, hours

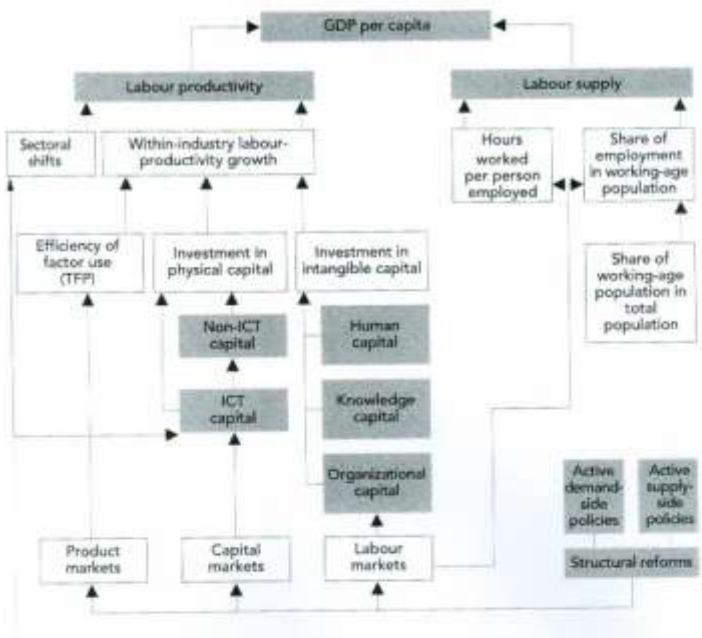
[8] The numbers in this section refer to total economy, not business sector, and hence are slightly different than the numbers used in the rest of the report, which refer to the Canadian business sector.

[9] In order to be consistent with Exhibit 2, continuous time growth rates were calculated (as opposed to growth rates that are compounded in discrete time periods).

worked per person employed and the unemployment rate had slightly negative contributions (-0.14 and -0.02 per cent per year, respectively), while the labour force participation rate and working age share of population rate had positive contributions (0.08 and 0.25 per cent per year, respectively). In the 2000-2010 period, labour productivity in Canada increased by 0.96 per cent, representing 120.4 per cent of GDP per capita growth, while the four labour supply variables had a net negative contribution of 20.5 per cent.

Although the basic structure of this growth accounting framework is quite straightforward, what happens underneath its surface is not. Exhibit 3 shows how the determinants of GDP per capita, both from the labour productivity side and from the labour supply side, are interconnected. Labour productivity levels and growth rates are determined by the interrelations of labour, capital, and product markets. Furthermore, Exhibit 3 makes it clear that MFP growth, in this framework, is also a source of labour productivity growth.

Exhibit 2: Analytical Framework of Sources of Growth



Source: van Ark (2002), p.71.

A country's aggregate labour productivity is approximately equal to the sum of the different sectors' labour productivity, with each sector being weighted by its respective labour input share. This is the mechanism whereby the food manufacturing subsector plays a role in contributing to overall labour productivity growth. Using the framework developed by Sharpe and Thomson (2010b), we decomposed the contributions of different sectors to aggregate labour productivity growth in Canada. According to CSLS calculations, food processing accounted for 4.4 per cent of aggregate labour productivity growth in Canada (business sector) during the 1961-2007 period. The sector experienced labour productivity growth above that of the business sector during the entire period, which contributed to increase its role in overall labour productivity growth. More specifically, the food processing labour productivity increased by 2.37 per cent per year during the 1961-2007 period, somewhat above the business sector average of 2.06 per cent per year.

Summary Table 2: Sectoral Contribution to Business Sector Labour Productivity Growth in Canada, 1961-2007

	1961-2007	1961-2000	2000-2007
		Percentage Points	
Business sector	2.06	2.24	1.08
Agriculture, forestry, fishing and hunting [11]	0.45	0.48	0.13
Mining and oil and gas extraction [21]	0.08	0.11	-0.05
Utilities [22]	0.07	0.08	0.01
Construction [23]	0.08	0.12	-0.10
Food manufacturing [311]	0.09	0.09	0.05
Non-Food Manufacturing	0.67	0.79	0.05
Wholesale trade [41]	0.14	0.10	0.28
Retail trade [44-45]	0.15	0.13	0.22
Transportation and warehousing [48-49]	0.14	0.17	0.02
Information and cultural industries [51]	0.11	0.09	0.14
Finance, insurance, real estate and renting and leasing	0.23	0.22	0.25
Professional, scientific and technical services [54]	-0.03	-0.03	0.02
Other services (except public administration)	-0.13	-0.15	0.06
		Per Cent	
Business sector	100.0	100.0	100.0
Agriculture, forestry, fishing and hunting [11]	22.3	22.0	11.8
Mining and oil and gas extraction [21]	3.7	4.9	-4.9
Utilities [22]	3.5	3.9	1.0
Construction [23]	3.9	5.5	-9.1
Food manufacturing [311]	4.4	4.1	4.5
Non-Food Manufacturing	32.8	35.8	4.5
Wholesale trade [41]	6.7	4.4	25.9
Retail trade [44-45]	7.4	5.8	20.0
Transportation and warehousing [48-49]	7.0	7.5	2.0
Information and cultural industries [51]	5.2	4.2	13.3
Finance, insurance, real estate and renting and leasing	11.1	9.8	23.2
Professional, scientific and technical services [54]	-1.5	-1.3	2.3
Other services (except public administration)	-6.4	-6.6	5.3

Note: Numbers may not sum up to the business sector total due to rounding.
Source: CSLS calculations based on Statistics Canada data (CANSIM Tables 383-0021 and 383-0022).

D. Data

Statistics Canada does produce official time series on productivity in food manufacturing subsector, but one can also estimate labour productivity from hours worked data and value added by industry data. This report uses both sources; Statistics Canada official measures are used for growth rates over the long term of 1961-2007. The productivity data computed by CSLS are used to estimate productivity levels as well as growth rates for the 1981-2009 period. The advantages of the official series from

Statistics Canada are that they conform to the national accounts and provide long time series on a consistent basis. The advantages of the productivity series calculated by CSLS are twofold. First, the official estimates are available only in index form; they can only be used to analyze growth rates, but not levels. Second, the official estimates are available only up to the year 2007. On the other hand, CSLS data allow for the analysis of both growth rates and levels up to the year 2009 and further allow for the analysis of food manufacturing industry groups. For the interval where CSLS and Statistics Canada data are both available (1981-2007), growth rates are nearly identical.

The analysis in this report focuses on the long term trend as well as the post-2000 period so as to emphasize recent developments. Growth rates calculated over the long term minimize the impact of short term distortions. The short term trend is more sensitive to fluctuations, but also serves as an important indicator of recent developments.

Statistics Canada publishes two sets of data on hours worked that could be used to construct productivity estimates for the food manufacturing subsector. There is a series from the Labour Force Survey (LFS) and a series from the Canadian Productivity Accounts (CPA). The CPA hours worked series is more accurate, because Statistics Canada makes adjustments to ensure that it is consistent with the output series that are also used in the CPA. This is particularly true when data is disaggregated by industry. However, LFS provides more up-to-date (to 2010 instead of 2009) and detailed industry data. Our analysis makes use of the CPA estimates due to the consistency with output data, though LFS data are included in the appendix tables.

Data for the international productivity comparisons has been retrieved from the EU KLEMS Growth and Productivity Accounts database maintained by the Groningen Growth and Development Centre in the Netherlands. Based on official data, this database contains productivity estimates for the food, beverage and tobacco sector. These estimates are available for most countries of interest only for the period 1970-2004. Detailed labour productivity indexes at the subsector and industry group levels are available for United States data from the Bureau of Labour Statistics and are compared with CSLS estimates for Canada.

Figure 1: Statistics Canada Official Data for Food Manufacturing

	Survey	Index or Level?	Food Manufacturing	Industry Groups
GDP				
Nominal	Productivity Measures and Related Variables - National (CPA)	L	1961-2007	1961-2007
	GDP by Industry - Provincial and Territorial (Annual)	L	1997-2007	1997-2007
Real, Chained	GDP by Industry - National (Monthly)	L	1997-2010	1997-2010
	Productivity Measures and Related Variables - National (CPA)	I	1961-2007	..
Real, Constant	GDP by Industry - National (Monthly)	L	1981-2010	1981-2010
	Productivity Measures and Related Variables - National (CPA)	I	..	..
Employment	Labour Productivity Measures - Provinces and Territories (Annual) (CPA)	L	1997-2009	1997-2009
	Labour Force Survey	L	1987-2010	1987-2010
	Productivity Measures and Related Variables - National (Old CPA)	L	1961-2000	..
Hours	Labour Productivity Measures - Provinces and Territories (Annual) (CPA)	L	1997-2009	..
	Labour Force Survey	L	1987-2010	1987-2010
	Productivity Measures and Related Variables - National (CPA)	I, L	1961-2007	..
Capital Stock				
Nominal	Fixed Capital Flows and Stocks	L	1961-2010	1961-2005
Real, Chained	Fixed Capital Flows and Stocks	L	1961-2010	1961-2005
Real, Constant	Fixed Capital Flows and Stocks	L	1961-2010	1961-2005
Capital Services	Productivity Measures and Related Variables - National (CPA)	I	1961-2007	..
Labour Productivity	Productivity Measures and Related Variables - National (CPA)	I	1961-2007	..
Capital Productivity	Productivity Measures and Related Variables - National (CPA)	I	..	..
Multifactor Productivity	Productivity Measures and Related Variables - National (CPA)	I	1961-2007	..

For details regarding the specific data series used in this report, see the appendix table references.

E. Measurement Issues

The quality of productivity estimates can be no better than the quality of the data on which they are based. Productivity estimates are constructed from data on current dollar output, food processing price deflators, capital input, and labour input. Some variables have data at the industry group level for all industry groups in food manufacturing, while other variables are available for only select industry groups and for a special aggregation of industry groups. When data are only available for select food manufacturing industry groups, NAICS industries 3112, 3118 and 3119 are aggregated into one category labeled "miscellaneous food manufacturing". For this reason, some sections of the paper present data on the nine official industry groups that compose the food manufacturing subsector, while other sections reference only seven industry groups including the special aggregation as an industry group.

i. Price Deflators

Productivity growth over time is a real or physical concept; it captures the change in the amount of output that is produced per unit of input. For example, labour productivity growth is meant to capture the per cent change in how many kilograms of fries can be produced by one worker in a packaged fry factory in an hour. However, current-dollar output measures are affected by the fact that prices may change over time for reasons that have nothing to do with the production process (for example, general price inflation or changes in relative prices). Since measures of productivity (output per unit of input) should not reflect such price changes, it is necessary to adjust nominal output data by a price deflator to ensure that the productivity estimates are measured in real terms.[10]

A subtle point related to prices and productivity is the issue of output quality. Prices and quality change over time, and indeed, some price changes are driven by quality changes. It is necessary to disentangle quality-driven price changes from pure price changes such as general inflation. To continue with the packaged fry factory example, suppose that the quality of the fries produced increased by 10 per cent and so did the price, with no change in the number of hours of work necessary to produce it (quality can increase because of healthier ingredients, or shorter cooking time, for example). Statisticians will consider that the price of packaged fries has remained constant (that is, the price increase was entirely due to an increase in quality), and productivity will have increased by 10 per cent. In this case, the entire increase in current dollar output (kilograms of fries times the price per kilogram of fries) will be accounted for by productivity increases. If, however, the 10 per cent price increase was not accompanied by a change in quality, productivity will remain unchanged even though the revenue obtained for each chair increased 10 per cent. In the latter case, the entire increase in current dollar output is accounted for by pure price changes. It is this sort of change in current-dollar output that is eliminated through the use of a price deflator.

[10] "Real terms" means either constant dollar or chained dollar estimates. Constant dollar estimates use a base year to establish both the level and the weights. Chained dollar estimates use changing weights such that the weights of year t are used for growth between t and t+1, using the base year only to establish the level.

ii. Capital Input

The quality and quantity of capital that firms use in the production process is a key determinant of productivity. Capital is a stock, and can be estimated over long time periods with data on investment. This report makes use of capital stock and investment data, as well as capital services data. Gross real investment estimates shed light on how much new capital is entering a sector, whereas net real investment data (net of depreciation) show whether a sector's capital stock is growing or shrinking. Capital stocks at the industry group level are only available to 2005 and were estimated by Statistics Canada using a different methodology than the sector level. This report estimates industry group capital stocks by assigning the same share of the official capital stock measure as the industry group had under the old measure. This calculation is made by CSLS because industry group capital stock estimates are not available on a basis consistent with subsector stocks following changes in methodology of data collection and accounting of capital service lives by Statistics Canada.

Capital service input includes services provided by fixed reproducible business assets (such as equipment and structures) as well as inventories, and land. The capital service input is calculated by Statistics Canada through aggregating the capital stock of different types of capital goods using the relative cost of capital as weights. Capital services growth is driven by increases in the level of capital stock, as well as shifts in the capital composition and their economic lives caused by more investment in assets that provide relatively more services per dollar of capital stock (i.e. short lived assets). Capital services data are available for the 1961-2007 period for the food manufacturing subsector, but are unavailable for industry groups.

iii. Labour Input

In the CPA, Statistics Canada estimates hours worked by first estimating average annual hours per job and the number of jobs by province, industry, and class of workers. The volume of hours worked is then obtained by multiplying these two estimates (Maynard, 2005). Establishments are surveyed using the Survey of Employment, Payroll and Hours (SEPH), while households are surveyed using the Labour Force Survey (LFS).[11] Because the coverage of the LFS is more comprehensive (e.g. it includes self-employed workers), the CPA uses this source as the main indicator of the number of jobs in the economy. However, Statistics Canada believes that the SEPH provides a more accurate classification of jobs according to industry, because firms responding to the SEPH tend to be more knowledgeable about their industry classification than workers

[11] LFS excludes the Armed Forces, Indian Reserves, and, in the past, the Territories. The CPA hours worked estimates make adjustments for these exclusions.

responding to the LFS. As a result, SEPH data are used to allocate hours worked to specific industries.

III. Productivity Trends in the Food Manufacturing Subsector in Canada

This part of the report is divided into three sections. The first reviews trends in food manufacturing output, input and productivity at the national level, for the aggregate sector and the industry groups. The second does the same as the first, but focuses on the four-digit industry groups. The third section explores productivity trends in the food manufacturing subsector by province. The focus of this report is on the period since 2000, but data from earlier periods are also discussed to provide context. Each section includes a concluding sub-section that highlights key findings.

A. Food Manufacturing Subsector Productivity Trends at the National Level

This section explores productivity trends in the seven industry groups within food manufacturing: animal food manufacturing, sugar and confectionary product manufacturing, fruit and vegetable preserving and specialty food manufacturing, dairy product manufacturing, meat product manufacturing, seafood product preparation and packaging and miscellaneous food manufacturing.[12] First, we outline long-run trends in nominal output to provide context for the remainder of this report. We then examine each of the components of productivity estimates: real output, labour input, and capital input. Then, trends in labour productivity and multifactor productivity are explored. Finally, key findings are summarized.

i. Nominal Value-Added Output (GDP)

Current dollar GDP in the food manufacturing subsector was $20.92 billion in 2007, up from $1.06 billion in 1961. The food manufacturing industry in 2007 was responsible for 1.46 per cent of total economy GDP, and represented 11.3 per cent of manufacturing output.

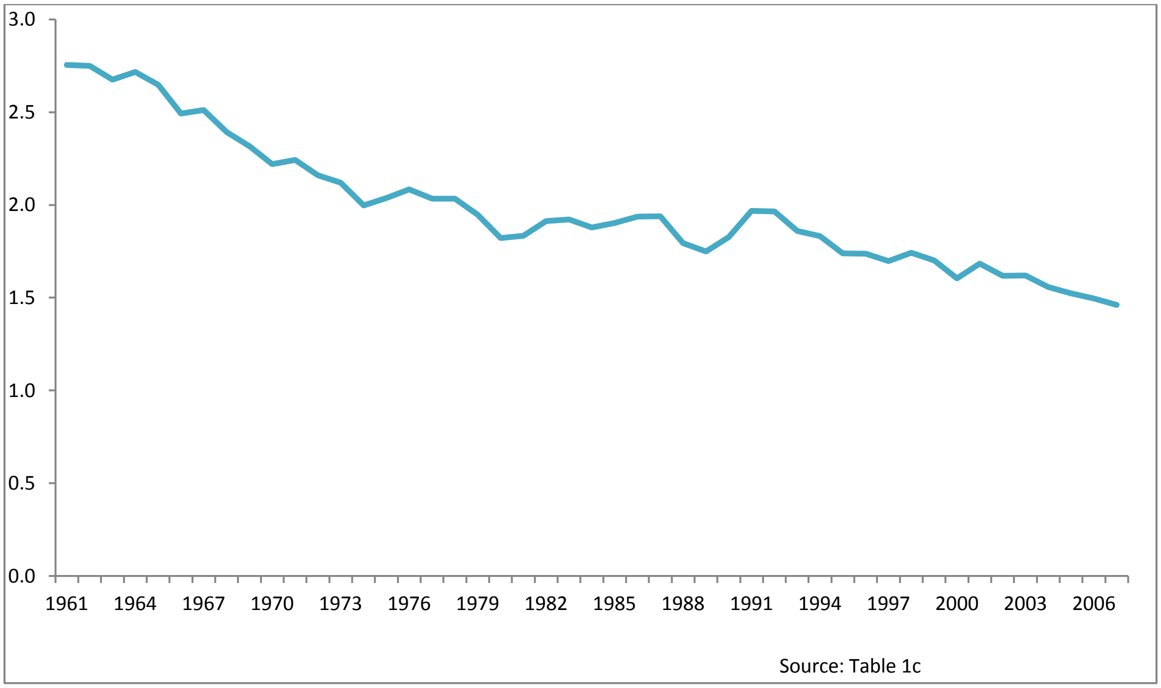
The food manufacturing subsector in Canada is in long-term decline in terms of its share of total economy GDP. It fell as a share of nominal output from 2.75 per cent in 1961 to 1.46 per cent in 2007. Chart 1 shows that the share of nominal GDP produced in the food manufacturing subsector. As will be seen in the next section, this does not mean

[12] Miscellaneous food manufacturing is a special aggregation of three NAICS four-digit industries: grain and oilseed milling, bakeries and tortilla manufacturing, and other food manufacturing, but is referred to as an industry group in the text for simplicity.

that output has fallen in an absolute sense; rather, it indicates that the rest of the Canadian economy has grown at a faster pace than the food manufacturing subsector.

Similarly, though less dramatically, food manufacturing has declined as a proportion of total manufacturing nominal output, from 12.3 per cent in 1961 to 11.3 per cent in 2007. This relative decline is in part related to the income elasticity for food, which is relatively low. Expenditure on food fell from 11.4 per cent of total household spending in 1997 to 10.2 per cent in 2007.

Chart 1: Nominal GDP in Food Manufacturing as a Share of the Total Economy, Per Cent, 1961-2007



ii. Real Output (GDP)

Real output indexes are available for food manufacturing, but not the industry groups, from the Canadian Productivity Accounts for the 1961-2007 period. Over the entire period, food manufacturing output grew at an average annual rate of 2.22 per cent, well below both manufacturing (3.39 per cent) and the business sector (3.81 per cent). During the 1961-2000 period, growth in food manufacturing averaged only 2.29 per cent, well below both the business sector (4.04 per cent) and manufacturing (4.10 per cent). The more recent 2000-2007 period witnessed a decline in output growth, though growth in food manufacturing output (1.83 per cent) was well above manufacturing (negative 0.49 per cent) and somewhat below the business sector (2.59 per cent) (Summary Table 1 and
Chart 2). The post-2000 divergence in output growth between manufacturing and food manufacturing indicates a falloff in demand for manufacturing output and continued

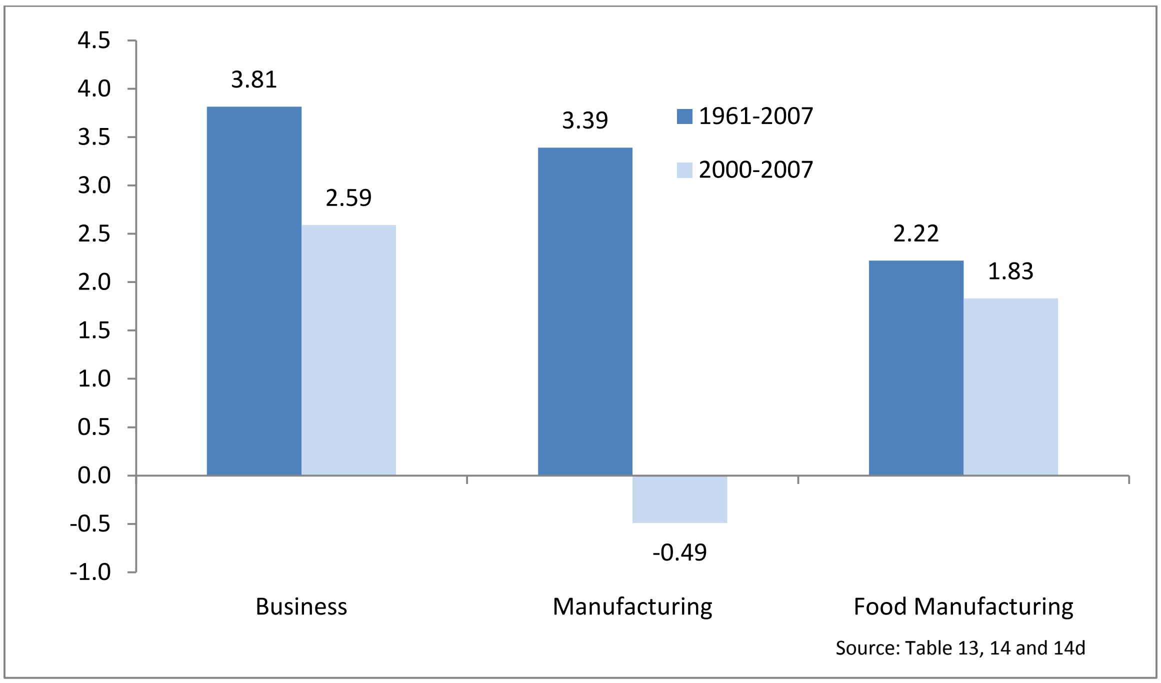
demand growth for food processing output. Increased demand implies pressure to increase capacity utilization in food manufacturing which has implications for multifactor productivity growth.

Summary Table 1: Real (Chained) Output in the Food Manufacturing Subsector, Canada, Compound Annual Growth Rates, per cent, 1961-2007

	1961-2007	1961-2000	2000-2007
Business Sector	3.81	4.04	2.59
Manufacturing [31-33]	3.39	4.10	-0.49
Food Manufacturing Sector	2.22	2.29	1.83

Source: Appendix Tables 13, 14 and 14d

Chart 2: Annual Growth Rates of Real Output in the Total Economy, Manufacturing Sector and Food Manufacturing Subsector, Canada, 1961-2007 and 2000-2007



iii. Gross Output and Intermediate Inputs

Gross output is defined as the sum of value added and the value of intermediate inputs. Gross output in the food manufacturing industry in 2007 was $75.4 billion dollars, of which only $20.9 billion is accounted for by value added. The growth rate of real gross output in food manufacturing was 2.32 per cent over the 1961-2007 period, below the 3.39 per cent growth experienced by manufacturing. From 1961 to 2000, average growth of real gross output was far higher in manufacturing (4.06 per cent) than in food manufacturing (2.46 per cent), though the post 2000 period has witnessed higher growth in food manufacturing (1.55 per cent) than in manufacturing (-0.25 per cent).

Summary Table 2: Intermediate Productivity Use, Manufacturing and Food Manufacturing, 1961-2007

	1961-2007	1961-2000	2000-2007
Manufacturing			
Average Annual Growth Rate			
Gross Output	3.39	4.06	-0.25
Intermediate Input Use	3.38	4.03	-0.15
Intermediate Input Productivity	0.01	0.03	-0.10
Level, Per Cent			
	1961	2000	2007
Intermediate Input/Gross Output Ratio	63.77	68.75	71.16
	1961-2007	1961-2000	2000-2007
Food Manufacturing			
Average Annual Growth Rate			
Gross Output	2.32	2.46	1.55
Intermediate Input Use	2.35	2.52	1.42
Intermediate Input Productivity	-0.03	-0.06	0.13
Level, Per Cent			
	1961	2000	2007
Intermediate Input/Gross Output Ratio	76.60	74.05	72.25

Source: Appendix Tables 14, 14b, 14d and 14f

Intermediate inputs accounted for $54.5 billion of the food manufacturing gross output, of which $45.4 billion was spent on materials, $7.6 billion on services and $1.4 billion energy. Intermediate inputs amounted to 72.25 per cent of food manufacturing gross output in 2007, slightly above the 71.16 per cent in manufacturing. Intermediate input use in food manufacturing increased at an average annual rate of 2.35 per cent between 1961 and 2007, which was below the 3.38 per cent annual growth experienced in manufacturing. From 1961 to 2000, real inputs increased 2.52 per cent in food manufacturing, a rate far below the 4.03 per cent experienced by manufacturing. In the more recent 2000-2007 period, food manufacturing experienced a higher growth rate in intermediate inputs (1.42 per cent) than manufacturing, which experienced declining intermediate input use (-0.15 per cent).

Intermediate input productivity growth was essentially unchanged over the 1961-2007 period in food manufacturing, having declined 0.03 per cent per year; intermediate input productivity was similarly flat in manufacturing as a whole, having advanced only

0.01 per cent. Intermediate input productivity growth since 2000, however, has been faster in food manufacturing (0.13 per cent) than in manufacturing (-0.10 per cent).

iv. Labour Input (Jobs and Hours Worked)

This subsection reviews trends in labour input in the food manufacturing subsector. Labour input can be expressed in terms of the number of workers or number of hours worked. Hours worked is a more appropriate measure of labour input from a productivity perspective, since the average number of hours worked per worker can change over time. In this report, hours worked is used as the measure of labour input. However, it remains important to examine data on the number of workers because employment is an indicator of the importance of the sector in the economy and because trends in employment largely drive changes in total hours worked.

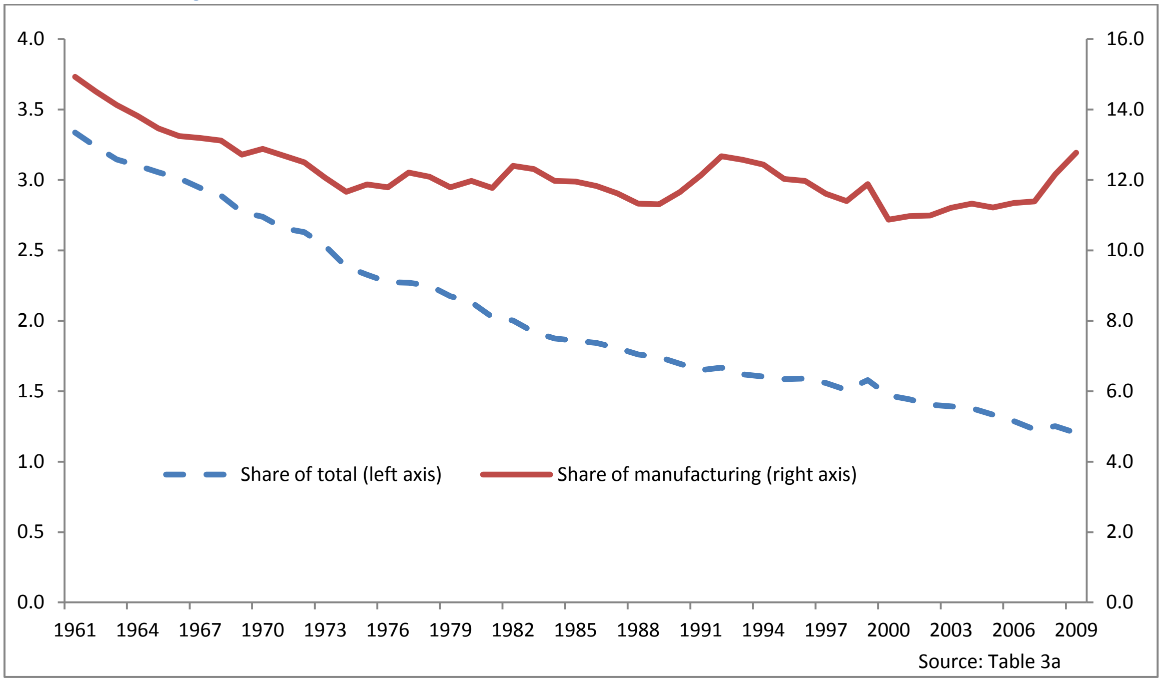
There were 205,290 jobs in the food manufacturing subsector in 2009, a small drop from 214,814 in 1961. The decline in the food manufacturing subsector's share of employment in the Canadian economy has been proportionately much larger; the sector accounted for 3.34 per cent of Canadian jobs in 1961, but only 1.20 per cent in 2009 (Table 3). The sector's share of Canadian employment declined by 2.10 per cent per year over the full 1961-2009 period, which compares with the 1.79 per cent decline experienced by manufacturing. The rate of decline accelerated to 2.20 per cent per year between 2000 and 2009.

Summary Table 3: Food Manufacturing Industry Group Employment as a Proportion of Sector Employment

	1997	2000	2007	2009
Animal food [3111]	5.0	6.1	3.9	4.0
Sugar and confectionery product [3113]	5.9	5.2	5.8	4.8
Fruit and vegetable preserving and specialty food [3114]	9.8	9.2	11.2	11.3
Dairy product [3115]	11.8	10.6	11.3	11.7
Meat product [3116]	25.1	25.2	28.1	28.5
Seafood product preparation and packaging [3117]	8.6	11.3	10.5	10.6
Miscellaneous food [311A]	33.8	32.4	29.1	29.2

Calculated from Table 4c

Chart 3: Number of Jobs in the Food Manufacturing Subsector as a Share of the Total Economy, Canada, 1961-2009



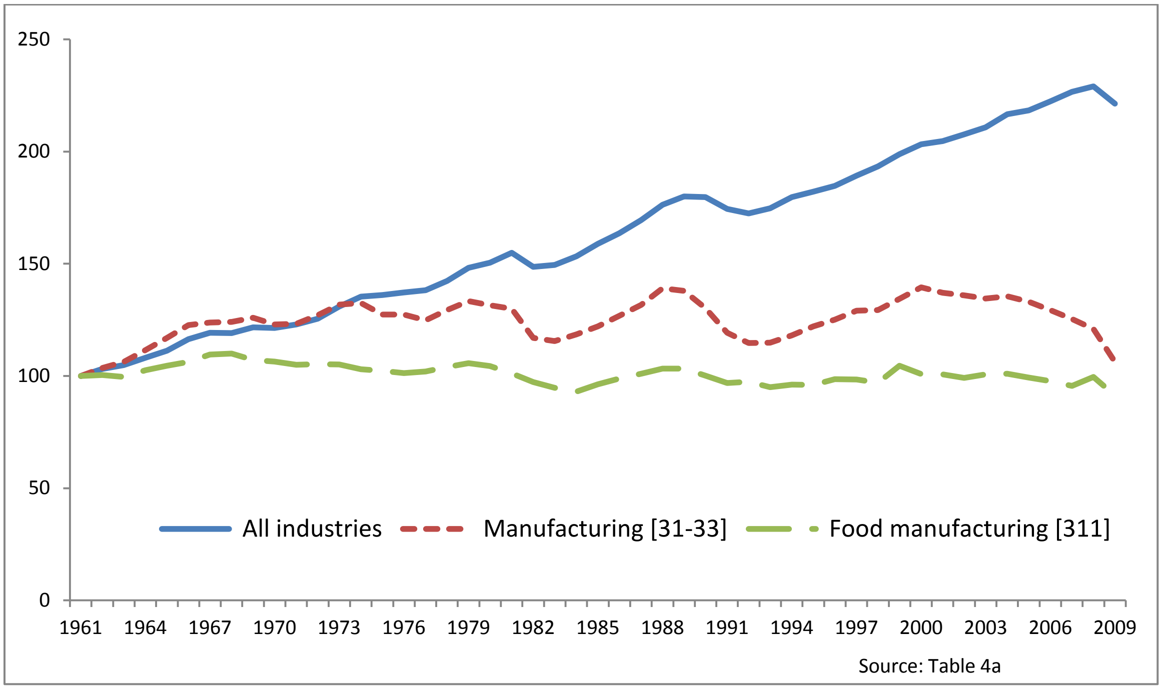
Total hours worked in the food manufacturing products sector have seen a slow decline over the past 48 years, averaging -0.19 per cent per year over the period 1961-2009 (Summary Table 4). The rate of decline has been faster in recent years. Between 2000 and 2009, total hours worked declined by 1.10 per cent per year in the subsector (Summary Table 4). Average annual per-job hours worked in the food manufacturing subsector were just 2.50 per cent lower in 2009 than in 2000, so the steep decline in total hours worked was driven by the employment changes discussed above. In contrast, hours worked in the total economy increased by 0.96 per cent per year over the 2000-2009 period, and manufacturing declined 2.97 per cent per year.

Summary Table 4: Total Hours Worked, Food Manufacturing Subsector, Canada, Compound Annual Growth Rates, per cent, 1961-2009

	1961-2009	1961-2000	1997-2009	2000-2009
All industries [T001]	1.67	1.83	1.32	0.96
Manufacturing [31-33]	0.13	0.86	-1.60	-2.97
Food manufacturing subsector	-0.19	0.02	-0.63	-1.10

Source: Appendix Table 4

Chart 4: Total Hours Worked, Food Manufacturing Subsector, Canada, Index 1961= 100, 1961-2009



Overall, employment in the sector has decreased even as output increased. Furthermore, the rate of decline increased in the 2000-2009 period.

v. Capital Input

There are two methods measures of capital input, capital stock and capital services. Capital stock is simply a measure of the real (constant dollar) physical capital held by the firm in the form of engineering structures, buildings and machinery and equipment. Capital service input includes services provided by fixed reproducible business assets (such as equipment and structures) as well as inventories, and land. The capital service input is calculated by aggregating the capital stock of different types of capital goods using the relative cost of capital as weights. Capital services growth is driven by increases in the level of capital stock, as well as 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).

Let us begin with capital input defined as the real (constant dollar) net stock of capital depreciated using a geometric depreciation rate.[13] Net capital stock increased at a compound average annual rate 1.57 per cent between 1961 and 2010, a rate somewhat

[13] Geometric depreciation assigns more depreciation to a capital asset in the early years of its service life than later in its service life. This practice is in contrast to straight line depreciation, which assigns an equal amount of depreciation to a capital asset in each year of its service life. Real capital stock, in contrast to nominal capital stock uses deflators to adjust the capital for the changing prices and quality of capital goods created or purchased.

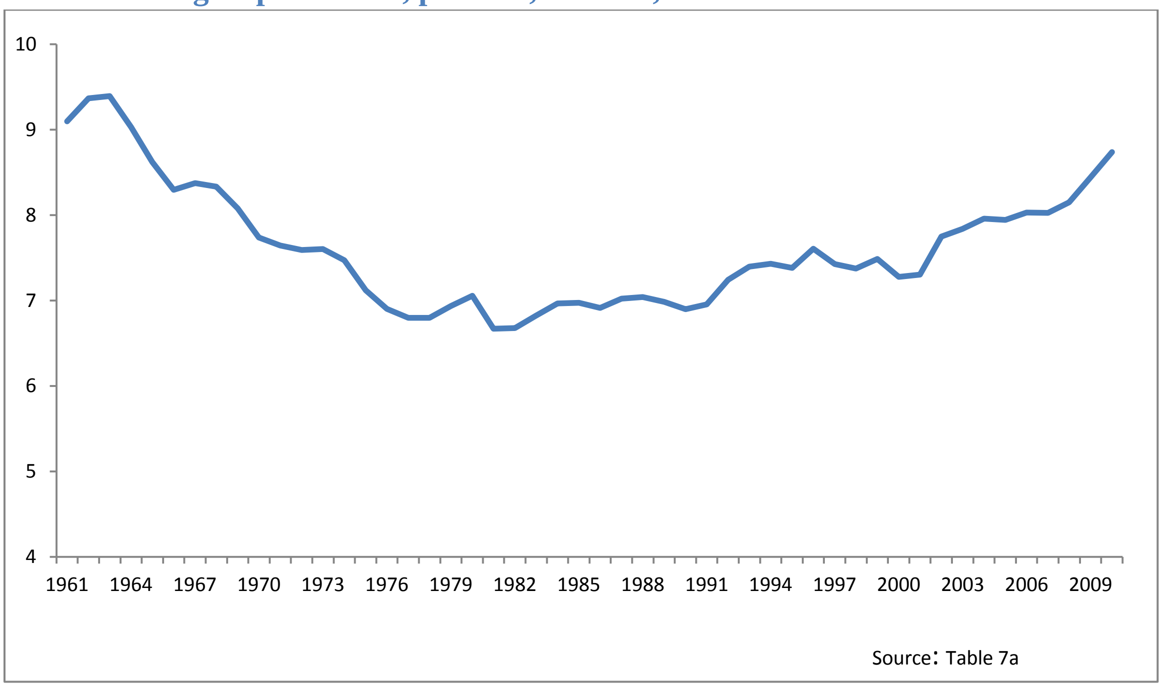
above that experienced by manufacturing, which grew at a rate of 1.44 per cent, but below the total economy rate of 2.77 per cent. Real capital stock in the food manufacturing subsector in Canada declined between 2000 and 2010 at an average annual rate of 0.27 per cent (Summary Table 5).

Summary Table 5: Real Capital Stock, Food Manufacturing Sector, Canada, Compound Annual Growth Rates, Per Cent, 1961-2010

	1961-2010	1961-2000	2000-2010
All industries [T001]	2.77	2.89	2.32
Manufacturing [31-33]	1.44	2.36	-2.06
Food Manufacturing Sector	1.57	2.05	-0.27

Source: 7b

Chart 5: Real Capital Stock in the Food Manufacturing Subsector as a Share of the Manufacturing Capital Stock, per cent, Canada, 1981-2010



Using the alternative definition of capital input, that is capital services, the trends have been similar to the capital stock method, though data are not available at the industry group level. Over the 1961-2007 period, capital services increased at an average annual rate of 2.53 per cent per year in the food manufacturing subsector, which was slower than manufacturing (3.04 per cent) and the business sector (5.06 per cent). During the 2000 to 2007 period, food manufacturing experienced capital services growth of 1.81 per cent per year, more than double the rate experienced by manufacturing (0.83 per cent), but less than half the rate experienced by the business sector (4.07 per cent). The positive difference between capital stock growth and capital services growth implies that there has been a change in capital composition towards shorter lived assets. This is consistent with a vast literature detailing the increasing importance of information and communication technology and other short lived assets.

Summary Table 6: Capital Services Input Compound Average Annual Growth Rate in the Business, Manufacturing and Food Manufacturing Subsectors, 1961-2007

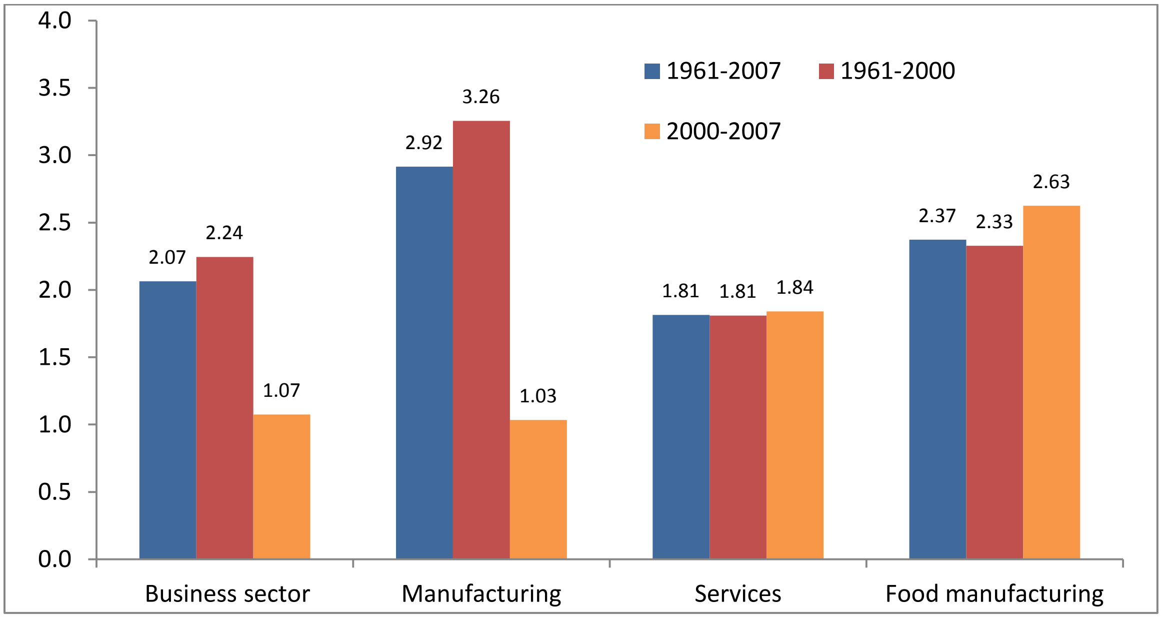
	1961-2007	1981-2007	1961-1981	1981-1989	1989-2000	2000-2007
Business Sector	5.06	3.91	6.58	4.05	3.71	4.07
Manufacturing	3.04	2.02	4.38	2.38	2.53	0.83
Food Manufacturing	2.53	1.91	3.35	2.22	1.75	1.81

Source: Appendix Tables 13b, 14b and 14f

vi. Labour Productivity

Productivity can be measured on a gross output basis or on a value added basis, and both methods have strengths and weaknesses. The OECD (2001) notably recommends the use of value added labour productivity for "analysis of micro-macro links, such as the industry contribution to economy-wide labour productivity and economic growth" because the value added labour productivity of each industry weighed by the proportion of total hours worked would sum to labour productivity in the economy. Furthermore, "value-added based labour productivity forms a direct link to a widely used measure of living standards, income per capita. Productivity translates directly into living standards." Labour productivity as measured by gross output, in contrast, can be increased without any true efficiency gain. The OECD (2001) notes, for instance, that outsourcing "implies substitution of primary factors of production, including labour, for intermediate inputs"; as gross output remains the same, but labour input falls, outsourcing increases gross output labour productivity measures. This holds even if the outsourced production is done the exact same way as was done previous to outsourcing. As an example, imagine a company that makes frozen dinners and has advertising and legal departments. If this firm outsourced advertising and legal services, productivity increases *because the value added of outsourced production is embedded in the final good* but not part of the value added of the firm. Growth rates in value added productivity and gross output productivity are the same only if the ratio of intermediate goods to gross output are constant. For these reasons, the analysis that follows uses a value-added approach.

Chart 6: Labour Productivity in Food Manufacturing and Benchmark Industries, Compound Average Annual Growth Rates Based on Value Added, 1961-2007, 1961-2000 and 2000-2007



Labour productivity growth data for manufacturing and food manufacturing are available on an official basis from Statistics Canada for the 1961-2007 period. Over the entire period for which data are available on an official basis, labour productivity in food manufacturing grew at a compound average rate of 2.37 per cent, significantly below the 2.92 per cent growth achieved in the manufacturing sector. The most recent period of 2000-2007 witnessed an acceleration of growth in food manufacturing to 2.63 per cent as well as an improvement in relative performance due to manufacturing productivity growth slowing to 1.03 per cent.

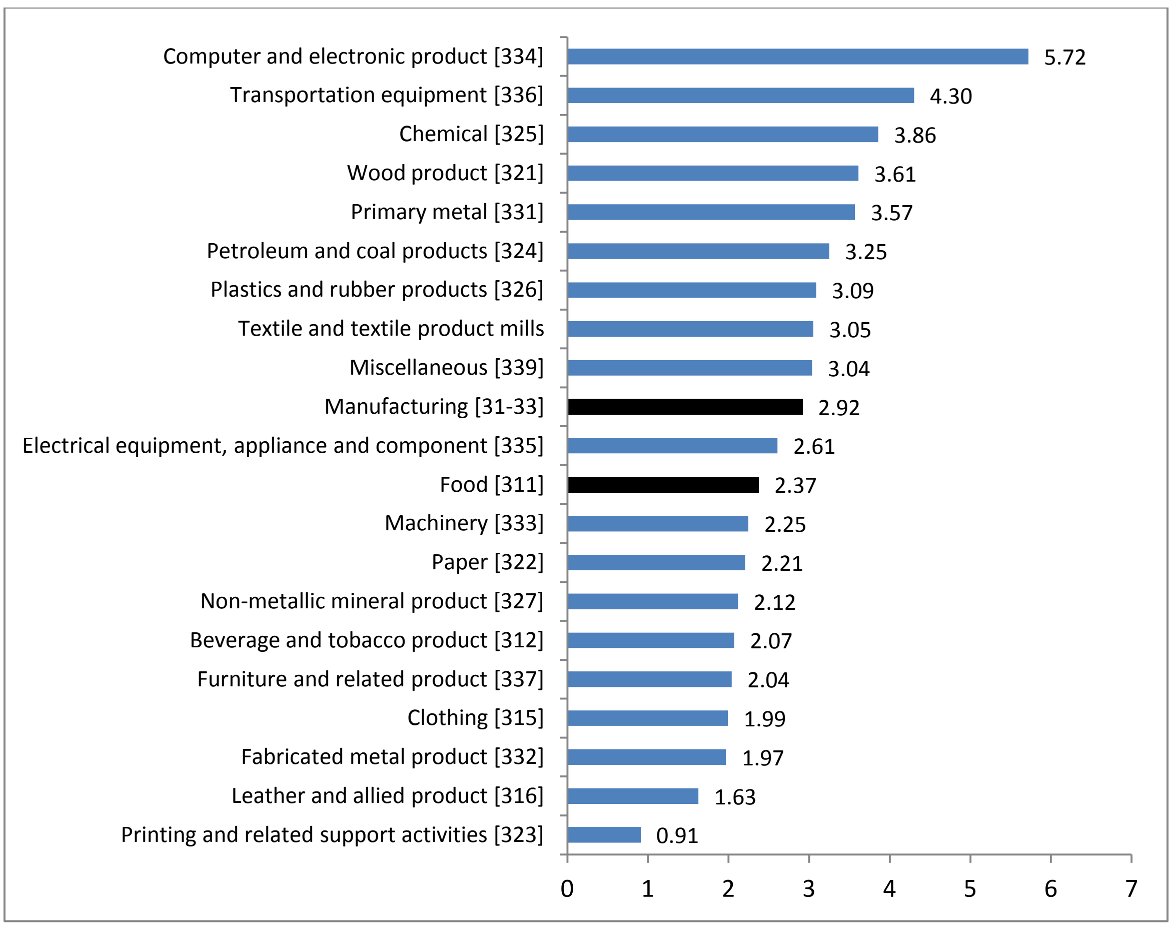
Summary Table 7: Labour Productivity, Real GDP (Chained 2002 Dollars) per Hour Worked, Food Manufacturing Subsector, Canada, 1961-2007

	1961-2007	1961-2000	2000-2007
	(compound annual growth rate, per cent)		
Business sector	2.07	2.24	1.07
Manufacturing	2.92	3.26	1.03
Food manufacturing	2.37	2.33	2.63
	(chained 2002 dollars per hour worked)		
	1961	2000	2007
Business sector	15.01	35.56	38.35
Manufacturing	13.42	46.91	50.42
Food manufacturing	15.52	38.03	45.59

Source: Appendix Table 5 for industry groups, Business Sector, Manufacturing and Food Manufacturing data found in Appendix Tables 13, 13a, 14, 14a, 14d and 14e

Over the entire timeframe of 1961 through 2007, food manufacturing outperformed nine subsectors in manufacturing and 10 experienced higher productivity growth (Chart 7). The subsector with the highest productivity growth was computer and electronic product manufacturing (5.72 per cent per year) and the lowest was printing and related support activities (0.91 per cent) compared to 2.37 per cent average annual growth in food manufacturing labour productivity. During the post-2000 period, food manufacturing had a very strong performance when compared to its peers in the manufacturing sector, ranking 4th out of 20 industry groups.[14] With an average annual labour productivity growth rate of 2.63 per cent, only wood product manufacturing (4.96 per cent), primary metal manufacturing (4.56 per cent), and miscellaneous manufacturing (2.68 per cent) experienced higher growth. Half of the subsectors in manufacturing experienced negative productivity growth from 2000 to 2007, with the leather and allied products contracting the most at 4.14 per cent per year per year.

Chart 7: Labour Productivity Growth Rates in Manufacturing Industries, Per Cent, 1961-2007



Source: Appendix Table 14h.

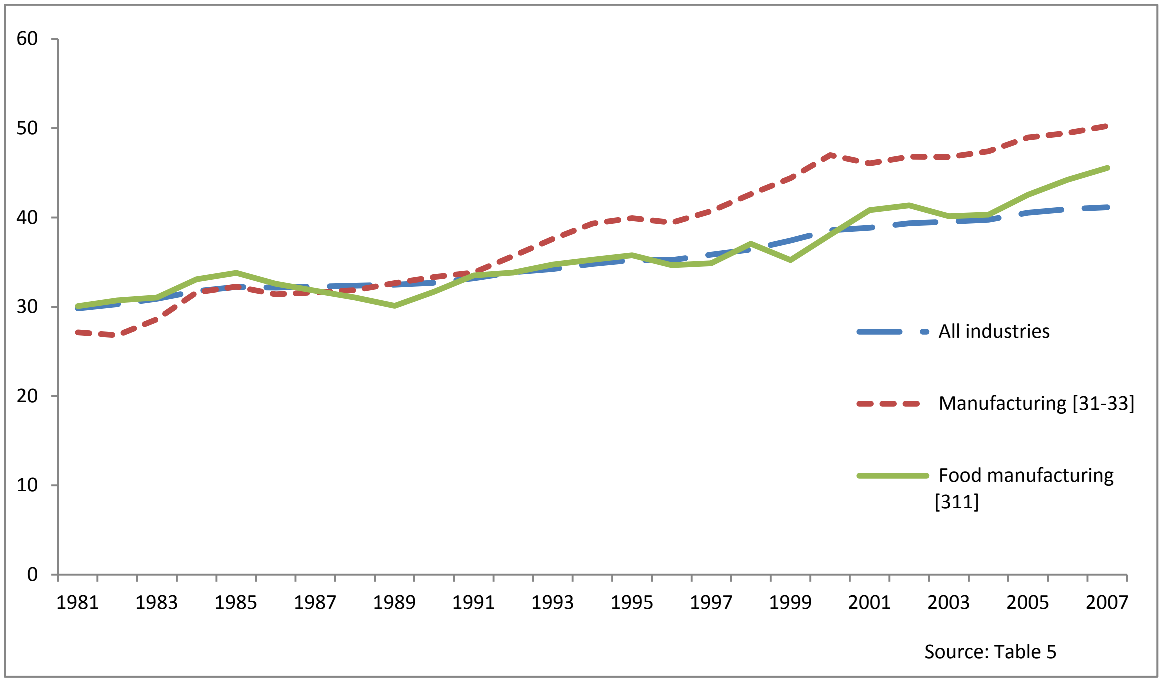
[14] There are officially 21 industry groups in manufacturing, but the available statistics group textile mills (NAICS 313) and textile product mills (NAICS 314) as one industry group.

Summary Table 8: Average Annual Labour Productivity Growth Rates in Manufacturing and Subsectors, per cent, 1961-2007

	1961-2007	1961-2000	2000-2007
Manufacturing [31-33]	2.92	3.26	1.03
Food [311]	2.37	2.33	2.63
Beverage and tobacco product [312]	2.07	2.88	-2.33
Textile and textile product mills	3.05	3.68	-0.39
Clothing [315]	1.99	2.65	-1.62
Leather and allied product [316]	1.63	2.70	-4.14
Wood product [321]	3.61	3.37	4.96
Paper [322]	2.21	2.70	-0.48
Printing and related support activities [323]	0.91	0.65	2.35
Petroleum and coal products [324]	3.25	4.45	-3.17
Chemical [325]	3.86	4.67	-0.57
Plastics and rubber products [326]	3.09	3.47	0.99
Non-metallic mineral product [327]	2.12	2.40	0.55
Primary metal [331]	3.57	3.39	4.56
Fabricated metal product [332]	1.97	2.27	0.28
Machinery [333]	2.25	2.41	1.31
Computer and electronic product [334]	5.72	7.53	-3.81
Electrical equipment, appliance and component [335]	2.61	3.64	-2.96
Transportation equipment [336]	4.30	4.77	1.72
Furniture and related product [337]	2.04	2.42	-0.09
Miscellaneous [339]	3.04	3.10	2.68

Source: Appendix Table 14h

Chart 8: Labour Productivity, Food Manufacturing Subsector, Canada, Chained 2002 Dollars, 1981-2007



The Centre for the Study of Living Standards estimated productivity growth based on GDP data from National Accounts and hours worked data from the Survey of Employment, Hours and Payroll. This methodology may lead to slightly differing growth rates due to data revisions compared to the above paragraph, but this allows for industry group growth rates and estimates data up to 2009. Intriguingly, productivity growth accelerated in food manufacturing over the 2000-2009 period compared to the 1981-2000 period, the opposite of what was experienced in manufacturing as well as the wider economy. Labour productivity in the total economy grew by 1.15 per cent per year over the 1981-2009 period, but productivity growth declined to 0.71 per cent per year in the 2000-2009 period, and the growth rates for manufacturing over those same periods were 2.13 per cent and 0.46 per cent respectively (Summary Table 9). The food manufacturing subsector outperformed the total economy, but not manufacturing, between 1981 and 2009, with an average annual labour productivity growth rate of 1.74 per cent. But between 2000 and 2009, the sector's labour productivity growth outpaced growth in both the economy and in manufacturing at 2.79 per cent per year.

Summary Table 9: Labour Productivity and Real GDP (Chained 2002 Dollars) per Hour Worked, Food Manufacturing Subsector, Canada 1997-2009

	1997-2009	1997-2000	2000-2009
	(compound annual growth rate, per cent)		
All Industries	1.15	1.36	0.71
Manufacturing	2.13	2.93	0.46
Food manufacturing	1.74	1.24	2.79
	(chained 2002 dollars per hour worked)		
	1981	2000	2009
All Industries	29.83	38.57	41.10
Manufacturing	27.14	47.00	48.99
Food manufacturing	30.09	38.06	48.75

Source: Summary Table 5

Overall, the labour productivity experience of the food manufacturing subsector has been diverse, but most industry groups outpaced both the total economy and manufacturing in terms of labour productivity growth from 2000 to 2009. In terms of productivity levels, the food manufacturing was ahead of the total economy but behind manufacturing. In terms of productivity growth, the sector as a whole has performed very well in recent years; labour productivity growth in the sector was more than double that experienced by the total economy and by manufacturing from 2000 to 2009, and growth was higher in the 2000-2009 period than it was for the 1981-2009 period. While the food manufacturing subsector has experienced declining hours, output has continued to grow resulting in high productivity growth. Section five of this report explores several possible explanations for these trends.

Box 1: McCain Foods Modernizes

Productivity growth fundamentally happens at the firm level, and there are always a few firms at the forefront that are increasing productivity faster than the industry in general. McCain Foods Ltd. is one such company that has embraced an ambitious plan to attain higher productivity.

McCain Foods Ltd. completed a new factory in Florenceville, New Brunswick in 2008 with the aim of increasing productivity compared to the 50 year old plant that was to be vacated. The new factory was part of an overall corporate strategy that sought greater efficiency at the input stage, modernized management techniques, optimal technology use, increased safety and reduced environmental impact.

At the input stage, technology has been used in a variety of ways to reduce waste. Camera vision systems are used in peeling, cutting and removing defective potatoes, a process that has reduced waste and improved quality. More efficient use of energy was also achieved through using an energy recovery system to reuse heat from the fryer in the manufacturing process.
Due to the extent of the modernization, training employees was central to the success of the plant. Simulation training was used as a pedagogical tool in training workers to use control screens, and those that manufactured the equipment were on site to deal with start-up problems. The focus on worker development does not end with training, but also a new workplace culture. Every shift starts with a review of the work done by the previous shift and the plan of the coming shift, a strategy that very much promotes worker engagement.

Food safety and employee safety were also given prominence in the overall design. The new received Gold Certification from the American Institute on Baking which recognizes food safety, quality and sanitation. The new factory also brags that it has operated for more than 500 days without suffering a lost-time accident.

Through the use of technology and training, the firm has attained higher worker productivity, while consumers have attained a better product and workers benefitted from greater safety.

Source: "Want fries with that?" *Refrigerated and Frozen Foods Magazine*. March 20, 2010. Available: http://www.refrigeratedfrozenfood.com/Articles/RFF_Extra/BNP_GUID_9-5-2006_A_10000000000000783621

vii. Multifactor Productivity

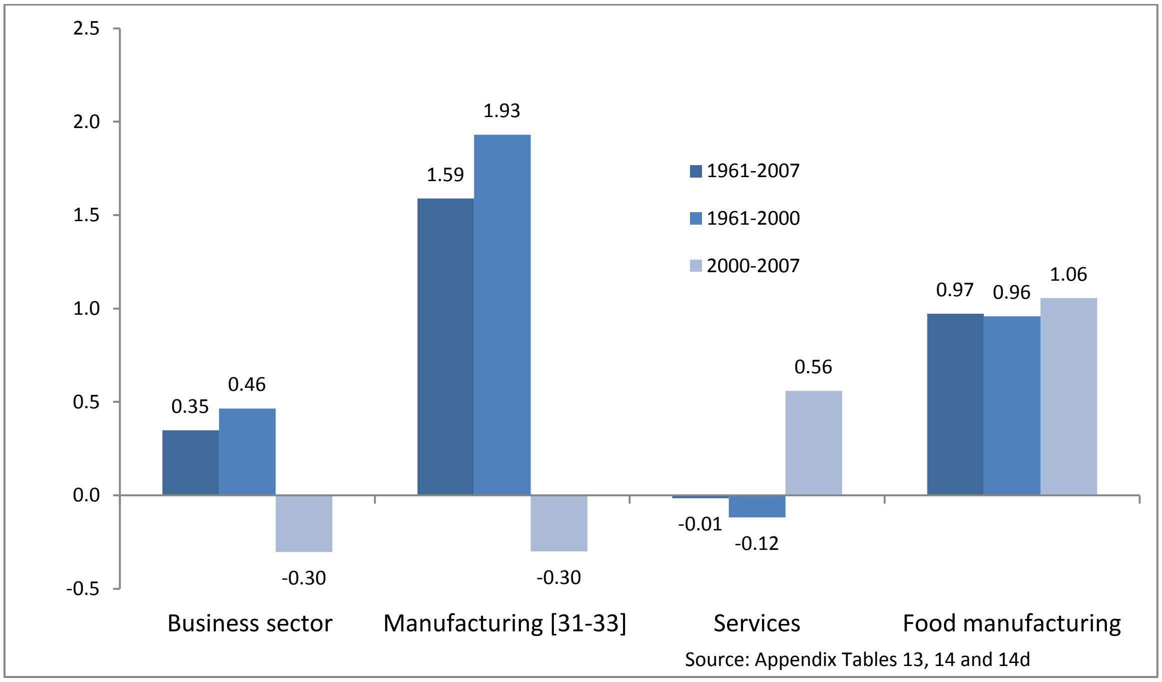
Statistics Canada estimates multifactor productivity (MFP) for major sectors of the economy on a long term basis of 1961-2007, but not for the four-digit industry groups. Multifactor productivity (MFP) is a residual term that captures productivity growth not associated with the growth of labour and capital inputs. Over the entire time frame, food manufacturing experienced average annual multifactor productivity growth of 0.97 per cent, which is only three-fifths of the 1.59 per cent attained in manufacturing, but three times higher than the rate in the business sector, 0.35 per cent. During the recent 2000-2007 period, food manufacturing benefitted from an accelerated MFP annual growth rate of 1.06 per cent while both the business sector and business sector faced negative rates of -0.30 per cent.

Summary Table 10: Multifactor Productivity in the Food Manufacturing Subsector Based on Capital Services Input, Compound Average Annual Growth Rate, 1961-2007

	1961-2007	1961-2000	2000-2007
Business Sector	0.35	0.46	-0.30
Manufacturing	1.59	1.93	-0.30
Business Services	-0.01	-0.12	0.56
Food Manufacturing	0.97	0.96	1.06

Source: Appendix Tables 13, 14 and 14f

Chart 9: Average Annual Multifactor Productivity Growth Rates, Based on Value Added, 1961-2007, 1961-2000 and 2000-2007



viii. Key Findings

This subsection highlights the key trends uncovered in this exploration of productivity in the food manufacturing subsector from 2000 to 2007. These key findings will form the basis for the discussion of the drivers of productivity in the food manufacturing subsector in section five.

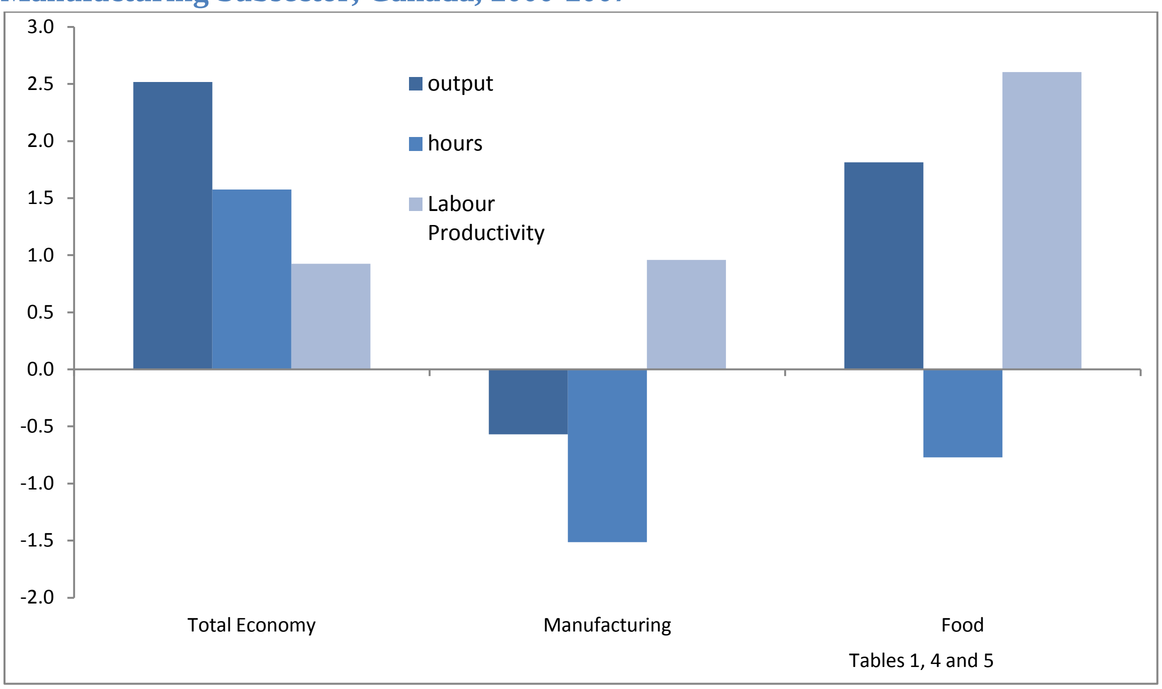
- The food manufacturing subsector experienced faster output growth than the manufacturing sector, but weaker than the Canadian economy as a whole between 2000 and 2007.

- The number of hours worked in the overall economy increased while decreasing in the food manufacturing subsector; the decline was greater in manufacturing over the 2000-2007 period.

- Labour productivity grew much faster in the food manufacturing subsector than in the Canadian economy as a whole and in the manufacturing sector over the 2000-2007 period.

- Over the same period, multifactor productivity growth was stronger in the food processing sector than in the Canadian business sector.

Chart 10: Labour Input, Output, and Labour Productivity Growth, Food Manufacturing Subsector, Canada, 2000-2007



- Labour productivity growth in the food manufacturing subsector accelerated after 2000 compared to the 1961-2000 period, unlike the manufacturing sector and the total economy.

- Multifactor productivity growth, which measures changes in real output not related to changes in hours worked or real capital stock, accelerated slightly for food manufacturing in the post-2000 period, at a time when both manufacturing and the business sector experienced declines. While food manufacturing has outperformed both the business sector and manufacturing since 2000, the sector did not outperform manufacturing over the longer 1961-2007 term.

B. Food Manufacturing Subsector Productivity Trends at the Four-Digit Industry Group Level

This section explores productivity trends in the seven industry groups within food manufacturing: animal food manufacturing, sugar and confectionary product manufacturing, fruit and vegetable preserving and specialty food manufacturing, dairy product manufacturing, meat product manufacturing, seafood product preparation and packaging and miscellaneous food manufacturing.[15] First, we outline long-run trends in nominal output to provide context for the remainder of this report. We then examine each of the components of productivity estimates: real output, labour input, and capital input. Then, trends in labour productivity and multifactor productivity are explored. Finally, key findings are summarized.

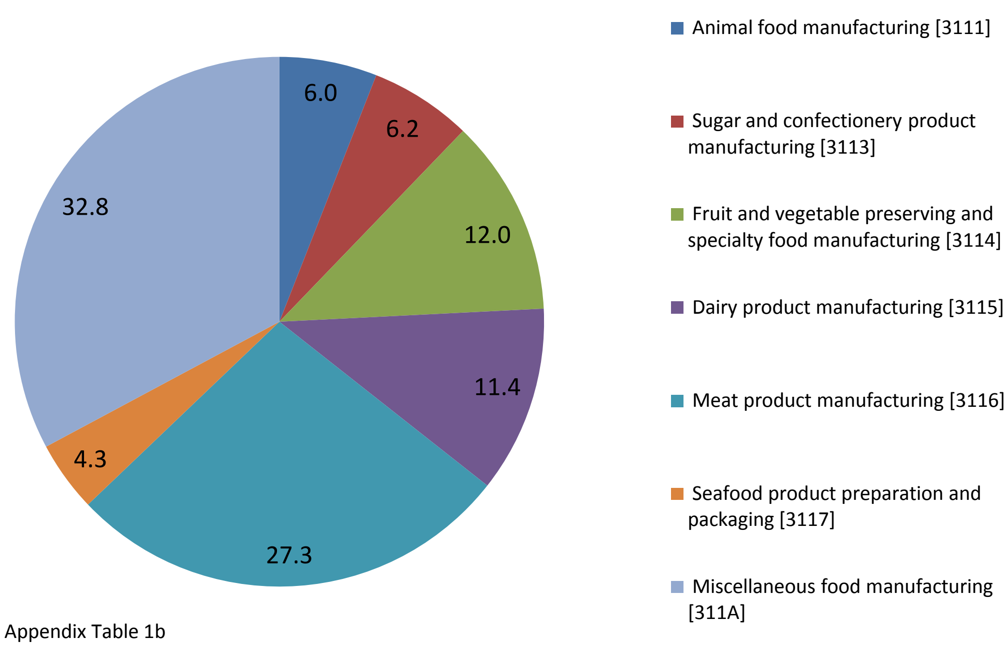
i. Nominal Value-Added Output (GDP)

Every industry group has seen large growth in nominal output over the period, which is unsurprising given 46 years of inflation and population growth.

Among food manufacturing industry groups in 2007, miscellaneous food manufacturing was the largest industry group in terms of output value at 32.8 per cent of value, followed by meat product manufacturing (27.3 per cent), fruit and vegetable preserving and specialty food manufacturing (12.0 per cent), dairy product manufacturing (11.4 per cent), sugar and confectionary product manufacturing (6.2 per cent), animal food manufacturing (6.0 per cent) and seafood product preparation and packaging (4.3 per cent). The relative importance of industry groups in 2007 is given in .

[15] Miscellaneous food manufacturing is a special aggregation of three NAICS four-digit industries: grain and oilseed milling, bakeries and tortilla manufacturing, and other food manufacturing, but is referred to as an industry group in the text for simplicity.

Chart 11: Nominal Food Manufacturing Industry Group Output as a Proportion of Subsector Output, 2007

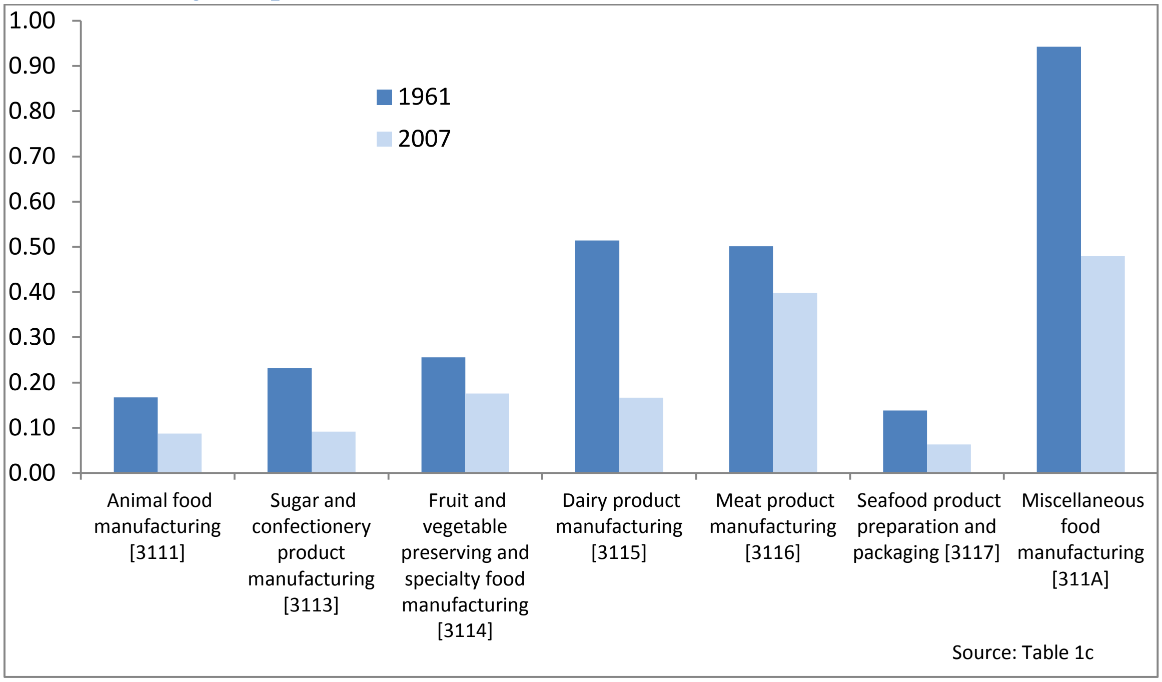


Source: Appendix Table 1b

Three industry groups in food processing have seen their shares of nominal total economy GDP fall by more than half since 1961; dairy manufacturing experienced the largest decline (67.6 per cent), followed by sugar and confectionary product manufacturing (60.7 per cent), seafood product preparation and packaging (54.5 per cent). In fact, every industry group saw output decline as a share of GDP over the period (Chart 12). Other industry groups with falling shares of output relative to the total economy included miscellaneous food manufacturing (49.1 per cent), animal food manufacturing (47.8 per cent), fruit and vegetable preserving and specialty food manufacturing (31.4 per cent) and meat product manufacturing (20.5 per cent).

Comparing industry groups to manufacturing, only two industry groups increased their share of output. Meat product manufacturing increased as a proportion of manufacturing output by 38.0 per cent while fruit and vegetable preserving and specialty food manufacturing increased by 19.2 per cent. Overall, the long term trend has clearly been a decline in the share of total output accounted for by the food manufacturing subsector.

Chart 12: Nominal Output of Food Manufacturing Industry groups as a Share of Total Economy Output, 1961 and 2007



ii. Real Output (GDP)

Data from National Economic Accounts are available on a shorter but more recent basis, and are available at the industry group level. Real output in the food manufacturing subsector advanced at an average annual rate 1.40 per cent from 1981 to 2010, compared to 1.58 per cent for manufacturing and 2.49 per cent for the total economy.

The strongest real output growth rate over the 1981-2010 period was attained by fruit and vegetable preserving and specialty food manufacturing at 3.42 per cent per year, the only industry with growth higher than two per cent (Summary Table 11). The next highest were sugar and confectionary products at 1.84 per cent and seafood product preparation and packaging at 1.78 per cent. Industry groups that grew less quickly than food manufacturing include miscellaneous food manufacturing at 1.40 per cent, animal food manufacturing at 1.29 per cent and meat product manufacturing 1.22 per cent. The only industry group that experienced a negative compound average annual growth rate over the 1981-2010 was dairy product manufacturing at -0.82 per cent. It is quite normal that output grow at different rates in different industry groups, not only because of trade opportunities, but also as noted by Azzam, Lopez and Lopez (2002) there are large variations in consumer preferences over time.

Real output growth accelerated in every industry group during the 2000-2010 period, with the exception of animal food manufacturing which shrank by 1.34 per cent and sugar and confectionary product which declined 0.28 per cent per year. Other industry groups that grew slower than the sector average were dairy product manufacturing (0.49 per cent), fruit and vegetable preserving and specialty food manufacturing (1.43 per cent), and seafood product preparation and packaging (1.51 per cent). To put this performance in context, note that while growth was much higher than in manufacturing, food manufacturing growth was still somewhat lower than total Canadian real GDP over the 2000-2010 time period, which averaged 1.87 per cent per year.

Chart 13: Real GDP, Food Manufacturing Subsector, Billions of Chained 2002 Dollars, 1981-2010

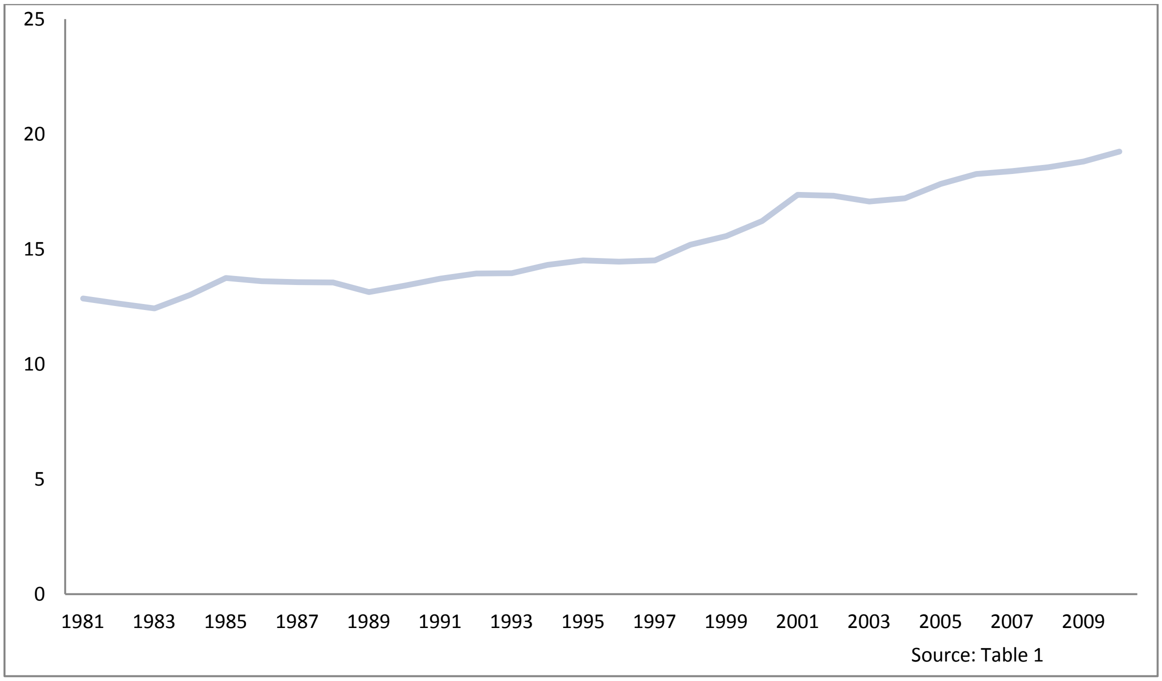
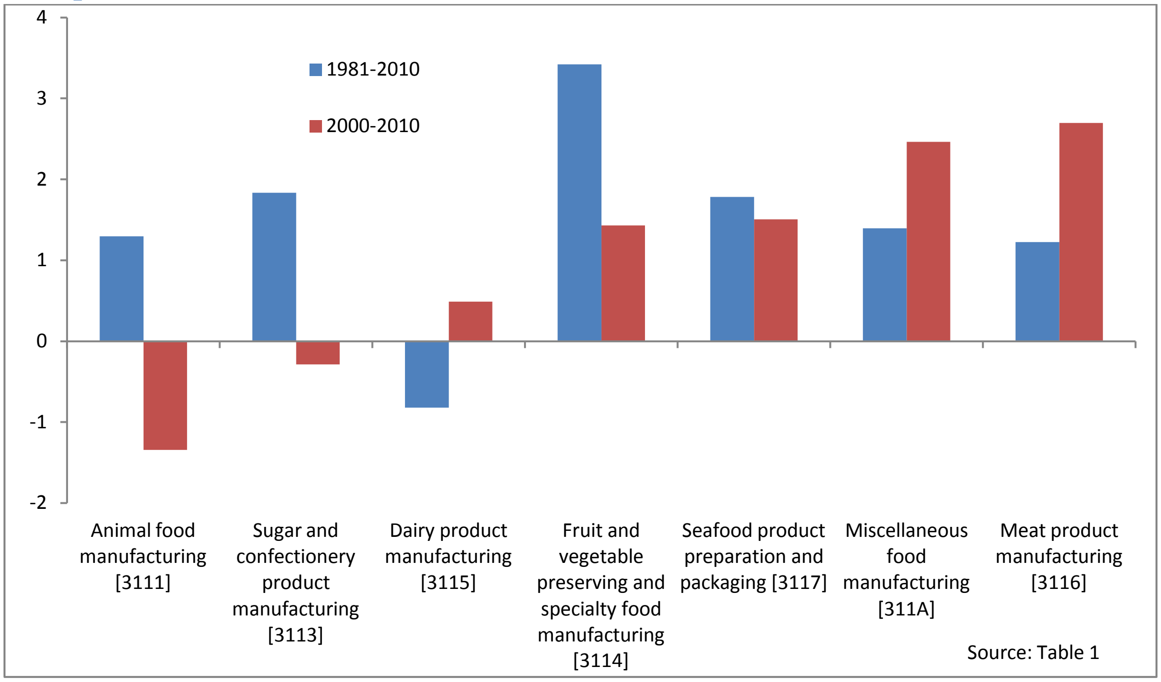


Chart 14: Annual Growth Rates of Real Output in Food Manufacturing Industry Groups, Canada, Per cent, 1981-2010 and 2000-2010



Summary Table 11: Real (Chained) Output in the Food Manufacturing Subsector, Canada, Compound Annual Growth Rates, per cent, 1981-2010

	1981-2010	1981-2000	1997-2010	2000-2010
Food manufacturing subsector	1.40	1.23	2.20	1.72
Animal food manufacturing [3111]	1.29	2.71	1.59	-1.34
Grain and oilseed milling [3112]	n.a.	n.a.	-0.96	1.83
Sugar and confectionery product manufacturing [3113]	1.84	2.97	0.98	-0.28
Fruit and vegetable preserving and specialty food manufacturing [3114]	3.42	4.48	2.04	1.43
Dairy product manufacturing [3115]	-0.82	-1.51	0.76	0.49
Meat product manufacturing [3116]	1.22	0.46	3.81	2.70
Animal (except poultry) slaughtering [311611]	n.a.	n.a.	2.57	1.24
Rendering and meat processing from carcasses [311614]	n.a.	n.a.	5.25	4.82
Poultry processing [311615]	n.a.	n.a.	4.25	2.81
Seafood product preparation and packaging [3117]	1.78	1.93	2.68	1.51
Bakeries and tortilla manufacturing [3118]	n.a.	n.a.	2.28	2.25
Other food manufacturing [3119]	n.a.	n.a.	3.81	3.09
Miscellaneous food manufacturing [311A]	1.40	0.84	1.96	2.46

Source: Appendix Tables 1

Overall, real output growth in the Canadian food manufacturing subsector has been quite strong compared to the manufacturing industry, though weak compared to the total economy in the post-2000 period. Some industry groups grew quite rapidly, such as the other food manufacturing subsector which grew at an average annual rate of 3.09 per cent, while one industry, animal food manufacturing shrank at a rate of 1.34 per cent annually over the 2000-2010 period.

iii. Labour Input (Jobs and Hours Worked)

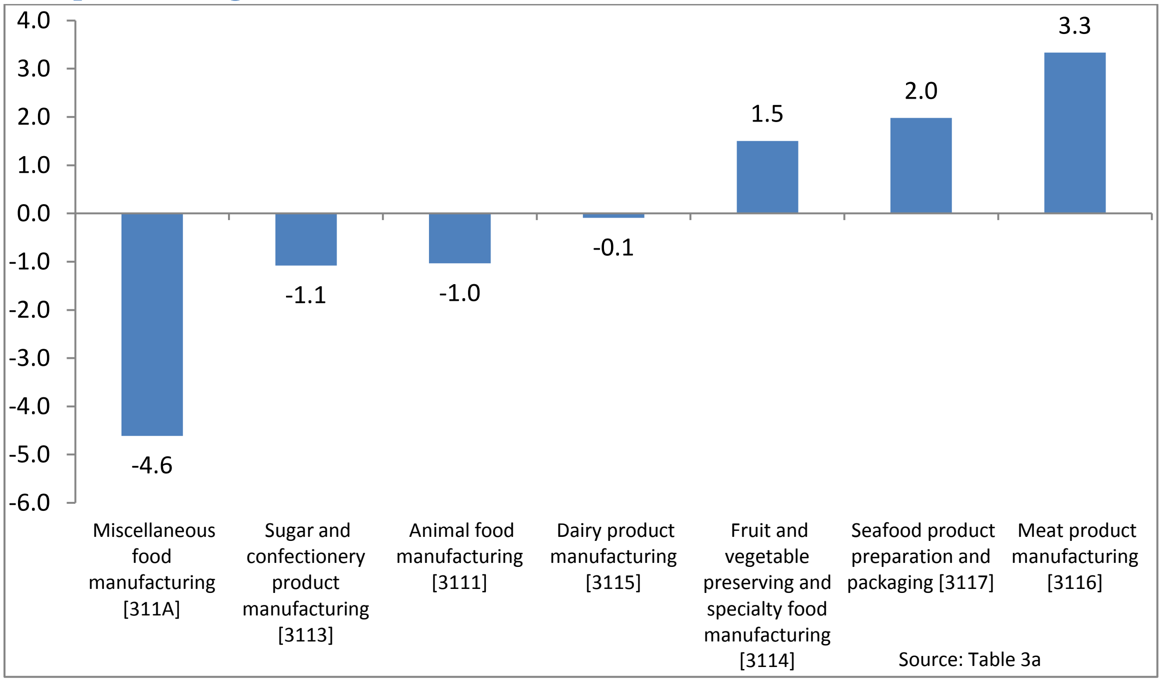
This subsection reviews trends in labour input in the four-digit industry groups that compose food manufacturing. Labour input can be expressed in terms of the number of workers or number of hours worked. Hours worked is a more appropriate measure of labour input from a productivity perspective, since the average number of hours worked per worker can change over time. In this report, hours worked is used as the measure of labour input. However, it remains important to examine data on the number of workers because employment is an indicator of the importance of the sector in the economy and because trends in employment largely drive changes in total hours worked.

Summary Table 12: Food Manufacturing Industry Group Employment as a Proportion of Sector Employment

	1997	2000	2007	2009
Animal food [3111]	5.0	6.1	3.9	4.0
Sugar and confectionery product [3113]	5.9	5.2	5.8	4.8
Fruit and vegetable preserving and specialty food [3114]	9.8	9.2	11.2	11.3
Dairy product [3115]	11.8	10.6	11.3	11.7
Meat product [3116]	25.1	25.2	28.1	28.5
Seafood product preparation and packaging [3117]	8.6	11.3	10.5	10.6
Miscellaneous food [311A]	33.8	32.4	29.1	29.2

Over the 1997 to 2009 period, the longest period for which data are available for the industry groups, there were large changes in the distribution of employment in food manufacturing, with some industry groups becoming much more important and others less important employers within the subsector. Three industry groups increased their share of employment within food manufacturing: fruit and vegetable preserving and specialty food manufacturing (up 1.5 percentage points to 11.3 per cent), meat product manufacturing (up 3.3 percentage points to 28.5 per cent) and seafood product preparation and packaging (up 2.0 percentage points to 10.6 per cent). The largest loss was in miscellaneous food manufacturing (down 4.6 percentage points to 29.2 per cent), followed by sugar and confectionery product manufacturing (down 1.1 percentage points to 4.8 per cent), animal food manufacturing (down 1.0 percentage points to 4.0 per cent) and dairy product manufacturing (down 0.1 percentage points to 11.7 per cent) (and Chart 15).

Chart 15: Change in the Proportion of Food Manufacturing Jobs in an Industry Group, Percentage Points, 1997-2009



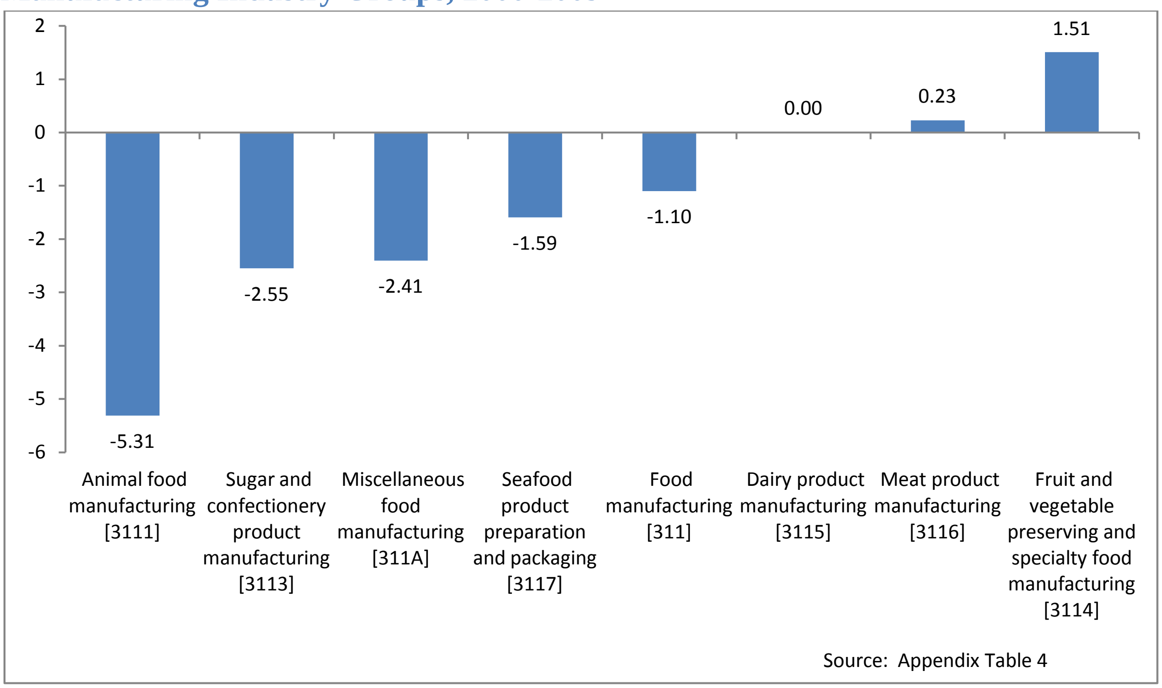
Most industry groups shared in the declining hours trend in the post 2000 era. Four of the seven industries for which data are available faced declining hours, with the greatest decline attained by animal food manufacturing (down 5.31 per cent per year), followed by sugar and confectionary product manufacturing (down 2.55 per cent), miscellaneous food manufacturing (down 2.41 per cent) and seafood preparation and packaging (down 1.59 per cent). Dairy product manufacturing saw no change in hours worked while growth in hours worked was experienced by fruit and vegetable preserving and specialty food manufacturing (1.51 per cent) and meat product manufacturing (0.23 per cent) (Summary Table 13).

Summary Table 13: Total Hours Worked, Food Manufacturing Industry Groups, Canada, Compound Annual Growth Rates, per cent, 1961-2009

	1997-2009	2000-2009
Food manufacturing subsector	-0.63	-1.10
Animal food manufacturing [3111]	-2.62	-5.31
Sugar and confectionery product manufacturing [3113]	-2.49	-2.55
Fruit and vegetable preserving and product specialty food manufacturing [3114]	0.81	1.51
Dairy product manufacturing [3115]	-0.60	0.00
Meat product manufacturing [3116]	0.41	0.23
Seafood product preparation and packaging [3117]	1.10	-1.59
Miscellaneous food manufacturing [311A]	-1.94	-2.41

Source: Appendix Table 4

Chart 16: Compound Average Annual Growth Rate in Hours Worked, Food Manufacturing Industry Groups, 2000-2009



iv. Capital Input

Capital stock data for industry groups are only available for the 1961-2005 period, and data for capital services are unavailable at the industry group level.[16] Only one

[16] Statistics Canada changed the methodology regarding data collection and service life estimates of capital for major subsectors like food manufacturing, but did not update industry groups with the new methodology, thus making the subsector and industry group estimates incompatible. CSLS uses approximated subsector capital stocks by assuming

industry group had strong growth in capital stock, sugar and confectionary experienced growth of 2.89 per cent. The other industry groups all had capital stock growth rates less than that seen by the total economy. The best performing of these industry groups was fruit and vegetable preserving and specialty food manufacturing (2.15 per cent), followed by other food manufacturing (2.12 per cent), dairy product manufacturing (1.96 per cent), seafood product preparation and packaging (1.93 per cent), meat product manufacturing (1.88 per cent), grain and oilseed milling (1.61 per cent), animal food manufacturing (1.30 per cent) and bakeries and tortilla manufacturing (0.87 per cent).

During the more recent 2000-2005 period, five of the nine industry groups in the food manufacturing industry experienced negative capital stock growth rates compared to one in the 1989-2000 period. In the more recent period, other food manufacturing was the best performing sector, having attained a growth rate of 1.99 per cent per year. Other high performers were fruit and vegetable preserving and specialty food manufacturing at 0.95 per cent, and sugar and confectionary product manufacturing at 0.78 per cent. The worst performer was grain and oilseed milling at -2.68 per cent, followed by animal food manufacturing at -1.49 and bakeries and tortilla manufacturing at -1.15 per cent. The previous 1989-2000 period witnessed strong performances by sugar and confectionary product manufacturing (3.38 per cent per year), meat product manufacturing (2.07) and fruit and vegetable preserving and specialty food (1.30 per cent). The worst performers were seafood product preparation and packaging (-1.95 per cent), animal food manufacturing (-0.51 per cent) and dairy product manufacturing, which experienced stagnant growth of 0.04 per cent.

Summary Table 14: Real Capital Stock, Food Manufacturing Industry Groups, Canada, Compound Annual Growth Rates, Per Cent, 1961-2005

	1961-2005	1961-2000	2000-2005
Food Manufacturing Sector	1.78	2.05	-0.28
Animal food manufacturing [3111]	1.30	1.67	-1.49
Grain and oilseed milling [3112]	1.61	2.18	-2.68
Sugar and confectionery product manufacturing [3113]	2.89	3.16	0.78
Fruit and vegetable preserving and specialty food manufacturing [3114]	2.15	2.30	0.95
Dairy product manufacturing [3115]	1.96	2.16	0.35
Meat product manufacturing [3116]	1.88	2.23	-0.82
Seafood product preparation and packaging [3117]	1.93	2.22	-0.30
Bakeries and tortilla manufacturing [3118]	0.87	1.13	-1.15
Other food manufacturing [3119]	2.12	2.14	1.99

Source: Appendix Table 7b

that a given subsector has the same proportion of the sector's capital under the new methodology as under the old, and multiplying this proportion by the official estimate at the sector level.

In terms of the proportion of food manufacturing capital held by industry groups, meat product manufacturing was the industry that accounted for the highest proportion of capital stock (19.2 per cent) (Summary Table 15). Fruit and vegetable preserving and specialty food manufacturing (14.5 per cent) along with dairy manufacturing (14.4 per cent) were also major holders. Seafood product preparation and packaging was the industry with lowest share of capital (6.8 per cent).

Summary Table 15: Distribution of Capital Stock Across Industry Groups in the Food Manufacturing Subsector, per cent, 1961, 1981, 2000 and 2005

	1961	1981	2000	2005
Animal food [3111]	9.41	9.25	8.22	7.91
Grain and oilseed milling [3112]	8.96	9.21	9.48	8.47
Sugar and confectionery product [3113]	5.16	5.71	7.51	7.52
Fruit and vegetable preserving and specialty food [3114]	12.07	12.14	13.63	14.51
Dairy product [3115]	13.91	15.64	14.08	14.37
Meat product [3116]	17.37	17.23	19.25	19.15
Seafood product preparation and packaging [3117]	5.89	8.81	6.59	6.75
Bakeries and tortilla [3118]	19.67	13.59	13.40	12.71
Other food [3119]	7.56	8.41	7.85	8.62

Source: Table 7a

v. Labour Productivity

In terms of productivity levels, five industry groups out of seven had productivity levels higher than both the total economy and manufacturing in 2007: animal food manufacturing ($72.71), miscellaneous food manufacturing ($59.53), sugar and confectionary product manufacturing ($55.30), dairy product manufacturing ($54.32) and fruit and vegetable preserving and specialty food manufacturing ($53.60) (Chart 17). Meat product manufacturing ($50.74) had a productivity level above the total economy, but below manufacturing. Seafood preparation and packaging ($20.25) had the lowest productivity level among the industry groups, and fell far short of both manufacturing and all industries.

Chart 17: Nominal Output per Hour Worked in the Food Manufacturing Industry and Industry Groups, Current Dollars, Canada, 2007

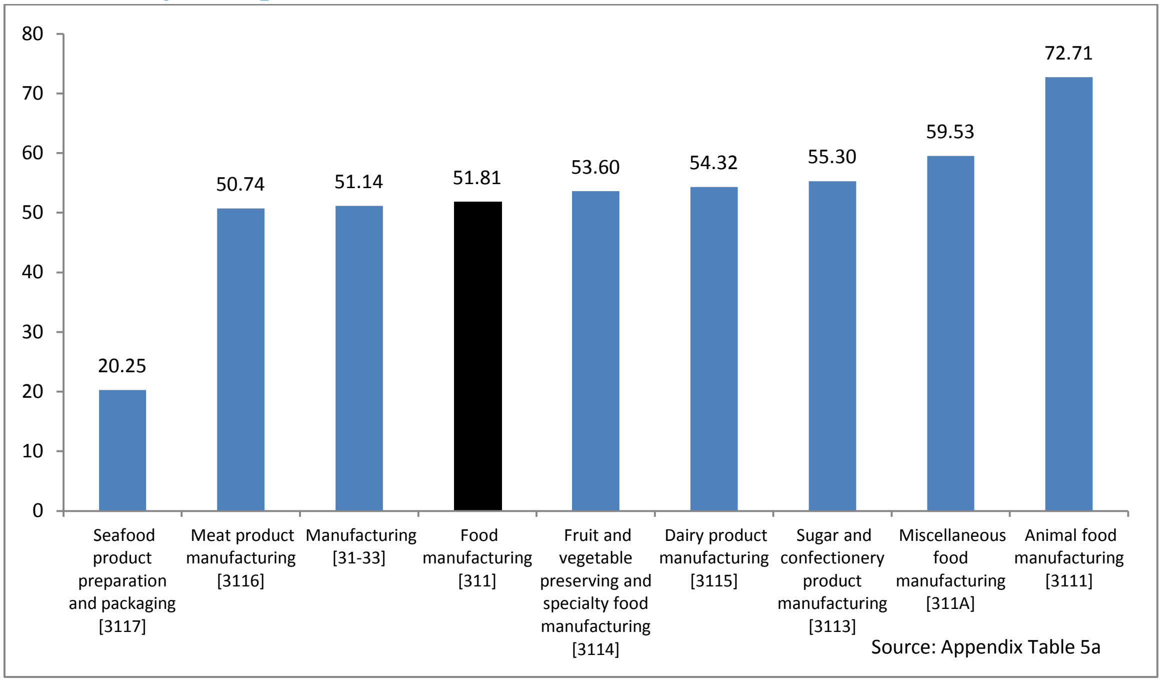
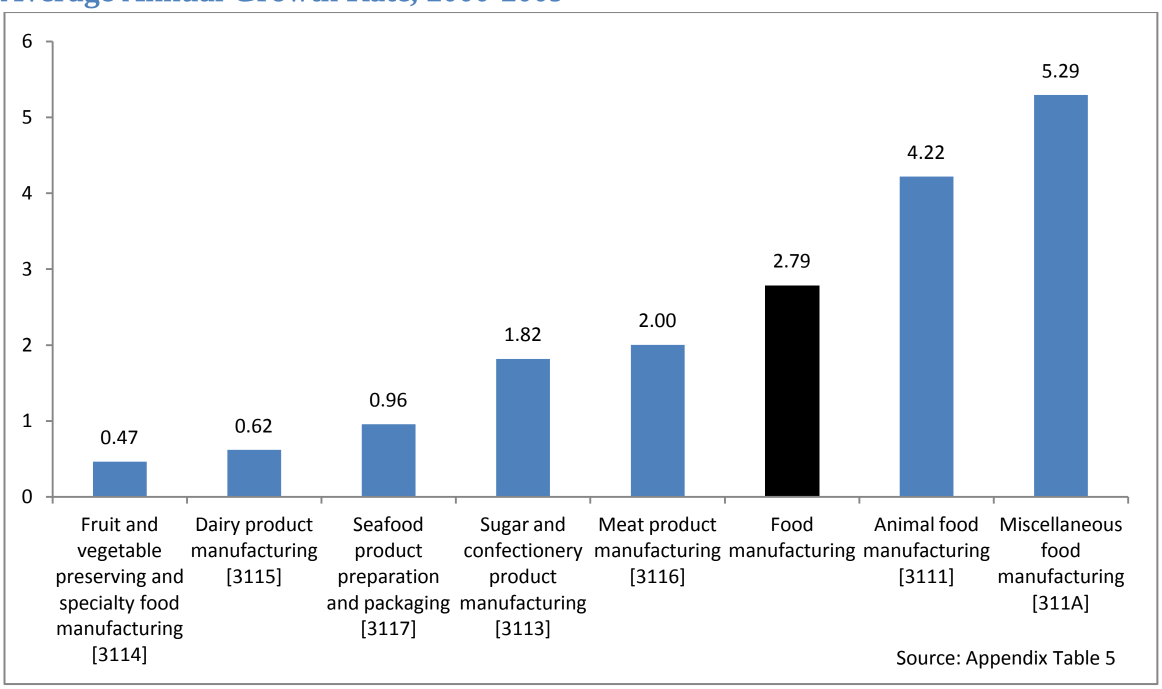


Chart 18: Labour Productivity in Food Manufacturing Industry groups, Compound Average Annual Growth Rate, 2000-2009



The CSLS estimates are also available on an industry group level. Over the 2000-2009 period, the industry group with the highest growth rate was miscellaneous food manufacturing (5.29 per cent per year), followed by animal food manufacturing (4.22 per cent), meat product manufacturing (2.00 per cent), sugar and confectionary product manufacturing (1.82 per cent), seafood product preparation and packaging (0.96 per cent) and dairy product manufacturing (0.62 per cent). Fruit and vegetable preserving and specialty food manufacturing experienced the weakest labour productivity growth over the period at 0.47 per cent.

Summary Table 16: Labour Productivity and Real GDP (Chained 2002 Dollars) per Hour Worked, Food Manufacturing Subsector, Canada 1997-2009

	1997-2009	1997-2000	2000-2009
	(compound annual growth rate, per cent)		
Food manufacturing	2.83	2.97	2.79
Animal food manufacturing [3111]	4.60	5.75	4.22
Sugar and confectionery product manufacturing [3113]	3.29	7.85	1.82
Fruit and vegetable preserving and specialty food manufacturing [3114]	1.68	5.41	0.47
Dairy product manufacturing [3115]	1.49	4.15	0.62
Meat product manufacturing [3116]	3.14	6.62	2.00
Seafood product preparation and packaging [3117]	0.04	-2.67	0.96
Miscellaneous food manufacturing [311A]	4.16	0.83	5.29
	(chained 2002 dollars per hour worked)		
	1997	2000	2009
Food manufacturing	34.87	38.06	48.75
Animal food manufacturing [3111]	33.92	40.11	58.20
Sugar and confectionery product manufacturing [3113]	43.01	53.95	63.46
Fruit and vegetable preserving and specialty food manufacturing [3114]	43.43	50.86	53.03
Dairy product manufacturing [3115]	45.32	51.20	54.12
Meat product manufacturing [3116]	27.31	33.09	39.56
Seafood product preparation and packaging [3117]	19.37	17.86	19.46
Miscellaneous food manufacturing [311A]	37.23	38.17	60.71

Changes in the composition of the food manufacturing subsector reduced productivity growth as the highest productivity growth industry groups became proportionately less significant employers, and lower productivity industry groups grew in their share of employment. Had employment shares remained as they were in 2000, food manufacturing would have experienced productivity growth of 2.91 per cent per year rather than the 2.79 per cent achieved from 2000 to 2009. This was caused by the three most productive sectors in 2009 having been the three sectors that experienced the largest percentage point decreases in employment share within the subsector. While it is true that the least productive industry group, seafood product preparation and packaging, also declined in employment share, this was not enough to make up for the declines in animal food manufacturing, sugar and confectionary products and specialty food manufacturing and miscellaneous food manufacturing.

Output growth outpaced growth in hours worked in every industry group except fruit and vegetable preserving and specialty food manufacturing. Section five of this report explores several possible explanations for these trends.

vi. Multifactor Productivity

Statistics Canada does not calculate MFP for the four-digit industry groups. Given the lack of multifactor productivity data available at the industry group level, we can construct another measure of multifactor productivity that tracks similar information but is not strictly comparable with the official measure. Using the capital share and capital intensity measured as by capital stock, we calculate a measure of multifactor productivity.[17] Over the entire 1997-2005 period, animal food manufacturing experienced the quickest growth in multifactor productivity at 4.69 per cent per year, though this was largely driven by growth from 1997-2000 when multifactor productivity was advancing 7.49 per cent per year. Meat manufacturing similarly witnessed a very high growth rate, at 3.91 per cent, that was driven by high growth from 1997-2000. The miscellaneous food manufacturing subsector grew at a rate of 3.59 per cent per year from 1997 to 2005 and was one of the few industry groups that grew quicker in the post 2000 period. Sugar and confectionary product manufacturing benefitted from multifactor productivity growth of 3.30 per cent over the period. On the low end of the growth spectrum were seafood product preparation and packaging at 1.97 per cent, dairy product manufacturing at 0.91 per cent, and lastly, fruit and vegetable preserving and specialty food manufacturing at only 0.30 per cent.

[17] This measure differs from the Statistics Canada measure because Statistics Canada controls for increases in quality of labour (due to age, experience and education). Also the capital input measure used by Statistics Canada accounts for the fact that "tangible assets have different service lives, depreciation rates, tax treatments and, ultimately, different marginal products" while the method used here uses capital stock as the capital input. For a detailed look at capital inputs as used by Statistics Canada, see Harchaoui and Tarkhani (2000). Given that the Statistics Canada measure controls for more factors, it is to be expected that the CSLS estimate is higher as MFP is an unexplained residual.

Summary Table 17: Average Annual Multifactor Productivity, Food Manufacturing Subsector, Based on Capital Stock Growth, Canada, 1997-2005

	1997-2005	1997-2000	2000-2005
Manufacturing [31-33]	2.94	6.12	1.08
Food manufacturing [311]	2.61	3.05	2.35
Animal food manufacturing [3111]	4.69	7.49	2.24
Sugar and confectionery product manufacturing [3113]	3.3	3.11	3.47
Fruit and vegetable preserving and specialty food manufacturing [3114]	0.3	3.03	-1.29
Dairy product manufacturing [3115]	0.91	3.66	-0.69
Meat product manufacturing [3116]	3.91	6.1	2.7
Seafood product preparation and packaging [3117]	1.97	1.82	2.23
Miscellaneous food manufacturing [311A]	3.59	1.71	4.84

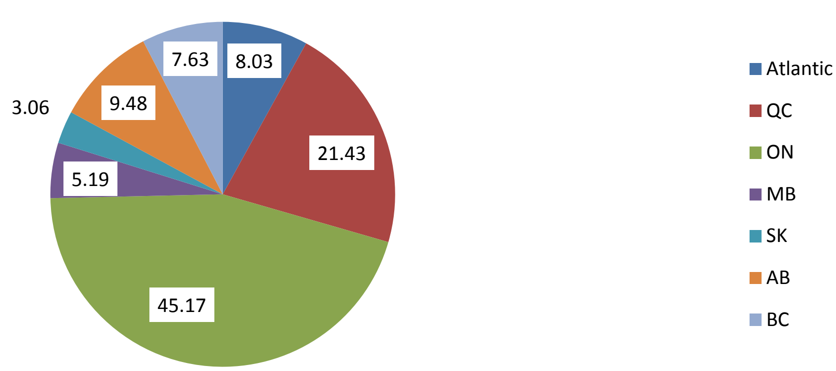
Source: Appendix Tables 8 through 8f

At the industry group level, animal food manufacturing in particular has seen strong growth, while the miscellaneous and seafood preparation industry groups significantly lagged their peers.

C. Food Manufacturing Subsector Productivity Trends by Province

This section examines productivity trends in the food manufacturing subsector by province. For many provinces, data are unavailable from Statistics Canada due to sample size issues or out of respect for commercial confidentiality. Generally, this lack of data affects provinces with small food manufacturing subsectors. For provinces with large food manufacturing subsectors, data are usually available for the period 1997-2009 for real measures and for 1997-2007 for nominal measures of output per hour worked.

Chart 19: Provincial Nominal Output as a Proportion of National Food Manufacturing Output, 2007



Source: Appendix Tables 1b, 23-23i

Summary Table 18: The Importance of the Food Manufacturing Subsector by Province, 2007

	Food [311]	Animal food [3111]	Sugar and confectionery product [3113]	Fruit and vegetable preserving and specialty food [3114]	Dairy product [3115]	Meat product [3116]	Seafood product preparation and packaging [3117]	Miscellaneous food
GDP in Millions of Current Dollars								
Can	20,915	1,247	1,305	2,512	2,385	5,700	901	6864
NL	308.6	n.a.	n.a.	n.a.	n.a.	n.a.	240.4	17.8
PE	202.5	n.a.	n.a.	n.a.	n.a.	n.a.	25.1	11.7
NS	501.3	16.5	n.a.	n.a.	54.8	80.3	155.8	128.5
NB	668.1	24.7	n.a.	n.a.	41.6	33.4	174.6	75.1
QC	4,482.0	328.3	n.a.	413.7	886.3	1,107.7	n.a.	1,387.9
ON	9,446.9	498.4	820.8	1,224.2	871.8	2,370.6	31.9	3,629.1
MB	1,084.6	n.a.	2.1	n.a.	n.a.	635.9	n.a.	192.5
SK	639.5	n.a.	n.a.	n.a.	n.a.	300.3	n.a.	231.0
AB	1,982.6	176.6	n.a.	n.a.	n.a.	712.7	0.4	n.a.
BC	1,595.6	114.8	143.3	136.4	142.9	404.1	167.5	486.6
As a Share of Nominal GDP, Per Cent								
Can	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NL	1.5	n.a.	n.a.	n.a.	n.a.	n.a.	26.7	0.3
PE	1.0	n.a.	n.a.	n.a.	n.a.	n.a.	2.8	0.2
NS	2.4	1.3	n.a.	n.a.	2.3	1.4	17.3	1.9
NB	3.2	2.0	n.a.	n.a.	1.7	0.6	19.4	1.1
QC	21.4	26.3	n.a.	16.5	37.2	19.4	n.a.	20.2
ON	45.2	40.0	62.9	48.7	36.6	41.6	3.5	52.9
MB	5.2	n.a.	0.2	n.a.	n.a.	11.2	n.a.	2.8
SK	3.1	n.a.	n.a.	n.a.	n.a.	5.3	n.a.	3.4
AB	9.5	14.2	n.a.	n.a.	n.a.	12.5	0.0	n.a.
BC	7.6	9.2	11.0	5.4	6.0	7.1	18.6	7.1

Source: Appendix Tables 1, 1b, 22-22i, 23-23i

In 2007, the size of the food manufacturing subsector varied across provinces in a manner strongly correlated with population shares (Summary Table 18). In terms of nominal output, Ontario had the largest food manufacturing subsector by far, producing 45.2 per cent of Canadian output. Quebec was also quite significant, accounting for 21.4 per cent of output. The other provinces collectively were responsible for one third of production; Alberta and British Columbia were responsible for 9.5 and 7.6 percentage points respectively, and Prince Edward Island had the smallest share, just below one percentage point. Food manufacturing as a share of the provincial output garners a very different ranking; food manufacturing was responsible for 4.9 per cent of Prince Edward Island's nominal total economy GDP, the highest share, and responsible for 0.8 per cent in Alberta, the lowest share.

The output of the industry groups that make up the food manufacturing industry is not evenly distributed, and demonstrates the expected regional specializations. Newfoundland is the largest producer of seafood product preparation and packaging output with 26.7 per cent of national output, and the next three largest producers (New Brunswick, British Columbia and Nova Scotia) are all provinces touching an ocean. Quebec was the largest producer of dairy products, accounting for 37.2 per cent of national production, followed by Ontario with 36.6 per cent. Ontario had the largest share of output in the animal food manufacturing (40.0 per cent), sugar and confectionery product manufacturing (62.9 per cent), fruit and vegetable preserving and specialty food manufacturing (48.7 per cent), meat product manufacturing (41.6 per cent) and miscellaneous food manufacturing (52.9 per cent), and Quebec had the second highest share of output in each of those industry groups, except sugar and confectionery product manufacturing, where data are unavailable.

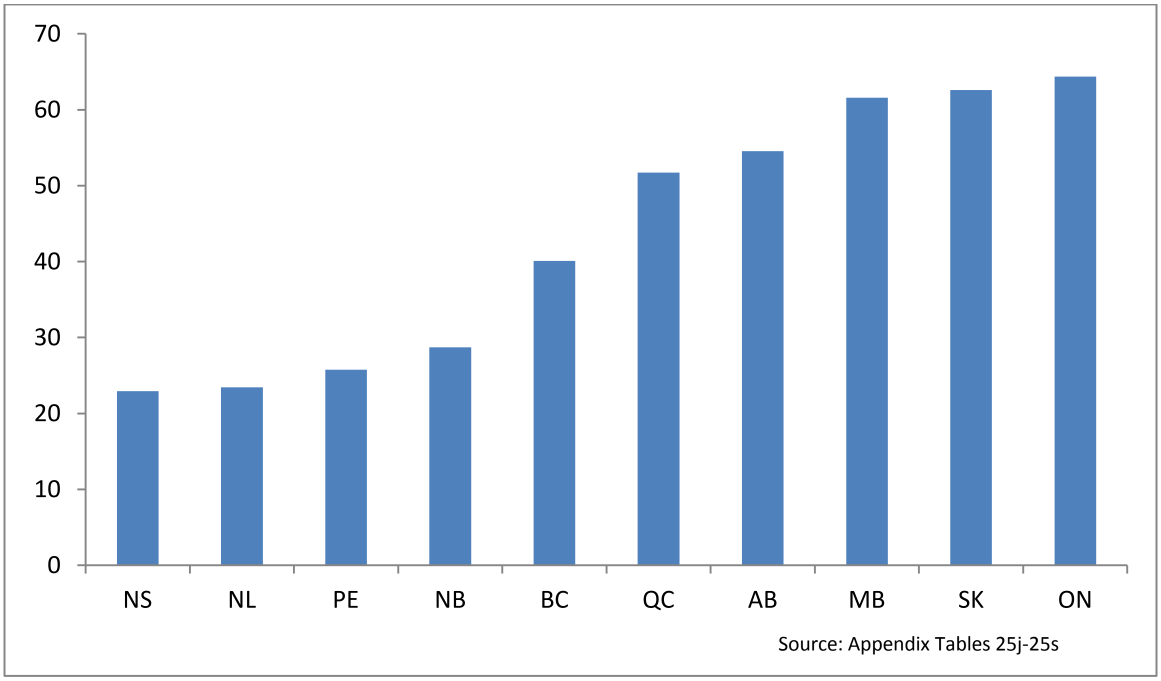
There is a wide variance in the importance of food manufacturing to provincial economies. Prince Edward Island is the most dependent on food manufacturing, with the subsector comprising 4.90 per cent of the nominal value added in 2007. New Brunswick (2.70 per cent) and Manitoba (2.39 per cent) also had large proportions of value added rooted in food manufacturing. In all other provinces, food production accounted for less than two per cent of nominal value added in the province, with Alberta (0.80 per cent) having the lowest dependence on food manufacturing (Summary Table 19). Another measure of the importance to the economy is the share of employment; by this measure Prince Edward Island (6.46 per cent of hours worked) was the most dependent on food manufacturing and Alberta (0.98 per cent) was still the least dependent.

Summary Table 19: Value Added and Hours Worked in the Food Manufacturing Subsector as a Proportion of the Total Economy, 2007

	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	CANADA
Value Added	1.12	4.90	1.66	2.70	1.62	1.74	2.39	1.33	0.80	0.91	1.46
Hours Worked	3.44	6.46	2.77	3.59	1.38	1.25	1.65	1.11	0.98	1.02	1.33

Calculated from Table 1b, 4, 23-23i and 24-24i

Chart 20: Output per Hour Worked in the Food Manufacturing Subsector, by Province, Current Prices, 2007

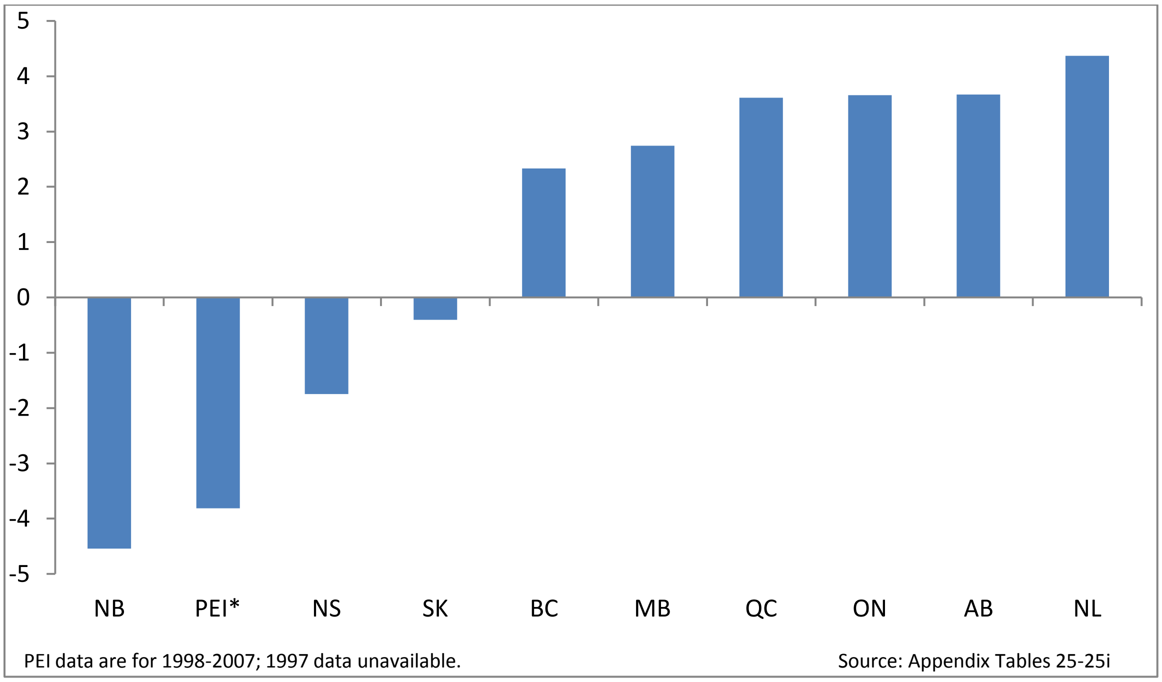


The level of labour productivity in current dollars in the food manufacturing subsector varies considerably by province as well, reflecting the differing industrial composition of the sector across provinces and cross-province differences in labour productivity levels at the industry level (Chart 20). There was a strong relationship between productivity level and region, with the four Atlantic provinces having the lowest productivity levels. The lowest productivity level in 2007 was found in Nova Scotia ($22.92 per hour worked), followed by Newfoundland ($23.44), Prince Edward Island ($25.77) and New Brunswick ($28.71). The highest productivity level was achieved by Ontario ($64.38 per hour), followed by Saskatchewan ($62.60), Manitoba ($61.58) and Alberta ($54.55), the four Western provinces that had higher value added per hour worked than the national level. While having lower productivity levels than observed nationally Quebec ($51.72) and British Columbia ($40.10) outperformed the Atlantic provinces.

Labour productivity in the food manufacturing subsector increased in six of the ten provinces over the period 1997-2009 (Chart 21 and Summary Table 20). There were six provinces in which labour productivity growth in food manufacturing exceeded average labour productivity growth in the total economy: Newfoundland (4.37 per cent), Alberta (3.67 per cent), Ontario (3.65 per cent), Quebec (3.61 per cent), Manitoba (2.74 per cent) and British Columbia (2.33 per cent). There were also four provinces in which labour productivity growth in food manufacturing was negative. Negative food manufacturing productivity growth occurred in New Brunswick (-4.54 per cent), Prince

Edward Island (-3.81 per cent), Nova Scotia (-1.75 per cent) and Saskatchewan (-0.40 per cent). The poor performance in Nova Scotia and Prince Edward Island was driven by declining productivity in the seafood preparation and packaging industry, whereas declining productivity in New Brunswick appears to be driven by changing industrial composition whereby the high-productivity miscellaneous food manufacturing subsector declined in employment share. Strong positive growth in most provinces reflects that most industry groups of food manufacturing had positive growth rates that outpaced the economy in general.

Chart 21: Average Labour Productivity Growth Rate in the Food Manufacturing Subsector, 1997-2009



Summary Table 20: Labour Productivity, Food manufacturing subsector, Canada, by Province, Compound Annual Growth Rate, per cent, 1997-2009

	Can	NL	PE*	NS	NB	QC	ON	MB	SK	AB	BC
All Industries	1.15	2.64	1.14	1.36	1.35	1.17	1.02	1.43	1.24	0.71	1.02
Manufacturing	1.56	2.15	-2.23	1.21	0.19	1.78	1.26	0.34	0.69	1.39	1.87
Food Manufacturing	2.83	4.37	-3.81	-1.75	-4.54	3.61	3.65	2.74	-0.40	3.67	2.33

*PEI uses 1998-2009 data as data are unavailable for 1997 Source: Appendix Tables 5, 25-25i

Based on the trends observed in this section, three findings are particularly noteworthy:

- Ontario is the largest contributor to the food manufacturing subsector by far in 2007, having the highest nominal output per hour worked of any province and enjoyed the third highest growth rate over the 1997-2009 period. Given the importance of Ontario to the nation's food manufacturing subsector, national outcomes are highly influenced by Ontario trends.

- Atlantic Canada as a region was responsible for only 8.0 per cent of the value of national output in the sector in of 2007, though this is large compared to the share of the total economy based in Atlantic Canada (6.1 per cent). Every province in the region, except Newfoundland, had a declining labour productivity over the 1997-2009 period and the provinces of that region had the lowest levels of output per hour worked in Canada in food manufacturing.

- Over the 1997-2009 period, Newfoundland experienced the fastest food manufacturing labour productivity growth in Canada, though from a low level. Alberta, Ontario and Quebec had the next three highest growth rates and were the three largest food manufacturing industries in Canada.

IV. Food Manufacturing Productivity in International Perspective

This part of the report examines trends in productivity in the food manufacturing subsector from an international perspective. The productivity performance of the food manufacturing subsector in the United States as compared to Canada is explored in detail. An appendix comparing the wider food, beverage and tobacco sector among select OECD countries is included at the end of the report.

The United States

Because more detailed information on labour productivity is available for the United States than is available for most other countries, this section presents a more up-to-date comparison of the labour productivity performance of the food manufacturing subsector in Canada and the United States than the OECD comparison offered as an appendix. The numbers presented here differ from those in the previous section because i) the data source is different, ii) this section analyzes the food manufacturing subsector rather than the broader food, drink and tobacco sector analyzed in the international section and iii) the time frame is different.

Over the entire time frame of 1987-2008, the food manufacturing subsector in the U.S. experienced a labour productivity growth of 1.08 per cent per year, less than the 1.57 per cent growth the Canadian counterpart enjoyed. Due to data availability and the aggregation of industries, only six industry groups can be directly compared for the 1997-2008 period.[18] Over this period, the best performing industry group in the United States food manufacturing industry was the seafood product preparation and packaging which obtained average annual productivity growth of 3.70 per cent, followed by animal food manufacturing at 3.57 per cent, fruit and vegetable preserving and specialty food manufacturing at 2.48 per cent and grain and oilseed milling at 2.12 per cent. The worst performing sector was sugar and confectionery product manufacturing at 0.29 per cent, followed by other food manufacturing at 0.66 per cent, bakeries and tortilla manufacturing at 0.63 per cent, dairy product manufacturing at 1.28 per cent and meat product manufacturing at 1.45 per cent.

Overall, the Canadian food manufacturing subsector outperformed that of the United States by 0.74 percentage points of average annual growth (2.15 per cent compared to 1.42 per cent per year) from 1997 to 2008, and experienced higher labour productivity growth rates in four of the seven industries for which data are available.

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[18] There are six subsectors for which data are available for both the United States and Canada: food manufacturing [3111], sugar and confectionery product manufacturing [3113], fruit and vegetable preserving and specialty food manufacturing [3114], dairy product manufacturing [3115], meat product manufacturing [3116] and seafood product preparation and packaging [3117]. The United States also offers data for grain and oilseed milling [3112], bakeries and tortilla manufacturing [3118] and other food manufacturing [3119], whereas Canada aggregates these in the miscellaneous food manufacturing [311A] category.

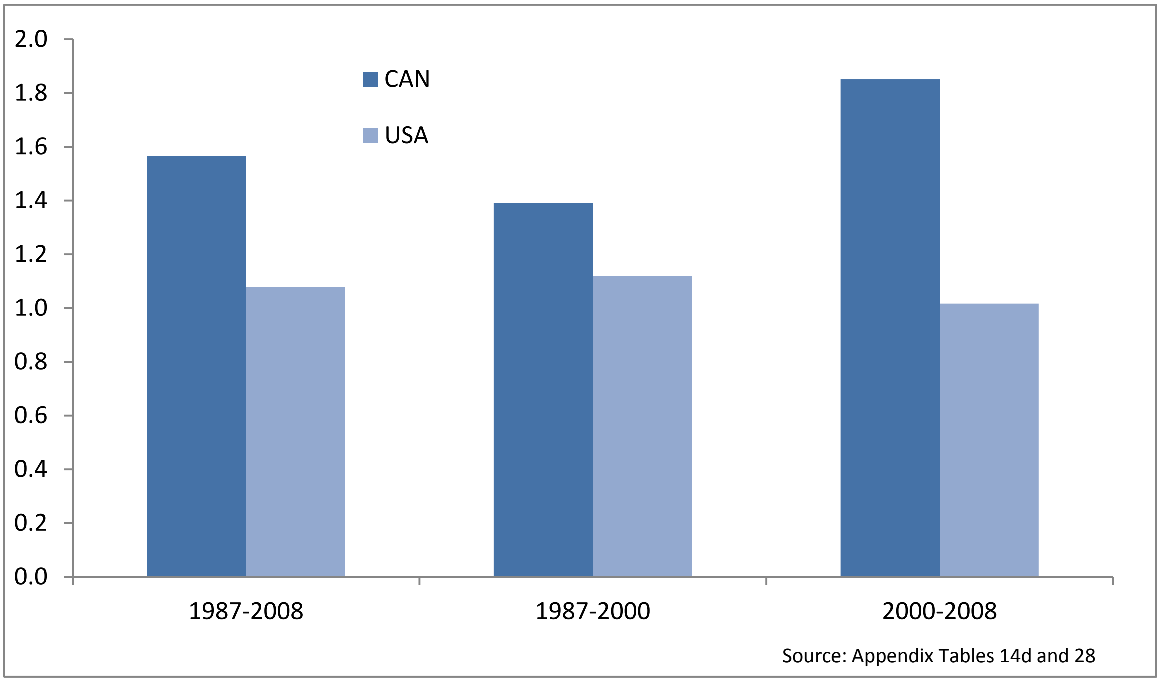
However, the United States performed quite strongly in some industry groups of food manufacturing when compared with Canada over the 1997-2008 period. Labour productivity in the United States outpaced Canadian compound average annual growth in seafood product preparation and packaging by 3.51 percentage points, fruit and vegetable preserving and specialty food manufacturing by 1.60 percentage points and dairy products by 0.48 percentage points. In contrast, Canada outperformed the United States in labour productivity in sugar and confectionery product manufacturing by 2.97 percentage points, in meat product manufacturing by 0.90 percentage points and in animal food manufacturing by 0.67 percentage points.

Summary Table 21: Labour Productivity, Manufacturing and Food Manufacturing, Canada and the United States, Compound Annual Growth Rate, per cent, 1987-2008

	1987-2008		1997-2008		1997-2000		2000-2008	
	CAN	USA	CAN	USA	CAN	USA	CAN	USA
Business Sector	1.35	2.18	1.45	2.67	3.07	3.33	0.84	2.42
Manufacturing	2.11	3.48	1.70	3.79	4.90	4.97	0.53	3.36
Food	1.57	1.08	2.15	1.42	2.97	2.49	1.85	1.02
Animal food	n.a.	2.75	4.24	3.57	5.75	3.04	3.68	3.77
Grain/Oilseed	n.a.	2.08	n.a.	2.12	n.a.	4.33	n.a.	1.31
Sugar/confectionery	n.a.	0.82	3.25	0.29	7.85	3.42	1.58	-0.86
Fruit/vegetable/specialty	n.a.	1.65	0.87	2.48	5.41	4.04	-0.78	1.90
Dairy product	n.a.	1.63	0.80	1.28	4.15	-1.73	-0.42	2.43
Meat product	n.a.	0.91	2.35	1.45	6.62	0.96	0.80	1.63
Seafood	n.a.	0.92	0.19	3.70	-2.67	11.98	1.28	0.75
Bakeries/tortilla	n.a.	0.44	n.a.	0.63	n.a.	3.32	n.a.	-0.35
Other	n.a.	0.46	n.a.	0.66	n.a.	3.98	n.a.	-0.56
Miscellaneous food	n.a.	n.a.	3.57	n.a.	0.83	n.a.	4.61	n.a.

Tables 5, 13, 14, 14d and 28

Chart 22: Labour Productivity Growth in Food Manufacturing, Canada and the United States, 1987-2008



Detailed Canada-U.S. Comparison of the, Food, Beverage and Tobacco industry

A recent article by Industry Canada economists (Tang, Rao, and Li, 2010) has presented comparable estimates of labour productivity, multifactor productivity (MFP) and capital intensity growth rates and levels for 37 industries in Canada and the United States based on different depreciation assumptions. This data source is very useful for comparing both trends and levels for these variables in the food, beverage and tobacco industry for these three variables between the two countries.

Summary Table 22: Canada-U.S. Comparison of Multifactor and Labour Productivity in the Food, Beverage, and Tobacco Industry, 1987-2008

Growth Rates						
	87-00		00-08		87-08	
	Canada	U.S.	Canada	U.S.	Canada	U.S.
Labour Productivity	1.6	0.5	1.0	1.3	1.4	0.8
Multifactor Productivity						
		87-00		00-07		
		Canada	U.S.	Canada	U.S.	
Statistics Canada Depreciation		0.6	0.5	0.6	1.9	
BEA Depreciation		1.1	0.3	0.8	1.4	

Source: Summary Table 31

Summary Table 22 shows that over the 1987-2008 period, output per hour in the food, beverage and tobacco industry grew at a 1.4 per cent average annual rate in Canada, above the 0.8 per cent rate experienced in the United States. This superior performance in Canada is consistent with the figures report in Summary Table 22. The stronger growth in Canada was concentrated in the 1987-2000 period (1.6 per cent versus 0.5 per cent) as the United States actually slightly outperformed Canada from 2000 to 2008 (1.3 per cent versus 1.0 per cent).

Summary Table 23: Canada-U.S. Level Comparisons (U.S.=100) in the Food, Beverage, and Tobacco Industry, Labour Productivity, Capital Intensity and Multifactor Productivity, 2002 and 2007

	2002	2007
(Statistics Canada depreciation rates for Canada and the U.S.)		
Labour Productivity	89.4	85.4
Capital Intensity	85.0	95.5
Multifactor Productivity	97.2	87.3
(BEA depreciation rates for Canada and the U.S.)		
Labour Productivity	89.4	85.4
Capital Intensity	73.9	78.5
Multifactor Productivity	104.4	95.8

Source: Summary Table 32

Labour productivity growth can be decomposed into changes in multifactor productivity and capital intensity. These latter two concepts are sensitive to depreciation assumptions, which differ across statistical agencies. Official MFP estimates for a country are based on the assumptions made by the country's national statistical agency. Based on official Statistics Canada and U.S. Bureau of Economic Analysis (BEA) depreciation assumptions, Summary Table 22 shows that MFP growth was slightly higher in Canada than in the United States in the 1987-2000 period (0.6 versus 0.5 per cent per year), but lower in the 2000-2007 period (0.6 per cent versus 1.9 per cent). These relative ranking do not change when depreciation in the two countries is measured on a consistent basis.[19]

[19] In the 1987-2000 period, MFP in Canada increases to 1.1 per cent per year from 0.6 per cent when BEA depreciation assumptions are applied to Canada while MFP in the United States rises to 0.5 per cent from 0.3 per cent when Statistics Canada assumptions are applied to the United States. In the 2000-2007 period, MFP in Canada increases to 0.8 per cent per year from 0.6 per cent when BEA depreciation assumptions are applied to Canada while MFP in the United States rises to 1.9 per cent from 1.4 per cent when Statistics Canada assumptions are applied to the United States.

Tang, Rao and Li (2010:Table 10) report that in 2007 the level of labour productivity in the food, beverage and tobacco industry in Canada was 85.4 per cent of its U.S. counterpart, well above the 72.8 per cent for the business sector and 73.1 per cent for manufacturing (Summary Table 23). This labour productivity gap can be decomposed into a capital intensity gap and a multifactor productivity gap. The relative importance of these two gaps is very sensitive to depreciation assumptions.

When Statistics Canada depreciation rates are used for both Canada and the United States, capital intensity in Canada in the food, beverage and tobacco industry was 95.5 per cent of the U.S. level while the MFP level was 87.3 per cent in 2007. When BEA depreciation rates are used for both Canada and the United States, capital intensity in Canada in the food, beverage and tobacco industry falls to 78.5 per cent of the U.S. level while the MFP level rises to 95.8 per cent. When one moves from the inconsistent (i.e. national) to consistent (i.e. identical) depreciation assumptions, almost all the adjustment in Canada's relative capital intensity level takes place in structures capital intensity. From an average 36.4 per cent of the U.S level under national depreciation assumptions in 2000-07, structures capital intensity rises to 100.2 per cent with the use of Statistics Canada depreciation assumptions for both countries and to 120.1 per cent under BEA assumptions.

Summary Table 24: Canada-U.S. Capital Intensity Comparisons (U.S.=100) in the Food, Beverage, and Tobacco Industry, Period Average

Total Capital		M&E		ICT		Structures	
87-99	00-07	87-99	00-07	87-99	00-07	87-99	00-07
(Statistics Canada Depreciation rates for both countries)							
71.5	85.5	76.7	89.2	36.5	57.4	81.0	100.2
(BEA Depreciation rates for both countries)							
71.0	73.1	51.5	57.0	33.5	52.6	117.6	120.1

Source: Appendix Table 32

Canadian industry is often compared to its U.S. counterpart, and Canadian industry generally has lower output per hour worked. The difference in nominal output per hour worked between Canada and the United States could be caused by greater market power rather than a physical productivity difference. Presumably branded products must have higher margins to pay off the advertising expenses associated with branding; otherwise firms would not undertake the exercise.[20]

[20] There may also be, however, differences in physical productivity differences between producers of branded and non-branded foods. The difference may be largely attributable to size (Kraft is more able to take advantage of economies of scale than the President's Choice label that Loblaw's produces). Alternatively, branded products could be of higher quality on average; certainly consumers must perceive branded products as higher quality if they are willing to pay a premium for it. It is quite conceivable that both market power and physical productivity differences explain the productivity difference between Canada and the United States, and one would assume that quality and scale are both associated with branded goods.

V. Factors Influencing Productivity in the Food Manufacturing Subsector

This part of the report offers potential explanations for the productivity performance of the food manufacturing subsector that was described in section three. It begins by setting out the overall approach to identifying productivity growth drivers, then discusses each of the potential drivers with a view to which offer the most promising hypotheses for the strong productivity performance of the food manufacturing subsector in Canada during the post 2000 period, as well as the long term explanation.

A. Sources of Productivity Growth

i. The Key Drivers of Productivity

The drivers of productivity are multiple and a vast number of factors can indirectly affect the productivity performance of a sector. It is generally accepted by economists that increased capital input per worker – measured with stock or capital services – will increase labour productivity. Similarly, increases in capacity utilization increase productivity because it amounts to increasing *effective* capital per worker. A more skilled workforce, that is one with more human capital due to training, schooling or raw talent, is also expected to be more productive. Another factor that unambiguously has the potential to increase labour productivity is advances in technology; think of manufacturing without the conveyor belt. There are also potential drivers where disagreement exists in the literature as to the relative importance to productivity. One such driver is economies of scale; while no one denies the possibility for this being a driver, economists often disagree on *which industries* economies of scale are present in. International trade is another such driver, though many economists note that international trade allows for greater economies of scale and very possibly facilitates knowledge transfer that would lead to growth

The contributions made by the factors listed above may vary across time and location. Many of the productivity growth drivers are interrelated and may act in synergy. Before discussing each driver in detail, we conduct a preliminary analysis using a growth accounting decomposition of labour productivity growth for the food manufacturing subsector in Canada.

ii. Labour Productivity Growth Decomposition

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.

Using this framework, contributions to labour productivity growth can be broken down into three factors: 1) capital intensity (defined here as capital services input per hour worked); 2) labour quality; and 3) multifactor productivity. 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 bakeries with the same number of workers. In the first bakery, there is only one oven while the second bakery has two ovens. The second bakery can cook twice as much in any given moment.

- Improvements in labour quality tend to increase the amount of output a worker can produce in a given time period. A baker trained by the greatest chefs in the world will likely produce higher quality output with fewer mistakes.

- Technological progress can substantially increase output per worker. Imagine a fry cooking device that can cook fries in half the time, allowing for twice as many fries to be processed in a unit of time.

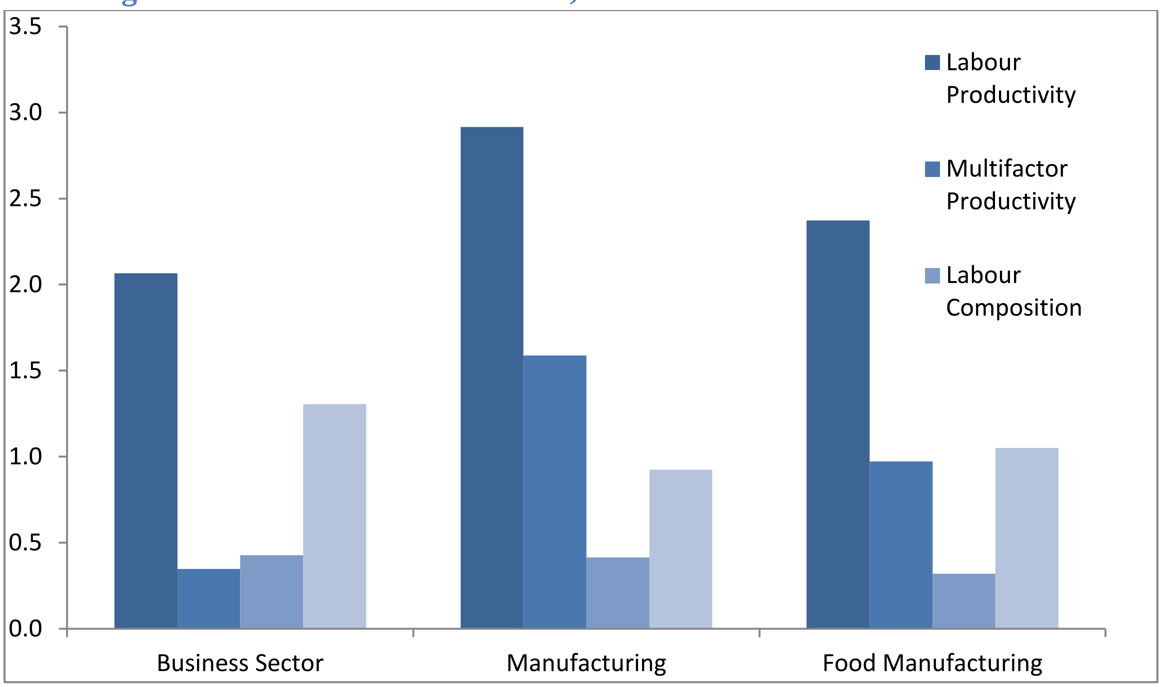
Labour productivity in the Canadian food manufacturing subsector grew at an average annual rate of 2.37 per cent during the 1961-2007 period, above the business sector average of 2.07 per cent per year, but below the 2.92 per cent achieved in the manufacturing sector (Chart 23 and Summary Table 25).

During the overall period, the food manufacturing subsector's labour productivity growth was driven mainly by MFP and capital intensity growth, which were responsible for 0.97 and 1.05 percentage points of the overall labour productivity growth (or, alternatively, 41.5 vs. 44.8 per cent of total growth). The increase in labour quality was responsible for the remaining 0.32 percentage points of the labour productivity growth experienced in the sector (13.7 per cent).

The picture in the business sector is slightly different. First, labour productivity growth in the Canadian business sector was slower than in the food manufacturing subsector, 2.07 per cent per year during the 1961-2007 period. Second, most of this growth came from increases in capital intensity, which accounted for 62.2 per cent of total labour productivity growth. Labour quality growth also played a very relevant role, accounting for 20.9 per cent of total growth, significantly more than its role in food manufacturing. MFP played a fairly small role in business sector labour productivity growth (only 16.9 per cent of growth) while playing a major role in food manufacturing.

The manufacturing sector experienced a very different composition of growth in labour productivity over the 1961-2007 period than that experienced by food manufacturing. Multifactor productivity growth, for instance, was responsible for the majority of growth (54.6 per cent) in manufacturing, while not being the preeminent cause of growth in the business sector or in food manufacturing. Capital intensity growth was responsible for only 31.0 per cent of growth in labour productivity for manufacturing, which is about three-quarters of the proportion in food manufacturing and half the rate in the business sector.

Chart 23: Labour Productivity Decomposition in the Food Manufacturing Industry, Percentage Point Contribution to Growth, 1961-2007

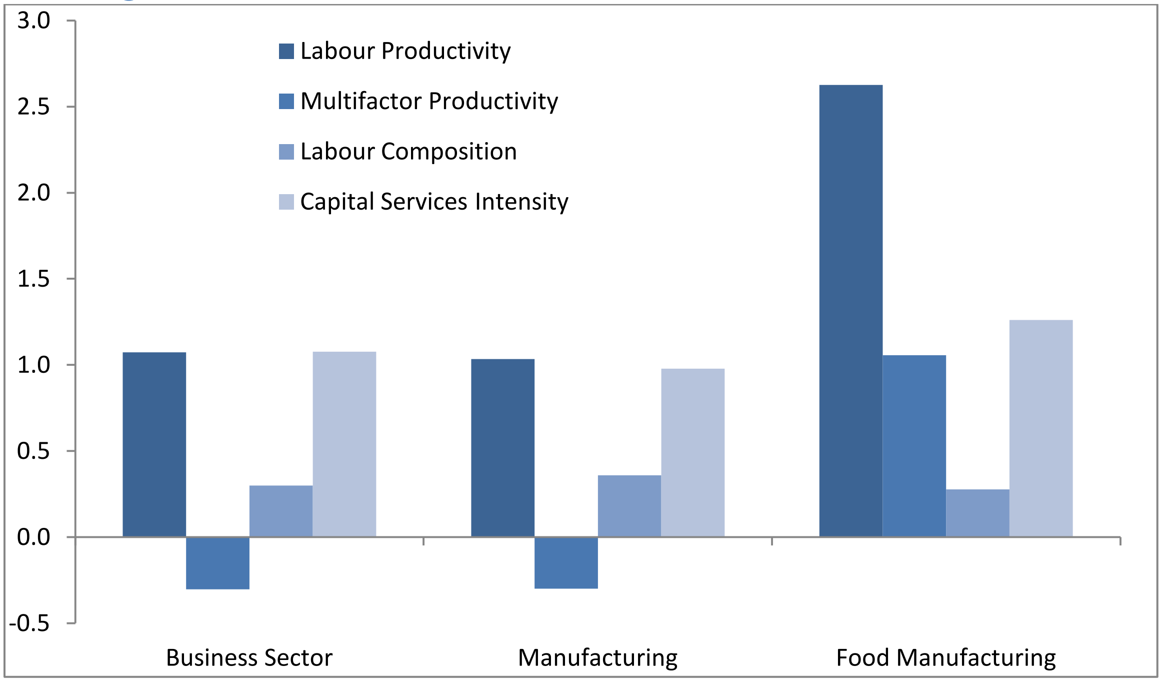


Source: Appendix Tables 13c, 14c, 14g

The more recent 2000-2007 period offered an interesting change in labour productivity growth decomposition, with the importance of multifactor productivity greatly diminishing in importance in manufacturing and the business sector, but not in food manufacturing. While multifactor productivity growth continued to be a significant driver for food manufacturing (responsible for 40.7 per cent of growth), this was not the case for the business sector or manufacturing; in the case of those sectors, MFP growth was negative and of similar magnitude to labour composition growth. While capital intensity growth was responsible for more than nine-tenths of growth in labour productivity for the business sector and manufacturing sectors, it was responsible for only

48.6 per cent of growth in food manufacturing. Labour composition was responsible for 10.7 per cent of growth in food manufacturing labour productivity.

Chart 24: Labour Productivity Decomposition in the Food Manufacturing Industry, Percentage Point Contribution, 2000-2007



Summary Table 25: Sources of Labour Productivity Growth in the Food Manufacturing Subsector, Canada, 1961-2007

	Contribution to Labour Productivity Growth, Percentage Points					
Business Sector	1961-2007	1961-1973	1973-1981	1981-1989	1989-2000	2000-2007
Labour Productivity	2.07	3.56	1.74	1.42	1.78	1.07
Multifactor Productivity	0.35	1.20	-0.25	0.15	0.42	-0.30
Labour Composition	0.43	0.66	0.28	0.38	0.41	0.30
Capital Services Intensity	1.28	1.66	1.72	0.88	0.95	1.08
Manufacturing						
Labour Productivity	2.92	4.11	2.52	2.44	3.46	1.03
Multifactor Productivity	1.59	2.75	1.02	1.37	2.11	-0.30
Labour Composition	0.42	0.52	0.35	0.43	0.38	0.36
Capital Services Intensity	0.90	0.81	1.15	0.66	0.95	0.98
Food manufacturing						
Labour Productivity	2.37	3.40	2.87	0.37	2.21	2.63
Multifactor Productivity	0.97	2.03	1.26	-0.92	0.95	1.06
Labour Composition	0.32	0.32	0.28	0.44	0.30	0.28
Capital Services Intensity	1.05	1.01	1.30	0.85	0.93	1.26
	Contribution to Labour Productivity Growth, Per Cent					
Business Sector						
Labour Productivity	100.0	100.0	100.0	100.0	100.0	100.0
Multifactor Productivity	16.9	34.1	-14.3	10.4	23.5	-28.3
Labour Composition	20.9	18.7	15.8	26.9	23.1	27.9
Capital Services Intensity	62.2	47.2	98.5	62.7	53.3	100.3
Manufacturing						
Labour Productivity	100.0	100.0	100.0	100.0	100.0	100.0
Multifactor Productivity	54.6	67.5	40.4	55.8	61.3	-28.8
Labour Composition	14.3	12.7	13.8	17.3	11.1	34.6
Capital Services Intensity	31.0	19.8	45.7	26.9	27.6	94.2
Food manufacturing						
Labour Productivity	100.0	100.0	100.0	100.0	100.0	100.0
Multifactor Productivity	41.5	60.5	44.4	-247.2	43.7	40.7
Labour Composition	13.7	9.5	9.8	117.6	13.6	10.7
Capital Services Intensity	44.8	30.0	45.9	229.6	42.7	48.6

Source: Appendix Tables 13c, 14c, 14g

B. Drivers of Productivity Growth

This section identifies drivers of labour productivity growth and describes trends of the drivers in the context of the food processing sector.

i. Rate of Technical Progress

There are two key ways that the Canadian food manufacturing subsector can innovate to increase productivity: either the sector performs research and development itself, or it adopts innovations from other countries and other sectors. According to ICP (2011), the Canadian business sector invests a lower portion of output on research and development than United States counterparts. Innovation certainly plays a large role in the food manufacturing industry. According to Bonti-Ankomah (2006) the motivations of innovation in food manufacturing are fourfold; introduction of new products, increase market share, meet customer requirements and improve productivity or reduce costs. The adoption of innovations can occur through imports of machinery and equipment, skilled personnel, new processes, and product innovations. Baldwin and Sabourin (1999) indicates that engineering practices may be just as important as research conducted by research and development departments within firms, and also notes that the implementation of either engineering practices or research and development departments significantly increase the probability of innovation. Agriculture and Agri-Food Canada (2011) identifies the lack of focus on innovation in products with specialty attributes for processing as a current weakness of the food manufacturing sector. In this section, we examine the best available measure of research and development (R&D) effort based on Statistics Canada data: R&D intensity. After noting the limitations of this measure, we look at alternative indicators of innovation. R&D in the Canadian food manufacturing products sector is compared to that of other high-income countries, and finally, a measurement issue related to technical progress is discussed.

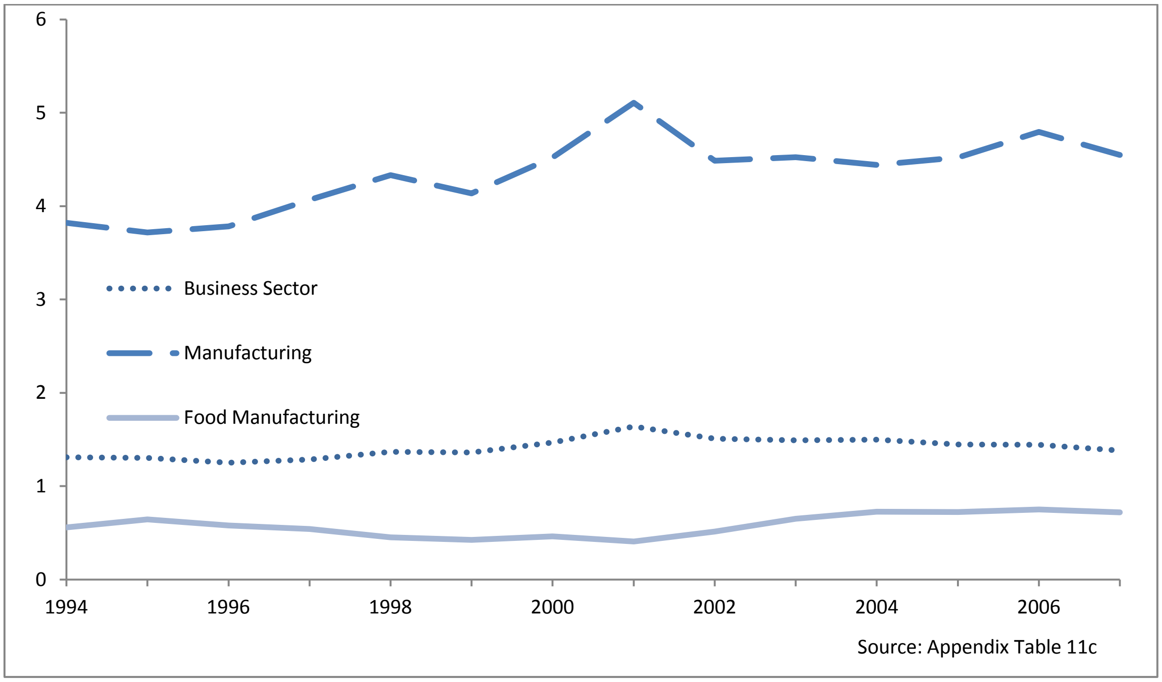
R&D Intensity

Research and development spending as a share of GDP (R&D intensity) in the food manufacturing subsector in Canada increased significantly from 1994 to 2007 (Chart 25). In 1994, the food manufacturing subsector spent 0.56 per cent of nominal value added on research and development, reaching a minimum of 0.41 per cent in 2001. Large increases in research expenditure following 2001 led to research intensity reaching a high of 0.75 per cent in 2006 before falling slightly to 0.72 per cent in 2007. Another barometer of growth in research is the growth in employment in research. The increase has been all the more remarkable by this metric, with employment in research and development in food processing more than doubling from 1,007 persons in 1994 to 2,857 in 2008.

Compared to the business sector and manufacturing, food manufacturing has experienced faster growth in research intensity. Despite this, the level of research intensity in food manufacturing in 2007, 0.72 per cent of GDP, was well below that achieved by the business sector at 1.38 per cent or the manufacturing sector at 4.55 per cent. The comparatively low level is not necessarily a problem as each industry has its own optimum research intensity. But the growth witnessed in intensity is a good omen of future productivity growth as research and development is important in creating higher quality products and more efficient production processes.

These data include only the R&D activities in Canadian industries and non-profit industrial research institutes and associations. They do not include the R&D activities of the federal and provincial governments or educational institutions. Also excluded are research and development expenditures by the makers of the machinery and equipment used in the food manufacturing subsector. As noted above, machinery and equipment often embodies significant new technology, so these exclusions are significant. A third important exclusion is research and development expenditures by foreign firms that have Canadian subsidiaries; if, for example, Heinz conducted research in the United States on better techniques in ketchup manufacturing, the company would likely inform its Canadian factories of the findings. As of 2007, 40 per cent of food manufacturing assets in Canada were foreign owned (Statistics Canada 2008b). These exclusions make it difficult to assess the overall R&D picture in the Canadian manufacturing sector. In order to gain a broader picture of technical progress in the food manufacturing subsector we briefly survey some alternative indicators.

Chart 25: Research and Development Expenditures, Food Manufacturing Subsector, Canada, Current Dollars, As a Share of GDP, Per Cent, 1994-2007



Other Indicators of Innovation

Another perspective on innovation in the Canadian food manufacturing subsector is provided by a study by the Committee on State of Science and Technology in Canada (2006) of the Council of Canadian Academies. The study examined science and technology in Canada from a global perspective, which is of particular interest for a global sector like food manufacturing.[21] The survey generally found the food processing sector to be a median-strength science and technology sector, ranking 105th out of 197 subsectors. Forty-eight per cent of respondents ranked food manufacturing as strong in science and technology, while only 15 per cent said it was weak. Meanwhile, 20 per cent of respondents said food manufacturing engineering in Canada was gaining ground globally, while 16 per cent thought it was losing ground.

Overall, Canada's food manufacturing subsector seems to be doing fairly well in terms of innovation, but broad comparisons with other countries and over time are difficult.

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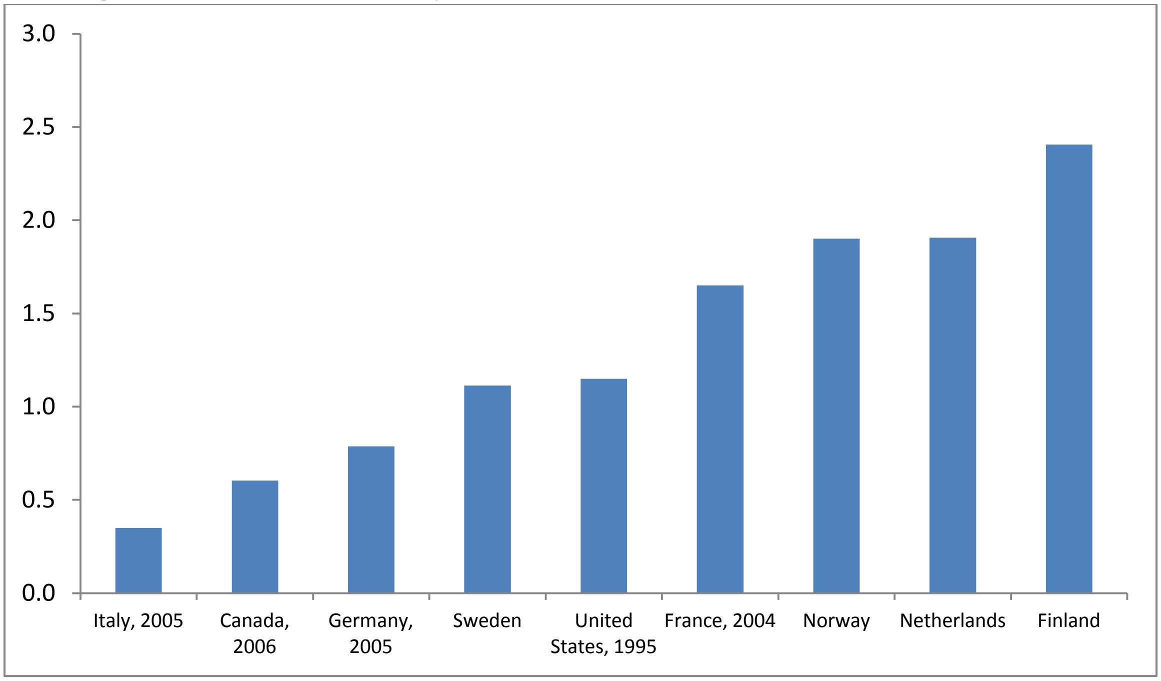
[21] The study used four different techniques to gauge the strength of science and technology in Canada: an opinion survey of Canadian science and technology experts; bibliometric data (quantity and quality of scientific journal publications and patents); a summary of reports and comments obtained from foreign sources; and a review of relevant publications including internationally comparable indicators of important aspect of science and technology strength. The survey of Canadian experts was by far the most important and widely used source in the report.

International Comparisons

Even if Canada has increased its R&D effort in food processing over time, Canada could still be lagging other countries. Data from the Organisation for Economic Cooperation and Development (OECD) allow a comparison of R&D spending across countries. The latest year for which data are available is 2007.

Chart 26: Research and Development as a Proportion of Value Added in the Food, Beverages and Tobacco Industry, 2007 or Most Recent Year



In the broad category of food, beverage and tobacco, data are available for nine countries available and Canada ranks second last in research and development intensity, ahead of only Italy (Chart 26). The Canadian food, beverage and tobacco industry invested only 0.62 per cent of value added on research and development, while Italy experienced the international low of 0.35 per cent and Finland experienced a high of 2.40 per cent. Other important countries included France at 1.65 per cent, the United States at 1.15 and Germany at 0.79 per cent. Data are only available for six countries in the more specific sector of food products and beverages. Again, Canada at 0.62 per cent outperforms only Italy at 0.48 per cent. Germany was not far ahead of Canada, with research and development expenditures amounting to 0.72 per cent of value added. Norway had the highest investment in research and development at 1.82 per cent of value added.

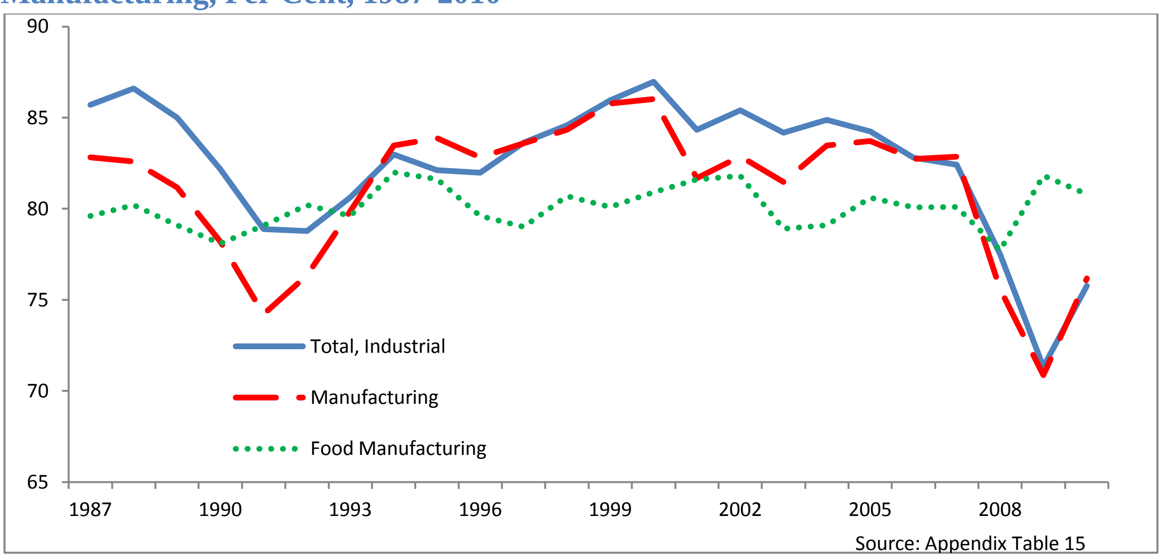
Potential Measurement Problems

It is often the case that the interaction of technical change and the system that statisticians use to capture data can create confusion. Often those working in the sector will observe productivity gains that will not show up in official statistics.[22] For instance, trucking is not considered part of the food processing sector in this report. However, many might consider trucking companies that primarily move raw food inputs to manufacturing plants or finished food products to storage or stores part of the food manufacturing industry given the strong interaction between such firms and the sector in question. This exclusion means that productivity gains in the trucking industry will not show up in the food manufacturing subsector.

ii. Capacity Utilization

The capacity utilization rate is the proportion of the capital stock that is used in the production process. Capacity utilization tends to be procyclical, rising during booms and falling during recessions. Capacity utilization falls as output falls because the size of the capital stock does not vary in the short term. As the capacity utilization rate falls, hours worked and output fall as well. If output falls proportionally more than employment, labour productivity will fall. If, on the other hand, hours worked fall proportionally more than output as a consequence of a decline in capacity utilization, labour productivity will rise.

Chart 27: Capacity Utilization, All Industrial, Manufacturing and Food Manufacturing, Per Cent, 1987-2010



[22] See for example, the discussion of pre-work in the construction sector in Harrison (2007).

Capacity utilization data are available for the 1987 to 2010 period. In 2010, capacity utilization in the food manufacturing subsector stood at 80.8 per cent, well above manufacturing (76.2 per cent) and total industrial capacity utilization (75.8 per cent). Though capacity utilization was higher in food manufacturing, this has not been the long term reality. In fact, there have only been five years in the past 24 in which capacity utilization in the food manufacturing subsector did exceed total industrial capacity utilization, the same number of years in which it exceeded capacity utilization in manufacturing. Indeed capacity utilization has been quite stable throughout the period, there were only 10 years in which the utilization rate differed by more than one percentage point from the 1987 value and only five years in which the difference exceeded two percentage points.

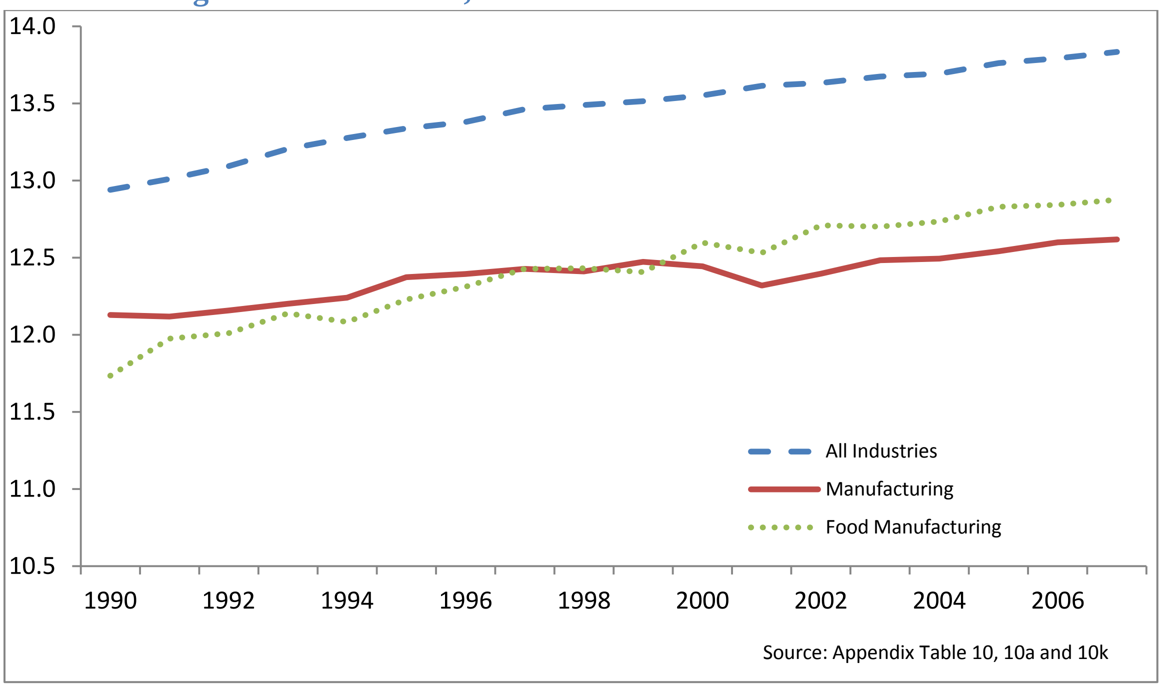
Capacity utilization fell by only 0.1 percentage points in food manufacturing from 2000 to 2010, while the total industrial rate fell by 11.2 percentage points and the manufacturing rate fell by 9.9 percentage points. Capacity utilization, therefore, cannot explain the acceleration of growth in food processing productivity in the post-2000 period, though it certainly contributed to the strong performance of the subsector relative to manufacturing and the total economy.

iii. Education Attainment and Human Capital of Workers

There is a general belief in economics that educated workers are more productive. This productivity increase may be causal, if for instance the education attained is directly relevant to the job at hand; a holder of an engineering degree may fairly be expected to be better at designing bridges than someone with no such training. The link may be that education simply exercises ones problem-solving capabilities, which would tend to make the individual better at solving any problem. Another controversial argument is that education is a sorting mechanism; under this view, education is not what makes people more productive. Rather, only more intelligent and presumably more productive individuals are able to achieve certain levels of education, so education screens out those with capacities below the threshold. It may well be a combination of all these explanations, but certainly there is a strong positive correlation between education and productivity. The most famous paper showing the role of human capital affecting productivity was Mankiw, Romer and Weil (1992), though the scope of this paper was the aggregate economy rather than a single industry. Articles focusing on the role of human capital in productivity growth specifically in food manufacturing are quite scarce. Nonetheless, it is intuitive that it applies in all industries; skilled workers can do more complicated tasks and are less prone to mistakes on simple tasks and are quicker to learn new tasks. Baldwin and Sabourin (2002) notes that firms lacking adequate training programs adapt fewer advanced technologies and that skilled workers are necessary to use advanced technologies. Similarly, Carew (2006) finds that human capital, as measured by post-secondary certificates and university degree attainment rates, is indeed positively correlated with productivity.

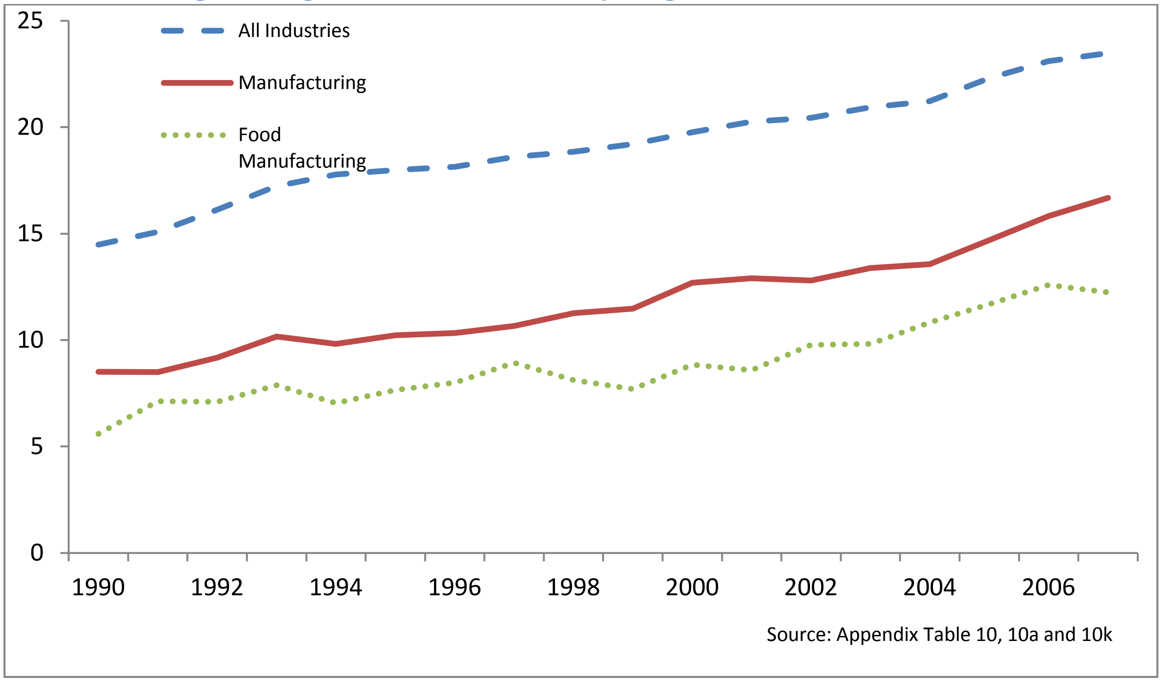
Educational attainment has certainly increased in the Canadian labour force over the 1990-2007 period. Workers in the food manufacturing subsector as of 2007 had attained an average of 12.9 years of education, a level below that observed among all workers at 13.8 years, but above that of manufacturing at 12.6 years (Chart 28).[23] The proportion with higher levels of education may also be an important element if one assumes education at certain levels has a greater marginal effect on labour productivity. The proportion with a university degree, however, remained well below both the total of all industries and manufacturing. Only 12.2 per cent of workers in the food manufacturing subsector had attained a university degree, three quarters of the proportion in manufacturing at 16.7 per cent and about half the proportion in all industries at 23.5 per cent (Chart 29).

Chart 28: Average Worker Education Attainment in Years, Food Manufacturing, Manufacturing and All Industries, 1990-2007



[23] Data are available for employment by education level rather than a specific number of years, the Centre for the Sturdy of Living Standards (CSLS) estimated years of education based on these education attainments. Average years of education estimated by CSLS assumes the following years of education for each cohort: 8 years for 0 to 8 Years, 11 years for Some High School, 12 years for High School Graduate, 13 years for Some Post Secondary, 14.5 years for Post-Secondary Certificate or Diploma, 16 years for Bachelors Degree and 18 years for Above Bachelors Degree.

Chart 29: Proportion of Workers in All Industries, Manufacturing and Food Manufacturing Having Attained a University Degree, 1990-2007



Trends in education attainment from 1990 through 2007 were very favourable to the food manufacturing industry and indicate this may have been an important component of labour productivity growth. Growth in average years of education attained by workers was faster in the food manufacturing subsector (0.55 per cent per year) than in the total economy (0.39 per cent), and more than double the growth rate in the manufacturing sector (0.23 per cent). Phrased differently, average years of education attainment increased by 9.72 per cent in food manufacturing from 1990-2007, while the total economy experienced only a 6.91 per cent increase and manufacturing experienced a mere 4.04 per cent increase. Trends in higher education attainment have been especially strong for food manufacturing. The proportion of workers with a university degree increased at an average annual rate of 4.73 per cent in food manufacturing, above the 4.03 per cent attained in manufacturing and well above the 2.89 per cent increase in the total economy.

Formal education is a component of human capital, but it is certainly not the entirety of it. Human capital is the entire stock of competencies an individual holds based on natural ability as well as knowledge from formal education, training and work experience. Statistics Canada has compiled an index on labour input that is essentially an index of human capital.[24] This measure indicates strong growth in human capital from

[24] Labour composition is defined as the ratio of labour input to hours worked, where labour input is obtained by chained-Fisher aggregation of hours worked of all workers, classified by education, work experience, and class of workers (paid workers versus self-employed and unpaid family workers) using hourly compensation as weights.

1961-2007, but in contrast the education measure in that labour composition growth was slower than in manufacturing and the business sector. Over the entire period, labour composition increased at an average annual rate of 0.54 per cent in the food manufacturing subsector compared with 0.65 per cent in the manufacturing sector and 0.71 per cent in the business sector. The most recent period of 2000 to 2007 has seen labour composition to increase faster in food manufacturing (0.56 per cent) than the business sector (0.54 per cent) due to a large decline in the business sector labour quality growth coupled with a modest increase in food manufacturing; manufacturing (0.64 per cent) continued to outperform food manufacturing.

Summary Table 26: Labour Composition Growth, 1961-2007

	Business Sector	Manufacturing	Food Manufacturing
1961-2007	0.71	0.65	0.54
1961-2000	0.74	0.65	0.54
1961-1973	1.05	0.77	0.49
1973-1981	0.44	0.51	0.44
1981-1989	0.65	0.64	0.73
1989-2000	0.68	0.62	0.54
2000-2007	0.54	0.64	0.56

Source: Appendix Tables 13a, 14a and 14e

iv. Economies of Scale Based on Establishment Size

Larger firms may be able to produce output at a lower average cost than smaller firms through more efficient use of capital and greater division of labour. The existing literature provides evidence of economies of scale in several industry groups, though there is debate on this point. Veeman, Peng and Fantino (1997) find evidence of economies of scale in meat processing plants in Canada based on a trend towards increased concentration as well as higher productivity in larger plants. Gervais, Bonroy and Couture (2006) and Gervais, Bonroy and Couture (2008) analyze provincial data similarly find economies of scale in meat processing, though their results are not statistically significant. Among small bakeries, however, they find strong evidence of economies of scale. They find mixed evidence for dairy manufacturing; after controlling for supply management on the input side, they find evidence of increasing returns to scale in smaller producing provinces, but decreasing returns in Ontario and Quebec, which are the two largest provinces. Optimum firm size can notably change due to technological change or government regulations, but the direction of actual change in firm size is quite likely to be the proper course for maximizing labour productivity, and the trend has been towards larger firms.

Changes in labour composition thus reflect the shifts in the educational attainment and work experience of the workforce.

There have been three official definitions of business establishment used by Statistics Canada from 1990 to 2008. Due to these definitional changes changes in the number of employees per establishment within each period that has a consistent definition may be analyzed, but the change cannot be calculated for the entire period. Food manufacturing actually experienced increases in the number of employees per establishment during each of the three periods: 1990-1999, 2000-2003 and 2004-2008. From 1990 through 1999, employees per business establishment increased 0.44 per cent per year. From 2000 to 2003, employees per business establishment increased 3.03 per cent. During the 2004 to 2008 period employees per business establishment increased 0.66 per cent.

Not every industry group in food manufacturing experienced increases in the size of firms. During the first interval of 1990 to 1999, five of the seven industry groups for which data are available experienced increases in the number of employees per firm. The industry group with the largest increase was meat product manufacturing, with an average annual increase of 5.28 per cent, followed by other food manufacturing at 4.87 per cent. The two industry groups experiencing decreases were bakeries and tortilla manufacturing (down 6.26 per cent per year) and grain and oilseed milling (down 1.74 per cent). During the next interval of 2000-2003, seven of the nine industries for which data are available experienced increases in firm size. The largest average annual rate of increase was in seafood product preparation and packaging (6.53 per cent), closely followed by grain and oilseed milling (6.51 per cent). The two industry groups that underwent decreasing firm size were animal food manufacturing (down 8.40 per cent per year) and other food manufacturing (down 2.38 per cent). During the most recent period of 2004 to 2008, five of the nine industry groups actually experienced decreasing firm size. The largest loss was in the sugar and confectionary product manufacturing industry group (down 9.20 per cent annually) followed by fruit and vegetable preserving and specialty food manufacturing (down 2.77 per cent). The largest increases were seen in the bakeries and tortilla manufacturing industry (5.82 per cent) and grain and oilseed milling (3.44 per cent). Overall, most industries have experienced increases in firm size implying greater economies of scale were utilized in the production process.

Box 2: Maple Leaf Foods Seeks Economies of Scale

Maple Leaf Foods has dealt with great adversity in recent years. A high Canadian dollar made the output of foreign firms more attractive (as prices were lowered relative to Canadian goods both domestically and abroad) while a recall of meat products following the listeriosis outbreak of 2008 battered brand value. The company, however, has responded with an ambitious plan to increase productivity and reduce unit costs through increasing the scale of operations.

To maximize efficiency of future operations, Maple Leaf has a $1.3 billion dollar plan. Their plan involved sending teams of engineers to do cost benchmarking against plants in Europe and the United States, which found that Maple Leaf had production costs 15-25 per cent higher. One reason for the cost differential is scale; the average plant in the United States is more than double the Canadian size. This means that often the cost of using new technology is lower per output unit in the United States because Maple Leaf needs to buy the technology for *two factories* rather than one in the United States. In their bakeries and meat processing plants, the company is aggressively moving to consolidate small, inefficient plants for large.

Beyond scale, the acquisition of new technology is also part of the plan. While the appreciation of the Canadian dollar has allowed U.S. manufacturers to double their share of the Canadian protein market (to 8 per cent), it has actually made the latest technology more affordable to Maple Leaf given that it is often produced in the United States or Europe.

Francis, Diane. "Michael McCain and Maple Leaf Foods" *Financial Post*. October 21, 2010. Available: http://www.financialpost.com/Saturday+Interview+Maple+Leaf+Michael+McCain/3706136/story.html

Summary Table 27: Average Annual Increase in the Number of Employees Per business Establishment in the Food manufacturing subsector, 1990-1999, 2000-2003 and 2004-2008

	1990-1999	2000-2003	2004-2008
Food Manufacturing	0.44	3.03	0.66
Animal food manufacturing	n.a.	-8.40	-1.62
Grain and oilseed milling	-1.74	6.51	3.44
Sugar and confectionery product manufacturing	n.a.	2.76	-9.20
Fruit and vegetable preserving and specialty food manufacturing	2.49	2.31	-2.77
Dairy product manufacturing	1.63	2.25	-1.14
Meat product manufacturing	5.28	1.06	1.22
Seafood product preparation and packaging	0.42	6.53	1.11
Bakeries and tortilla manufacturing	-6.26	7.65	5.82
Other food manufacturing	4.87	-2.38	-2.62

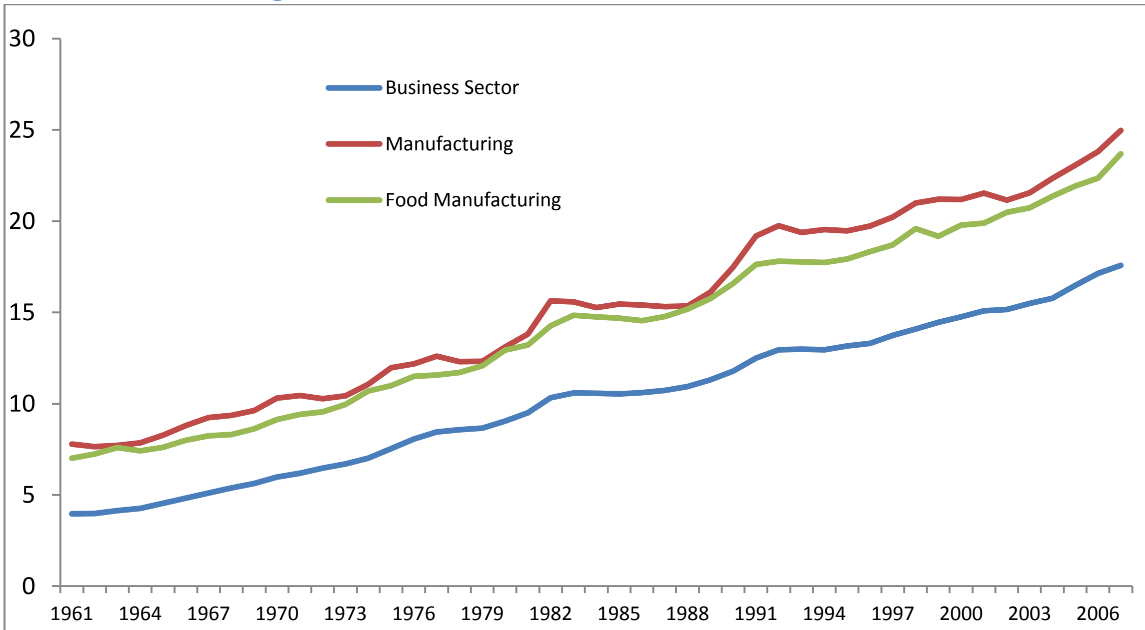
Source: Appendix Tables 17-17i

v. Capital Intensity – Capital Services per Hour Worked

Capital intensity defined here as capital services input per hour worked, is a direct contributor to output. As of 2007, the capital intensity level in the food manufacturing subsector was $23.69 chained 2002 dollars, somewhat lower than in manufacturing ($24.98) and well above the business sector ($17.58). In 1961 the food manufacturing industry had $7.01 chained 2002 dollars capital services per hour worked, at which time the industry was also more capital intensive than the business sector ($3.97) but less capital intensive than the manufacturing sector ($7.78).

The growth in capital intensity has been quite strong over the entire 1961 through 2007. Over that period capital intensity grew at an average annual rate of 2.68 per cent in the food manufacturing industry, which was higher than the rate achieved by manufacturing (2.57 per cent), but lower than the total business sector (3.29 per cent). From 1961 to 1973, food manufacturing capital intensity increased at a rate of 2.96 per cent. The rate of growth accelerated to a peak of 3.60 per cent from 1973-1981, before dropping to 2.23 per cent for the 1981-1989 interval. The rate of growth in capital intensity dropped further from 1989 to 2000, averaging only 2.09 per cent. The new millennium, however has witnessed the acceleration of capital intensity growth to an average of 2.60 per cent for the 2000-2007 period, above both manufacturing (2.54 per cent) and the total business sector (2.37 per cent).

Chart 30: Capital Services per Hour Worked, Business Sector, Manufacturing and Food Manufacturing, 2002 Chained Dollars, 1961-2007



Source: Appendix Tables 13b, 14b and 14f

Summary Table 28: Compound Average Annual Growth Rate in Capital Intensity, Food Manufacturing, Manufacturing and Business Sector, 1961-2007

	Business Sector	Manufacturing	Food Manufacturing
1961-2007	3.29	2.57	2.68
1961-2000	3.42	2.60	2.70
1961-1973	4.46	2.48	2.96
1973-1981	4.46	3.57	3.60
1981-1989	2.21	1.94	2.23
1989-2000	2.44	2.53	2.09
2000-2007	2.54	2.37	2.60

Source: Appendix Tables 13b, 14b and 14f

Another contributor to the recent increases in capital intensity was the downward trend in marginal effective tax rates on capital in Canada. Chen and Mintz (2008) find that the marginal effective tax rate on manufacturing capital in Canada decreased from 37.1 per cent in 2005 to 19.3 per cent in 2008.[25] The steady reduction in capital taxes has increased business incentive to invest in more capital, and this encouragement of greater capital intensity has surely had a positive impact on labour productivity. The Canadian government has approved corporate income tax cuts from the current rate of 18 per cent to 15 per cent in 2012, and such a move is indeed anticipated to further increase capital intensity.

vi. Machinery and Equipment

While investment in capital is important to productivity growth, the link is especially strong for machinery and equipment. Machinery and equipment builds the productive capacity used directly in production and is an important aspect of innovation adoption; firms cannot use the latest production techniques without the latest technology. Sabourin, Baldwin and Smith (2003) note that productivity growth was higher for firms in the food manufacturing subsector that adopted more advanced technologies, like information and communications technology, advanced packaging and advanced process control. Similarly, Baldwin, Sabourin and West (1999) find that increased quality of manufactured food output is the major motivator for acquiring such machinery. Nominal gross machinery and equipment investment in the food manufacturing subsector amounted to $1.45 billion in 2010, equivalent to 88.7 per cent of total investment in the sector. The share of investment is above that observed in manufacturing (81.8 per cent), and more than double the share in the total of all industries (42.2 per cent). Real

[25] Marginal effective tax rates on capital investments incorporate corporate income taxes, sales taxes on capital purchases and other capital-related taxes including asset and net worth taxes, stamp duties on securities, taxes on contributions to equity. Special tax holiday regimes operating in some countries are not included in the analysis. Property taxes are not included due to lack of data.

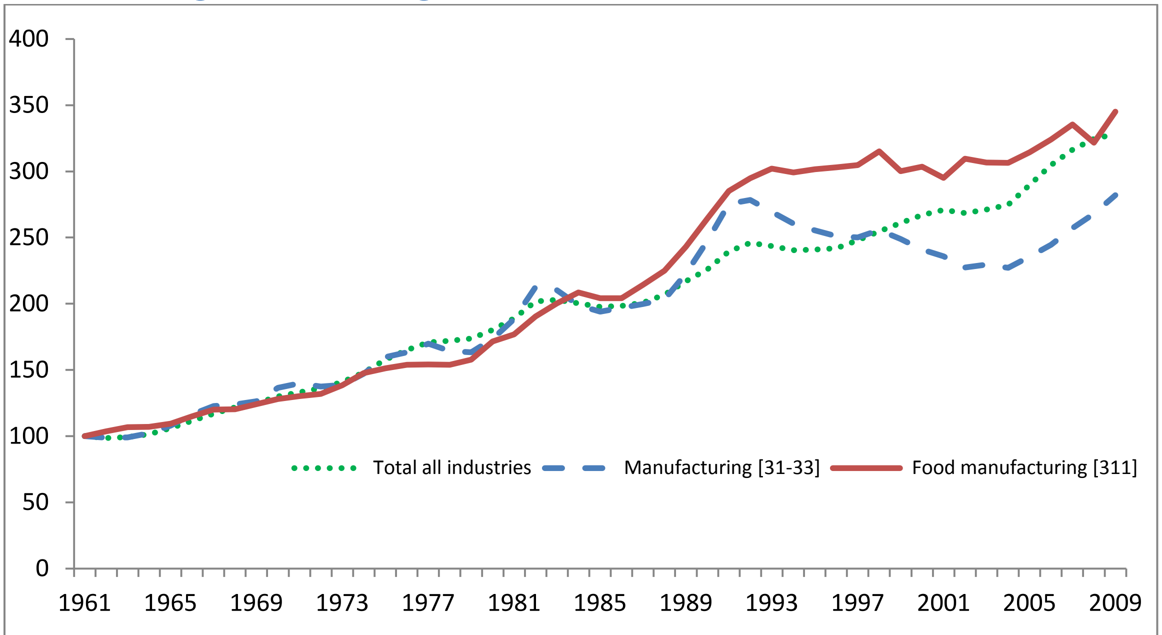
investment in machinery and equipment grew at an average annual rate of 2.28 per cent from 1961-2010, well above manufacturing (1.21 per cent), but also well below the total of all industries (4.19 per cent).

The recent appreciation of the Canadian dollar, while certainly posing some challenges for the industry, actually makes investments in machinery and equipment more affordable.[26] Holden (2003) finds that 80 per cent of manufacturing machinery and equipment is imported from other countries. The implication is that appreciation of Canadian currency makes the price of machinery and equipment fall in terms of Canadian dollar cost. The point must be stressed, however, that the appreciation is not unambiguously positive for the industry; while importing machinery and equipment is made cheaper, Canadian exports are made more expensive from the perspective of foreign consumers.

Though it is true that investment in machinery and equipment is an important driver of output growth, a better metric in determining labour productivity growth would be investment per hour worked. In terms of level, food manufacturing was comparatively low at $3.16 (chained 2002 dollars) compared with $3.42 in the total economy and $3.82 in the manufacturing sector in 2009. Over the period of 1961 to 2009, real investment per hour worked in the food manufacturing subsector grew at a compound average annual rate of 2.16 per cent, somewhat below the total economy (2.51 per cent), but more than double that in manufacturing (0.93 per cent).

[26] Sharpe and Moeller (2011) found that since 2003, an appreciation in the value of the Canadian dollar has coincided with a decrease in ICT investment prices, and vice versa. Progressively smaller appreciations from 2003 to 2008 lead to progressively smaller price declines.

Chart 31: Machinery and Equipment Stock per Hour Worked, Food Manufacturing, Manufacturing and Total All Industries, 1961-2009, 1961=100



Source: Appendix Table 7n

Despite investment trends, real machinery and equipment capital stock per hour worked grew faster over the 1961-2009 period in food manufacturing (2.61 per cent per year) than in manufacturing (2.18 per cent) or the total economy (2.51 per cent) (Chart 31). Growth has been slower, however, since 2000; real growth in food manufacturing has averaged only 1.44 per cent annually, while the total economy continued to enjoy high growth in machinery and equipment stock per hour worked (2.32 per cent) and manufacturing has seen growth below its long term average (1.77 per cent). With a level of $16.29 in 2009, food manufacturing was somewhat ahead of the total economy ($15.13) but far below manufacturing ($25.41).

Summary Table 29: Machinery and Equipment in the Food Manufacturing Subsector, Stock and Investment per Hour Worked, Compound Average Annual Growth Rate, 1961-2009

	Total all industries	Manufacturing [31-33]	Food manufacturing [311]
Average Annual Growth in Chained Machinery and Equipment Stock per Hour Worked, per cent			
1961-2009	2.51	2.18	2.61
1961-1981	3.23	3.22	2.89
1981-1989	1.74	2.11	4.06
1989-2000	1.91	0.71	2.04
2000-2007	2.45	0.93	1.44
2000-2009	2.32	1.77	1.44
Average Annual Growth in Chained Machinery and Equipment Gross Investment per Hour Worked, per cent			
1961-2009	2.51	0.93	2.16
1961-1981	3.53	2.29	3.61
1981-1989	2.11	0.92	1.50
1989-2000	6.94	1.79	3.16
2000-2007	-4.16	-0.79	-2.31
2000-2009	-4.46	-3.01	-1.59

Source: Appendix Tables 7n and 9k

vii. International Trade

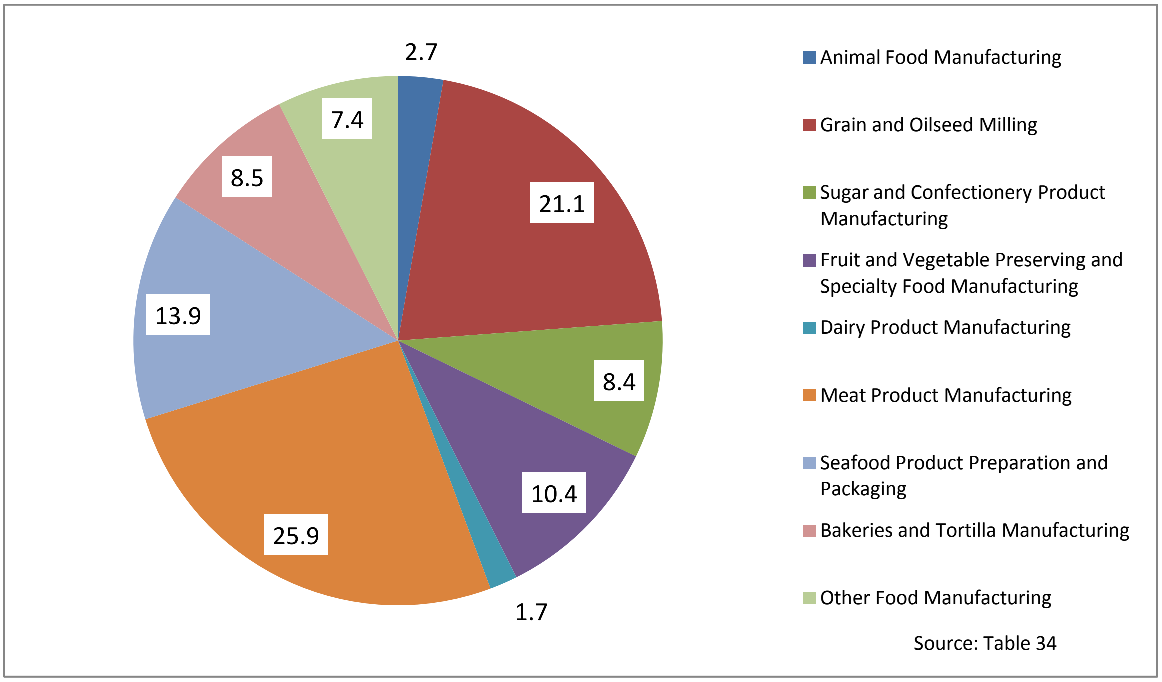
Trade can play a large role in fostering productivity through increasing competition and through allowing for greater economies of scale in production and through greater profit opportunities for innovative firms that find better methods of production. The importance of trade to the industry is made quite clear in the literature. Adam Smith, often credited as the father of modern economics, actually used a perishable example to demonstrate the necessity of trade in his famous *Inquiry into the Nature and Causes of the Wealth of Nations*. Smith (1776) declares "By means of glasses, hot-beds, and hot-walls, very good grapes can be raised in Scotland, and very good wine, too, can be made of them, at about thirty times the expense for which at least equally good can be brought from foreign countries. Would it be a reasonable law to prohibit the importation of all foreign wines, merely to encourage the making of claret and Burgundy in Scotland?" More recently, Charlebois, Gagne and Gendron (2008) estimated how much value added was produced in the red meat processing industry over the 1988-2007 period due to seven international trade agreements, and concluded that value added was increased by $432 million annually.[27] Trade allows for the exploitation of economies of scale, encourages greater efficiency through competition and allows for greater knowledge transfer across borders.

[27] The agreements covered were with the United States, Mexico, Australia, South Korea, Japan, Philippines and Indonesia.

International trade, however, is greatly influenced by exchange rates which are highly variable. Statistics Canada (2009) finds that from 2003 to 2008, Canadian unit labour costs in manufacturing increased at an average annual rate of 8.0 per cent in U.S. dollars while U.S. unit labour costs fell 1.0 per cent per year, with most of this gap attributed to a 5.7 per cent annual appreciation of the Canadian dollar relative to the U.S. dollar. The industry is certainly aware of these challenges. Bonti-Ankomah (2006) declares that the recent appreciation of the Canadian dollar was one of the three top concerns food processors had going forward, along with consolidation of food retailers and wholesalers and availability of competitively priced raw agriculture prices.

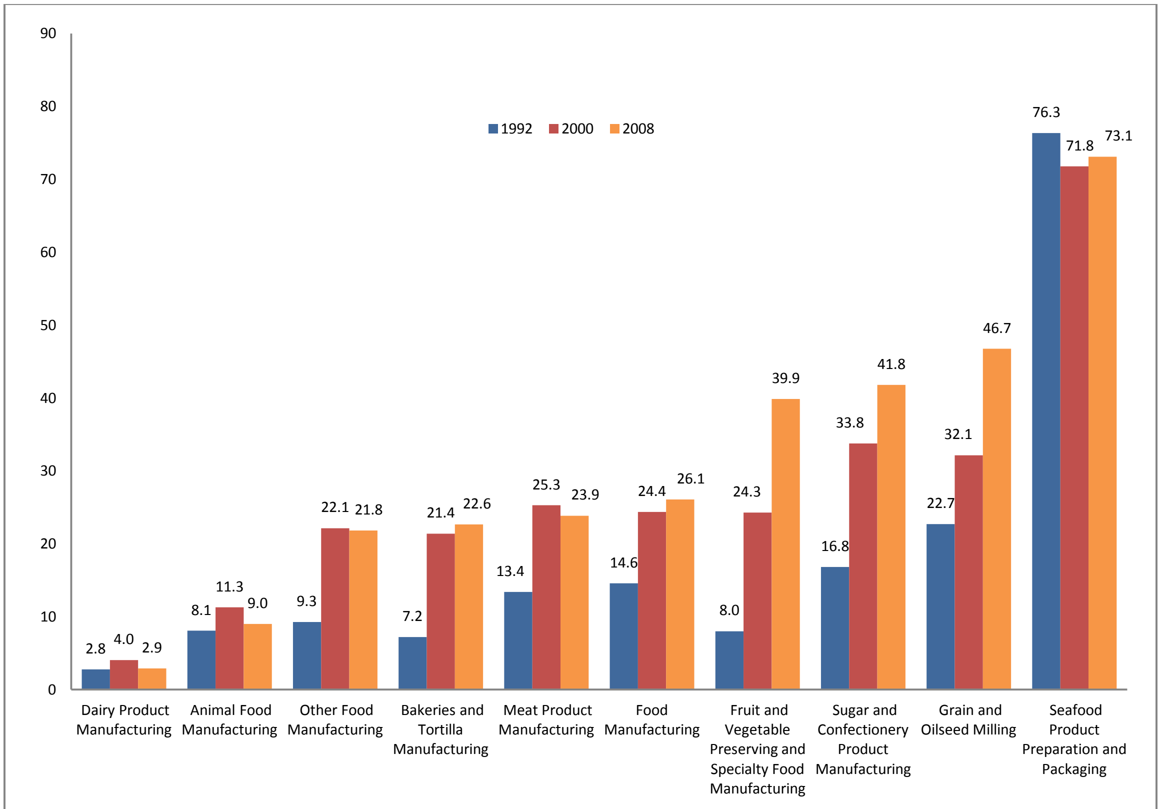
The Canadian food manufacturing exports, expressed in current dollars, amounted to $19.93 billion in 2010, up from $5.80 billion in 1992. The industry group with the greatest value of exports was meat product manufacturing ($5.16 billion), followed by grain and oilseed milling ($4.20 billion), seafood product preparation and packaging ($2.77 billion), fruit and vegetable preserving and specialty food manufacturing ($2.08 billion) and bakeries and tortilla manufacturing ($1.69 billion). The industry group with the lowest export value in 2010 was dairy product manufacturing ($0.34 billion). followed by animal food manufacturing ($0.55 billion), other food manufacturing ($1.48 billion) and sugar and confectionary product manufacturing ($1.67 billion). There was, however, strong competition from foreign produced goods as well, with Canada having imported $17.18 billion dollars worth of food manufacturing output in 2010.

Chart 32: Distribution of Food Manufacturing Exports by Industry Group, Per Cent, 2010



One measure of the importance of trade to an industry is export intensity, which is the proportion of manufacturing shipments (gross output) that are exported. The export intensity of food manufacturing as a whole stood at 26.1 per cent in 2008, up slightly from 24.4 per cent in 2000 and 14.6 per cent in 1992. The most export intensive industry group by far was seafood product preparation and packaging (73.1 per cent), followed by grain and oilseed milling (46.7 per cent), sugar and confectionary product manufacturing (41.8 per cent), fruit and vegetable preserving, specialty food manufacturing (39.9 per cent) and meat product manufacturing (23.9 per cent). The least export intensive industry group was dairy product manufacturing (2.9 per cent), followed by animal food manufacturing (9.0 per cent), other food manufacturing (21.8 per cent) and bakeries and tortilla manufacturing. Seafood product preparation and packaging was the only industry group that experienced declining export intensity between 1992 and 2008, and even here the decline was quite small. In contrast, fruit and vegetable preserving and specialty food manufacturing experienced an almost quintupling of export intensity, bakeries and tortilla manufacturing experienced a tripling and other food manufacturing, sugar and confectionery product manufacturing and grain and oilseed milling all more than doubled their export intensities.

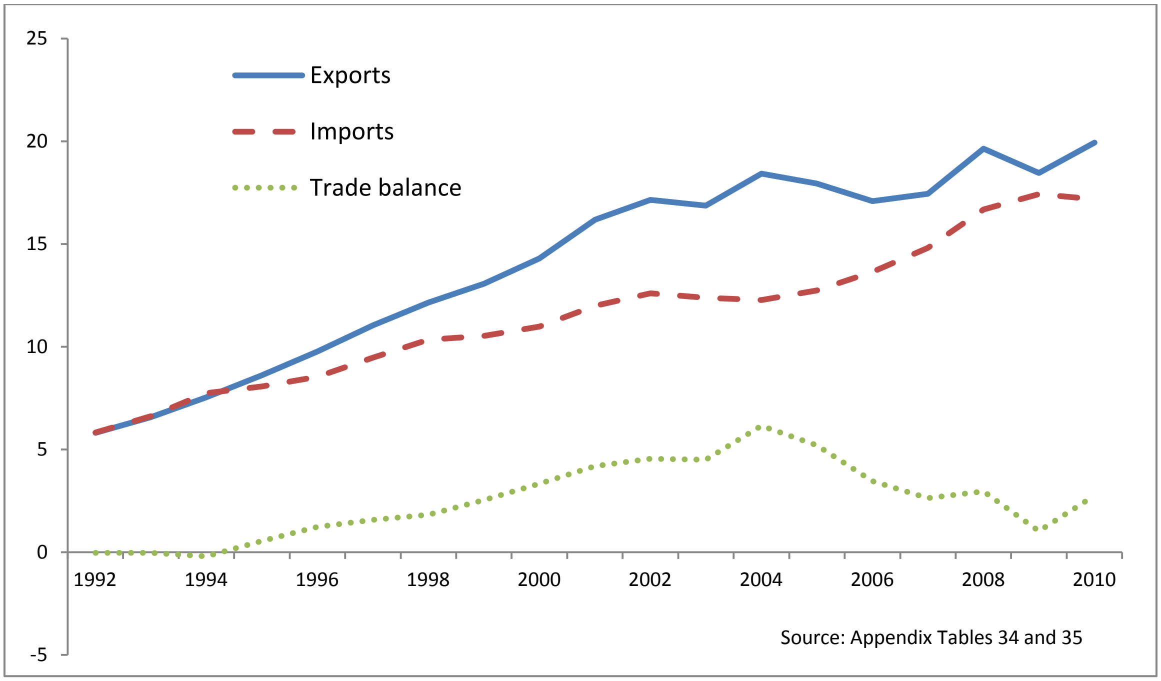
Chart 33: Export Intensity in the Food Manufacturing Subsector, Per Cent, 1992, 2000 and 2008



Source: Table 34

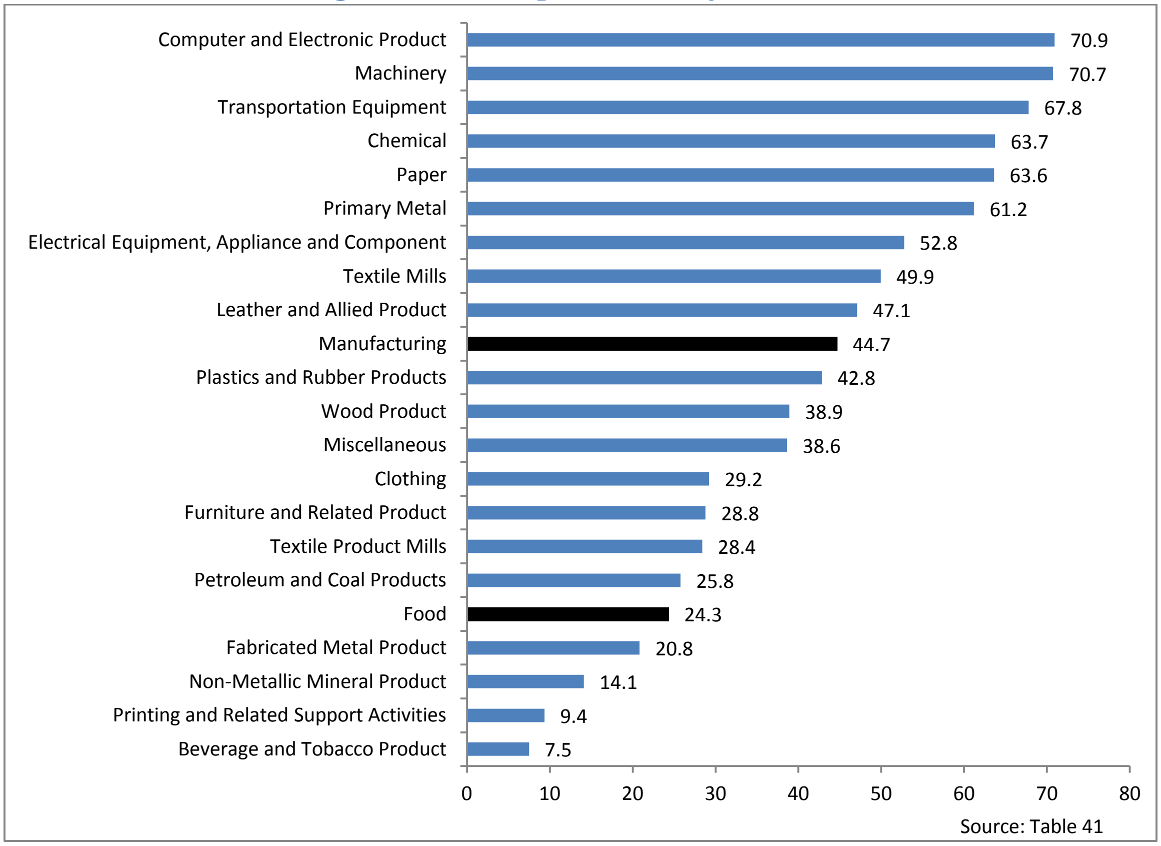
The Canadian food manufacturing industry contributed $2.76 billion to the national trade surplus in 2010, a large improvement from the trade deficit of $0.03 billion in 1992. The industry enjoyed an increasing trade surplus every year from 1995 through 2002, fell slightly in 2003 and peaked at $6.15 billion in 2004. In 2010, four of the nine industry groups contributed to the surplus. The greatest contributor was meat product manufacturing ($2.75 billion), followed by grain and oilseed milling ($1.53 billion), seafood product preparation and packaging ($0.92 billion) and bakeries and tortilla manufacturing ($0.54 billion). Of the five industry groups for which there was a trade deficit, other food manufacturing attained the largest deficit ($1.49 billion), followed by fruit and vegetable preserving and specialty food manufacturing ($0.67 billion), sugar and confectionery product manufacturing ($0.43 billion), dairy product manufacturing ($0.23 billion) and animal food manufacturing ($0.16 billion).

Chart 34: Exports, Imports and Trade Balance in the Food Manufacturing Subsector, Billions of Current Dollars, 1992-2010



Food manufacturing is one of the least export-oriented manufacturing subsectors. There are 21 subsectors for which export intensity data for 2009 are available, and food manufacturing (24.3 per cent) has higher export intensity than only four subsectors: beverage and tobacco product manufacturing (7.5 per cent), printing and related support activities (9.4 per cent), non-metallic mineral product manufacturing (14.1 per cent), and fabricated metal product manufacturing (20.8 per cent) (Chart 35: Manufacturing Subsector Export Intensity, 2009). In contrast, computer and electronic product manufacturing and machinery manufacturing had export intensities in excess of 70 per cent, and manufacturing as a whole exported 44.7 per cent of manufacturing shipments in 2009.

Chart 35: Manufacturing Subsector Export Intensity, 2009



viii. Microeconomic Policy - Regulations

Food manufacturing is a highly regulated industry, and for good reason; citizens demand that the food they buy be safe and that information provided on nutrition labels are true. Poor regulation at either the implementation or rule-making stage, however, robs industry of incentive to innovate and deprives consumers of potentially valuable information that would better inform consumption choices. One of the most cited problems is the timeframe required for new foods and additives to receive approval, and another problem is the approval of health claims, which signal health and well-being attributes of food products.

The creation of new foods acts as a business opportunity as well as increasing consumer choice. Given the research and development support through tax credits and grants, along with protections of intellectual property, such initiatives are clearly encouraged by the government. There are regulations, however, that act as massive disincentive to innovate. One example is restrictions on health claims for non-novel food additives. George Morris Centre (2008) finds that such regulations are the cause significant expenditure on inefficient advertising by firms: "In order to compensate for the inability to make health claims on the package, many food companies develop extremely intricate print advertisements designed to communicate product benefits indirectly. Print advertising does not require pre-market approval by Health Canada."

George Morris Centre (2008) conducted 12 case studies in how firms deal with Canadian food processing regulations, and a recurrent theme was slow processing applications allowing for a novel food to be sold or for allowing food health claims to be listed. Examples include very long processing time leading to firms dropping requests, and a confusing variety of application streams with different requirements. The study concludes that the regulatory lags are caused by Health Canada having low research capacity, there is poor communication and guidance from the department to applying firms, there is an overwhelming inertia such that it is very hard for mineral additives to be added to an approved list, and finally, there is allegedly a lack of accountability in Health Canada for processing claims in a timely manner.

CAPI (2011) argues that "policy silos" are responsible for much of the poor regulation. Regulations of one department may come in conflict with the goals of another department. If the overall governance structure is to be efficient, all affected departments must work together. Government departments, such as Industry Canada, Health Canada and Agriculture and Agri-Food Canada, must coordinate their regulations so they do not have the impact of pulling-and-pushing at the same time.

viii. Public Infrastructure

The perishable nature of some processed foods is somewhat unique. The susceptibility to spoilage makes transportation networks quite important. Bernstein and Mamuneas (2008) attempt to estimate the role that public infrastructure investments have on factor demand in the Canadian food manufacturing subsector, output cost and productivity based on estimates of firm production functions, cost functions and price elasticities of factors of production. Public infrastructure from all levels of government acts as an input in the production function determined exogenously and firms maximize profit subject to this fixed level of input. The authors find that a one per cent increase in infrastructure capital decreased labour requirements by 0.07 per cent, intermediate inputs demanded fell by 0.18 per cent and capital input increased 0.16 per cent. This is equivalent to declaring labour and intermediate inputs may be, to some extent, substituted by the publicly provided infrastructure, but capital is a complement to public infrastructure. As one would expect, the authors concluded also that the public infrastructure capital stock increases reduce firm production costs; a one dollar increase in public infrastructure capital decreased cost by $0.03. A particularly strong finding is that public infrastructure investment was entirely responsible for total factor productivity growth in the food manufacturing subsector in Canada from 1964 through 1996. Fundamentally, this study demonstrates that public policy regarding infrastructure investment has a significant impact on the food manufacturing subsector, from factor demand through production cost.

Gu and MacDonald (2009) find that public infrastructure has grown markedly over the last several decade. While private sector capital stock increased more quickly than public sector stock, both grew every decade. During the recent 2000-2006 period, public capital formation grew at an average annual rate of 1.2 per cent, far below the growth rate experienced in the sixties (3.6 per cent) but well above the rate in the nineties (0.8 per cent). The authors make no industry-specific estimates, but do note that for the aggregate economy, public infrastructure formation contributed 0.2 percentage points to labour productivity growth from 1962-2006. Presumably this public infrastructure growth increased labour productivity in the food manufacturing sector as well.

Summary Table 30: Average Annual Capital Stock Growth by Decade, 1960-2006

	Public sector	Business sector
	per cent	
1962-1970	3.6	4.7
1970s	2.8	4.6
1980s	1.4	2.8
1990s	0.8	1.7
2000-2006	1.2	2.4
1962-2006	1.7	2.8

Source: Gu, Wulong & Macdonald, Ryan, 2009. "The Impact of Public Infrastructure on Canadian Multifactor Productivity Estimates," The Canadian Productivity Review 2008021e, Statistics Canada, Economic Analysis Division. Available: http://www.statcan.gc.ca/pub/15-206-x/15-206-x2008021-eng.pdf

VI. Policy Implications

Importance of Labour Productivity Growth for the Future of the Subsector

Labour productivity growth will be more important to the prosperity of Canada's food manufacturing subsector in the future than in the past for two main reasons: increased need for the sector's output globally; and rising competitive pressures internationally. According to a recent report from the United Nation's Food and Agriculture Organization, agricultural productivity needs to increase by about 70 per cent globally between now and 2050, to feed an estimated world population of 9.2 billion people. In addition, the demand for sector's output from emerging economies is expected to accelerate because of the fast growth in real incomes and the rising middle-class in these countries. Canada is the fourth largest global exporter of agricultural and food manufacturing products. Therefore, Canada is expected to play a major role in meeting the increased global demand for these products.

The increased processed food production in Canada in the future needs to be supported by increases in MFP and capital intensity. Competition from emerging economies and OECD countries is likely to intensify in the food manufacturing subsector. Hence, strong labour productivity growth in the sector is necessary to effectively meet the rising demand for food manufacturing products and the rising competitive challenge.

What Could be Done to Ensure a Strong Labour Productivity Growth?

Going forward, Canada's food manufacturing subsector needs to maintain its long standing strong labour productivity performance, if not improve, to meet effectively the rising competitive challenge from emerging economies in Asia and Latin America and play its part in meeting the need for increased global production of its products.

For focusing on the productivity imperative, both the federal and provincial agriculture and agri-food departments should make productivity the central tenant of their policy discussion. Furthermore, they should consider evaluating and disseminating widely the productivity impacts (both direct and indirect impacts) of all new policies and programs relating to food manufacturing. In addition to these two broad policy directions, a number of specific policy suggestions could be considered for raising the rate of productivity growth of the sector. These include stimulating innovation by encouraging and undertaking effective R&D spending; encouraging and facilitating the increased adoption rates of available technologies and knowledge; facilitating market induced shifts in resources within the sector; promoting competition; reducing regulatory burden; and improving market access to Canadian exports.

R&D Investments

There is a well-established link between R&D spending and labour productivity growth in general. This is also true in the case in the food manufacturing subsector. R&D spending leads to the development of new products and processes, the main drivers of labour productivity growth. In addition, R&D is also crucial for effective adoption of new technologies and knowledge developed outside of Canada. Despite the paramount importance of R&D for productivity growth, Canada's food manufacturing industry has been lagging other major OECD countries in R&D-intensity. Governments need to increase the effectiveness of their financial support to private sector R&D spending.

Adequate and effective intellectual property protection (IPR) in the food manufacturing subsector is essential for encouraging private sector R&D. But, in some cases, intellectual property rights could hinder the adoption and diffusion of new technologies. Federal governments need to ensure a proper balance with its IPR policies between the interests of creators and users of new technologies and knowledge so that the overall productivity benefits from R&D spending to the sector are maximized.

Innovation Adoption

For a small open economy like Canada, the wide-spread use and an effective adoption of new technologies and knowledge developed outside of Canada, especially in the United States might be more important to productivity growth than domestic innovation.

Factors that would stimulate innovation adoption include continued government efforts such as toward increasing investments in M&E, especially ICTs, R&D, education, skills development and upgrading and transport and telecommunications infrastructure.

The economic life of M&E capital in general, especially ICT capital, is being shortened increasingly quickly because of rapid technological advances. Consequently, the capital cost allowance rates need to respond quickly to these fast moving technology trends so that the cost of capital in Canada is competitive with other jurisdictions and does not become a hindrance to investments in new technologies in the food manufacturing subsector.

Better coordination of the innovation and innovation adoption activities of business, universities and governments would also increase overall productivity dividends to the sector from innovation and innovation adoption.

Increased competition intensity from both domestic and external sources, improved market access to export markets, the availability of skilled and unskilled labour and the wage rates, and climate change and other environmental factors would increase the incentives to innovate, adopt and adjust.

Regulatory and other policy settings

The regulatory systems with regard to food safety and health concerns should constantly reevaluate the level of regulatory burden needed on food manufacturers necessary to ensure health standards, and encourage innovation and innovation adoption.

Policies with regard to income support, supply management, production subsidies and marketing arrangements at the input stage need to ensure that they do not distort the incentive structures of food manufacturers so that innovation, innovation adoption, flexibility and economic adjustment within the sector are not adversely affected.

Market access

The food manufacturing industry is increasingly becoming export oriented as Canada is exporting more and more of its agricultural exports in processed form. Therefore, a healthy growth in domestic and foreign demand for Canada's food manufacturing products is vital for expanding the scale and scope of production, increasing investments in innovation and innovation adoption, the key drivers of trend productivity.

Reducing the remaining inter-provincial barriers to trade in food manufacturing products, especially trade in meat products, would be helpful in addressing the domestic side of market access concerns In addition, improving access to the United States and other export markets, especially emerging markets in Asia and Latin America, would ensure sufficient external demand for the sector's products.

Since the United States is Canada's largest export market for the sector's products, reduction of tariff and non-tariff barriers between the two countries to trade in agricultural and food manufacturing products would improve the sector's access to the U.S. market and increase the two-way trade between the two countries as well as allow for the acquisition of potentially cheaper imported inputs. Non-tariff barriers, such as differences in food and health standards and food safety regulations in the two countries act as major barriers to Canada's trade in agricultural and food manufacturing products with the U.S. Canada could work towards harmonization of these with the U.S. and improve a great deal the access to the U.S. market. Furthermore, given that the Doha Round of multi-lateral negotiations on issues related to food manufacturing trade are not likely to produce any concrete results in the near future, Canada might consider negotiating bilateral trade agreements with the fast growing emerging economies, especially China, India, South Korea and Brazil.

Public Infrastructure

Adequate and state-of the art provision of transportation and telecommunication infrastructures is imperative to long-term productivity growth in the food manufacturing subsector. A good transportation system is a key determinant of productivity and competitiveness since it allows producers to deliver their products in an effective, efficient and timely manner to their domestic and foreign customers. Well-maintained road and rail networks help producers to minimize costs with longer shipping distances within North America. For exports destined to overseas markets, adequate port facilities are also essential.

Many industries, including food manufacturing, are increasingly relying on telecommunications and web-based tools and services for making rational input and output choices, obtaining up-to-date market information and managerial skills and knowledge. Providing adequate telecommunication infrastructure could yield significant productivity benefits to the Canadian food manufacturing subsector.

Policy Implications Conclusion

Trend productivity in food manufacturing is the outcome of complex interactions of actions of farmers and food manufacturers, their suppliers and customers, universities and governments. Nevertheless, the longer-term productivity performance of the sector is mainly determined by the private sector investments in innovation and innovation adoption, and the size and pace of economic adjustment by producers to rapidly changing market conditions. Of course, federal and provincial governments can play an important role in improving the sector’s productivity performance and competitiveness by supporting and fostering innovation and innovation adoption, improving access to export markets, removing inter-provincial barriers to trade, reducing regulatory burden, providing adequate and state-of the art transportation and telecommunication infrastructure and facilitating the market driven structural changes and economic adjustment.

VII. Conclusion

Productivity levels are quite high in the food manufacturing subsector, in fact they are higher than the economy in general as well as the manufacturing sector. Among the industry groups in food manufacturing, sugar and confectionary product manufacturing and miscellaneous food manufacturing have particularly high productivity levels when compared with manufacturing or the total economy. The only industry group with productivity far below that enjoyed by the total economy is seafood product preparation and packaging with a productivity level less than half of the level attained by the food manufacturing subsector.

The food manufacturing subsector has seen stronger productivity growth than the economy in general over the 1961-2007 period. Though generally outperformed by the manufacturing sector over that timeframe, the new millennium has witnessed higher labour productivity growth in food manufacturing. Food manufacturing has been impressive not just in productivity growth, but also achieved a productivity level higher than the manufacturing average. Over this time frame, increases in capital intensity have contributed 46.1 per cent of total labour productivity growth. This includes the change in capital composition to capital with a shorter service life and also growth in capital stock. Multifactor productivity growth was also very important to growth, accounting for 40.5 per cent of growth. Contributors to multifactor productivity growth include capacity utilization, technological progress resulting from research and development and the exploitation of economies of scale. Changes in the composition of the work force have played a role in labour productivity developments as well. Changes towards a more educated and experienced labour force has been responsible for 13.3 per cent of growth. The post-2000 divergence in output growth between manufacturing and food manufacturing indicates a falloff in demand for manufacturing output and continued demand growth for food processing output. Increased demand implies pressure to increase capacity utilization in food manufacturing which has implications for multifactor productivity growth.

Trends in the identified productivity drivers appear favourable to future labour productivity growth in food manufacturing. Education attainment among workers has been increasing rapidly, a trend indicating more capable workers are being attracted to the sector. Research and development intensity has climbed in recent years, a trend that implies higher quality products and more efficient production processes may be actualized. Firms have increased in size allowing for more efficient production methods due to greater division of labour and more efficient use of capital. The food manufacturing industry has seen faster increases in capital intensity then either manufacturing or the business sector over the last 46 years for which data are available. Finally, capacity utilization in 2010 was above its historical average; an increase in capacity utilization is the most efficient way an industry can increase output because it amounts to more effective use of assets. Taken together, these indicators point the way to a bright future for the sector.

Nevertheless, the policy maker must be mindful that longer-term productivity performance of the sector is mainly determined by the private sector investments in innovation and innovation adoption, and the size and pace of economic adjustment by producers to rapidly changing market conditions. Federal and provincial governments can play an important role in improving the sector's productivity performance and competitiveness by supporting and fostering innovation and innovation adoption, improving access to export markets, removing inter-provincial barriers to trade, reducing regulatory burden, providing adequate and state-of the art transportation and telecommunication infrastructure and facilitating the market driven structural changes and economic adjustment.

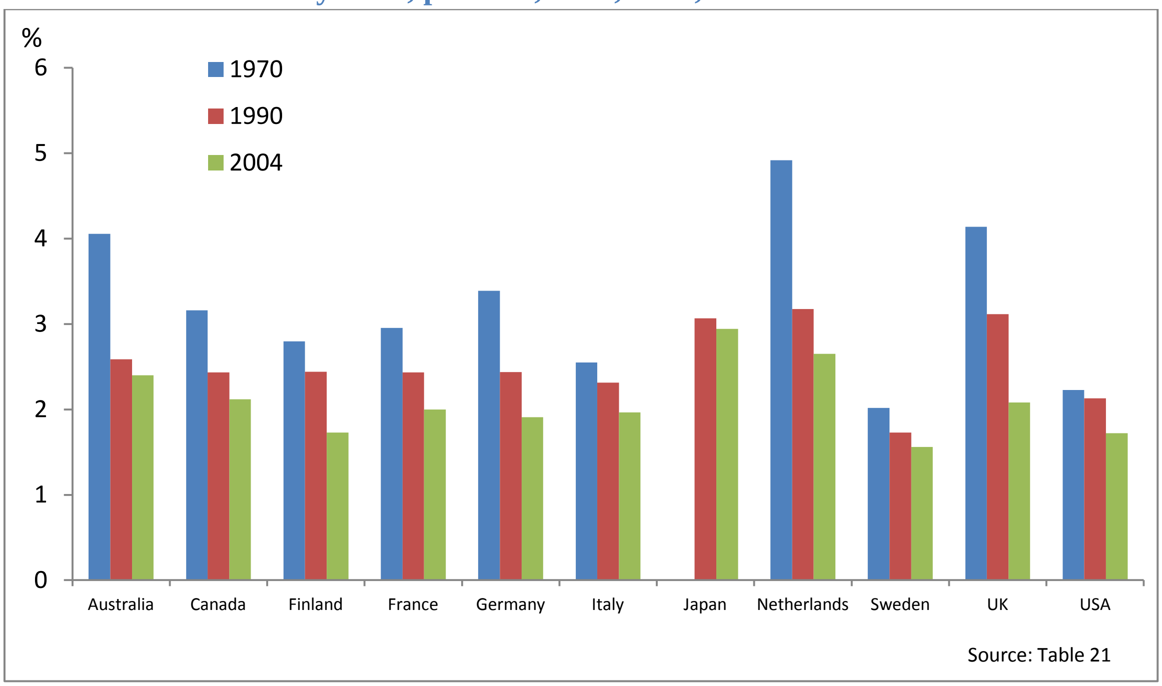
There remain areas of further research to understand the whole story of food manufacturing productivity. Often policymakers care not only of the aggregate affects of a policy, but also the regional distribution of consequences. This raises the question of how important food manufacturing productivity growth has been for each province. Similarly, the existing literature is in agreement that public infrastructure provision increases productivity in food manufacturing, but it would certainly be valuable to estimate the productivity impact of public capital by capital type. Lastly, the importance of regulation to food processing also requires special attention. Two specific aspects of regulation that warrant further special attention is a cross-country comparison of regulations comparing the Canadian rule set to that of other developed nations, and a review of current Canadian regulations and how they have changed over time.

Appendix: The Canadian Food Beverage and Tobacco Sector in the International Context

OECD Countries[28]

The food, drink and tobacco industry is important to the Canadian economy as it contributed more than 2 per cent of GDP in 2004.[29] Japan is the only G7 country that has a larger food, beverage and tobacco sector than Canada relative to total output (Chart 36). Australia and the Netherlands also have slightly larger sectors than Canada as a proportion of value added. The sector is most important to Japan, where it accounts for 2.94 per cent of total output, followed by the Netherlands (2.65 per cent) and Australia (2.40 per cent). There has been a clear downward trend in each country in the proportion of total output accounted for by the food, beverage and tobacco industry from 1970 to 2004.

Chart 36: Nominal Value Added of the Food, Beverage and Tobacco Sector as a Share of Total Economy GDP, per cent, 1970, 1990, and 2004



[28] The data used in this section are calculated by CSLS from the EU KLEMS Growth and Productivity Accounts database maintained by Groningen Growth and Development Centre (GGDC), March 2008, http://www.euklems.net/, These data are used because they offer comparability across countries. Unfortunately, the latest year for which these data were generally available was 2004. Because GGDC data differ somewhat from Statistics Canada data used in the previous part and the broader industrial aggregation used here, the figures that appear in this section for Canada may be different from those that appeared earlier.

[29] The food, drink and tobacco sector includes food manufacturing in it and is the closest industry for which international data are available; in 2007, in Canada food manufacturing accounted for 76.3 per cent of the food, beverage and tobacco industry by value added.

Unfortunately, estimates of labour productivity levels in the food, beverage and tobacco sector cannot be constructed because data on the relative prices purchasing power parities of output in different countries, which are needed to adjust prices, are not available. As a result, our analysis focuses only on growth rates.

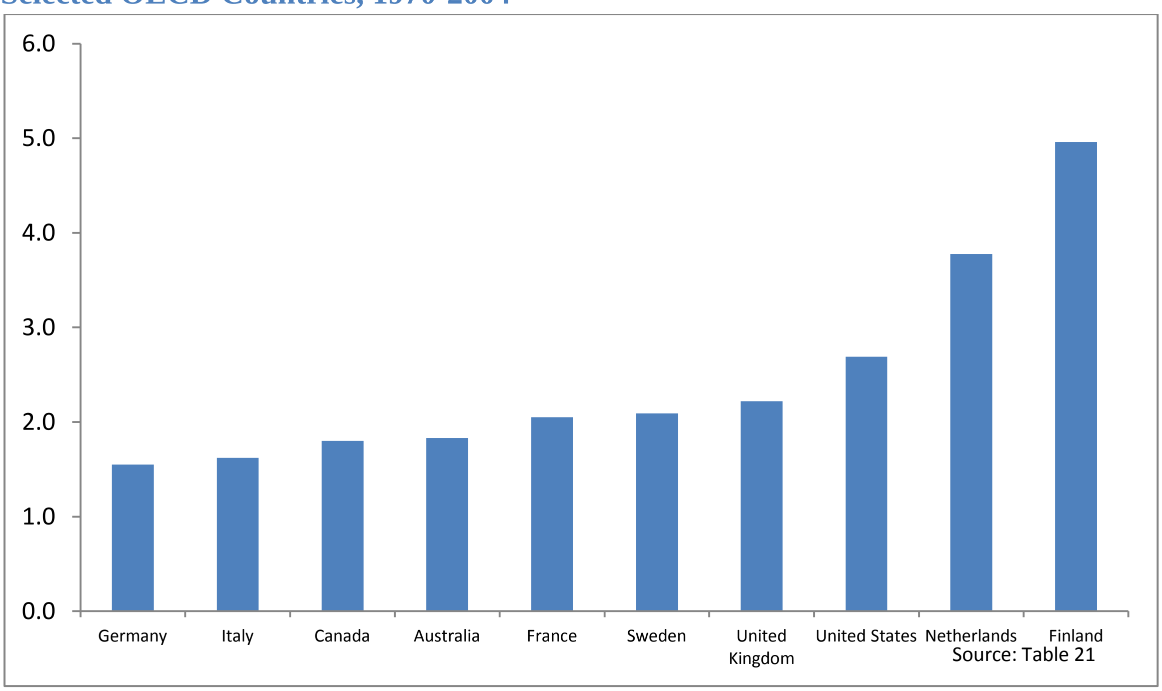
It should also be noted that international comparisons of productivity growth must be interpreted with caution as we cannot be sure what proportion of the sector is food production and what proportion is beverages or tobacco. Assuming for a moment that the tobacco industry has a higher labour productivity growth rate than the food, beverage and tobacco industry in all countries, it means that countries with relatively larger tobacco industry groups would have higher labour productivity growth rates in the food, beverage and tobacco industry as a whole.

Summary Table 31: Labour Productivity Growth in the Food, Beverage and Tobacco, Selected OECD Countries, 1970-2004

	AUS	CAN	FIN	FRA	DEU	ITA	JPN	NLD	SWE	GBR	USA
1970-2004	1.83	1.80	4.96	2.05	1.55	1.62	n.a.	3.77	2.09	2.22	2.69
1970-1980	2.45	3.42	4.14	3.88	3.85	3.29	n.a.	5.22	2.07	1.81	3.64
1980-1990	2.43	0.60	3.98	1.95	1.49	2.16	-0.35	3.04	0.98	3.72	2.33
1990-2004	0.96	1.52	6.26	0.83	-0.02	0.07	1.09	3.28	2.90	1.46	2.28

Source: Table 21

Chart 37: Labour Productivity Growth, Food, Beverages and Tobacco Sector, Selected OECD Countries, 1970-2004



In comparison with other countries, over the 1970-2004 period, Canada had the third slowest labour productivity growth in the food, beverage and tobacco sector of the 10 countries examined (Chart 37 and Summary Table 24).[30] Labour productivity in Canada's food, beverage and tobacco sector grew at an annual average rate of 1.80 per cent in this period, while most other countries with major food, beverage and tobacco sectors experienced greater labour productivity growth. The fastest labour productivity growth occurred in Finland (4.96 per cent per year) and the lowest rate was registered in Germany (1.55 per cent).

What conclusions can be drawn from this overview of labour productivity trends in selected OECD countries?

- In comparison with other high-income countries, labour productivity performance in Canada's food, beverage and tobacco products sector has been weak. Between 1970 and 2004, Canada ranked eighth out of 10 countries in terms of labour productivity growth.

- Internationally, the sector performed best between 1970 and 1980, after which growth dropped by about a quarter. The most recent period, 1990-2004, had much weaker growth.

[30] Japan is not included for this part of the analysis because data start only in 1973.

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