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Multinationals and Reallocation: Productivity Growth in the Canadian Manufacturing Sector

by Wulong Gu and Jiang Li

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Abstract

The paper examines the role of multinationals and reallocation in productivity growth in the Canadian manufacturing sector for the period from 2001 to 2010, a period of significant change in this sector. It finds that foreign-controlled enterprises were more important than domestically controlled enterprises in overall labour productivity growth for this period, but that their contribution declined after 2006 because of an increase in the exits of large and productive foreign-controlled firms in that period. Restructuring in the manufacturing sector intensified after 2006. During that period, there was an increase in reallocation toward enterprises that are more productive, as well as an increase in reallocation of labour toward industries that are more capital and intermediate input intensive. The effect of new enterprises displacing exiters also increased after 2006, mostly because of the increased effect of domestic entrants displacing exiters, while the effect of foreign entry and exit declined. Offsetting the positive effects of reallocation on labour productivity growth is the effect of reallocation of labour toward the firms with lower relative capital and intermediate intensities within the same industries, which contributed negatively to aggregate input deepening and aggregate labour productivity growth. Overall, the paper finds that the decline in labour productivity growth after 2006 was mostly due to a decline in labour productivity growth within domestically controlled enterprises. There were some sizeable reallocation effects, such as the negative effect of the exit of large and productive foreign-controlled enterprises, but this was offset by aspects of reallocation that had a positive impact on productivity growth.

Keywords: foreign-controlled enterprises; restructuring; productivity; manufacturing

Executive summary

Output growth in Canadian manufacturing was slower in the 2000s than in the 1990s. The sector's real output declined, in contrast to an overall increase in output in the business sector (Clarke and Couture 2017). It fell rapidly during the 2007-to-2009 financial crisis, and returned to its pre-crisis level only in 2016. The market share of foreign-controlled firms also declined after 2000 (Baldwin and Li 2017).

At issue, in this study, is the extent to which the challenges facing Canadian manufacturing in the post-2000 period have affected aggregate productivity growth and the channels through which productivity growth is impacted. In order to understand the determinants of productivity growth and develop policies that could facilitate such growth, this paper examines the role of multinationals and reallocation in productivity growth in the Canadian manufacturing sector for the period from 2001 to 2010. It examines whether the decline in labour productivity growth during the second half of the 2000s was associated with changes in the effect of reallocation and the decline in the importance of foreign multinationals.

The paper finds that the reallocation of inputs in the manufacturing sector intensified after 2006, some of which contributed positively to labour productivity growth while others contributed negatively. During that period, there was an increase in reallocation toward enterprises with higher multifactor productivity. There was also an increase in reallocation of labour toward industries that are more capital and intermediate input intensive.

The effect of reallocation of labour between firms within the same industries offset these positive effects of reallocation on aggregate labour productivity growth. There was a shift in employment toward firms with lower relative capital and intermediate intensities, which contributed negatively to aggregate input deepening and aggregate labour productivity growth.

Overall, however, the combined impact of reallocation of inputs between incumbent enterprises on labour productivity growth in manufacturing changed little before and after 2006. The decline in labour productivity growth after 2006 was due to a decline in labour productivity growth within domestically controlled enterprises; to a decline in the productivity contribution of foreign entry and exit, resulting from exits of large and productive foreign-controlled firms; and to a lesser extent, the decline in labour productivity growth within foreign-controlled firms.

Foreign-controlled enterprises were more important than domestically controlled enterprises in manufacturing labour productivity growth from 2001 to 2010, but their contribution declined after 2006. In fact, foreign-controlled firms contributed little to aggregate labour productivity growth from 2006 to 2010; the contribution of foreign-controlled incumbents was offset completely by the exit of large and productive foreign-controlled enterprises over that period.

1 Introduction

Output growth in Canadian manufacturing was slower in the 2000s than in the 1990s. The sector's real output declined, in contrast to an overall increase in output in the business sector (Clarke and Couture 2017). It fell rapidly during the 2007-to-2009 financial crisis, and returned to its pre-crisis level only in 2016. The market share of foreign-controlled firms also declined after 2000 (Baldwin and Li 2017).

At issue is the extent to which the challenges facing Canadian manufacturing in the post-2000 period affect aggregate productivity growth, and the channels through which productivity growth is impacted. To understand the determinants of productivity growth and develop policies that could facilitate such growth, numerous studies have examined the importance of foreign ownership and resource reallocation among incumbents and from entry and exit in aggregate productivity growth (for example, Baldwin and Gu 2005).[1] These studies, however, have focused mainly on the period before the most recent financial crisis.

This paper examines the role of multinationals and reallocation in productivity growth in the Canadian manufacturing sector for the period from 2001 to 2010, a period of significant change in this sector. It contributes to the literature on several fronts. First, it complements the literature by examining productivity growth at the firm level. This paper also seeks to examine whether the decline that started around 2006 was associated with changes in the effect of reallocation and the role of foreign multinationals in aggregate productivity growth.

Second, this paper distinguishes between reallocation between firms within the same industries and reallocation between industries. The reallocation between industries tends to generate more benefits for industries with comparative advantages, compared to those with comparative disadvantages (Bernard, Redding and Schott 2007). This paper takes such industry heterogeneity into account, and further decomposes the effect of reallocation on aggregate labour productivity growth into its effect on the two main components of labour productivity growth: multifactor productivity (MFP) growth and input deepening. When there is reallocation of resources toward firms that are more productive, the reallocation makes a positive contribution to MFP growth and labour productivity growth. In contrast, when there is reallocation of labour toward firms that are more capital and intermediate input intensive, the reallocation makes a positive contribution to capital and intermediate input deepening and thus to overall labour productivity growth.

Finally, this paper improves upon previous studies by using a direct measure of capital input. In most existing studies, proxies for capital stock are used due to the lack of data. These proxies range from the cost of fuel and electricity consumption and capital income to the estimates of capital derived from allocating the industry-level capital stock among firms in the industry. A direct measure of capital stock will provide a better understanding of several issues related to the source of labour productivity growth: it will allow us to better understand the role of investment and capital in labour productivity growth, and to examine the relative importance of domestic and foreign capital formation in aggregate labour productivity growth.

A direct measure of capital stock can also be used to construct an improved measure of capacity utilization and investigate its effect on productivity growth. Excess capacity is an important factor

1. Baldwin and Gu (2005) examined the role of reallocation and firm turnover in productivity growth in the total manufacturing sector. Chan, Gu and Tang (2012 and 2014) examined the role of reallocation and firm turnover in the industry with the weakest productivity growth (petroleum and coal products) and the industry with the strongest productivity growth (electronic and electrical products) to examine differences in the sources of labour productivity growth between industries.

in explaining the post-2000 slowdown in manufacturing productivity (Baldwin, Gu and Yan 2013). Conceptually, excess capacity is the ratio of capital used for production to capital available for production. The direct measure of capital stock available for production in this paper allows for an improved measure of capacity utilization.

The rest of this paper is organized as follows: Section 2 presents the empirical framework for the analysis; Section 3 describes data sources and variable construction; Section 4 presents empirical results; and Section 5 concludes the report.

2 Empirical framework

This paper follows Baldwin, Gu and Yan (2013) and extends the standard growth accounting and growth decomposition of Jorgenson, Ho and Stiroh (2005) to the analysis at the firm level. Specifically, the paper decomposes changes in labour productivity into three components: (1) within-firm growth, including the effects of scale economies, capacity utilization, technological progress, capital deepening, and intermediate input deepening; (2) between-firm reallocation effect; and (3) the effect of entry and exit. The between-firm reallocation contributes positively to aggregate labour productivity growth when there is reallocation of inputs toward firms with high relative productivity and high relative input intensities. The effect of entry and exit is positive if entrants are more productive than exiters.

This study differs from Baldwin, Gu and Yan (2013) in two aspects. First, the paper expands the analysis to more a recent period to examine whether there are changes in the effect of reallocation and multinationals on productivity growth in the manufacturing sector after 2006, when output declined. Second, this paper distinguishes between the effect of reallocation between firms within industries and the effect of reallocation between industries. The traditional trade theories focus on comparative advantages and the interindustry specialization as the main source of aggregate productivity growth and welfare improvement. The more recent trade literature emphasizes the effect of between-firm reallocation within industries as a source of productivity growth and welfare (Melitz 2003). The results in this paper provide an assessment of the role of within-industry versus between-industry reallocation in aggregate productivity growth.

Firm i is assumed to have a production function that is characterized by increasing returns to scale. Gross output Y for firm i is expressed as

$$Y_i = F_i\left(\mu_{K_i}K_i, \mu_{L_i}L_i, \mu_{M_i}M_i, T_i\right), \tag{1}$$

where K_i, L_i, and M_i denote capital, labour and intermediate inputs; μ_{K_i}, μ_{L_i}, and μ_{M_i} are unobserved utilization rates of those inputs; and T_i is a technology index.

Changes in gross output can be expressed as a weighted sum of changes in inputs, changes in utilization of inputs, and technological progress (Hall 1990; Basu and Fernald 2001):

$$\Delta \ln Y_i = \lambda_i \Delta \ln X_i + e_i \Delta \ln \mu_i + \Delta \ln T_i, \tag{2}$$

where $\Delta \ln X_i$ is the cost-weighted sum of changes in capital, labour and intermediate inputs and $\Delta \ln \mu_i$ is the cost-weighted sum of changes in the utilization of the inputs, where the cost shares

of capital, labour and intermediate inputs ($\bar{\alpha}_{Ki}$, $\bar{\alpha}_{Li}$, $\bar{\alpha}_{Mi}$) are used as weights. λ_i denotes the mark-up, which equals the return to scale if economic profit is zero under monopolistic competition. e_i denotes the effect of changes in capacity utilization on output growth.

Labour productivity growth for firm i is calculated as the difference in growth in gross output and growth in labour: $\Delta \ln LP_i = \Delta \ln Y_i - \Delta \ln L_i$. Using Equation (2), labour productivity growth for firm i can be written as

$$\Delta \ln LP_i = (\lambda_i - 1)\Delta \ln X_i + e_i \Delta \ln \mu_i + \Delta \ln T_i + \bar{\alpha}_{Ki}\Delta \ln(K_i / L_i) + \bar{\alpha}_{Mi}\Delta \ln(M_i / L_i). \quad (3)$$

Labour productivity growth in firms can be aggregated to derive aggregate labour productivity growth, which is calculated using the production possibility frontier approach (Jorgenson, Ho and Stiroh 2005). According to that approach, aggregate gross output is a Tornqvist aggregation of gross output of individual firms: $\Delta \ln Y = \sum_i \bar{w}_i \Delta \ln Y_i$ where $\bar{w}_i$ denotes two-period average share of firm i in aggregate gross output. Aggregate capital, labour and intermediate inputs (denoted by K, L and M) are the sum of capital, labour and intermediate inputs of individual firms. Implicit in the aggregation is the assumption that the prices of capital, labour and intermediate inputs are the same across firms. The growth in aggregate labour productivity is defined as the difference between growth in aggregate output and growth in aggregate labour:

$$\Delta \ln LP = \Delta \ln Y - \Delta \ln L = \sum_i \bar{w}_i \Delta \ln LP_i + (\sum_i \bar{w}_i \Delta \ln L_i - \Delta \ln L). \quad (4)$$

In Equation (4), aggregate labour productivity growth is decomposed into the effect of within-firm growth and the effect of reallocation between firms. The effect of reallocation is positive when labour shifts toward firms with high relative labour productivity.

Combining Equations (3) and (4) yields a decomposition of aggregate labour productivity growth:

$$\begin{aligned} \Delta \ln LP = {} & \sum_i \bar{w}_i (\lambda_i - 1)\Delta \ln X_i + \sum_i \bar{w}_i e_i \Delta \ln \mu_i + \sum_i e_i \Delta \ln T_i + \sum_i \bar{w}_i \bar{\alpha}_{Ki} \Delta \ln(K_i / L_i) + \sum_i \bar{w}_i \bar{\alpha}_{Mi} \Delta \ln(M_i / L_i) \\ & + \bar{\alpha}_K (\sum_i \bar{w}_{Ki} \Delta \ln K_i - \Delta \ln K) + \bar{\alpha}_M (\sum_i \bar{w}_{Mi} \Delta \ln M_i - \Delta \ln M) + \bar{\alpha}_L (\sum_i \bar{w}_{Li} \Delta \ln L_i - \Delta \ln L) \\ & + \bar{\alpha}_K [\Delta \ln(K / L) - \sum_i \bar{w}_{Ki} \Delta \ln(K_i / L_i)] + \bar{\alpha}_M [\Delta \ln(M / L) - \sum_i \bar{w}_{Mi} \Delta \ln(M_i / L_i)], \end{aligned} \quad (5)$$

where $\bar{\alpha}_K$, $\bar{\alpha}_L$ and $\bar{\alpha}_M$ are the shares of aggregate capital, labour and intermediate input costs in aggregate output averaged over two periods; and $\bar{w}_{Ki}$, $\bar{w}_{Mi}$ and $\bar{w}_{Li}$ are the shares of firm i in aggregate capital, intermediate and labour costs, averaged over two periods.

The within-firm effect (the first row) measures the direct contribution of labour productivity growth occurring at the firms that includes the effects of scale economies, variable input utilization, MFP growth, and capital and intermediate input deepening. The between-firm effect measures the effect of reallocation on MFP growth (the second row) and capital and intermediate input deepening (the third row). The effect of reallocation on MFP growth is positive when inputs shift toward firms with a higher input price or higher marginal productivity.

In order to understand the effect of reallocation on input deepening shown in the third row of Equation (5), the effect of reallocation on input deepening is rewritten as

$$\bar{\alpha}_K[\Delta\ln(K/L)-\sum_i \bar{w}_{Ki}\Delta\ln(K_i/L_i)] = \bar{\alpha}_K\sum_i(\bar{w}_{Ki}-\bar{s}_{Li})\Delta\ln L_i - \bar{\alpha}_K(\sum_i \bar{w}_{Ki}\Delta\ln K_i-\Delta\ln K)$$

and

$$\bar{\alpha}_M[\Delta\ln(M/L)-\sum_i \bar{w}_{Mi}\Delta\ln(M_i/L_i)] = \bar{\alpha}_M\sum_i(\bar{w}_{Mi}-\bar{s}_{Li})\Delta\ln L_i - \bar{\alpha}_M(\sum_i \bar{w}_{Mi}\Delta\ln M_i-\Delta\ln M), \quad (6)$$

where $\bar{s}_{Li}$ is the share of firm i in aggregate labour input. The effect of reallocation on input deepening is equal to the reallocation of labour toward firms with different capital and intermediate input intensities minus the productivity effect of changes in the composition of capital and intermediate input that is already included in the direct contribution of firms to capital and intermediate input deepening. The reallocation of labour toward firms with high relative capital and intermediate input intensities contributes positively to aggregate input deepening and aggregate labour productivity growth.

The between-firm effect in Equation (5) can be further decomposed into reallocation between firms in the same industries and reallocation between industries. For example, the effect of reallocation of capital on MFP growth can be decomposed into between-firm and between-industry effects:

$$\bar{\alpha}_K(\sum_i \bar{w}_{Ki}\Delta\ln K_i-\Delta\ln K)=\sum_j \bar{w}_j\bar{\alpha}_{Kj}\sum_i(\bar{w}_{Kij}\Delta\ln K_i-\Delta\ln K_j)+\bar{\alpha}_K(\sum_j \bar{w}_{Kj}\Delta\ln K_j-\Delta\ln K), \quad (7)$$

where $\bar{w}_j$ is the share of industry j in total manufacturing output; $\bar{\alpha}_{Kj}$ is the share of capital costs in total input costs of industry j; $\bar{w}_{Kij}$ is the share of firm i in aggregate capital costs of industry j; $\bar{w}_{Kj}$ is the share of industry j in capital costs of aggregate manufacturing sector; and K_j is capital stock in industry j. The first term captures the effect of the reallocation of capital on MFP growth between firms in the same industry, while the second term captures the effect of reallocation on MFP growth between industries.

The decomposition in Equations (5) and (7) can be extended to distinguish contributions by foreign-controlled enterprises (FCEs) and domestically controlled enterprises (DCEs) and to estimate the effect of entry and exit (Baldwin, Gu and Yan 2013). As inputs and output are only observed at the end of the period for entrants and at the start of the period for exiters, the growth rates cannot be calculated for entrants and exiters for a given period. To estimate the effect of entrants and exiters, it is assumed that a hypothetical firm exists whose initial inputs and output equal those of exiting firms at the start of the period, and whose inputs and output at the end of period equal those of entrants at the end of period. In this formulation, the contribution of entry and exit to aggregate labour productivity growth is estimated as the difference between the average labour productivity of the entry at the end of a period and that of the exit at the start of the period, multiplied by their average shares in aggregate output.[2]

2. Alternatively, the effects of entrants and exitors are estimated separately by comparing their productivity with that of average incumbents (Foster, Haltiwanger and Krizan 2001; Diewert and Fox 2005; Melitz and Polanec 2015). Baldwin and Gu (2006) show that while alternative decompositions make use of different assumptions about the displacement process, they provide similar estimates of the net effect of entry and exit.

3 Data sources and construction of variables

3.1 Data sources

The dataset for the analysis is obtained by linking Statistics Canada's Annual Survey of Manufactures (ASM) with Canada Revenue Agency's (CRA) T2 (*Corporation Income Tax Return*). The ASM provides information on output, intermediates and labour by establishment. The T2 file includes the General Index of Financial Information (GIFI) that businesses file with their tax returns. For each business in Canada identified by a business number (BN), this cross-sectional GIFI file tracks its stock of tangible assets each year starting in 2000.

The GIFI file's target population is all incorporated businesses in Canada that filed a T2 with the CRA from 2001 to 2010.[3] To construct a longitudinal file, the ASM and GIFI are linked using BNs and aggregated to the enterprise level. This is the definition of firm at which the analysis in this paper is conducted.[4] The dataset is also restricted to enterprises that report positive and non-missing data on output, payroll, intermediate inputs and tangible assets.[5]

This paper distinguishes between DCEs and FCEs. Between 2000 and 2010, an enterprise in the ASM is classified as foreign-controlled if more than 50% of voting share is held, directly or indirectly, by a foreign group or corporation, except for 2000 to 2007. For that period, effective control was used if the 50-plus-one rule could not be derived. For the analysis in this paper, country of control for a firm in a period is defined based on its country of control at the end of the period.

3.2 Variable construction

The variables for the analysis include gross output, intermediate input, labour input, capital input and the utilization of capital. Data on gross output, intermediates and employment are obtained from the ASM, while data on capital stock are obtained from the GIFI file. Gross output is the total shipments of goods of own manufacture and excludes purchases for resale or non-operating revenues. Intermediate inputs include the costs of raw materials and energy consumption, but exclude those of service inputs. Employment measures the number of workers, including production and non-production employees. The cost of labour consists of wages for production workers and salaries for non-production workers.

Capital stock is measured as the stock of tangible assets, including land and building; depletable assets; machinery; equipment; furniture and fixtures; capital lease; and other engineering or tangible capital assets. Capital income is derived residually as the difference between output and the sum of labour and intermediate input costs.

The variables in current dollars are converted to 2007 constant dollars using the industry-specific deflators from the Canadian Productivity Accounts.

Capacity utilization is commonly defined as the ratio of actual to potential output by statistical agencies; however, that measure is not the one that can be used to adjust MFP growth for

3. The year 2000 is excluded for two reasons: the switch in the ASM framework to the Business Register (BR) in 2000 introduced a change in target population; and the GIFI file for 2000 is incomplete since 2000 was the first year the file became available.
4. The linkage of the ASM to the T2 file introduces a measurement issue pertaining to the estimation of capital stock. See the Appendix for a detailed discussion.
5. The excluded observations accounted for 2.9% of total manufacturing output from 2001 to 2010.

changes in capacity utilization. The correct measure for such purposes is the ratio of capital used in production to capital available for production, which can be estimated as the ratio of ex-post to ex-ante returns to capital. This non-parametric measure was first introduced by Berndt and Fuss (1986), and further developed by Gu and Wang (2013). One of the challenges of implementing this procedure is to estimate the ex-ante return to capital since it is not observed. Assuming that the ex-ante rate of return is constant, the ratio of ex-post capital income to capital stock provides a measure of capacity utilization that will be used for adjusting MFP growth for changes in capacity utilization.

4 Empirical results

This section first examines differences between FCEs and DCEs, focusing on input structures, growth in output, inputs and productivity, rates of entry and exit, and capacity utilization. It then presents the results from estimating Equation (2) and carrying out the productivity decomposition. The results are presented for total manufacturing and for 16 manufacturing industries.

4.1 Relative performance of foreign-controlled and domestically controlled firms

Table 1 presents the average shares of FCEs and DCEs in the number of enterprises, output, labour, intermediates and capital inputs from 2001 to 2010.

The share of enterprises under foreign control was generally small in the manufacturing industries. The industries wherein FCEs accounted for over 10% of the number of firms were petroleum, coal and chemicals, primary metals, and paper.

Despite their small number, FCEs produced over one-half of gross output in six industries: paper (52.7%); petroleum, coal and chemicals (60.4%); non-metallic mineral (50.0%); primary metals (75.7%); electrical equipment (57.9%); and transportation (61.9%).

Table 1

Average shares in the number of enterprises, inputs and output, by industry and ownership, 2001 to 2010

	Share of enterprises		Share of output		Share of employment		Share of labour compensation		Share of intermediate inputs		Share of capital income	
Industry (NAICS code)	**Domestic**	**Foreign**	**Domestic**	**Foreign**	**Domestic**	**Foreign**	**Domestic**	**Foreign**	**Domestic**	**Foreign**	**Domestic**	**Foreign**
						percent						
Food, beverage and tobacco (311-312)	97.2	2.8	65.6	34.4	77.8	22.2	72.1	27.9	65.7	34.3	61.7	38.3
Textiles, clothing, leather and allied product (313-316)	98.6	1.4	86.5	13.5	90.7	9.3	88.4	11.6	87.1	12.9	78.9	21.1
Wood (321)	98.3	1.7	87.0	13.0	90.3	9.7	89.2	10.8	87.2	12.8	82.1	17.9
Paper (322)	88.7	11.3	47.3	52.7	52.2	47.8	49.3	50.7	47.7	52.3	40.2	59.8
Printing and related activities (323)	99.1	0.9	90.8	9.2	92.0	8.0	91.1	8.9	91.7	8.3	82.2	17.8
Petroleum, coal and chemicals (324-325)	86.4	13.6	39.6	60.4	49.7	50.3	44.5	55.5	39.3	60.7	50.4	49.6
Plastics and rubber products (326)	91.7	8.3	55.8	44.2	63.3	36.7	59.8	40.2	54.6	45.4	44.8	55.2
Non-metallic mineral products (327)	96.0	4.0	50.0	50.0	62.4	37.6	57.3	42.7	51.9	48.1	45.5	54.5
Primary metals (331)	87.1	12.9	24.3	75.7	33.1	66.9	29.8	70.2	22.9	77.1	22.2	77.8
Fabricated metals (332)	97.5	2.5	82.7	17.3	87.3	12.7	85.9	14.1	82.1	17.9	80.7	19.3
Machinery (333)	95.0	5.0	70.1	29.9	78.4	21.6	76.8	23.2	67.1	32.9	68.7	31.3
Computer and electronic products (334)	92.1	7.9	62.9	37.1	64.5	35.5	60.3	39.7	62.7	37.3	48.2	51.8
Electrical equipment (335)	90.7	9.3	42.1	57.9	49.7	50.3	46.1	53.9	40.7	59.3	38.6	61.4
Transportation equipment (336)	92.2	7.8	38.1	61.9	56.6	43.4	50.1	49.9	36.5	63.5	48.8	51.2
Furniture and related products (337)	99.1	0.9	82.5	17.5	85.8	14.2	85.0	15.0	82.8	17.2	77.1	22.9
Miscellaneous (339)	98.0	2.0	82.3	17.7	86.1	13.9	85.0	15.0	82.3	17.7	72.6	27.4
Manufacturing (31–33)	**96.2**	**3.8**	**53.8**	**46.2**	**71.7**	**28.3**	**65.6**	**34.4**	**51.3**	**48.7**	**50.2**	**49.8**

Note: NAICS stands for North American Industry Classification System.

Source: Statistics Canada, authors' calculations based on data from the linked Annual Survey of Manufactures–T2 file.

The industry presence of FCEs differs from that of DCEs as shown in Table 2. For DCEs, the four most important industries were food, beverage and tobacco; petroleum, coal and chemicals; fabricated metals; and transportation. Those four industries accounted for 52.7% of total output by DCEs. In contrast, FCEs were mainly located in transportation equipment, followed by petroleum, coal and chemicals; primary metals; and food, beverage and tobacco.

Table 2
Average industry shares of the aggregate output of all enterprises, and domestically controlled and foreign-controlled enterprises, 2001 to 2010

Industry (NAICS code)	All enterprises	Domestically controlled enterprises	Foreign-controlled enterprises
		percent	
Food, beverage and tobacco (311-312)	14.4	17.5	10.8
Textiles, clothing, leather and allied product (313-316)	2.1	3.4	0.6
Wood (321)	4.2	6.9	1.2
Paper (322)	5.9	5.2	6.7
Printing and related activities (323)	2.1	3.6	0.4
Petroleum, coal and chemicals (324-325)	16.2	11.9	21.2
Plastics and rubber products (326)	4.3	4.5	4.2
Non-metallic mineral products (327)	2.4	2.2	2.6
Primary metals (331)	7.4	3.3	12.1
Fabricated metals (332)	5.5	8.5	2.0
Machinery (333)	5.1	6.7	3.3
Computer and electronic products (334)	3.5	4.1	2.8
Electrical equipment (335)	1.9	1.4	2.3
Transportation equipment (336)	21.0	14.8	28.2
Furniture and related products (337)	2.3	3.6	0.9
Miscellaneous (339)	1.6	2.5	0.6
Manufacturing (31–33)	**100**	**100**	**100**

Notes: NAICS stands for North American Industry Classification System. Percentages may not add up to 100% because of rounding.
Source: Statistics Canada, authors' calculations based on data from the linked Annual Survey of Manufactures–T2 file.

4.1.1 Cost shares of capital, labour and intermediate inputs

Table 3 presents the cost shares of capital, labour and intermediate inputs by industry and by ownership, averaged over the period from 2001 to 2010. The largest component of input costs was intermediate inputs for all manufacturing industries, followed by capital and labour. For total manufacturing, the cost of intermediate inputs accounted for 62.2% of total costs, compared with 23.3% for capital and 14.5% for labour.

Table 3
Average cost shares of labour, intermediate inputs and capital, by industry and by ownership, 2001 to 2010

	All enterprises			Domestically controlled enterprises			Foreign-controlled enterprises		
Industry (NAICS code)	**Labour**	**Intermediates**	**Capital**	**Labour**	**Intermediates**	**Capital**	**Labour**	**Intermediates**	**Capital**
					percent				
Food, beverage and tobacco (311-312)	11.2	63.9	24.9	12.3	64.0	23.7	9.1	63.5	27.4
Textiles, clothing, leather and allied product (313-316)	26.0	49.8	24.2	26.5	50.2	23.3	22.3	47.5	30.3
Wood (321)	17.7	59.9	22.3	18.2	60.1	21.7	14.7	58.8	26.5
Paper (322)	15.1	60.2	24.7	15.8	60.7	23.5	14.5	59.7	25.8
Printing and related activities (323)	28.0	42.4	29.5	28.1	42.8	29.0	27.6	38.4	34.1
Petroleum, coal and chemicals (324-325)	6.0	74.4	19.6	6.9	73.7	19.4	5.6	74.6	19.8
Plastics and rubber products (326)	19.6	55.8	24.6	21.0	54.6	24.4	17.8	57.3	24.9
Non-metallic mineral products (327)	18.0	49.4	32.7	20.7	51.3	28.1	15.3	47.4	37.3
Primary metals (331)	11.2	63.3	25.5	13.8	59.6	26.6	10.4	64.5	25.1
Fabricated metals (332)	25.8	50.3	24.0	26.8	49.9	23.3	21.1	51.8	27.2
Machinery (333)	24.5	51.0	24.5	26.9	48.8	24.3	19.1	56.0	24.9
Computer and electronic products (334)	22.5	50.3	27.2	21.6	50.2	28.2	24.0	50.4	25.5
Electrical equipment (335)	20.6	55.4	24.0	22.6	53.6	23.9	19.2	56.8	24.0
Transportation equipment (336)	10.6	69.5	19.9	13.9	66.8	19.4	8.5	71.5	20.0
Furniture and related products (337)	26.5	48.0	25.5	27.3	48.2	24.4	22.5	47.1	30.4
Miscellaneous (339)	25.3	49.3	25.4	26.2	49.4	24.4	21.6	47.1	31.3
Manufacturing (31–33)	**14.5**	**62.2**	**23.3**	**17.7**	**59.3**	**23.0**	**10.8**	**65.7**	**23.5**

Note: NAICS stands for North American Industry Classification System. The cost shares for labour, intermediates and capital may not add up to 100% because of rounding.

Source: Statistics Canada, authors' calculations based on data from the linked Annual Survey of Manufactures–T2 file.

The composition of input costs differs between DCEs and FCEs. Compared with DCEs, FCEs use more intermediate input and less labour. The share of capital costs was comparable between FCEs and DCEs. The ratios of capital and intermediates to labour were much higher for FCEs, suggesting that FCEs have higher capital and intermediate input intensities than DCEs.

4.1.2 Growth in output, inputs and labour productivity

Table 4 summarizes the average rates of growth in output, inputs and labour productivity. From 2001 to 2010, gross output, capital, labour and intermediate inputs declined in almost all manufacturing industries. Labour productivity increased in most manufacturing industries as the decline in labour input is faster than the decline in gross output.

Table 4
Average annual growth in inputs, output and labour productivity, by industry and by ownership, 2001 to 2010

	All enterprises					Domestically controlled enterprises					Foreign-controlled enterprises				
Industry (NAICS code)	**Y**	**L**	**M**	**K**	**LP**	**Y**	**L**	**M**	**K**	**LP**	**Y**	**L**	**M**	**K**	**LP**
								percent							
Food, beverage and tobacco (311-312)	1.9	1.0	2.3	3.4	0.9	2.3	1.2	2.6	2.3	1.0	1.3	0.3	1.7	5.2	0.9
Textiles, clothing, leather and allied product (313-316)	-11.6	-13.7	-10.5	-7.8	2.1	-11.5	-13.5	-10.4	-8.1	2.0	-12.7	-16.1	-11.6	-6.7	3.5
Wood (321)	-1.5	-2.9	-3.1	0.8	1.5	-1.7	-2.9	-3.3	0.4	1.2	0.2	-3.1	-1.5	2.7	3.3
Paper (322)	-4.7	-6.7	-4.6	-4.0	2.0	-4.6	-5.9	-4.6	-4.5	1.3	-4.8	-7.5	-4.6	-3.7	2.7
Printing and related activities (323)	-3.9	-4.6	-4.1	0.3	0.7	-3.8	-4.4	-4.0	-0.6	0.7	-4.7	-6.4	-5.2	5.4	1.6
Petroleum, coal and chemicals (324-325)	-1.1	-0.8	-0.7	-4.6	-0.3	0.1	0.8	0.3	-11.0	-0.7	-2.0	-2.4	-1.5	0.4	0.4
Plastics and rubber products (326)	-1.5	-2.3	-0.9	1.0	0.8	-0.9	-1.8	-0.2	1.1	1.0	-2.3	-3.3	-1.7	0.9	1.0
Non-metallic mineral products (327)	0.5	-0.5	2.0	3.1	1.0	2.6	0.6	4.8	3.0	2.0	-1.4	-2.1	-0.6	3.2	0.7
Primary metals (331)	-2.4	-4.5	-2.8	1.3	2.1	-5.1	-5.9	-4.7	-0.2	0.8	-1.6	-3.8	-2.3	1.7	2.2
Fabricated metals (332)	-2.1	-2.0	-1.4	-0.4	-0.1	-1.4	-1.6	-0.4	1.0	0.2	-5.4	-4.9	-5.6	-5.6	-0.5
Machinery (333)	-0.8	-1.5	0.6	1.9	0.7	1.2	-0.4	2.9	2.8	1.6	-5.3	-5.7	-3.7	-0.2	0.4
Computer and electronic products (334)	-2.6	-2.3	-2.4	-3.8	-0.3	-3.2	-2.0	-4.0	-5.4	-1.2	-1.5	-3.0	0.6	-2.1	1.5
Electrical equipment (335)	-4.5	-3.6	-4.0	-1.9	-1.0	-0.8	-1.9	0.3	-1.8	1.1	-7.0	-5.2	-6.6	-1.9	-1.8
Transportation equipment (336)	-1.9	-3.6	-1.6	-2.6	1.8	-0.3	-3.0	-0.9	-3.7	2.7	-2.9	-4.5	-2.0	-1.9	1.7
Furniture and related products (337)	-5.0	-4.2	-3.5	-0.2	-0.7	-3.4	-2.6	-2.0	1.1	-0.8	-13.0	-14.5	-11.6	-6.1	1.5
Miscellaneous (339)	1.1	-0.8	4.9	2.1	1.8	2.2	-0.5	7.1	1.0	2.7	-3.8	-2.1	-5.3	3.7	-1.7
Manufacturing (31–33)	**-1.6**	**-2.9**	**-1.2**	**-0.9**	**1.2**	**-1.0**	**-2.4**	**-0.6**	**-2.6**	**1.4**	**-2.4**	**-4.2**	**-1.8**	**0.5**	**1.7**

Note: NAICS stands for North American Industry Classification System. Y denotes gross output. L, M and K denote labour, intermediate inputs and capital. LP denotes labour productivity defined as gross output per worker.

Source: Statistics Canada, authors' calculations based on data from the linked Annual Survey of Manufactures–T2 file.

Output, labour and intermediate inputs declined for both DCEs and FCEs from 2001 to 2010. The decline was much faster for FCEs than for DCEs. As a result, the share of FCEs in gross output and labour declined over that period.

Capital stock increased for FCEs while it declined for DCEs. The large increase in capital stock in the FCEs occurred in food, beverage and tobacco; printing; non-metallic mineral products; and miscellaneous industries. The large decline in capital stock in DCEs occurred in textiles, clothing, leather and allied products; paper; petroleum, coal and chemicals; computer and electronic products; and transportation equipment.

Labour productivity increased for both FCEs and DCEs over the period. The increase was faster for FCEs: it increased 1.7% per year for FCEs, compared with 1.4% per year in DCEs.

4.1.3 Capacity utilization

Table 5 summarizes average annual changes in capacity utilization. For total manufacturing, capacity utilization declined 2.0% per year, a result of the 4.6% decline in the foreign-controlled sector and the 0.5% increase in their domestically controlled sector.

Table 5
Average annual growth in capacity utilization, by industry and by ownership, 2001 to 2010

	All enterprises	Domestically controlled enterprises	Foreign-controlled enterprises
		percent	
Industry (NAICS code)			
Food, beverage and tobacco (311-312)	-1.2	0.0	-2.9
Textiles, clothing, leather and allied product (313-316)	-5.9	-5.7	-6.6
Wood (321)	-5.8	-5.9	-5.1
Paper (322)	-3.9	-3.7	-4.1
Printing and related activities (323)	-2.8	-1.9	-8.9
Petroleum, coal and chemicals (324-325)	4.1	12.5	-2.2
Plastics and rubber products (326)	-3.5	-3.3	-3.8
Non-metallic mineral products (327)	-2.5	-1.3	-3.4
Primary metals (331)	-0.2	-3.2	1.0
Fabricated metals (332)	-2.2	-3.0	1.2
Machinery (333)	-4.9	-3.5	-8.4
Computer and electronic products (334)	-1.1	1.4	-4.6
Electrical equipment (335)	-3.5	-0.5	-5.4
Transportation equipment (336)	-3.1	2.5	-6.2
Furniture and related products (337)	-6.2	-5.9	-7.1
Miscellaneous (339)	-3.8	-3.1	-3.5
Average annual growth, manufacturing			
2001 to 2006	-2.4	-1.0	-3.9
2006 to 2010	-1.6	2.5	-5.5
2001 to 2010	-2.0	0.5	-4.6

Note: The top panel presents average growth in capacity utilization at the detailed industry level from 2001 to 2010. The bottom panel presents the growth in various periods for the total manufacturing sector.
Source: Statistics Canada, authors' calculations based on data from the linked Annual Survey of Manufactures–T2 file.

The deterioration in capacity was much larger over the period from 2001 to 2006, when capacity utilization declined in both FCEs and DCEs. This occurred as a result of the early-2000 recession in the U.S. market and the appreciation of the Canadian dollar during that period. Capacity

utilization in DCEs has since recovered, while the FCEs continued to experience a decline in capacity utilization in the period from 2006 to 2010.

4.1.4 Entry and exit rates

Tables 6 and 7 summarize firm dynamics and the performance of entering and exiting enterprises relative to incumbents in total manufacturing sector for the period from 2001 to 2010 and for two sub-periods: 2001 to 2006 and 2006 to 2010.[6]

From 2001 to 2010, exit rates were generally higher than entry rates in both DCEs and FCEs (Table 6). Historically, the entry and exit rates were comparable in manufacturing industries (Baldwin and Gu 2006). The low entry rates relative to exit rates in recent years may suggest a decline in the rate of innovation and knowledge-based capital that, potentially, could be gained via new ideas of entrants (OECD 2015).

Table 6
Accumulative share of entrants and exiters and their relative labour productivity, 2001 to 2010

Ownership	Number of enterprises	Share of enterprises	Share of gross output	Share of employment	Share of capital stock	Relative labour productivity
	number			percent		
Domestic						
Continuers	24,250	…	…	…	…	…
Entrants	10,280	29.8	19.5	21.4	18.9	0.91
Exiters	19,985	45.2	30.0	33.9	35.5	0.88
Foreign						
Continuers	958	…	…	…	…	…
Entrants	398	29.4	16.4	19.1	14.7	0.86
Exiters	766	44.4	22.8	28.4	17.6	0.80

… not applicable

Note: The share attributable to entrants is calculated as the contribution of entrants divided by the sum of the contributions from entrants and continuers. The share attributable to exiters is calculated as the contribution of exiters divided by the sum of the contributions from exiters and continuers.

Source: Statistics Canada, authors' calculations based on data from the linked Annual Survey of Manufactures–T2 file.

Entry and exit rates were generally lower in the foreign-controlled sector than in the domestically controlled sector. The shares of entrants and exiters in the number of firms, output and inputs were lower in the foreign-controlled sector than those in their domestically controlled sector. Over the 2001-to-2010 period, entrants and exiters are less productive than incumbents. Entrants tend to be more productive than exiters.

Table 7 shows that entry and exit rates increased after 2006 with the exception of the exit rates for DCEs. Moreover, entrants and exiters were larger and more productive for 2006 to 2010, compared with entrants and exiters in 2001 to 2006. The increases were more pronounced among foreign entrants and exiters. Foreign entrants and exiters were considerably less productive than foreign incumbents in 2001 to 2006, and they were more productive than or as productive as foreign incumbents in 2006 to 2010.

6. To be more comparable to Tables 9 and 10, Tables 6 and 7 differ slightly from the same tables in Gu and Li (2017). The shares in the tables in this paper are based on output and capital stock in constant dollars, and are constructed at the NAICS 3 digit industry level and then aggregated to the total manufacturing sector. The shares in Gu and Li (2017) are based on output and capital in nominal dollars, and are constructed at the total manufacturing sector level.

Table 7
Annualized accumulative share of entrants and exiters and their relative labour productivity, 2001 to 2006 and 2006 to 2010

Ownership	Share of enterprises	Share of gross output	Share of employment	Share of capital stock	Relative labour productivity
			percent		
2001 to 2006					
Domestic					
Entrants	4.5	3.0	3.2	2.5	0.95
Exiters	7.0	4.6	4.9	4.4	0.94
Foreign					
Entrants	4.0	1.6	2.2	1.2	0.70
Exiters	5.6	2.5	3.4	2.7	0.72
2006 to 2010					
Domestic					
Entrants	4.8	4.4	4.0	3.5	1.09
Exiters	6.3	4.9	5.2	5.6	0.94
Foreign					
Entrants	4.5	4.2	4.0	3.6	1.03
Exiters	7.1	5.2	4.8	2.0	1.09

Source: Statistics Canada, authors' calculations based on data from the linked Annual Survey of Manufactures–T2 file.

4.2 Parameterization

This section estimates the scale economies and the effect of capital utilization that are required for the decomposition.[7] The estimation equation is

$$\Delta \ln Y_i = \lambda \Delta \ln X_i + e \Delta \ln \mu_i + \varepsilon_i . \quad (8)$$

A sample of continuing enterprises, from 2001 to 2010, using both OLS and quantile regressions, is used to estimate Equation (8). The OLS estimation assumes that the error term ε_i is normally distributed. However, the distribution of the growth rates of output and inputs differ from the normal distribution, as it has heavier tails and likely follows a Laplace distribution.

Consequently, the quantile regression was selected as the preferred method. Quantile estimators are appropriate when there are Laplace errors arising from asymmetric distribution with heavy tails and the estimators are also robust to outliers. Industry-fixed effects are included to control for the differences in productivity growth across industries.

To examine the difference in the productivity contribution of FCEs and DCEs, the equation will be estimated separately for domestically controlled and foreign-controlled continuers. Three sets of estimates are presented in Table 8: one for all enterprises, one for DCEs, and one for FCEs.

7. Alternatively, the inverse of Equation (2), which expresses the growth in combined inputs as a function of growth in output, is estimated. The estimates are similar.

Table 8
Estimation of scale economies and the effect of capacity utilization

	All enterprises		Domestically controlled enterprises		Foreign-controlled enterprises	
	OLS	Quantile	OLS	Quantile	OLS	Quantile
$\Delta \ln X$						
Coefficient	0.988 **	0.995 **	0.989 **	0.995 **	0.973 **	0.990 **
Standard error	0.004	0.002	0.004	0.002	0.018	0.008
$\Delta \ln CU$						
Coefficient	0.243 **	0.235 **	0.243 **	0.234 **	0.248 **	0.259 **
Standard error	0.002	0.002	0.002	0.002	0.011	0.007
H_0: Returns to Scale =1						
Test statistics	10.895	4.557	9.057	4.344	2.371	1.528
p-value	0.001	0.033	0.003	0.037	0.124	0.217
Number of observations	21,254	21,254	20,424	20,424	830	830
Adjusted *R* squared / Pseudo *R* squared	0.947	0.791	0.947	0.790	0.951	0.803

** significantly different from reference category (p < 0.01)

Note: OLS denotes ordinary least squares. The sample includes continuing enterprises in 2001 to 2010. Regressions are run on first differences over the 9-year period. Quantile regressions are for the 50th percentile. Standard errors are bootstrapped using 500 iterations. A constant and industry fixed effects are not reported.

Source: Statistics Canada, authors' calculations based on data from the linked Annual Survey of Manufactures–T2 file.

The estimated coefficients of the input and capacity utilization variables are positive and statistically significant. The estimate from quantile regression, however, differ from the OLS estimates. The following discussion focuses on the estimates from quantile regression, which are more robust to outliers and more appropriate when errors are Laplace.

4.2.1 Returns to scale

In all three sets of regressions, the estimated cost-weighted input coefficient variable, $\Delta \ln X$, is close to one. The null hypothesis of constant return to scale cannot be rejected at the 1% level, suggesting that the production process in the manufacturing sector is best characterized as constant returns to scale. This also holds true for DCEs and FCEs. The estimates on return to scale are consistent with Baldwin, Gu and Yan (2013), who use different measures of output and capital stock.[8]

4.2.2 Effects of capacity utilization

The estimated coefficient of capacity utilization is 0.235, using all continuing enterprises. A 1% increase in capacity utilization is associated with about one-quarter of a percent increase in gross output and productivity. Consequently, the decline observed in capacity utilization post-2001 contributed to a decline in gross output and productivity over the period.

The estimated coefficients of capacity utilization are found to be larger for FCEs than for DCEs. As capacity utilization improves in an economic boom, *ceteris paribus*, FCEs translate such improvement into a greater increase in production than DCEs. As multinationals are highly integrated into the global value chain, they benefit from their global connections with suppliers and customers, comparative advantages in host countries, and lower trade barriers (OECD 2015). As a result of this integration, economic conditions may have a magnified impact on the production of multinationals compared with companies operating locally.

8. Baldwin, Gu and Yan (2013) use value added as output measure rather than gross output. A value-added framework tends to produce higher returns to scale than a gross-output framework. See, for example, Basu and Fernald (1997) and Diewert and Fox (2008).

4.3 Decomposition results

This section examines the sources of aggregate productivity growth in Canadian manufacturing using the decomposition outlined in Equations (5) and (7). It begins by looking at the period from 2001 to 2010, which is then divided it into two periods (2001 to 2006 and 2006 to 2010) to examine whether changes occurred in the sources of productivity growth after 2006.

4.3.1 Sources of labour productivity growth from 2001 to 2010

The second column in Table 9 presents the decomposition results from 2001 to 2010. Over that period, aggregate labour productivity rose 1.4% per year. Productivity growth that took place within firms accounted for 1.1 percentage points or about 80% of aggregate labour productivity growth. The effect of reallocation among incumbents and from net entry contributed to 0.2 percentage point or 20% of the aggregate labour productivity growth.

Table 9
Decomposition of average annual aggregate labour productivity growth

	All enterprises		
	2001 to 2010	2001 to 2006	2006 to 2010
	percent		
Within-enterprise growth	**1.1**	**1.9**	**0.4**
Scale economies	0.0	0.0	0.0
Capacity utilization	-0.2	-0.4	-0.5
MFP growth	0.1	0.2	0.0
Capital deepening on labour productivity	0.4	0.4	0.6
Intermediates deepening on labour productivity	0.8	1.7	0.3
Between-enterprise reallocation	**0.2**	**0.1**	**0.2**
Reallocation on MFP within industries	**0.2**	**-0.1**	**0.6**
Capital	0.0	-0.2	0.6
Labour	0.0	0.0	0.0
Intermediates	0.2	0.1	0.1
Reallocation on input deepening within industries	**-0.3**	**0.2**	**-1.5**
Capital	-0.1	0.3	-0.7
Intermediates	-0.3	-0.1	-0.8
Reallocation on MFP across industries	**0.0**	**0.3**	**0.0**
Capital	0.0	0.1	0.0
Labour	0.0	0.0	0.0
Intermediates	0.0	0.2	0.0
Reallocation on input deepening across industries	**0.3**	**-0.3**	**1.1**
Capital	0.1	-0.1	0.2
Intermediates	0.2	-0.2	0.9
Net entry	**0.1**	**0.0**	**0.1**
Average annual aggregate labour productivity growth	**1.4**	**2.0**	**0.7**

Note: MFP stands for multifactor productivity.
Source: Statistics Canada, authors' calculations based on data from the linked Annual Survey of Manufactures–T2 file.

Labour productivity growth within firms is mostly due to the effect of capital and intermediate input deepening. There is little MFP growth among firms. The decline in capacity utilization led to a 0.2 percentage point decline in aggregate labour productivity growth.

The effect of reallocation between incumbents contributed 0.2 percentage point to aggregate labour productivity growth. This was mostly a result of the positive effect of the reallocation of labour between industries on aggregate capital and intermediate input deepening, which contributed 0.3 percentage point to aggregate labour productivity growth. In contrast, the reallocation of labour between firms within the same industries lowered aggregate input deepening and contributed negatively to aggregate labour productivity growth. The results

suggest that the reallocation of labour between industries differs from the reallocation of labour between firms within the same industries. Employment shifted toward industries with high relative capital and intermediate input intensities, while employment within the same industries shifted toward firms with lower relative capital and intermediate input intensities.

The effect of net entry contributed 0.1 percentage point or about 10% of aggregate labour productivity growth from 2001 to 2010. The positive contribution is a result of the relatively high productivity of entrants compared to that of exiters during that period (Table 6).

4.3.2 Sources of labour productivity growth from 2001 to 2006 and from 2006 to 2010

Decomposition results are presented for two periods (2001 to 2006 and 2006 to 2010) in the last two columns of Table 9 to examine the changes between the two periods. Real output in Canadian manufacturing started to decline in 2006. The period from 2006 to 2010 is also characterized by the incidence of the financial crisis, a decline in output, and a decline in labour productivity growth in the manufacturing sector. Labour productivity growth declined from 2.0% per year from 2001 to 2006 to 0.7% per year from 2006 to 2010 in the aggregate manufacturing sector, which represents a 1.3-percentage-point decline between those two periods.

The decline in labour productivity growth after 2006 resulted from the decline in productivity growth within enterprises. The contribution of labour productivity growth within the firms declined from 1.9 percentage points per year from 2001 to 2006 to 0.4 percentage point per year from 2006 to 2010. That decline contributed 1.5 percentage points to the overall decline in aggregate labour productivity growth between the two periods.

The effect of reallocation on aggregate labour productivity growth increased after 2006. The effect of reallocation across firms increased from 0.1 percentage point to 0.2 percentage point after 2006, and the effect of entry and exit increased by 0.1 percentage point after 2006.

Restructuring and reallocation in the manufacturing sector intensified after 2006, some of which contributed positively to labour productivity growth while others contributed negatively to labour productivity growth.

From 2006 to 2010, there was an increase in reallocation toward enterprises that are more productive and an increase in reallocation of labour toward industries that are more capital and intermediate input intensive, which contributed positively to aggregate labour productivity growth through their positive effects on MFP growth and input deepening. The decomposition results in Table 9 show that the reallocation of capital toward firms that are more productive contributed 0.6 percentage point per year to aggregate labour productivity growth from 2006 to 2010. The reallocation of labour toward industries that are more capital and intermediate input intensive contributed 1.1 percentage points to aggregate input deepening effect and aggregate labour productivity growth.[9] The effect of new enterprises displacing exiters also increased after 2006.

Offsetting the positive effects of reallocation is the effect of reallocation of labour between firms within the same industries. There was reallocation of labour toward firms with lower relative capital and intermediate input intensities, which contributed -1.5 percentage points to the aggregate input deepening effect and to aggregate labour productivity growth.

9. The effect of reallocation of labour toward industries with high relative capital and intermediate input intensities equals the effect of reallocation on input deepening plus the effect of compositional changes of capital and intermediate inputs (Equation 6).

4.3.3 Contribution of foreign-controlled and domestically controlled firms to labour productivity growth

Table 10 presents the contribution of foreign-controlled and DCEs to aggregate labour productivity growth. This paper will examine the direct contribution and the effect of net entry and will not decompose the reallocation effect among incumbents into the contributions of different types of firms as such decomposition relies on strong assumptions of the reallocation process (Baldwin 1995; Reinsdorf 2015).

Table 10
Direct contribution of domestically controlled and foreign-controlled enterprises to aggregate labour productivity growth

	Domestically controlled enterprises			Foreign-controlled enterprises		
	2001 to 2010	2001 to 2006	2006 to 2010	2001 to 2010	2001 to 2006	2006 to 2010
			percent			
Within-enterprise growth	**0.4**	**1.1**	**-0.1**	**0.6**	**0.8**	**0.5**
Scale economies	0.0	0.0	0.0	0.0	0.0	0.0
Capacity utilization	0.0	-0.2	-0.1	-0.3	-0.2	-0.4
Multifactor productivity growth	0.0	0.3	-0.2	0.1	-0.1	0.2
Capital deepening	0.1	0.2	0.2	0.3	0.3	0.4
Intermediates deepening	0.3	0.9	0.0	0.5	0.8	0.3
Net entry	**0.0**	**-0.1**	**0.6**	**0.1**	**0.0**	**-0.5**
Total direct contribution	**0.5**	**1.0**	**0.5**	**0.7**	**0.9**	**0.0**

Source: Statistics Canada, authors' calculations based on data from the linked Annual Survey of Manufactures–T2 file.

FCEs were more important than DCEs in overall labour productivity growth from 2001 to 2010. For that period, FCEs contributed 0.7 percentage point per year to overall labour productivity growth while DCEs contributed 0.5 percentage point per year to overall labour productivity growth.

The contribution of both FCEs and DCEs declined after 2006; however, the decline was larger for FCEs. As a result, the contribution of FCEs to aggregate labour productivity growth was smaller than the contribution of DCEs after 2006. In fact, FCEs contributed little to aggregate labour productivity growth from 2006 to 2010. The large decline in the productivity contribution of FCEs after 2006 was a result of a decline in the contribution of foreign entry and exit in that period. Entry and exit of FCEs reduced aggregate labour productivity growth by 0.5 percentage point from 2006 to 2010. The negative contribution of foreign entry and exit during that period was due to an increase in the exits of relatively large and productive FCEs, compared with foreign-controlled entrants in individual manufacturing industries in that period.

Future research should focus on the factors explaining the decline in the contribution of foreign-controlled firms to productivity and output in Canadian manufacturing. The potential factors affecting the decision of multinationals to locate in Canada include labour costs, business environment, human capital endowment and trade barriers (Wang 2014).

5 Conclusions

This paper examines the role of multinationals and reallocation in productivity growth in the Canadian manufacturing sector for the period from 2001 to 2010, a period of significant change in this sector. The paper finds that foreign-controlled enterprises (FCEs) were more important than domestically controlled enterprises (DCEs) in overall labour productivity growth from 2001 to 2010. The contribution of both FCEs and DCEs declined after 2006; however, the decline was larger for foreign-controlled firms than for domestically controlled firms. In fact, foreign-controlled firms contributed little to aggregate labour productivity growth from 2006 to 2010. The large decline in the productivity contribution of foreign-controlled firms after 2006 was the result of a decline in the contribution of foreign entry and exit during that period.

The reallocation in the manufacturing sector intensified after 2006, some of which contributed positively to labour productivity growth, while others contributed to it negatively. During that period, there was an increase in reallocation toward enterprises that are more productive; there was also an increase in reallocation of labour toward industries that are more capital and intermediate input intensive, which contributed positively to aggregate labour productivity growth via their positive effects on multifactor productivity growth and input deepening. The effect of new enterprises displacing exiters also increased after 2006, mostly due to the increase in the effect of domestic entrants displacing exiters, while the effect of foreign entry and exit declined.

The effect of reallocation of labour between firms within the same industries offset the positive effects of reallocation. There was a shift in employment toward the firms with lower relative capital and intermediate intensities, which contributed negatively to aggregate input deepening and aggregate labour productivity growth.

Overall, the paper found that the decline in labour productivity growth in the manufacturing sector, was mostly due to a decline in labour productivity growth within DCEs after 2006. There were some notable reallocation effects, such as the decline in the productivity contribution of foreign entry and exit as a result of exits of large and productive FCEs. However, this negative impact was offset by other aspects of reallocation that had a positive effect on productivity growth.

6 Appendix

Linking the ASM to the T2 file

The linkage of the Annual Survey of Manufacturers (ASM) file to the T2 file introduces a measurement issue, which has been addressed for the analysis in the paper.

The issue is related to the estimate of capital stock. Each business files one tax return. When a business has a complex structure, including multiple plants in and outside of manufacturing, the data in the tax return is not specific to a particular plant. This implies that tangible assets reported by a complex business consist of capital from multiple activities—manufacturing and non-manufacturing. To estimate capital stock for manufacturing plants, the ratio of manufacturing output from the ASM to total sales from the General Index of Financial Information (GIFI) is used to proportionate tangible assets reported by business number (BN) in the GIFI.

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