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Why Are Multinationals More Productive than Non-multinationals? Evidence from Canada

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Abstract

Using a rich micro dataset of all business industries from 2000 to 2014, this paper shows that, in Canada, multinationals are about 23% more productive than non-multinationals, and that Canadian multinationals are as productive as foreign multinationals. The productivity advantage of multinationals is largely due to the selection effect (e.g., their characteristics and actions before becoming a multinational) and, to a lesser extent, the learning effect (e.g., actions or benefits that occur after becoming a multinational). In addition, new multinationals are less productive than old multinationals, and there is a long learning process for firms to capture the full benefits of multinationality. Furthermore, the productivity advantage of multinationals is largely due to multinationals having conscious selection behaviour in investments and the ability to generate higher productivity dividends from investments in research and development than non-multinationals.

Keywords: multinationals, productivity, selection effect, learning effect, Canada

Executive summary

Multinationals (i.e., firms that have established affiliates or subsidiaries in other countries) have played an increasingly important role in many economies. In Canada, multinationals accounted for only 0.8% of all enterprises in 2016, but they held 67% of all assets in the Canadian economy (Schaffter and Fortier-Labonté 2019). Given the importance of multinationals to the Canadian economy, it is essential for policy makers to understand the economic performance and productivity advantage of multinationals operating in Canada.

To address policy-relevant research questions, a rich micro dataset covering all industries from 2000 to 2014 has been constructed for this study, using several administrative microdata files at Statistics Canada. This dataset is used to delve deeper into and estimate the productivity advantage of multinationals, including the selection and learning effects associated with multinationality. In addition, this study investigates whether and how research and development (R&D) investment contributes to the superior productivity performance of multinationals.

This study shows that (1) Canadian multinationals are as productive as foreign multinationals; (2) multinationals are, on average, about 23% more productive than non-multinationals; and (3) the productivity advantage of multinationals is larger in service industries than in goods-producing industries.

The productivity advantage of multinationals can be ex-ante or ex-post. The literature on foreign direct investment suggests that firms must possess firm-specific advantages to operate in a foreign environment, since businesses may incur additional costs from new markets, differences in cultural norms, less association with the local community and management challenges related to the greater distances between locations. As a result, only the most productive firms are able to overcome these "foreignness" factors and afford to operate profitably in foreign markets. The ex-ante productivity advantage is called the "selection effect."

Firms can also learn and improve their productivity after becoming multinationals through foreign operation—this is called the "learning effect". First, multinationals can achieve economies of scale by going beyond the domestic market. Ideas, management practices or technologies developed by foreign companies may be used freely by their affiliates in Canada. Second, the strategies of firms operating in different international markets often provide more flexible production structures that can better handle both supply and demand shocks, adding to the firms' competitive advantage. Third, the presence of physical operations in a foreign market allows firms to improve their knowledge of local business opportunities, which provides them with access and the opportunity to subsequently transfer location-specific knowledge, or even the host country's advanced technologies and resources (e.g., capital and skilled labour). Finally, firms that are exposed to international markets face vigorous global competition with the highest-performing companies. This enforces product market competition, reduces managerial slack, and generates incentives to improve efficiency through product, process or organizational innovation.

This study shows that the productivity advantage of multinationals is dominated by the selection effect. Multinationals are 19% more productive than non-multinationals before they become multinationals and 23% more productive after. The 4-percentage-point difference represents the scale of the learning effect.

This study looks into why multinationals are more productive than non-multinationals. A popular explanation is that multinationals have advanced firm-specific technologies. R&D efforts represent a key strategy for firms to develop firm-specific advantages. In addition to innovative products, services and production processes, firm advantages also include the development of intellectual property, which gives firms an edge in both their home and host markets. R&D efforts also enhance a firm's absorptive capacity. It improves the ability of the firm to learn from both

domestic and foreign markets. A vast amount of the empirical literature has shown that investments in R&D contribute to productivity performance. Multinationals are found to be more R&D-intensive than non-multinationals, especially before they become multinationals. In addition, firms may differ in how they exploit R&D efforts to improve productivity. There are many reasons for which multinational firms are expected to be able to better exploit their R&D investments and thus generate higher productivity from those investments than non-multinationals. Multinationals may be able to generate more R&D returns because of flexible production structures across countries, larger product markets, and access to foreign advanced technologies and resources, or because of superior managerial skills and strategic thinking.

This study finds that the productivity advantage of multinationals can largely be explained by their R&D efforts. Specifically, R&D effects explain all of the selection effect and a large proportion of the learning effect.

1 Introduction

Multinationals have played an increasingly important role in many economies, including in Canada. According to Schaffter and Fortier-Labonté (2019), multinationals accounted for only 0.8% of all enterprises operating in Canada in 2016, but they held 67% of all assets in the Canadian economy. Therefore, it is important for policy makers to understand the economic and productivity performance of multinationals operating in Canada relative to Canadian domestic firms.

Baldwin and Gu (2005) compared the productivity performance of multinationals in Canada. They singled out both Canadian-controlled and foreign-controlled multinationals operating in Canada, and showed that while foreign-controlled plants were more productive than domestic-controlled plants, they did not perform significantly better than Canadian-controlled multinationals. In other words, the productivity advantage for foreign-controlled plants is a multinational enterprise advantage. However, their study has limitations: the main data are from Statistics Canada's 1993 Survey of Innovation and Advanced Technology; the sample is old and small (about 4,000 observations) and covers only the manufacturing sector.

Other studies on multinationals in Canada include those by Globerman, Ries and Vertinsky (1994) and Gu and Li (2017).[1] Because of data limitations, Canadian-controlled multinationals could not be separated from Canadian non-multinationals in these studies. Consequently, the results represent the productivity performance of foreign-controlled multinationals relative to both Canadian-controlled multinationals and non-multinationals. This may cause the performance differential between multinationals and non-multinationals to be understated.

This current study uses Canadian data to provide an in-depth analysis of the productivity performance of multinationals. In particular, the causal effects of investing abroad and firm productivity are verified. As with the well-established literature on exporting and productivity (for example, Bernard and Jensen 1999; De Loecker 2007, 2013; Lileeva and Trefler 2010), this study aims to determine whether the productivity advantage of multinationals is because of the selection effect or the learning effect from investing abroad. The selection effect means that high productivity leads to investing abroad. Firms start to invest abroad because they possess high productivity from previous investments or other firm-specific management and technology advantages. Investing abroad is profitable because high productivity allows these firms to overcome certain costs associated with operating in foreign countries. In contrast, the learning effect refers to productivity gains at home from investing abroad.

To this end, a rich micro dataset was constructed from several of Statistics Canada's administrative microdata files. The dataset covers all industries from 2000 to 2014. Foreign-controlled and domestic-controlled multinationals are identified with the microdata and compared with non-multinationals using various economic indicators. Then, the productivity advantage of multinationals, including the selection and learning effects associated with multinationality, can be estimated. In addition, this study looks into whether the behaviour and efficiency in research and development (R&D) investment affect the superior productivity performance of multinationals.

This current study contributes to the literature by systematically documenting and explaining the productivity advantage of multinationals. Using Canadian micro-database, this study quantifies not only the theoretical prediction that multinationals have higher productivity ex-ante (e.g., Caves 1982; Dunning 1977; Antràs and Helpman 2004; Helpman, Melitz and Yeaple 2004), but also the theoretical prediction that firms learn and improve their productivity after becoming multinationals

1. For a review of the literature on foreign-controlled firms in Canada and their relative performances, see Baldwin and Gellatly (2007).

(e.g., Cantwell 1990; Doz, Santos and Williamson 2001; Andersson, Forsgren and Holm 2002; and Johanson and Vahlne 2009).

It should also be noted that this current paper studies the within-firm productivity effect associated with foreign direct investment (FDI), and does not include the operation of parent companies or foreign affiliates outside Canada. It also does not deal with aggregate productivity in Canada, which is influenced by the reallocation effect across firms.

The rest of this paper is organized as follows. In Section 2, four hypotheses on the behaviour of multinationals are developed; then, in Section 3, the microdata are described and multinationals are defined based on the dataset. In Section 4, the productivity advantage of multinationals is examined, and the selection and learning effects associated with multinationals are quantified. Section 5 addresses the R&D effects on the productivity advantage of multinationals, and Section 6 presents a comparison of the differences between multinationals and non-multinationals in R&D and tangible assets investment. The paper is concluded in Section 7.

2 Development of hypotheses

The FDI literature suggests that firms must possess firm-specific advantages to operate in a foreign environment, since businesses may incur additional costs from new markets, differences in cultural norms, less connection with local communities and more management challenges related to the greater distances between locations (Dunning 1977; Caves 1982). As a result, only the most productive firms are able to overcome these "foreignness" factors and afford to operate profitably in foreign markets (Head and Ries 2003; Antràs and Helpman 2004; Helpman, Melitz and Yeaple 2004).

Hypothesis 1: Multinational firms are more productive than non-multinationals because more productive firms go on to become multinationals.

Aside from the challenges associated with foreignness, there are many opportunities for firms to operate in foreign markets (e.g., Cantwell 1990; Doz, Santos and Williamson 2001; Andersson, Forsgren and Holm 2002; Johanson and Vahlne 2009). First, multinationals can achieve economies of scale by going beyond the domestic market.[2] This allows the firms to benefit from cost advantages and improve their investment returns. Second, the strategies of firms operating in different international markets often provide more flexible production structures that can better handle both supply and demand shocks, adding to the firms' competitive advantages (Dunning 1996). Third, the presence of physical operations in a foreign market allows firms to improve their knowledge of local business opportunities, which provides them with access to location-specific knowledge and the opportunity to subsequently transfer it (Hejazi and Safarian 1999). This may also go beyond location-specific knowledge to further include the host country's advanced technologies and resources (e.g., capital and skilled labour) (Cantwell and Mudambi 2005; Shaver and Flyer 2000). Finally, firms that are exposed to international markets face vigorous global competition with the highest-performing companies. This enforces product market competition, reduces managerial slack, and generates incentives to improve efficiency through product, process or organizational innovation (Baily and Gersbach 1995). The second hypothesis was derived for these reasons.

Hypothesis 2: Multinationality improves productivity. That is, there is a positive learning effect and firms become more productive after becoming multinationals.

2. The economies of scale should be interpreted broadly. For example, ideas, management practices or technologies developed by foreign companies may be used freely by their affiliates in Canada.

Learning takes time. Developing an understanding of a new business organization, human resources, markets, cultural norms and local communities is a process. Doing so requires information, knowledge or technologies from foreign markets, parent companies or subsidiaries. These need to be examined and explored from different perspectives and often demand coordination, collaboration and consensus. Therefore, Canadian multinationals in Canada need time to learn from their foreign subsidiaries, and foreign subsidiaries in Canada need time to implement their firm-specific knowledge in business activities in Canada.[3] This leads to the third hypothesis.

Hypothesis 3: The learning effect increases over time, and new multinationals are less productive than old multinationals.

Why are multinationals more productive than non-multinationals? A popular explanation is that multinationals have advanced firm-specific technologies, which represent the firm's technological capacity to apply new ideas and information to the production of products or services from inputs. In this paper, the firm-specific technological capacity is quantified and approximated by firm-level R&D efforts. This approach is taken from Aghion and Howitt (1992), who suggest that a firm's technological capacity feeds on their past and current investment in R&D.

R&D efforts represent a key strategy for firms to develop firm-specific advantages. In addition to innovative products, services and production processes, firm advantages also include the development of intellectual property, which gives firms an edge in both their home and host markets. In addition, R&D efforts enhance a firm's absorptive capacity, allowing it to better learn from both domestic and foreign markets. A vast amount of the empirical literature has shown that investments in R&D contribute to productivity performance (e.g., Griliches 1979, 1986; Wakelin 2001; Griffith, Redding and Van Reenen 2004; Hall, Mairesse and Mohnen 2010). As previously discussed, multinationals tend to be more R&D-intensive than non-multinationals, and this may partly explain the productivity advantage of multinationals.

In addition, firms may differ in how they exploit R&D efforts to improve productivity. There are many reasons that multinational firms are expected to be able to better exploit their R&D investments and thus generate higher productivity from those investments than non-multinationals. Multinationals may be able to generate more R&D effects because of flexible production structures across countries, larger product markets, and access to foreign advanced technologies and resources, or because of superior managerial skills and strategic thinking. The survey results of Dunning (1996) demonstrate that deeper cross-border structural integration among multinationals results in a greater likelihood that these activities would add to the firm's competitive advantage.

The fourth hypothesis is based on both R&D efforts and their effects.

Hypothesis 4: Higher firm-level R&D efforts and effects contribute significantly to the productivity advantage of multinational firms.

This paper tests the four hypotheses using microdata for Canada.

3. For a discussion on learning from foreign business activities, see Ambos, Ambos and Schlegelmilch (2006); Mu, Gnyawali and Hatfield (2007); and Furuya et al. (2009).

3 Microdata and definition of multinationals

To provide a systematic analysis of multinationals in Canada, a number of administrative micro databases were linked. The linked micro database covers all industries from 2000 to 2014.

The first micro dataset covers both Canadian direct investment abroad (CDIA) and foreign direct investment in Canada (FDIC).[4] This database provides both inward and outward FDI data, by selected firm operating in Canada. Investments are considered as FDI when foreign investors have lasting interest and significant influence on the management of the invested firms. In practice, FDI occurs when foreign investors own at least 10% of the voting equity in an invested firm.

The second micro dataset is the National Accounts Longitudinal Microdata File (NALMF),[5] which has information on the financial statements and balance sheet of each firm. A firm's gross output, physical capital stock, capital income, labour income, intermediate inputs, age and foreign ownership are derived from this dataset.[6] In addition, data on R&D spending, including both in-house and purchased R&D, are collected from the Scientific Research and Experimental Development Program. R&D stock is derived using the perpetual inventory method with a depreciation rate of 15%.

To ensure comparison over time, the nominal variables—such as gross output, physical capital assets and intermediate inputs—are deflated using detailed industry deflators based on the Canadian KLEMS (Capital, Labour, Energy, Materials and Services) database.

In this paper, all foreign-controlled firms operating in Canada are defined as foreign multinationals.[7] Canadian multinationals are defined as domestic-controlled firms that had either outward or inward FDI in any year during the sample period. Foreign multinationals are flagged based on the information from NALMF and, therefore, represent the total population of this group. However, the definition of Canadian multinationals is survey-based. Canadian-controlled small firms with outward FDI that were not surveyed are flagged as non-multinationals in the dataset for this study. This may have some effect on the empirical results in this paper.

4. There are several questionnaires that collect data that are used directly for compiling Canada's international investment position. This paper uses data from two annual questionnaires from the survey: Canadian Investment Abroad (BP-CIA) and Foreign Investment in Canada (BP-FIC). These two questionnaires are sent to Canadian enterprises known or believed to have significant international assets or liabilities. The survey is believed to cover nearly 100% of the target population. Following a survey redesign in 2008, some changes were made to the sampling strategy—particularly a move from a quasi-census to a sample-based survey. As a result, many of the smaller, previously surveyed units were dropped from the survey to help reduce survey costs. While this did not affect the overall quality of the survey, it did result in a significant reduction in the number of survey units.
5. The NALMF is an administrative data file created by the Economic Analysis Division at Statistics Canada. It uses administrative tax records (T2 Corporation Tax Return and PD7 Statement of account for current source deductions); data from the T4 Statement of Remuneration Paid; and information from the Business Register (BR) and the Survey of Employment, Payrolls and Hours (SEPH). The T2 data include corporations that file a T2 tax return with the Canada Revenue Agency. The T4 data, PD7 and SEPH include corporations and unincorporated firms that hire employees.
6. Firm characteristics in the NALMF originate from the BR. The BR is the central repository of information on businesses in Canada. As the principal framework for the economic statistics program at Statistics Canada, the BR maintains a complete, up-to-date and unduplicated list of all active businesses in Canada that have a corporate, payroll, or goods and services tax account.
7. Foreign control is defined in this current study using the country of control variable from the BR database. The BR classifies the country of control for each enterprise as the country of residence of the ultimate shareholder or group of shareholders. This information is derived from ownership questionnaires filed annually with Statistics Canada by corporations liable under the *Corporations Returns Act*, from information obtained from the Canada Revenue Agency's administrative records, or from enterprise profiling. This definition follows the inter-corporate ownership concept, notably differing from the FDI concepts used in Statistics Canada's international accounts program, which are based on international standards.

4 Productivity advantage of multinationals

How much more productive are multinationals than non-multinationals? Are Canadian multinationals as productive as foreign multinationals? In this section, these questions are addressed by testing the four hypotheses developed in Section 2.

4.1 Regression model

To quantify the productivity advantage of multinationals, a simple production function regression model is first estimated as follows:

$$\ln(Y_{it}) = \alpha_0 + \alpha_1 \ln(L_{it}) + \alpha_2 \ln(K_{it}) + \alpha_3 \ln(M_{it}) + \mathbf{\beta F_{it}} + \mathbf{\Gamma X_{it}} + \mathbf{\Lambda D_{it}} + \varepsilon_{it} \quad (1)$$

where Y_{it}, L_{it}, K_{it} and M_{it} are the components associated with firm production in Canada, representing gross output, labour, capital and intermediate inputs, which are deflated using detailed industry deflators. $\mathbf{F_{it}}$ and $\mathbf{\beta}$ are the sets of dummy variables and corresponding coefficients associated with Canadian multinationals and foreign multinationals (with the reference group being non-multinationals). $\mathbf{X_{it}}$ and $\mathbf{\Gamma}$ are the vectors of additional variables that may be important for productivity (such as the young firm dummy variable and capacity utilization) and their corresponding coefficients. $\mathbf{D_{it}}$ and $\mathbf{\Lambda}$ are the vectors of industry–year dummy variables and the corresponding coefficients. ε_{it} are the error terms.

Multifactor productivity (MFP) can be measured as gross output net of contributions of labour, capital and intermediate inputs. Therefore, the remaining variables in Equation (1), including the $\mathbf{F}$ and $\mathbf{X}$ factors, explain variations in MFP at the firm level.

To reflect that young firms may be less efficient than established firms, a dummy variable was introduced for young firms. According to Liu and Tang (2017), entrants in Canada take about five years to become as efficient as incumbents. Therefore, the dummy variable equals 1 if a firm is 6 years old or less, and 0 otherwise.

The effect of production capacity utilization[8] is controlled for to capture how changes in demand conditions affect productivity. An unexpected change in demand conditions affects the utilization of production capacity since firms are unable to adjust installed machines or workforce in a timely manner. For example, lower than expected demand will lead to the underutilization of production capacity. Basu and Kimball (1997) show that changes in capacity utilization could explain up to 60% of short-run economic fluctuation. Baldwin, Gu and Yan (2013) show that the Canadian manufacturing sector experienced excess capacity after 2000, with a decline in capacity utilization in 16 of the 20 manufacturing industries.

The introduction of industry–year dummy variables is to control for all time-variant and time-invariant industry specific effects. For example, industry–year dummy variables capture industry–year specific spillovers effects, such as those from external R&D and effects from changes in business environment, including competition and business dynamism (e.g., entry, exit).

While multinationals tend to be large, most non-multinationals are very small. To have a meaningful comparison between multinationals and non-multinational in this econometric

8. Capacity utilization is derived by assuming that the capacity in use is proportional to labour and intermediate inputs after adjusting for the input substitution effect from a change in relative input prices. More detail on the derivation can be provided upon request.

analysis, only firms with over 10 annual employees on average across the sample period were included.[9] With this restricted sample, non-multinationals are relatively comparable to multinationals.

4.2 The productivity advantage of multinationals

To quantify the productivity advantage of multinationals over non-multinationals, in Column 1 of Table 1, Canadian and foreign multinationals are singled out in order to examine whether they perform differently compared to non-multinationals. The estimation is based on ordinary least squares (OLS) estimation with robust standard errors. Using robust standard errors is a common and effective way to deal with heteroscedasticity, minor problems associated with the lack of normality, or some observations with large influence.[10] The estimation results support the first hypothesis and show that Canadian multinationals are as productive as foreign multinationals, and that multinationals are, on average, about 23% more productive than relatively comparable non-multinationals.[11] The conclusion does not change after controlling for the young firms and the capacity utilization (Column 2). As expected, the estimated coefficient is negative for the young firm dummy variable and positive for capacity utilization. Both are statistically significant.

9. The productivity advantage of multinationals would be larger if firms with fewer than 10 employees were included, because these firms are less productive.
10. However, similar results are obtained when OLS with clustered standard errors at the firm level is used. Clustered standard error is used to address the within-firm error correlations.
11. Expressed in logarithmic value, the ratio of multinational MFP to non-multinational MFP is equal to 0.21; expressed in numerical value, the ratio is equal to 1.23.

Table 1
Estimation of multinationals' productivity advantage, 2000 to 2014

	All industries	All industries	Goods-producing industries	Services-producing industries
	Column 1	Column 2	Column 3	Column 4
Log labour				
Coefficient	0.2910 **	0.2890 **	0.3070 **	0.2830 **
Standard error	0.0008	-0.0008	0.0017	0.0009
Log capital				
Coefficient	0.0430 **	0.0490 **	0.0610 **	0.0450 **
Standard error	0.0003	0.0000	0.0007	0.0004
Log intermediate input				
Coefficient	0.6500 **	0.6460 **	0.6180 **	0.6550 **
Standard error	0.0008	0.0008	0.0017	0.0009
Canadian multinational				
Coefficient	0.2140 **	0.2140 **	0.1810 **	0.2350 **
Standard error	0.0030	0.0030	0.0044	0.0040
Foreign multinational				
Coefficient	0.2070 **	0.2070 **	0.1750 **	0.2230 **
Standard error	0.0019	0.0019	0.0028	0.0024
Young firm				
Coefficient	Not included	-0.0050 **	0.0230 **	-0.0130 **
Standard error	Not included	0.0007	0.0013	0.0008
Capacity utilization				
Coefficient	Not included	0.0390 **	0.0470 **	0.0360 **
Standard error	Not included	0.0006	0.0013	0.0007
Industry–year dummy variables	Included	Included	Included	Included
Number of observations	1,893,380	1,893,380	524,859	1,368,521
R-squared	0.9470	0.9473	0.9529	0.9439

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

Notes: Column 1 and Column 2 represent different model specifications for the sample of all industries. All columns show regression results of ordinary least squares (OLS) with robust standard errors, but results remain intact under firm-clustered standard errors.

Source: Statistics Canada, authors' compilation based on data from the linked survey of Canada's International Investment Position and National Accounts Longitudinal Microdata File.

The regression was performed separately for goods and services in order to examine the difference between these two groups of industries (see Column 3 and Column 4 in Table 1). The estimations show that the productivity advantage of multinationals is larger in the services-producing industries (about 25%) than in the goods-producing industries (20%).

There is significant debate in the international trade literature as to whether firms with higher productivity actively choose to be involved in exporting, and whether exporting enhances productivity (Trefler 2004; Bernard and Jensen 1999). Similarly, the selection and learning effects associated with multinationality are explored in this paper. In other words, this paper addresses whether firms with higher productivity actively choose to become multinationals, and whether being multinational enhances their productivity. The analysis reveals whether selection, ex-post learning, or both, explain the superior productivity performance of multinationals.

To facilitate the analysis, the dummy variables associated with multinationals in Equation (1) are re-specified. In particular, firms are divided into three groups. The first group includes firms that switched their type from non-multinationals to multinationals over the sample period. Two dummy variables are introduced for this group: multinationality ex-ante and multinationality ex-post. The ex-ante dummy variable is set to 1 before firms become multinationals, and 0 otherwise. The ex-post dummy variable is set to 1 after firms become multinationals, and 0 otherwise. The second group includes firms that have been multinationals since 2000, the first year of the sample. For this group, a multinationality all-time dummy variable is introduced. The third group, which is the reference group, includes firms that are non-multinationals over the whole sample period.

The regression results without and with the two control variables, the dummy variable for the young firm and the capacity utilization, are reported in Columns 1 and 2 in Table 2. The estimation results show that firms that became multinationals during the sample period are more productive than all-time non-multinationals before making the switch. These firms are then even more productive after switching. These results suggest that both selection and learning effects exist.

Table 2
Estimation of multinationals' productivity advantage, 2000 to 2014

	Ordinary least squares					
	Unbalanced data				Balanced data	Fixed effects
	All industries	All industries	Goods-producing industries	Services-producing industries	All industries	All industries
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Log labour						
Coefficient	0.2900 **	0.2880 **	0.3060 **	0.2820 **	0.2780	0.2320 **
Standard error	0.0008	0.0008	0.0017	0.0009	0.0010	0.0015
Log capital						
Coefficient	0.0430 **	0.0490 **	0.0661 **	0.0450 **	0.0510	0.1710 **
Standard error	0.0003	0.0003	0.0007	0.0004	0.0004	0.0022
Log intermediate						
Coefficient	0.6480 **	0.6440 **	0.6170 **	0.6540 **	0.6610	0.5070 **
Standard error	0.0008	0.0008	0.0017	0.0009	0.0009	0.0030
Multinationality: Ex-ante						
Coefficient	0.1740 **	0.1770 **	0.1450 **	0.1930 **	0.1430	Not included
Standard error	0.0023	0.0023	0.0035	0.0029	0.0027	Not included
Multinationality: Ex-post						
Coefficient	0.2110 **	0.2100 **	0.1790 **	0.2250 **	0.1860	0.0200 **
Standard error	0.0023	0.0023	0.0036	0.0030	0.0028	0.0037
Multinationality: All-time						
Coefficient	0.2250 **	0.2260 **	0.1950 **	0.2440 **	0.1960	Not included
Standard error	0.0021	0.0021	0.0032	0.0028	0.0024	Not included
Young firm						
Coefficient	Not included	-0.0070 **	0.0210 **	-0.0150 **	-0.0030 †	-0.0150 **
Standard error	Not included	0.0006	0.0013	0.0007	0.0014	0.0008
Capacity utilization						
Coefficient	Not included	0.0390 **	0.0480 **	0.0360 **	0.0370	0.1430 **
Standard error	Not included	0.0006	0.0013	0.0007	0.0009	0.0018
Industry–year dummy variables	Included	Included	Included	Included	Included	Not included
Year dummies	Not included	Not included	Not included	Not included	Not included	Included
Number of observations	1,893,380	1,893,380	524,859	1,368,521	1,035,620	1,893,380
R-squared	0.9472	0.9475	0.9531	0.9442	0.9573	0.9066

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

† significantly different from reference category ($p < 0.10$)

Notes: Column 1 and Column 2 represent different model specifications for the sample of all industries. Columns 1 to 4 show regression results of ordinary least squares (OLS) with robust standard errors, but results remain intact under firm-clustered standard errors. The regression with fixed effects (Column 5) has robust standard errors adjusted for clusters in firms.

Source: Statistics Canada, authors' compilation based on data from the linked survey of Canada's International Investment Position and National Accounts Longitudinal Microdata File.

In this study, the difference in productivity between multinationality ex-ante and multinationality ex-post is interpreted as the learning effect. The learning effect is statistically significant for both goods and services (Columns 3 and 4), and is not affected when entrants and exits over the sample period are excluded from the estimation (Column 5). The statistically significant learning effect is also captured in the regression with firm fixed effects (Column 6).[12] The significant learning effect confirms the second hypothesis—multinationality improves productivity. Note, however, that the learning effect is numerically much smaller than the selection effect. In other words, the productivity advantage of multinationals is dominated by the selection effect.

In addition, an F-test shows that the coefficient of the all-time multinational variable is significantly higher than the coefficient of the multinationality ex-post dummy variable. This is consistent with the third hypothesis: learning takes time, and new multinationals are less productive than old multinationals. To further support this hypothesis, multinationals were placed into five groups corresponding with years of multinationality: first year, second year, third year, fourth year, and fifth year and beyond. Both OLS and the regression with firm fixed effects show that the learning effect increases over time (Table 3). Although the incremental increases between adjacent years are not statistically significant, the difference between the first year and the fifth year and beyond is statistically significant. This suggests that new multinationals face a long process of learning about foreign operation management and foreign markets before they can fully benefit from these foreign operations.

12. Fixed effects capture all time-invariant firm-specific effects. For multinationals, this model is able to show only the learning effect—that is, the incremental productivity after becoming multinationals.

Table 3
Estimation of incremental learning effects over the years, 2000 to 2014

	Ordinary least squares	Fixed effects
	Column 1	Column 2
Log labour		
Coefficient	0.2870 **	0.2320 **
Standard error	0.0008	0.0015
Log capital		
Coefficient	0.0490 **	0.1710 **
Standard error	0.0003	0.0022
Log intermediate		
Coefficient	0.6440 **	0.5070 **
Standard error	0.0008	0.0030
Multinationality: Ex-ante		
Coefficient	0.1770 **	Not included
Standard error	0.0008	Not included
Multinationality: First year		
Coefficient	0.2060 **	0.0170 **
Standard error	0.0055	0.0039
Multinationality: Second year		
Coefficient	0.2100 **	0.0190 **
Standard error	0.0058	0.0044
Multinationality: Third year		
Coefficient	0.2110 **	0.0190 **
Standard error	0.0060	0.0046
Multinationality: Fourth year		
Coefficient	0.2170 **	0.0230 **
Standard error	0.0070	0.0054
Multinationality: Fifth year and beyond		
Coefficient	0.2230 **	0.0210 **
Standard error	0.0019	0.0051
Young firm		
Coefficient	-0.0070 **	-0.0150 **
Standard error	0.0006	0.0008
Capacity utilization		
Coefficient	0.0390 **	0.1430 **
Standard error	0.0006	0.0018
Industry–year dummy variables	Included	Not included
Year dummies	Not included	Included
Number of observations	1,893,380	1,893,380
R-squared	0.9475	0.9066

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

Notes: Column 1 shows regression results of ordinary least squares (OLS) with robust standard errors, but results remain intact under firm-clustered standard errors. The regression with fixed effects (Column 2) has robust standard errors adjusted for clusters in firms.

Source: Statistics Canada, authors' compilation based on data from the linked survey of Canada's International Investment Position and National Accounts Longitudinal Microdata File.

4.3 Endogeneity issues in estimating multinationals' productivity advantage

The earlier econometric analysis ignored the potential endogeneity and selection biases associated with the estimation of the productivity advantage of multinationals. The issues arise from a correlation between productivity and input levels—a firm may respond to a productivity shock by adjusting input levels. If the problem is not corrected, traditional estimation such as OLS will lead to biased parameter estimates and, therefore, incorrect statistical inference. As a robust check to the previous results, this study follows the Levinsohn-Petrin analytical framework for estimating the production function, and the simultaneity and selection biases are explicitly corrected (Levinsohn and Petrin 2003). This approach allows verification of the causal effect that becoming a multinational has on productivity.

To explicitly correct for the simultaneity and selection biases in estimating the production function, Equation (1) needs to be specified differently. For the purpose, this study closely follows the models used by De Loecker (2013) and Bai, Krishna and Ma (2017) for detecting learning by exporting. Specifically, the empirical model for detecting the learning effect after becoming multinationals becomes:

$$\ln(Y_{it}) = \alpha_0 + \alpha_1 \ln(L_{it}) + \alpha_2 \ln(K_{it}) + \alpha_3 \ln(M_{it}) + \alpha_4 C_{it} + \mathbf{\Lambda D_{it}} + \varpi_{it} + \eta_{it} \quad (2)$$

$$\varpi_{it} = g(\varpi_{it-1}, \mathbf{F_{it}}, D_{it}^{Y}) + \xi_{it} = \theta_0 + \sum_{j=1}^{3} \theta_j (\varpi_{it-1})^j + \mathbf{\beta F_{it}} + \gamma_1 D_{it}^{Y} + \xi_{it} \quad (3)$$

where C_{it} is capacity utilization; ϖ_{it} and η_{it} are the transmitted productivity component and the error terms, respectively; and D_{it}^{Y} is the young firm dummy variable. The remaining variables are the same as those in Equation (1). All variables are defined as before.

In the production function, capacity utilization and industry–year specific effects are controlled for as before. The error terms are uncorrelated with input choices, while the transmitted productivity component is a state variable that affects firm input decisions. This causes the simultaneity and selection problem when estimating the production function.

Under the model specification, the transmitted productivity component in Equation (2) is governed by the productivity evolution process in Equation (3). The current productivity level is specified as a function of the previous productivity level, multinationality and firm age. Similar to Petrin, Poi and Levinsohn (2004) and Bai, Krishna and Ma (2017), a cubic polynomial is used in this current study to approximate the dependence of current productivity on previous productivity.

The current productivity level depends on the productivity level the year prior. Therefore, the multinationality coefficient captures the current incremental learning from becoming a multinational. The estimation of the model can test whether learning is present. However, unlike the regression model for OLS estimation, the analysis here is close to the regressions with firm fixed effects and does not directly provide evidence on the selection effect.

The model is estimated using the Levinsohn-Petrin framework[13]—a two-step estimation. The first step is to run the following linear regression by OLS:

$$\ln(Y_{it}) = \alpha_0 + \alpha_l \ln(L_{it}) + \sum_{a=0}^{3} \sum_{b=0}^{3-a} \beta_{ab} \left[\ln(K_{it})\right]^a \left[\ln(\mathrm{M}_{it})\right]^b + \alpha_c C_{it} + \mathbf{\Lambda D_{it}} + \eta_{it} \tag{4}$$

For a set of candidate values for capital and intermediate inputs, a prediction for ω_{it} can be calculated:

$$\begin{aligned} \hat{\phi}_{it} &= \hat{\alpha}_0 + \sum_{a=0}^{3} \sum_{b=0}^{3-a} \hat{\beta}_{ab} \left[\ln(K_{it})\right]^a \left[\ln(\mathrm{M}_{it})\right]^b \\ \hat{\omega}_{it} &= \hat{\phi}_{it} - \alpha_k \ln(K_{it}) - \alpha_m \ln(\mathrm{M}_{it}) \end{aligned} \tag{5}$$

The second step is to run the following non-linear regression:

$$\hat{\omega}_{it} = \gamma_0 + \gamma_1 \hat{\omega}_{it-1} + \gamma_2 \hat{\omega}_{it-1}^2 + \gamma_3 \hat{\omega}_{it-1}^3 + \mathbf{\beta F_{it}} + \gamma_d D_{it}^Y + \xi_{it} \tag{6}$$

Substituting Equation (5) into Equation (6) provides the following equation:

$$\begin{aligned} \hat{\phi}_{it} = {} & \gamma_0 + \alpha_k \ln(K_{it}) + \alpha_m \ln(\mathrm{M}_{it}) + \sum_{j=1}^{3} \gamma_j \left[\hat{\phi}_{it-1} - \alpha_k \ln(K_{it-1}) + \alpha_m \ln(\mathrm{M}_{it-1}) \right]^j \\ & + \mathbf{\beta F_{it}} + \gamma_d D_{it}^Y + \xi_{it} \end{aligned} \tag{7}$$

The estimation results are reported in Table 4. The coefficients for labour, capital and intermediate inputs are similar to those in OLS regressions. Importantly, the estimated coefficients for the multinational dummy variables are positive and highly statistically significant. Therefore, the alternative model specification that corrects for potential endogeneity issues continues to show that there is a learning effect after firms become multinationals, which confirms the results earlier in the current paper.

13. For a description of how to estimate such a model using the Levinsohn-Petrin framework, see Petrin, Poi and Levinsohn (2004).

Table 4
Correcting the simultaneity and selection biases in estimating the production function, 2000 to 2014

	All multinationals	Canadian and foreign multinationals separated
	Column 1	Column 2
First-stage estimation		
Log labour input		
Coefficient	0.2670 **	0.2670 **
Standard error	0.0007	0.0007
Capacity utilization		
Coefficient	0.0240 **	0.0240 **
Standard error	0.0005	0.0005
Industry–year dummy variables	Included	Included
Number of observations	1,893,380	1,893,380
Second-stage estimation		
Log capital input		
Coefficient	0.0400 **	0.0400 **
Standard error	0.0001	0.0001
Log intermediate input		
Coefficient	0.5980 **	0.5980 **
Standard error	0.0001	0.0001
Young firm		
Coefficient	-0.0030 **	-0.0030 **
Standard error	0.0002	0.0005
Multinational		
Coefficient	0.0140 **	Not included
Standard error	0.0003	Not included
Canadian multinational		
Coefficient	Not included	0.0130 **
Standard error	Not included	0.0005
Foreign multinational		
Coefficient	Not included	0.0140 **
Standard error	Not included	0.0003
Number of observations	1,685,365	1,685,365

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

Source: Statistics Canada, authors' compilation based on data from the linked survey of Canada's International Investment Position and National Accounts Longitudinal Microdata File.

5 Research and development and the productivity advantage of multinationals

Why are multinationals more productive than non-multinationals? This section discusses the link between productivity and investment in R&D. R&D is considered to be the most important factor in developing a firm's technological or innovative capacity and is the key driver in improving productivity. This section tests the fourth hypothesis—that is, whether or not the productivity advantage of multinationals ex-ante or ex-post is due to their higher investment in R&D and their ability to generate higher returns from the investment.

R&D is a process of applying new ideas and initiatives, and it requires time to create innovation capacity and generate innovative products and production methods. Therefore, R&D is measured in this study as stock, and R&D intensity is measured as R&D stock per worker.

The estimation results for the linkage between R&D and productivity are reported in Table 5. Those regressions are based only on R&D-performing firms to determine whether R&D-performing multinationals behave differently than R&D-performing non-multinationals. Multinational firms are treated differently before and after becoming multinationals in this study. The first five regressions (Columns 1 to 5 in Table 5) are based on unbalanced data, while the last regression (Column 6 in Table 5) is based on balanced data.

Table 5
Estimation of the linkage between research and development and the productivity advantage of multinationals, 2000 to 2014

	Unbalanced data					Balanced data
	All industries	All industries	All industries	Goods-producing industries	Services-producing industries	All industries
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Log labour input						
Coefficient	0.2930 **	0.3150 **	0.3150 **	0.2840 **	0.3460 **	0.2940 **
Standard error	0.0023	0.0023	0.0023	0.0035	0.0031	0.0026
Log capital input						
Coefficient	0.0700 **	0.0660 **	0.0660 **	0.0780 **	0.0530 **	0.0610 **
Standard error	0.0010	0.0010	0.0010	0.0014	0.0015	0.0011
Log intermediate input						
Coefficient	0.6180 **	0.6150 **	0.6150 **	0.6310 **	0.6000 **	0.6480 **
Standard error	0.0024	0.0024	0.0024	0.0039	0.0029	0.0025
Multinationality: Ex-ante						
Coefficient	0.1240 **	0.1090 **	-0.0120	0.0100	-0.0470	0.0240
Standard error	0.0035	0.0025	0.0198	0.0254	0.0307	0.0214
Multinationality: Ex-post						
Coefficient	0.1780 **	0.1620 **	0.0550 **	0.0150	0.1260 **	0.1160 **
Standard error	0.0037	0.0036	0.0179	0.0231	0.0273	0.0184
Multinationality: All-time						
Coefficient	0.2090 **	0.1910 **	0.1150 **	0.0560 **	0.2120 **	0.0380 †
Standard error	0.0038	0.0038	0.0160	0.0197	0.0266	0.0164
Young firm						
Coefficient	0.0440 **	0.0450 **	0.0450 **	0.0380 **	0.0480 **	0.0270 **
Standard error	0.0021	0.0021	0.0021	0.0025	0.0033	0.0045
Capacity utilization						
Coefficient	0.0480 **	0.0470 **	0.0470 **	0.0540 **	0.0380 **	0.0430 **
Standard error	0.0016	0.0016	0.0016	0.0021	0.0024	0.0022
Log R&D intensity						
Coefficient	Not included	0.0310 **	0.0290 **	0.0200 **	0.0390 **	0.0220 **
Standard error	Not included	0.0005	0.0005	0.0006	0.0008	0.0005
Log R&D intensity × Multinationality: Ex-ante						
Coefficient	Not included	Not included	0.0120 **	0.0090 **	0.0160 **	0.0060 †
Standard error	Not included	Not included	0.0021	0.0028	0.0032	0.0023
Log R&D intensity × Multinationality: Ex-post						
Coefficient	Not included	Not included	0.0110 **	0.0120 **	0.0070 †	0.0020
Standard error	Not included	Not included	0.0020	0.0026	0.0029	0.0019
Log R&D intensity × Multinationality: All-time						
Coefficient	Not included	Not included	0.0080 **	0.0110 **	0.0020	0.0130 **
Standard error	Not included	Not included	0.0018	0.0022	0.0028	0.0019
Industry–year dummy variables	Included	Included	Included	Included	Included	Included
Number of observations	243,736	243,736	243,736	145,717	98,019	148,803
R-squared	0.9645	0.9655	0.9655	0.9727	0.9554	0.9754

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

† significantly different from reference category ($p < 0.10$)

Notes: Columns 1 to 3 are different model specifications for the sample of all industries. All columns show regression results of ordinary least squares (OLS) with robust standard errors, but results remain intact under firm-clustered standard errors. R&D: research and development.

Source: Statistics Canada, authors' compilation based on data from the linked survey of Canada's International Investment Position and National Accounts Longitudinal Microdata File.

As shown in Column 1, the productivity advantage for R&D-performing multinationals ex-ante or ex-post is smaller than those in table 2. This is expected, since the groups of firms are more comparable after excluding non-R&D-performing firms that are most likely non-multinationals, smaller and less productive. The coefficient of the young firm dummy variable now becomes positive and significant. This implies that among all R&D-performing firms, younger firms (6 years or less) are more productive than older firms. The previous estimation results (including all firms) indicate that younger firms are generally less productive than older firms. Therefore, the productivity gap between younger and older firms is larger among non-R&D-performing firms. Given that non-R&D-performing firms are usually small firms, this result is consistent with findings in the literature for Canada.[14]

For Column 2, the R&D variable is introduced under the assumption that the returns from R&D are the same for multinationals (ex-ante and ex-post) and non-multinationals. The estimation shows that the coefficients on the multinational dummy variables become smaller. This means that part of the productivity advantage among multinationals comes from having higher R&D intensity than non-multinationals. In particular, the introduction of the R&D variable causes the productivity advantage to decrease from 13.2%[15] to 11.5% for multinationals ex-ante, and from 19.5% to 17.6% for multinationals ex-post.

For Column 3, it is assumed that the R&D returns to multinationals are different from those to non-multinationals. As a result, the interaction terms between the R&D variable and the multinational dummy variables are introduced. All interaction terms are positive and statistically significant, meaning that the returns to R&D are higher for all multinationals than for non-multinationals. Notably, the coefficients on the multinational dummy variables are substantially lower. That is, after R&D effects are controlled for, the productivity advantage of multinationals decreases from 13.2% to almost 0.0% ex-ante, and from 19.5% to 5.7% ex-post. Therefore, the productivity advantage of multinationals largely results from more investment in R&D, and the selection effect disappears for R&D-performing firms.

The estimations are then recalculated separately for goods-producing and services-producing industries. Unsurprisingly, the selection effect disappears in both regressions after controlling for the impact of R&D, and the learning effect disappears for goods-producing industries, but not for services-producing industries (see Columns 4 and 5 of Table 5).

The results with the balanced panel (Column 6) are similar to those with the unbalanced panel (Column 3) for all industries, indicating that entrants and exits over the sample period have no significant impact on estimation results.

In summary, the empirical evidence suggests that among R&D-performing firms, the productivity advantage of multinationals can largely be explained by their higher investment in R&D than non-multinationals, and the productivity advantage of firms before becoming multinationals can be fully explained by their higher investment in R&D than non-multinationals. The findings confirm the fourth hypothesis: higher firm-level R&D efforts and effects contribute significantly to the productivity advantage of multinational firms.

14. Tang (2014) and Liu and Tang (2017) show that young firms are less productive, on average, and Tang and Van Assche (2017) show that young firms become more productive when small firms are excluded.
15. The productivity advantage of multinationals can be calculated based on coefficients of multinational dummy variables. For example, because the coefficient of multinationals ex-ante equals 0.124 in Column 1 of Table 5, the corresponding productivity advantage of multinationals ex-ante becomes 13.2% (the exponential value of 0.124, minus 1).

Why, then, is R&D more important to multinationals than to non-multinationals? A popular explanation is that multinationals are better able to exploit their R&D investments and, therefore, generate higher productivity from those investments than non-multinationals. Multinationals may be able to generate greater R&D returns because of flexible production structures across countries, larger product markets, and access to foreign advanced technologies and resources, or because of superior managerial skills and strategic thinking.

6 The conscious selection behaviour of multinationals

To further determine why multinationals are more productive than non-multinationals, this section discusses their differences in investment behaviours—in particular, how a firm's current-year investments in R&D are associated with firm specifics, given the firm's investments in the previous year. Besides firm age, firm size and productivity, the important firm specifics are multinationality and ownership. The large firm dummy variable is 1 for firms with 500 employees or more, and 0 otherwise.

The variable on previous-year investments captures not only the firm's past investment behaviours, but also its operational scale. Industry–year dummy variables are introduced for all regressions. These capture all time-variant and time-invariant industry-specific effects. For example, they capture industry–year specific effects from changes in the business environment, including competition and business dynamism (e.g., entry or exit).

Table 6 reports the estimation results for investments and their association with multinationals. Column 1 shows that R&D investments in the current year are positively and significantly related to investments in previous years.[16] They are also positively and significantly associated with Canadian multinationals, large firms, young firms and productivity in previous years.

16. Firms might not invest every year. To facilitate this analysis with dependent variables in logs, 1 is added to each firm's investment value. Since any investment is fairly large, this does not affect the results.

Table 6
Estimation results of the relationship between investments and multinationality, 2000 to 2014

	Research and development investment (log)		Physical investment (log)	
	Column 1	Column 2	Column 3	Column 4
Lagged dependent variable				
Coefficient	0.8640 **	0.8640 **	0.6140 **	0.6130 **
Standard error	0.0008	0.0008	0.0008	0.0008
Canadian multinational				
Coefficient	0.0690 **	Not included	0.4330 **	Not included
Standard error	0.0193	Not included	0.0290	Not included
Foreign multinational				
Coefficient	-0.0510	Not included	0.3790 **	Not included
Standard error	0.0114	Not included	0.0186	Not included
Canadian multinationality: Ex-ante				
Coefficient	Not included	0.2400 **	Not included	0.8200 **
Standard error	Not included	0.0475	Not included	0.0602
Foreign multinationality: Ex-ante				
Coefficient	Not included	0.1500 **	Not included	0.6890 **
Standard error	Not included	0.0192	Not included	0.0246
Mixed multinationality:[1] Ex-ante				
Coefficient	Not included	0.2960 **	Not included	0.7360 **
Standard error	Not included	0.0879	Not included	0.1184
Canadian multinationality: Ex-post				
Coefficient	Not included	0.0650 **	Not included	0.4450 **
Standard error	Not included	0.0367	Not included	0.0577
Foreign multinationality: Ex-post				
Coefficient	Not included	-0.0430 †	Not included	0.3890 **
Standard error	Not included	0.0176	Not included	0.0277
Mixed multinationality:[1] Ex-post				
Coefficient	Not included	0.0220	Not included	0.7340 **
Standard error	Not included	0.0526	Not included	0.0679
Canadian multinationality: All-time				
Coefficient	Not included	0.1140 **	Not included	0.3360 **
Standard error	Not included	0.0321	Not included	0.0494
Foreign multinationality: All-time				
Coefficient	Not included	-0.0530 **	Not included	0.3350 **
Standard error	Not included	0.0169	Not included	0.0300
Mixed multinationality:[1] All-time				
Coefficient	Not included	0.0030	Not included	0.5620 **
Standard error	Not included	0.0215	Not included	0.0310
Large firm				
Coefficient	0.4900 **	0.4730 **	1.6610 **	1.6130 **
Standard error	0.0223	0.0223	0.0287	0.0289
Young firm				
Coefficient	0.0480 **	0.0480 **	-0.3200 **	-0.3190 **
Standard error	0.0034	0.0034	0.0076	0.0076
Lagged multifactor productivity in log				
Coefficient	0.0660 **	0.0620 **	0.2360 **	0.2200 **
Standard error	0.0037	0.0037	0.0096	0.0095
Industry–year dummy variables	Included	Included	Included	Included
Number of observations	1,685,365	1,685,365	1,685,365	1,685,365
R-squared	0.7994	0.7994	0.3991	0.3995

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

† significantly different from reference category ($p < 0.10$)

1. Mixed multinationality refers to multinationals that switched from Canadian to foreign ownership, or vice versa.

Notes: The difference between Column 1 and Column 2 is that they represent different model specifications for investment in research and development. The same explanation applies to Column 3 and Column 4 for physical investment. All columns show regression results of ordinary least squares (OLS) with robust standard errors, but results remain intact under firm-clustered standard errors.

Source: Statistics Canada, authors' compilation based on data from the linked survey of Canada's International Investment Position and National Accounts Longitudinal Microdata File.

Notably, only Canadian multinationals are involved in more R&D investment than non-multinationals. This result is consistent with findings by Tang and Rao (2003), who show that foreign-controlled firms are less R&D-intensive than Canadian-controlled firms, since R&D activities for multinationals tend to be centralized in their respective parent countries. However, despite centralization of R&D activities abroad, foreign-controlled firms in Canada may still benefit from technology and knowledge transfers from their parent companies.

In Column 2, multinationals are specified in more detail and their R&D investment behaviour ex-ante and ex-post is examined. Given the estimation results in Column 1 for Canadian and foreign multinationals, the signs, magnitudes and significances of coefficients in Column 2 for multinationals, ex-post and all-time, by type, are expected. However, the results of coefficients for multinationals ex-ante are interesting: for all three coefficients for ex-ante multinationals (Canadian, foreign and mixed),[17] the results are positive, statistically significant and much larger than the corresponding ex-post and all-time results. This result implies that during the period beforehand, multinationals invested more in R&D, on average, than non-multinationals. After becoming multinationals, these firms largely reduced their R&D investments.

R&D activities are investments in intangibles. To see how multinationals behave differently in investments in tangibles, the same exercise was repeated for investments in machinery, equipment and building structures (Columns 3 and 4 in Table 6). The estimation results show that both Canadian and foreign multinationals invest more in tangible assets than non-multinationals, and they invest more before they become multinationals.

There are two important differences between investments in R&D and investments in tangible assets. First, young firms are found to invest more in R&D but less in tangible assets than older firms. This may be because young firms focus more on the development and improvement of their products, which require more intangible assets, while established firms focus more on the production of mature products, which requires more physical assets. Second, foreign multinationals rival Canadian multinationals in tangible investment but not in R&D investment.

However, both Canadian and foreign multinationals reduce their investments in both R&D and tangible assets after they become multinationals. This may be related to conscious selection behaviour, as discussed by Alvarez and Lopez (2005) in the context of exports. In this context, this means that firms consciously invest more to enhance their productivity and ability to undertake outward FDI before achieving multinationality.

17. Firms that were Canadian multinationals in some years and foreign multinationals in other years are called mixed multinationals in this paper.

7 Conclusion

Multinationals play an important role in the world economy because they are larger, innovate more, are more productive and pay higher wages compared with non-multinationals.

A systematic analysis of the economic performance of multinationals was provided using a micro database constructed from several administrative microdata files in Canada. The sources of the multinationals' superior productivity performance were then traced. This current study showed that Canadian multinationals were as productive as foreign multinationals and that multinationals were about 23% more productive than comparable non-multinationals on average. In addition, it showed that more productive firms not only chose to become multinationals, but also became more productive after becoming multinationals. This suggests that both selection and learning effects are at play in the superior productivity performance of multinationals. In addition, the results show that the selection effect is much larger than the learning effect. Furthermore, the superior productivity performance of multinationals was largely because of their conscious selection behaviour in terms of investments in both tangible assets and research and development (R&D), as well as their ability to generate higher productivity from their R&D investments.

The finding that the productivity advantage of multinationals mainly results from the selection effect has important implications for policy development associated with both inward and outward foreign direct investment. Firms can learn from foreign operations or affiliates, but to enter foreign markets, they need to improve their productivity beforehand by consciously investing in R&D and tangible capital, and by developing the capacity for efficiency.

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