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The Productivity Advantage of Multinationals in Canada

Jianmin (ISED)
Weimin Tang (Statistics Canada)

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Abstract

Canada is an important host and home country of multinationals which have become increasingly important to the world economy. Using a rich micro dataset covering all industries from 2000 to 2014, this paper provides a systematic analysis of the economic performance of multinationals in Canada, with a focus on productivity. It shows that multinationals are about 23 percent more productive than non-multinationals in Canada and that Canadian multinationals are as productive as foreign multinationals. The productivity advantage of multinationals is due to both selection and learning effects. In other words, firms are more productive before turning into multinationals and become even more productive after the fact. In addition, the paper shows that new multinationals are less productive than old multinationals, which may suggest that learning is a long process and it takes time for firms to capture the full benefits of multinationality. Furthermore, it finds that the productivity advantage of multinationals is due to their conscious selection behaviour in investments and their ability in generating higher productivity dividend from their investments in R&D than non-multinationals.

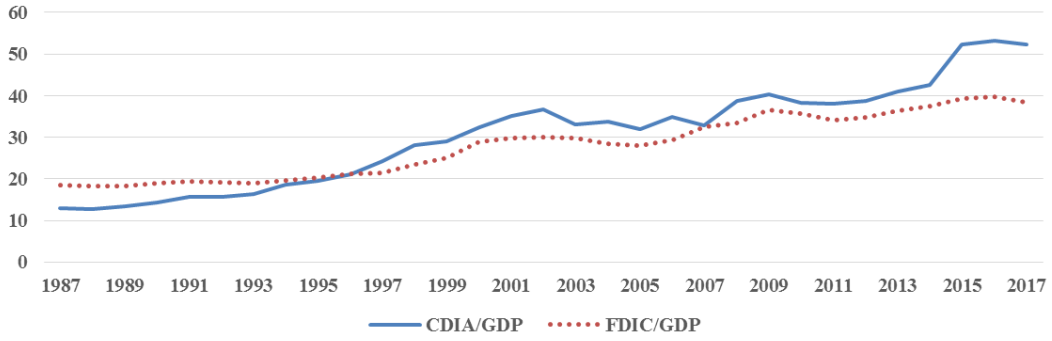
Keywords: multinationals, productivity, selection effect, learning effect, Canada

JEL codes: F23, D24

1. Introduction

Multinationals have played an increasingly important role in almost all economies. Canada is one of the most active host and home nations, as evidenced by a substantial increase in its inward and outward foreign direct investments (FDI) since 1990 (Figure 1).

Figure 1
Inward and Outward FDI in Canada
(Percent of GDP)



Source: Statistics Canada

Given the importance of multinationals to the Canadian economy, it is essential for policy makers to understand the economic performance of multinationals operating in Canada. We need to know how much multinationals outperform non-multinationals and why?

There have been many studies on the economic performance of foreign-controlled firms versus Canadian-controlled firms (Globerman, et al. 1994; Gu and Li, 2017).[1] However, mainly due to data limitation, those studies could not specifically identify Canadian-controlled multinationals from within the Canadian-controlled firms. Consequently, the study results regarding foreign-controlled multinationals are relative to both Canadian-controlled multinationals and non-multinationals. This may be inappropriate if one aims to solely estimate the performance differential between multinationals and non-multinationals or between foreign and Canadian-controlled multinationals.

The one exception to these prior studies is the Baldwin and Gu (2005). The Baldwin-Gu study singles out both Canadian-controlled and foreign-controlled multinationals operating in Canada and shows that while foreign-controlled plants are 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 enterprises advantage. That study, however, has its limitation. The main data for that study is from the 1993 Survey of Innovation and Advanced Technology at Statistics Canada. The one-year dataset is a small sample and covers only the manufacturing sector.

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

Overall, these previous studies do not provide solid evidence on why multinationals have a performance advantage. For policy development, however, it is essential to understand what drives the advantages of multinationals.

In this study, we provide a systematic analysis of multinationals in Canada. To this end, we construct a rich micro dataset from several administrative micro data files at Statistics Canada. The data set covers all industries and has a time span from 2000 to 2014. Using this micro dataset, we first single out foreign-controlled and domestic-controlled multinationals and compare them to non-multinationals using various economic indicators. Second, we delve deeper and estimate the productivity advantage of multinationals, including the selection and learning effects associated with multinationality. Finally, we investigate whether the behaviour and efficiency in investment in R&D play important roles in the superior productivity performance of multinationals.

The rest of this paper is organized as follows: In Section 2, we develop hypotheses on the behaviour of multinationals, with the economic rationale as support. In section 3, we describe the micro data, which are formed from four administrative microdata files in Canada. In section 4, we provide descriptive results, with a focus on the comparison of economic performance of multinationals versus non-multinationals. In section 5, we discuss the results on the productivity performance of multinationals compared to non-multinationals, the selection and learning effects associated with multinationals, the R&D effects on the productivity advantage of multinationals, and multinational investment behaviour in R&D. In section 6, we conclude.

2. Development of Hypotheses

The FDI literature postulates that firms must possess firm-specific advantages to operate in a foreign environment where businesses may have additional costs due to new markets, differences in cultural norms, less association with the local community, and challenges in management due to the greater distance (Dunning 1977 and Caves 1982). As a result, only the most productive firms are able to overcome these "foreignness" factors and afford the cost to operate profitably in foreign markets, as discussed in Head and Ries (2003), Antràs and Helpman (2004), Helpman et al. (2004). These lead to our first hypothesis in the paper:

Hypothesis 1: Multinational firms are more productive than non-multinationals.

Besides the challenges associated with "foreignness", there are many opportunities for firms operating in foreign markets. First, by going beyond domestic market, multinationals can achieve economies of scale, which allows those firms to benefit from cost advantage and improve returns to their investments. Second, the strategies deployed by firms operating in different international markets often provide a more flexible production organization that can better deal with both supply and demand shocks, which would add to the firms' competitive advantage (Dunning, 1996). Third, the presence of physical operations in a foreign market will allow firms to enhance their knowledge of local business opportunities, which provides them the access and subsequently the transfer of location-specific knowledge (Hejazi and Safarian, 1999). This may also go beyond location-specific knowledge to further include the host country's advanced technologies and resources (for example, capital, and skilled labour) (Cantwell and

Mudambi 2005, Shaver and Flyer 2000). Finally, firms exposed in international markets face vigorous global competition with best-performing companies. This enforces product market competition, which reduces managerial slack, and generates incentives to improve efficiency through product, process, or organizational innovation (Baily and Gersbach, 1995). For these reasons, we derive our second hypothesis:

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

Learning is a process to develop understanding of new business organization and human resources, new markets, and new cultural norms and local community. This requires information, knowledge, or technologies from foreign markets, parents or subsidiaries to be examined and explored from different perspectives, and often demands coordination, collaboration and developing consensus. Thus, there is a learning curve for Canadian multinationals in Canada to learn from their foreign subsidiaries and for foreign subsidiaries in Canada to implement their firm-specific knowledge in business activities in Canada.[2] As such, we further hypothesize:

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 in the deliberate application of new ideas and information to produce products or services from inputs. In this paper, we quantify and approximate firm-specific technological capacity by firm-level R&D efforts, as Aghion and Howitt (1992) suggest that a firm's technological capacity feeds on their past and current investment in R&D.

R&D effort represents a key strategy deployed by firms to develop firm specific advantages. Besides innovative products/services and production process, the firm advantages also include the development of intellectual property, giving firms an edge in both their home and host markets. In addition, R&D efforts enhance a firm's absorptive capacity. It improves the ability to learn from both domestic and foreign markets. There has been a vast amount of the empirical literature showing that investments in R&D contribute to productivity performance (e.g., Griliches 1979 and 1986; Wakelin, 2001; Griffith et al., 2004 and Hall et al., 2010). As previously discussed, multinationals tend to be more R&D intensive than non-multinational, which may partly explain the productivity advantage of multinationals.

In addition, firms may differ in exploiting R&D efforts in improving productivity. There are many reasons that multinational firms are expected to have stronger abilities exploiting their R&D investments and thus generating higher productivity from those investments than non-multinationals. The ability to generate greater R&D effects may be due to the multinationals' cross-country flexible production structure, larger markets for their products, and access to foreign advanced technologies and resources. It may also depend on their superior managerial

[2] For a discussion of learning from foreign business activities, see Ambos et al. (2006), Mu et al. (2007), and Furuya et al. (2009).

skills and strategic thinking. Dunning's survey results (1996) demonstrate that the deeper a multinational's cross-border structural integration , the greater the likelihood that these activities would add to the firm's competitive advantage.

Taking into account both R&D efforts and their effects, we derive our fourth and final hypothesis.

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

In the remaining of the paper these four hypotheses will be tested.

3. Micro Data

To provide a systematic analysis of multinationals in Canada, we made a great effort to link a number of administrative micro databases together. The linked micro database covers all industries for the years 2000 to 2014.

The first micro dataset used is from the Canadian Direct Investment Abroad (CDIA).[3] The database provides both inward and outward FDI data by surveyed firms operating in Canada, including the total dollar amount of FDI investment positions, the year in which the investment positions are associated, and by country. Investments are considered foreign direct investments when foreign investors have lasting interest and significant degrees of influence on the management of the invested firms. In practice, direct investment occurs when foreign investors own at least 10% of the voting equity in an invested firm. Inward direct investments are investments by a firm (or investors) outside of Canada in a firm operating in Canada, while outward direct investments are investments by firms operating in Canada in a firm operating in a foreign country.

The second micro dataset is from the General Index of Financial Information (GIFI). This data file collects financial statement and balance sheet information from each firm when it files a Canadian T2 Corporation Income Tax Return. We extract information from this data file and derive a firm's gross output, physical capital stock, and intermediate inputs. In addition, we obtain data on R&D stock from the scientific research and experimental development (SRED) program. This includes in-house R&D and purchased R&D (contract-out or third party R&D) while excluding contract-in R&D (or R&D performed for others). R&D stock is estimated from real R&D investment using the perpetual inventory method and a depreciation rate of 15%.

Firm data on payroll and employment are from the National Accounts Longitudinal Microdata File (NALMF). NALMF is an administrative data file created by the Economic Analysis Division at Statistics Canada. The NALMF uses administrative tax records (T2 and PD7), T4 data, and information from the Business Register and the Survey of Employment, Payrolls and

[3] CDIA is an annual survey by Statistics Canada. Questionnaires are sent to Canadian enterprises known to have or believed to have significant amount of international assets or liabilities. These surveys do not cover all firms in Canada, but are believed to cover close to 100% of the target population before 2009 (quasi-census). Since 2008 the survey sampling strategy has been changed such that a lot of the smaller firms have been dropped.

Hours (SEPH). The T2 data includes corporations that file a T2 tax return with the Canada Revenue Agency (CRA). The T4 data, PD7 and SEPH include corporations and unincorporated firms that hire employees.

Table 1: Sample Observation Distribution

Industry	2000	2005	2009	2014	**Total 2000-2014**
Crop and animal production	8037	7361	8128	8393	120820
Forestry and logging	6961	6339	5342	4507	86875
Fishing, hunting and trapping	2244	2483	2371	2323	35756
Support activities for agriculture and forestry	3200	3170	3296	3514	48691
Oil and gas extraction	1408	1784	2042	1998	27520
Mining and quarrying	912	781	754	721	11995
Support activities for mining and oil and gas extraction	4937	6333	7956	8220	102754
Utilities	591	732	734	721	10619
Construction	86732	99120	120089	139433	1657981
Food	5482	4863	4747	5075	74337
Beverage and tobacco	568	571	611	831	9281
Textile and product mills	1742	1434	1184	1011	19818
Clothing, leather and allied product	3646	2790	2044	1696	38058
Wood product	3770	3540	3418	3166	52355
Paper	750	668	575	455	9128
Printing	4956	4545	4189	3687	65016
Petroleum and coal	276	177	164	186	2855
Chemical	1943	1796	1740	1748	26981
Plastics and rubber	2312	2245	2072	1995	32011
Non-metallic mineral	1934	1844	1841	1721	27531
Primary metal	667	615	616	559	9132
Fabricated metal	8095	8053	7969	7721	119770
Machinery	5359	5267	5177	4927	77852
Computer and electronics	2415	2046	2002	1804	30939
Electrical equipment	1179	1127	1123	1158	17041
Transportation equipment	2352	2156	2056	1854	31564
Furniture	3680	3948	3997	3887	58751
Miscellaneous manufacturing	4813	5411	5523	5873	81301
Wholesale trade	52505	52850	53224	50230	785224
Retail trade	88525	93380	94970	97432	1403842
Transportation and warehousing	35748	39948	51615	67004	713369
Information and cultural industries	11343	11850	12806	14236	189543
Finance, insurance, real estate, and company management	76989	76654	86397	84187	1210255
Professional, scientific and technical services	89443	107861	129289	146861	1782096
Administrative, waste management	31770	37175	42970	46082	596552
Arts, entertainment and recreation	12178	14543	16032	16595	225676
Accommodation and food services	51677	56341	60009	68361	886882
Other services except public administration	50134	59818	70783	79905	983320
Total business sector	671273	731619	819855	890077	11663491

Data on firm age and foreign ownership were also obtained from NALMF. This data mainly originates from the Business Register (BR). Based on the foreign ownership information, firms

are identified as foreign- or domestic-controlled. BR is the central repository of information on businesses in Canada. Used as the principal framework for the economic statistics program at Statistics Canada, it maintains a complete, up to date, and unduplicated list of all active businesses in Canada that have a corporate, payroll, or a goods and services tax account.

To ensure comparison overtime, we deflate the nominal variables using detailed industry deflators based on KLEMS.[4] In particular, gross output, physical capital assets, and labour compensation at the firm level are deflated by gross output, capital stock, and value added with the intermediate inputs deflated at a detailed industry level.

The sample observation distribution by industry by selected years is exhibited in Table 1. Please note that this excludes the education, health, and public administration sectors as they are government-related sectors with possible measurement issues.[5] There were over 11.7 million observations in the sample period. The number of observations increased over time from 671 thousand in 2000 to 890 thousand in 2014. The increase was due to the expansion of non-manufacturing industries as the number of observations related to manufacturing firms decreased from 55.9 thousand in 2000 to 49.4 thousand in 2014.

4. Descriptive Statistics Related to Multinationals

Multinational firms in Canada are defined in this paper as firms operating in Canada with either outward FDI, inward FDI, or both, in the current year or any previous year in the sample period. Foreign multinationals are such firms that are foreign-controlled while Canadian multinationals are Canadian-controlled multinationals. [6]

About one percent of firms in our dataset were multinationals, and the majority of these multinationals were foreign owned (Table 2).[7] The total number of multinationals in our database increased over time. The increase was driven by foreign multinationals as we observe a decline in the number of Canadian multinationals and an increase in the number of foreign multinationals. Notably, the decline in the number of Canadian multinationals was widespread in all industry groups since 2005.[8]

[4] For a description of the KLEMS, please see Baldwin et al. (2007).

[5] Due to the absence of markets, output for government enterprises is often based on inputs.

[6] It is important to note that we define foreign control using the Country of Control variable from the Business Register database. It classifies the Country of Control for each enterprise as to 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, information obtained from the Canada Revenue Agency's administrative records, or via profiling of the enterprise. It follows the Inter-Corporation Ownership (ICO) concept. Notably, this differs from the foreign direct investment concepts used in Statistics Canada's international accounts' program, which are based on international standards.

[7] The table reports the number of observations of multinationals in our database. It does not cover all multinationals in the Canadian economy since the firms in our database are mainly determined by the firms in the surveys for CDIA. Nevertheless, we believe that our database captures almost all large Canadian enterprises known to have or believed to have significant international assets or liabilities.

[8] The change in sampling for CDIA since 2008 might be largely responsible for the drop in the number of Canadian multinationals as the change mainly has reduced the number of small Canadian-controlled firms in the survey.

Multinationals have been playing a vital role to the Canadian economy. In our dataset, they accounted for 49.5 percent of gross output, 28.6 percent of employment, and 58.3 percent of R&D investments in 2014. These percentages increased respectively from 32.3 percent, 19.4 percent, and 36.1 percent in 2000 (Table 3). Their importance was more pronounced in the manufacturing sector. Multinationals accounted for 68.2 percent in gross output, 43.5 percent in employment, and 66.7 percent in R&D investments in 2014, which had increased respectively from 52.2 percent, 32.3 percent, and 37.8 percent in 2000.

Table 2: Multinational Observation Distribution

	2000	2005	2009	2014	**Total 2000-2014**
Canadian Multinationals					
Manufacturing	732	783	384	277	8281
Other Goods Producing Industries	266	294	275	255	4059
Service Industries	1265	1652	1341	1229	20934
Total Business Sector	2263	2729	2000	1761	33274
Foreign Multinationals					
Manufacturing	757	1137	1774	1703	20434
Other Goods Producing Industries	268	322	574	762	6961
Service Industries	2699	3620	5736	6562	70456
Total Business Sector	3724	5079	8084	9027	97851

Table 3: Shares of Canadian and Foreign Multinationals in Gross Output, Employment and R&D

	2000			2005			2009			2014		
Multinationals' Share in Gross Output (%)												
	Can.	For.	Total	Can.	For.	Total	Can.	For.	Total	Can.	For.	Total
Manufacturing	18.9	33.3	52.2	24.3	40.5	64.8	16.8	51.1	67.9	12.4	55.8	68.2
Other Goods Producing	8.9	11.0	19.9	15.5	12.9	28.4	13.6	26.7	40.3	15.9	24.9	40.8
Service Industries	13.6	11.3	24.9	18.3	18.3	36.6	18.6	23.7	42.3	17.5	28.8	46.3
Total Business Sector	14.6	17.7	32.3	19.6	23.6	43.2	17.4	30.0	47.4	16.3	33.2	49.5
Multinationals' Share in Employment (%)												
	Can.	For.	Total	Can.	For.	Total	Can.	For.	Total	Can.	For.	Total
Manufacturing	15.8	16.5	32.3	17.3	23.6	40.9	12.9	33.0	45.9	11.1	32.4	43.5
Other Goods Producing	4.2	3.1	7.3	6.8	6.2	13.0	9.5	9.6	19.1	8.5	10.4	18.9
Service Industries	8.4	8.1	16.5	12.3	12.3	24.6	10.5	16.7	27.2	10.6	17.0	27.6
Total Business Sector	9.8	9.6	19.4	12.7	13.8	26.5	10.7	18.4	29.1	10.4	18.2	28.6
Multinationals' Share in R&D Investment (%)												
	Can.	For.	Total	Can.	For.	Total	Can.	For.	Total	Can.	For.	Total
Manufacturing	21.7	16.1	37.8	30.2	25.6	55.8	29.3	35.9	65.2	30.0	36.7	66.7
Other Goods Producing	8.2	12.5	20.7	34.0	20.9	54.9	30.4	36.9	67.3	49.0	29.0	78.0
Service Industries	21.9	13.0	34.9	31.8	14.3	46.1	13.2	27.8	41.0	14.1	35.0	49.1
Total Business Sector	21.3	14.8	36.1	31.1	20.2	51.3	21.8	32.2	54.0	23.1	35.2	58.3

The increased importance of multinationals in our dataset was mainly driven by foreign multinationals as the number of Canadian multinationals increased by a small margin over the

sample period. In 2014, Canadian multinationals' shares in the total business sector were 16.3 percent in gross output, 10.4 percent in employment, and 23.1 percent in R&D investment, which increased slightly from 14.6 percent, 9.8 percent, and 21.3 percent in 2000, respectively. At the same time, the shares of foreign multinationals increased from 17.7 percent in 2000 to 33.2 percent in 2014 for gross output, from 9.6 percent in 2000 to 18.2 percent in 2014 for employment, and from 14.8 percent in 2000 to 35.2 percent in 2014 for R&D investment.

Compared to non-multinationals, multinationals tend to be larger (in both output and employment), more capital and R&D intensive, and more productive (in both labour productivity and MFP) (Table 4). In addition, they are paying higher wages and are more established (or older). These results are consistent with the findings on foreign-controlled firms over Canadian-controlled firms from previous literature (Baldwin and Gellatly, 2007). Interestingly, Canadian multinationals perform better than foreign multinationals in all of these economic indicators except in productivity.

Table 4: Economic Performance, Multinationals vs Non-multinationals, by Year

Economic indicator	2000	2001	2002	2014
Canadian multinationals				
Gross output (millions, $2000) per firm	133.4	160.8	194.1	241.6
Employment per firm	369.4	429.5	510.2	608.6
Tangible capital stock per worker (thousands, $2000)	150.0	159.0	329.8	332.5
R&D stock per worker ($2000)	14092	18266	17109	15374
Labour productivity (thousands, $2000)	361.0	374.4	380.5	397.0
MFP (2000=100)	100.0	103.3	99.7	102.7
Real labour compensation per worker (thousands, $2000)	49.8	50.2	53.8	58.2
Firm age	10.3	15.5	18.5	23.1
Foreign multinationals				
Gross output (millions, $2000) per firm	98.5	107.4	82.8	97.7
Employment per firm	221.4	252.2	215.8	208.7
Tangible capital stock per worker (thousands, $2000)	105.2	106.6	130.9	165.2
R&D stock per worker ($2000)	7100	10337	14702	13566
Labour productivity (thousands, $2000)	444.9	425.7	383.6	468.3
MFP (2000=100)	100.0	102.9	96.4	99.5
Real labour compensation per worker (thousands, $2000)	45.4	45.0	42.7	46.3
Firm age	7.2	11.0	14.3	17.1
Non-multinationals				
Gross output (millions, $2000) per firm	2.1	1.8	1.4	1.5
Employment per firm	10.4	9.4	8.3	8.4
Tangible capital stock per worker (thousands, $2000)	56.5	52.3	61.1	66.6
R&D stock per worker ($2000)	2657	4065	3807	3294
Labour productivity (thousands, $2000)	202.6	186.6	167.6	174.1
MFP (2000=100)	100.0	101.0	98.9	99.9
Real labour compensation per worker (thousands, $2000)	34.9	35.2	32.6	32.3
Firm age	6.5	8.8	10.3	11.8

The overall better economic performance of multinationals may be a result of their maturity, economic scale, production organization (or flexibility), and greater investments in innovation

and technology. In the remaining sections, we conduct econometric analysis to tease out the linkage, with a focus on productivity.

5. Multinational's Superior Productivity Performance

How much more productive are multinationals than non-multinationals? Are Canadian multinationals as productive as foreign multinationals? Why do multinationals perform better than non-multinationals? In this section, we address these questions by testing our four hypotheses.

5.1. The Regression Model

To quantify the productivity advantage of multinationals and its determinants, we estimate a standard production function regression model as follows:

$$\ln(Y_{it}) = \alpha + \alpha_1 \ln(L_{it}) + \alpha_2 \ln(K_{it}) + \alpha_3 \ln(M_{it}) + \mathbf{\beta F_{it}} + \mathbf{\Gamma_C X}_{it}^{C} + \mathbf{\Lambda}_D \mathbf{D}_{it} + \varepsilon_{it} \quad (1)$$

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; $\mathbf{F_{it}}$ are a set of dummy variables associated with Canadian multinationals and foreign multinationals. The reference group is non-multinationals; $\mathbf{X}_{\mathrm{it}}^{\mathrm{C}}$ is a vector of additional variables that may be important for productivity, including the young firm dummy, R&D intensity, and capacity utilization; $\mathbf{D_{it}}$ is a vector of industry-year dummies; and ε_{it} is the error term.

Gross output after controlling for contributions from labour, capital and intermediate inputs equals the standard productivity measure – multifactor productivity (MFP). Thus, the remaining variables, including the F and X factors, explain firm variation in MFP.

To reflect the fact that young firms may be less efficient than established ones, we introduce a dummy on young firms. According to Liu and Tang (2017), entrants in Canada take about five years to become as efficient as incumbents. Thus, the dummy equals 1 if a firm is less than six years old; 0 otherwise.

R&D is used to explain productivity as productivity reflects a firm's technological development. This is determined broadly by the firm's innovation capacity, which facilitates the firm's deliberate application of new ideas and knowledge to produce products or services from the inputs. The technological or innovative capacity feeds on past and current investments in R&D (Aghion and Howitt, 1992). R&D is a process of applying new ideas and initiatives, which requires a certain length of time to create innovation capacity and generate innovative products and production methods. Thus, R&D is in this paper measured in stock. R&D intensity is measured as R&D stock per worker.

We control for the effect associated with production capacity utilization to capture the influence of changes in demand conditions on productivity. An unexpected change in demand condition affects the utilization of production capacity as firms are unable to adjust installed machines in a timely manner. For example, an unexpected lower demand will lead to the underutilization of production capacity. Basu and Kimball (1997) shows that changes in capacity utilization could explain up to 60 percent of short run economic fluctuation. Baldwin et al. (2013) shows that the Canadian manufacturing sector experienced excess capacity post-2000, with a decline in capacity utilization in 16 of the 20 manufacturing industries. It suggests that the development of access capacity was mainly due to the large decline in exports as a result of the trade environment changes during that period. The measure of capacity utilization for this paper is in Appendix A.

The introduction of industry-year dummies is to control for all time-variant and time-invariant industry specific effects. For example, they 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 (for example, entry/exit).

Multinationals tend to be large, but most non-multinationals are very small. To have a meaningful comparison between multinationals and non-multinational in our econometric analysis, we only include firms with an average of over 10 annual employees across the sample period.[9]

5.2. The Productivity Advantage of Multinationals

To quantify the productivity advantage of multinationals over non-multinationals, in regression (1) of Table 5, we single out Canadian and foreign multinationals to examine whether they perform differently compared to non-multinationals. The estimation is based on ordinary least square estimation (OLS) with a robust standard error. Robust standard error is a common and effective way to deal with heteroscedasticity, minor problems associated with the lack of normality, or some observations that exhibit large influence. [10] The estimation supports our first hypothesis and shows that Canadian multinationals are as productive as foreign multinationals, and that multinationals are about 23 percent more productive than non-multinationals.[11] The results do not change after controlling for the young firm dummy and capacity utilization (Regression (2)).

As expected, the estimation finds that young firms are less productive and capacity utilization is positively associated with productivity.

There is a significant debate in the international trade literature as to whether higher productivity firms actively choose to be involved in exporting and/or whether exporting enhances productivity (Trefler, 2004; Bernard and Jensen, 1999). Similar to the debate, in this paper, we analyze the selection and learning effects that are associated with multinationality. In other words, we want to know whether higher productivity firms actively choose to become

[9] The general results will better when smaller firms are included as smaller firms tend to be less productive.

[10] Note, however, that 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] Ln(MFP_multi/MFP_non-multi)=0.21, or MFP_multi/MFP_non-multi=1.23.

multinationals and/or whether being multinationality enhances their productivity. The analysis shall reveal if selection, ex post learning, or both are at play in explaining the superior productivity performance of multinationals.

Table 5: Estimation of Multinationals' Productivity Advantage

	Ordinary Least Square (OLS)				Fixed Effects
	(1)	(2)	(3)	(4)	(5)
Ln(labour)	0.291*** (0.0008)	0.289*** (0.0008)	0.290*** (0.0008)	0.288*** (0.0008)	0.232*** (0.0015)
Ln(capital)	0.043*** (0.0003)	0.049*** (0.0003)	0.043*** (0.0003)	0.049*** (0.0003)	0.171*** (0.0022)
Ln(intermediate)	0.650*** (0.0008)	0.646*** (0.0008)	0.648*** (0.0008)	0.644*** (0.0008)	0.507*** (0.0030)
Canadian multinational	0.214*** (0.0030)	0.214*** (0.0030)			
Foreign multinational	0.207*** (0.0019)	0.207*** (0.0019)			
Multinationality: ex-ante			0.174*** (0.0023)	0.177*** (0.0023)	
Multinationality: ex-post			0.2110*** (0.0023)	0.210*** (0.0023)	0.020*** (0.0037)
Multinationality: all-time			0.225*** (0.0021)	0.226*** (0.0021)	
Young firm		-0.005*** (0.0007)		-0.007*** (0.0006)	-0.015*** (0.0008)
Capacity utilization		0.039*** (0.0006)		0.039*** (0.0006)	0.143*** (0.0018)
Industry-year dummies	YES	YES	YES	YES	
Year dummies					YES
Number of observation	1893380	1893380	1893380	1893380	1893380
R square	0.9470	0.9473	0.9472	0.9475	0.9066

Note: Standard errors are in parentheses. "***" stands significance at the 1% level. OLS regressions (1)-(4) assume robust standard error, but results remain intact under firm clustered standard error. The regression with fixed effect (5) has a robust standard error adjusted for clusters in firm.

To facilitate the analysis, we specify here the dummy variables associated with multinationals in regression model (1). In particular, we divide firms into three groups. The first group includes firms that switched from non-multinationals to multinationals over the sample period. Two dummy variables are introduced for this group of firms: multinationality ex-ante and multinationality ex-post. The ex-ante dummy is set to 1 before switching to multinationals and 0 otherwise. The ex-post dummy variable is set to 1 after switching to multinationals and 0 otherwise. The second group includes firms that are multinationals since the first year of the

sample, 2000. For this group, we introduce a multinationality all-time dummy. The third group, which is the reference group, includes firm that are non-multinationals over the whole sample period.

Table 6: Estimation of Incremental Learning Effects

	Ordinary Least Square (OLS)	Fixed Effects
	(1)	(2)
Ln(labour)	0.287*** (0.0008)	0.232*** (0.0015)
Ln(capital)	0.049*** (0.0003)	0.171*** (0.0022)
Ln(intermediate)	0.644*** (0.0008)	0.507*** (0.0030)
Multinationality: ex-ante	0.177*** (0.0008)	
Multinationality: 1st year	0.206*** (0.0055)	0.017*** (0.0039)
Multinationality: 2nd year	0.210*** (0.0058)	0.019*** (0.0044)
Multinationality: 3rd year	0.211*** (0.0060)	0.019*** (0.0046)
Multinationality: 4th year	0.217*** (0.0070)	0.023*** (0.0054)
Multinationality: 5th year or more	0.223*** (0.0019)	0.021*** (0.0051)
Young firm	-0.007*** (0.0006)	-0.015*** (0.0008)
Capacity utilization	0.039*** (0.0006)	0.143*** (0.0018)
Industry-year dummies	YES	
Year dummies		YES
Number of observation	1893380	1893380
R square	0.9475	0.9066

Note: Standard errors are in parentheses. "***" stands significance at the 1% level. OLS regression (1) assumes robust standard error, but results remain intact under firm clustered standard error. The regression with fixed effect (3) has a robust standard error adjusted for clusters in firm.

The regression results without and with control variables young firm dummy and capacity utilization are reported in regressions (3) and (4), Table 5. The estimation shows that firms, before they become multinationals, are more productive than non-multinationals. After these firms become multinationals, they become even more productive. These results suggest that there exists both the selection and learning effects. We interpret the difference in productivity between multinationality ex-ante and multinationality ex-post is the learning effect. The

statistically highly significant learning effect is also largely captured with a regression with firm fixed effects (regression (5), Table 5).[12] The learning effect confirms our second hypothesis—multinationality improves productivity.

In addition, an F-test shows that the coefficient of the all-time multinational variable is significantly higher than that of multinationality ex-post dummy. This is consistent with our hypothesis 3: learning takes time and new multinationals are less productive than old multinationals. To further support this hypothesis, we group multinationalities into five groups corresponding to multinationality 1st year, multinationality 2nd year, multinationality 3rd year multinationality 4th year, and multinationality 5th year or more. Both OLS and regression with firm fixed effects show that the learning effect increases over time (Table 6). Although the incremental increase between adjacent years are not statistically significant, the difference between 1st year and 5th year or more is statistically highly significant. This suggests that learning foreign operation management and foreign markets is a long process before r new multinationals can fully benefit from these foreign operations.

5.3. R&D Investments and the Productivity Advantage of Multinationals

Why are multinationals more productive than non-multinationals? In this section, we link productivity to investment in R&D. R&D is considered to be the most important factor to develop a firm's technological or innovative capacity and is the key driver in improving productivity. In this section, we test hypothesis 4. In particular, we want to know if the productivity advantage of multinationals is due to their higher investment in R&D and their ability to generate higher returns from the investment.

The estimation results on the linkage between R&D and productivity are reported in Table 7. Those regressions are based on only R&D performing firms. That is, we want to know if R&D multinationals behave differently from R&D non-multinationals. As shown in regression (1), the productivity advantage of multinationals for R&D performing firms is slightly smaller than before. This is expected as we are now comparing similar groups of firms after excluding non-R&D performing firms which are generally non-multinationals, smaller, and less productive. An important departure of the estimation based only on R&D firms from the estimation based on both R&D and non-R&D firms is the estimated coefficient on the young firm dummy. The young firm dummy is now positive and significant under the R&D firm estimation while it was negative and significant under the combined R&D and non-R&D firm estimation. This is indicative of young non-R&D firms being highly less productive. This is consistent with the Canadian literature that young firms tend to be less productive when all small firms are included in the regression model (Tang 2014; Liu and Tang 2017) while they become more productive when small firms are excluded (Tang and Van Assche, 2017).

Table 7: Estimation of the Linkage between R&D and Productivity Advantage of Multinationals

	(1)	(2)	(3)	(4)	(5)	(6)
Ln(labour input)	0.294***	0.316***	0.316***	0.293***	0.315***	0.315***

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

	(0.0023)	(0.0023)	(0.0023)	(0.0023)	(0.0023)	(0.0023)
Ln(capital input)	0.071*** (0.0010)	0.067*** (0.0010)	0.067*** (0.0010)	0.070*** (0.0010)	0.066*** (0.0010)	0.066*** (0.0010)
Ln(intermediate input)	0.620*** (0.0024)	0.617*** (0.0024)	0.617*** (0.0024)	0.618*** (0.0024)	0.615*** (0.0024)	0.615*** (0.0024)
Canadian multinational	0.178*** (0.0046)	0.159*** (0.0045)	0.053*** (0.0217)			
Foreign multinational	0.182*** (0.0033)	0.167*** (0.0032)	0.104*** (0.0143)			
Multinationality: ex-ante				0.124*** (0.0035)	0.109*** (0.0025)	-0.012 (0.0198)
Multinationality: ex-post				0.178*** (0.0037)	0.162*** (0.0036)	0.055*** (0.0179)
Multinationality: all-time				0.209*** (0.0038)	0.191*** (0.0038)	0.115*** (0.0160)
Young firm	0.046*** (0.0021)	0.047*** (0.0021)	0.047*** (0.0021)	0.044*** (0.0021)	0.045*** (0.0021)	0.045*** (0.0021)
Capacity utilization	0.047*** (0.0016)	0.046*** (0.0016)	0.046*** (0.0016)	0.048*** (0.0016)	0.047*** (0.0016)	0.047*** (0.0016)
Ln(R&D intensity)		0.032*** (0.0005)	0.031*** (0.0005)		0.031*** (0.0005)	0.029*** (0.0005)
Ln(R&D intensity)*Canadian multinational			0.011*** (0.0024)			
Ln(R&D intensity)*Foreign multinational			0.007*** (0.0016)			
Ln(R&D intensity)* Multinationality: ex-ante						0.012*** (0.0021)
Ln(R&D intensity)* Multinationality: ex-post						0.011*** (0.0020)
Ln(R&D intensity)* Multinationality: all-time						0.008*** (0.0018)
Industry-year dummies	YES	YES	YES	YES	YES	YES
Number of observation	243736	243736	243736	243736	243736	243736
R square	0.9643	0.9653	0.9653	0.9645	0.9655	0.9655

Note: Standard errors are in parentheses. "***" stands significance at the 1% level. The regressions assume robust standard error, but results remain intact under firm clustered standard error.

For regression (2), we introduce the R&D variable under the assumption that the returns from R&D are the same for multinationals as for non-multinationals. The estimation shows that the coefficients on the Canadian and foreign multinational dummies are reduced. This reflects that multinationals are doing more R&D than non-multinationals. Although the reductions are statistically highly significant, they represent a productivity advantage reduction from 19.5

percent to 17.2 percent for Canadian multinationals and from 19.9 percent to 18.1 percent for foreign multinationals.

For regression (3), we also assume that the R&D returns to both Canadian and foreign multinationals are different from those to non-multinationals. So we introduce the interaction terms of the R&D variable with Canadian and foreign multinational dummies. Both interaction terms are positive and statistically significant. This means that the returns to R&D are higher for multinationals than for non-multinationals. Importantly, we observe that the coefficients on both Canadian and foreign multinational dummies are substantially reduced. In other words, after controlling for the R&D effects, the respective 19.5 percent and 19.9 percent productivity advantage of Canadian and foreign multinationals are reduced to 5.4 percent and 10.9 percent respectively.

Notably, the R&D effects are smaller for foreign multinationals than for Canadian multinationals. A large part of f the difference is due to the ability of Canadian multinationals to generate higher returns from their R&D investments compared to that of foreign multinationals.

For the remaining three regressions (4)-(6) in Table 7, we treat multinational firms differently before and after becoming multinationals. The estimation shows that the ex-ante and ex-post productivity advantage of multinationals also relate to higher R&D effects for multinationals, especially the ability to generate higher returns from R&D investments. After controlling for R&D effects, the 13.2 percent of ex-ante productivity advantage of multinational firms disappeared and the 19.5 percent of ex-post productivity advantage of multinationals is reduced to 5.6 percent. Again, the results suggest that the ex-ante and ex-post productivity advantage of multinationals is largely due to higher R&D effects for multinationals

The 5.6 percent of the ex-post productivity advantage of multinationals that could not be explained by the introduced explanatory variables may be associated with the multinationals' more efficient operations as a result of a more flexible production organization across countries, access to larger markets, better information about the market for their products, and greater exposure to international advanced technologies and management practices.

The finding that the productivity advantage of multinationals can be largely explained by the higher R&D effort and higher R&D effects for multinationals confirms our fourth hypothesis: higher firm-level R&D efforts and effects contribute significantly to the productivity advantage of multinational firms.

5.4. Investments and Multinationals

Continuing the search for answers on why multinationals are more productive than non-multinationals, we investigate in this section the difference in the investment behaviours between multinationals and non-multinationals. In particular, we investigate how a firm's investments in R&D in the current year 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 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 behavior but also its operational scale. For all regressions, we introduce industry-year dummies, which 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 (for example, entry/exit).

Table 8 reports the estimation results of investments and its association with multinationals. Regression (1) shows that R&D investments in the current year are positively and significantly related to previous investments. Importantly, they are also positively and significantly associated with Canadian multinationals, large-sized firms, young firms, and productivity. The finding that only Canadian multinationals are involved in more R&D than non-multinationals is interesting. The result is consistent with the study of Tang and Rao (2003) which shows that foreign-controlled firms are less R&D-intensive than Canadian-controlled firms due to the fact that R&D activities for multinationals tend to be centralized at their respective parent countries. Note, however, that despite the centralization in R&D activities abroad, foreign-controlled firms may still benefit from technology and knowledge transfers from their parent companies in their R&D initiatives in Canada.

In regression (2), we specify multinationals in more detail and examine the multinationals' R&D investment behaviour before and after becoming multinationals. We continue to observe that Canadian multinational firms are pursuing more R&D investments, but more so before becoming multinationals than after becoming multinationals. Foreign multinationals are doing more R&D investments before becoming multinationals and less after.

R&D activities are investments in intangibles. To see how multinationals behave differently in investments in tangibles, we repeat the same exercise for investments in machinery, equipment, and building structures as for investments in R&D (regressions (3) and (4) in Table 8). The estimation results show that both Canadian and foreign multinationals invest more in tangible assets than non-multinationals, and more so before they become multinationals.

Table 8: Estimation on the Relationship between Investments and Multinationals

	R&D investment (log)		Physical investment (log)	
	(1)	(2)	(3)	(4)
Lagged dependent variable	0.864*** (0.0008)	0.864*** (0.0008)	0.614*** (0.0008)	0.613*** (0.0008)
Canadian multinational	0.069*** (0.0193)		0.433*** (0.0290)	
Foreign multinational	-0.051 (0.0114)		0.379*** (0.0186)	
Canadian multinationality: ex-ante		0.240*** (0.0475)		0.820*** (0.0602)
Foreign multinationality: ex-ante		0.150*** (0.0192)		0.689*** (0.0246)
Other multinationality: ex-ante		0.296*** (0.0879)		0.736*** (0.1184)
Canadian multinationality: ex-post		0.065*** (0.0367)		0.445*** (0.0577)
Foreign multinationality: ex-post		-0.043** (0.0176)		0.389*** (0.0277)
Other multinationality: ex-post		0.022 (0.0526)		0.734*** (0.0679)
Canadian multinationality: all-time		0.114*** (0.0321)		0.336*** (0.0494)
Foreign multinationality: all-time		-0.053*** (0.0169)		0.335*** (0.0300)
Other multinationality: all-time		0.003 (0.0215)		0.562*** (0.0310)
Large firm	0.490*** (0.0223)	0.473*** (0.0223)	1.661*** (0.0287)	1.613*** (0.0289)
Young firm	0.048*** (0.0034)	0.048*** (0.0034)	-0.320*** (0.0076)	-0.319*** (0.0076)
Lagged MFP in log	0.066*** (0.0037)	0.062*** (0.0037)	0.236*** (0.0096)	0.220*** (0.0095)
Industry-year dummies	YES	YES	YES	YES
Number of observation	1685365	1685365	1685365	1685365
R square	0.7994	0.7994	0.3991	0.3995

Note: Other multinationality stands for multinationals switched ownership from Canadian to foreign or vice versa. Standard errors are in parentheses. "***" stands significance at the 1% level. The regressions assume robust standard error, but results remain intact under firm clustered standard error.

There are two important differences between investments in R&D and investments in tangible assets. First, unlike in investments in R&D, young firms are found to be negative and significant in investments in tangible assets. In other words, young firms invest less in tangible assets compared to older or more established firms. This result is in contrast with the results which showed that young firms are doing more R&D investments than established firms. This variance

may be due to the fact that young firms focus more on the development and improvement of their products, which requires more intangible assets, while established firms focus more on the production of mature products, which require more physical assets.

Unlike in R&D investments, we also observe that foreign multinational firms' investments in tangible assets rival the levels of Canadian multinationals before and after becoming multinationals. Like R&D investments, both Canadian and foreign multinationals have less investments in tangible assets after becoming multinationals. This may be related to the conscious selection behaviour, discussed by Alvarez and Lopez (2005), in the context of export. Basically, applied to this context, it means that firms consciously invest more to enhance their productivity to be able to undertake outward FDI before achieving multinational.

6. Conclusions

Canada is a highly open economy and a major host and home country in FDI. Multinationals have been very active and have become the main blood vein of the Canadian economy. In 2014, multinationals accounted for 49.5 percent of gross output, 28.6 percent of employment, and 58.3 percent of R&D activities. In addition, they are larger, more innovative, more productive, and pay higher wages compared to non-multinationals.

By constructing a micro database from several administrative micro data files, we provided a systematic analysis of economic performance in Canada and traced the sources of the superior productivity performance of multinationals. We showed that Canadian multinationals were as productive as foreign multinationals and that multinationals were on average about 23 percent more productive than non-multinationals. In addition, we showed that firms which were more productive before they became multinationals were even more productive after the fact, which suggests that both selection and learning effects are at play in terms of their superior productivity performance. Furthermore, we showed that the superior productivity performance of multinationals was due to their conscious selection behaviour associated with investments and their ability to generate higher productivity from their investments in R&D.

Multinationals are most productive firms, which ensures the most efficient use of production resources. The increasing role of multinationals in the Canadian economy bodes well for Canada's general productivity performance as higher productivity of multinationals helps to shore up an otherwise even more miserable productivity performance.[13] The Canadian governments should continue to improve the regulatory and tax frameworks to attract and retain FDI into Canada, and work towards improving access to Canadian direct investment abroad.

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Appendix A: Measuring Capacity Utilization at the Firm Level

The methodology for measuring capacity utilization is the same method used by Tang and Wang (2018). It begins with the common definition: capacity utilization is the extent to which a firm uses its installed productive capacity. Under the assumption that the installed productive capacity is the productive capital stock of the firm and that there is no labour hoarding, the use intensity of installed capital by labour and intermediate inputs for firm *i* in industry *j* at time *t* is proportional to capacity utilization after adjusting for the input substitution effect due to a change in relative prices of inputs:

$$U_{i,j,t} = \underbrace{\left(S_{i,j,t} / K_{i,j,t}\right)}_{\text{Capital use intensity}} \Big/ \underbrace{\left(P^K_{i,j,t} / P^S_{i,j,t}\right)}_{\text{Substitution effect}} \tag{A1}$$

where $K_{i,j,t}$ is capital stock, and $S_{i,j,t}$ is the combined input of labour and intermediate inputs. $P^K_{i,j,t}$ and $P^S_{i,j,t}$ are the user cost of capital stock and the price of the combined input of labour and intermediate inputs, respectively.

$P^K_{i,j,t} / P^S_{i,j,t}$ represents the input substitution effect since under the Cobb-Douglas production function with Hicks-neutral technical change, a profit-maximizing firm will ensure that the ratio of the combined input (*S*) to capital (*K*) is proportional to the user cost of capital (P^K) relative to the price of the combined input (P^S). It represents the optimal level of capital use intensity.

The measure has several desirable properties. First, during normal business operation with normal capacity utilization, the capacity utilization measure equals 1 as any change in capital use intensity is due to the change in input substitution. Second, the capacity utilization measure still equals 1 under any Hicks-neutral productivity shocks. Finally, when there is a negative (positive) shock to the demand condition, actual capital use intensity is below (above) the optimal intensity and the capacity utilization measure is below (above) 1. The extent it is below (above) 1 depends on how far the actual capital use intensity is below (above) the optimal level. Now let's illustrate by an example, by looking at the change in the capacity utilization firm *i* in industry *j* at time *t* from time *t*-1 when demand for firm *i* is unexpectedly reduced at time *t* compared to the previous period. For simplicity, we assume that the prices of inputs do not change between *t* and *t-1* and that the firm can quickly adjust the combined input of labour and intermediate inputs. The firm's capacity utilization at time *t* relative to *t-1* will then be $\left(S_{i,j,t} / K_{i,j,t}\right) \Big/ \left(S_{i,j,t-1} / K_{i,j,t-1}\right)$. Thus, the change in capacity utilization is proportional to the change in the use intensity of capital.

The combined labour-intermediate input for firm *i* industry *j* at time *t* is calculated as a weighted sum of labour and real intermediate inputs in the *Törnqvist index* as follows:

$$\Delta \ln(S_{i,j,t}) = \overline{w}_{i,j,t} \Delta \ln(L_{i,j,t}) + (1 - \overline{w}_{i,j,t}) \Delta \ln(M_{i,j,t}) \quad \text{(A2)}$$

where $\overline{w}_{i,j,t}$ is the average share of labour cost and intermediate inputs between *t* and *t*-1.

We do not have data on input prices at the firm level so detailed industry-level prices, assuming that individual firms are the price takers of their industry prices, is used. The combined input ($S_{j,t}$) for industry *j* is estimated according to equation (A2) at the industry level. The implicit price ($P^S_{j,t}$) for the combined input in industry *j* is the total cost of labour and intermediate inputs divided by the combined input ($S_{j,t}$).