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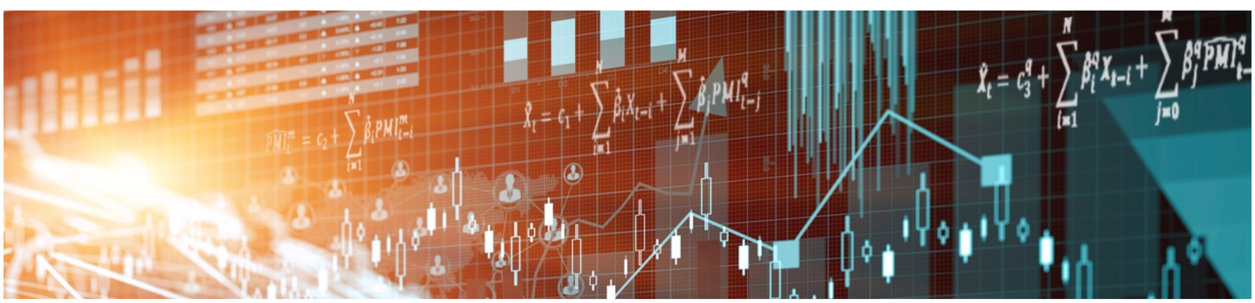

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Does Outward Foreign Investment Matter for Canadian Productivity? Evidence from Greenfield Investments

by

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Abstract

This paper seeks to understand how outward foreign direct investment (FDI) affects the productivity of Canadian firms. We estimate the impact of outward greenfield investment on measures of firm-level productivity using FDI data from roughly 2,000 Canadian firms and more than 4,000 outward FDI projects over the 2003–14 period. Combining matching techniques with a difference-in-difference approach, we find that firms that invest abroad tend to see more important productivity gains one to two years after the investment, compared with firms that are otherwise similar but remain domestic, suggesting that outward investment has beneficial implications for investing firms. Further, panel regression analysis at the provincial level shows that an increase in the number of outward investment projects is found to be associated with higher productivity growth, particularly for investments in OECD countries. The result suggests that learning or technological spillover effects are particularly important when investing in countries close to the home country's technological frontier.

Bank topics: Firm dynamics; Productivity
JEL codes: D24, F21, F23

Résumé

Dans cette étude, nous cherchons à comprendre comment les investissements directs étrangers sortants influent sur la productivité des entreprises canadiennes. Nous estimons les effets d'investissements directs étrangers de création sur certaines mesures de la productivité des entreprises, à l'aide de données sur plus de 4 000 projets d'investissement de ce type réalisés par quelque 2 000 sociétés canadiennes de 2003 à 2014. Nous employons la méthode des doubles différences avec des techniques d'appariement des coefficients de propension et trouvons que les entreprises canadiennes qui investissent à l'étranger enregistrent généralement, après un ou deux ans, des gains de productivité plus marqués que celles qui — par ailleurs analogues — ne s'implantent pas à l'étranger, ce qui donne à penser que les investissements sortants sont bénéfiques pour les entreprises qui les font. De plus, il ressort d'une analyse de régression sur données de panel provinciales qu'une augmentation du nombre de projets d'investissement sortant est associée à une croissance accrue de la productivité, notamment dans les cas où les pays d'accueil sont ceux de l'OCDE. Les résultats donnent à penser que les investissements s'accompagnent d'externalités de connaissance ou technologiques d'autant plus importantes que la frontière technologique des pays d'accueil est proche de celle du pays de l'entreprise investisseuse.

Sujets : Dynamique des entreprises; Productivité
Codes JEL : D24, F21, F23

Non-technical summary

Canadian firms have continued to expand their investment footprint abroad in recent years. As global value chains expand and firms continue to internationalize, outward foreign direct investment (FDI) and its implications for the domestic economy are an important subject of debate. Does the investment of Canadian firms abroad come at the cost of reduced investment, jobs and productivity in Canada as firms substitute away from domestic operations? Or do international investments help to support Canadian firms' competitiveness as they access new markets and resources? This paper contributes to this debate by examining the impact of Canadian firms' greenfield FDI – i.e., their foreign investments in tangible assets – on productivity.

There is currently scant literature on the topic, particularly in the Canadian context. A few existing studies show that outward FDI is positive for the investing firm as it learns from best practices abroad or adopts a more efficient organizational structure, for example. The impact is, however, ambiguous on the aggregate level, i.e., for the region in which the investing firm is headquartered. Concentration in high- or low-productivity activities in the home region could impact productivity positively or negatively, for example.

In order to understand the balance of these potential impacts in the Canadian context, we investigate how outward greenfield FDI matters for firms' labour productivity, or the amount they are able to produce with a unit of labour. First, we explore the question at the firm level by constructing a database that combines data on Canadian public firms' labour productivity with a dataset that catalogues greenfield FDI announcements. We use these data to compare firms that are similar in many ways, but differ in one important factor: whether or not they invested abroad. Tracking their productivity just after the initial foreign investment shows that firms that go international by investing in a foreign country see their productivity grow faster in the one to two following years.

We then look at the region in which the investing firms are headquartered, and show that growth in labour productivity across Canadian provinces is positively associated with outward greenfield FDI. In particular, investments in OECD countries seem to have a positive impact, while investments in non-OECD countries do not. This may be because investments in OECD countries allow for more transfers of knowledge and know-how, potentially because of cultural and institutional similarity. Overall, these results suggest that outward greenfield FDI is not negative for the productivity of Canadian firms or for the regions where they are headquartered. Instead, it has modestly positive impacts, particularly if the foreign investment was destined for an OECD country.

1. Introduction

As global value chains expand and firms continue to internationalize, outward foreign direct investment (FDI) and its implications for the domestic economy are an important subject of debate. Some policy makers suggest that outward FDI comes at the cost of reduced domestic investment and jobs, thereby impacting productivity. These policy makers support policies that discourage foreign investment. Examples include moves by France to restrict outward FDI by auto manufacturers (Head and Mayer, 2015) and recent threats by political leaders against companies planning to make investments in other countries.[1] Others, including Export Development Canada and the Conference Board of Canada, argue that foreign operations of firms generate benefits for the investing companies, such as higher productivity and competitiveness (Globerman, 2012; Poloz, 2012; Desai et al., 2009), and advocate against barriers to outward investment. The debate is important, as the impacts of outward FDI on productivity can have implications for both the design of trade agreements and potential economic growth.

In this paper, we estimate the impact of Canadian firms' foreign greenfield investment on their productivity over the 2003–2014 period. While several studies have examined the impact of outward investment on domestic activity more generally,[2] the literature on how outward investment may affect productivity is sparse (Lipsey, 2004; Blomström et al., 1997), particularly in the Canadian context. The investing firm may see productivity increase as a result of intra-firm spillovers (as skills and technologies in the host country are adopted by the company) or as a result of changes in the organizational structure (Braconier et al., 2001; Van Pottelsberghe de la Potterie and Lichtenberg, 2001).[3,4]

We shed light on the question by examining the impact of outward FDI on both firm-level and aggregate productivity growth. At the firm level, we compare the performance of

[1]In their 2017 edition of *The fDi Report*, fDi Markets states that the United States is discouraging companies from investing overseas. They suggest that this has resulted in a significant drop in outward investments since the 2016 election.

[2] See Imbriani et al. (2011) for a review (p. 370).

[3] For instance, foreign operations may induce a reorganization of the different operations within the firm. As resource allocation changes between foreign and domestic operations, productivity is bound to change as well (Falzoni and Grasseni, 2007; Barba Navaretti et al., 2010; Blomström and Kokko, 2000). Vertical FDI that separates operational stages between different geographic locations may lead to specialization (which can be productivity-enhancing), but may also lead to decreasing scale effects at the plant level, which could hamper productivity (Imbriani et al., 2011). Coe and Helpman (1995) develop a model in which a country's total factor productivity depends on foreign R&D capital, while Ethier (1982) models scale effects of specialization. Baldwin et al. (2005) develop a theoretical growth model where multinational firms directly affect the endogenous growth rate via technological spillovers. See Dunning and Buckley (1977) and Feenstra (2015) for a comprehensive review of related models.

[4] As an example of inter-firm spillovers, if the investing firm sees its activity increase overall, this would tend to imply increased demand for products and services from its suppliers, with associated scale effects for productivity (Desai et al., 2009). In terms of reallocation of resources across sectors and firms, the internationalizing firm may reorganize its supply chain in a way that reduces domestic input, with implications for related domestic firms (Castellani and Pieri, 2013), or even force less competitive domestic peers out of business, increasing aggregate average productivity in the sector.

firms investing abroad for the first time with that of similar firms that remain domestic. Using a difference-in-difference (DID) approach in combination with propensity score matching allows us to address concerns about endogeneity: in particular, the fact that investing firms are more productive than domestic firms to start with (Helpman et al., 2004). We find that firms that invest outside the country experience about 9–13 per cent greater labour productivity gains one to two years after the investment than their domestic counterparts. Similarly, gains in total factor productivity (TFP) and gross profits of firms becoming multinationals outpace those of otherwise similar but domestic firms.

Next, taking a macroeconomic lens, we show that the region in which the firm is headquartered also sees productivity benefits associated with outward FDI, suggesting that firm-level productivity benefits support productivity in the home economy more generally. Using a provincial panel controlling for several known determinants of productivity, we find that outward greenfield FDI is associated with higher productivity growth in the following year. In particular, investment in OECD countries (compared with those in non-OECD countries) implies stronger domestic productivity growth. The result suggests that learning or technological spillover effects are particularly important when investing in countries close to the home country's technological frontier or with similar cultural and institutional backgrounds. Inward FDI is also found to positively contribute to productivity growth. Taken together, the results show positive productivity impacts on both the firm and the home country's macroeconomy when firms engage in outward FDI.

Our research contributes to the literature in three distinct ways. First, we expand on the thin literature on the impact of outward FDI on productivity, allowing for a better understanding of the implications of outward investment for the domestic economy. In particular, to our knowledge, we are the first to empirically investigate the question for Canada, a small, open, and developed country.[5] Second, our empirical methodology goes beyond previous work in that we address both firm–level and aggregate macroeconomic impacts with estimations at the provincial, i.e., aggregate, level. This encompassing approach allows us to seize effects both at the firm level and at the regional or aggregate level and illuminate several dimensions of the question. In particular, the provincial panel reveals the importance of the destination of investments; we are the first to show that greenfield investment in OECD countries (with respect to investment in non-OECD countries) is more productivity-enhancing. The firm-level approach is also unique in that it explicitly accounts for the direction of causality (from investment to productivity, rather

[5] For evidence on Italian and French firms, see Barba Navaretti et al. (2010) and Imbriani et al. (2011). Globerman (2012) studies the effect of Canadian multinationals' outward investment on domestic investment using a case study approach, but does not address the effects on productivity.

than the reverse) and allows us to capture lagged effects on firm performance.[6] Finally, we are the first to estimate impacts of greenfield investment in particular, i.e., the creation of new productive capacity, as opposed to the acquisition of existing assets through, for example, mergers and acquisitions (M&As). Greenfield investment appears to be more controversial, as it may come at the expense of domestic investment. While these two forms of foreign investment are clearly different, previous work has failed to make this distinction in analyzing foreign investment more generally.

The remainder of the paper is organized as follows. Section 2 introduces the data, including the combination of firm-level financial statement information with a rich dataset on Canadian foreign greenfield FDI. Section 3 details the methodology, including propensity score matching to estimate effects at the firm level, as well as the provincial panel setting, and presents the results. Section 4 concludes.

2. Measures of Productivity and Data

This section presents the measures of firm–level productivity and describes the data used in both the firm–level and macroeconomic models.

2.1. Calculating firm-level productivity

Our firm–level analysis uses several measures of productivity, including both labour productivity and TFP.

Labour productivity is usually defined as the value added per unit of labour, where value added is defined as output minus intermediate goods.[7] However, our dataset does not include intermediate goods. We therefore use sales per employee as our main measure of labour productivity (Bartelsman and Doms, 2000; Ardanaz-Badia et al., 2017; Yeaple, 2009; Vogel and Wagner, 2010):

$$\emptyset = ln\left(\frac{Y}{L}\right),$$

where $\emptyset$ denotes labour productivity, Y is sales and L the number of employees.

[6] Hejazi and Tang (2016) do examine the impact on productivity for Canada empirically, using a different dataset and methodology. Their approach, however, focuses on contemporaneous effects of FDI on productivity and does not account for issues of self-selection and endogeneity. We hypothesize that it takes some time for productivity improvements to be felt following an investment, and our approach is designed to take both endogeneity and lagged impacts into account. Our empirical approach also allows us to control for unobserved differences between switching and domestic firms not taken into account in the author's strategy.

[7] E.g., cf. Statistics Canada Table 383-0011: Labour productivity and related variables.

As a robustness check, we use alternative measures of labour productivity: first, we approximate value added by sales minus a proxy of intermediate goods M,[8] though the sample size is reduced substantially for the resulting measure of productivity because of limited data availability:

$$\emptyset = ln\left(\frac{Y-M}{L}\right).$$

Second, we follow Tomiura (2007) in measuring labour productivity as the gross profit per employee, i.e.,

$$\emptyset = ln\left(\frac{Y-C}{L}\right),$$

where C denotes cost of goods sold. The latter includes material, salaries and overhead costs. The numerator can thus be thought of as a lower-bound measure of value added.

Finally, we also use two measures of TFP. A considerable literature proposes ways to estimate TFP at the plant level, often as the residual of a production function, using sales or value added as the output variable, and labour and capital as measures of inputs. As a first and simple measure, we follow Head and Ries (2003), defining approximate total factor productivity (ATFP), as

$$ATFP = ln\frac{Y}{L} - \frac{1}{3}ln\frac{K}{L},$$

where K denotes property, plant and equipment. This measure can be thought of as an estimate of labour productivity accounting for capital intensity.

Measures that define TFP as the residual of a production function are, however, plagued with endogeneity problems (Tomlin, 2014): firms that observe a positive productivity shock are likely to increase their variable inputs such as labour, such that labour and productivity are jointly determined, biasing the labour coefficient if this simultaneity is not taken into account. To address this issue, we follow Levinsohn and Petrin (2003) and Olley and Pakes (1996) in using an instrumental variable approach. In particular, the production function is given by

$$ln(Y_t) = \beta_0 + \beta_L \ln(L_t) + \beta_K \ln(K_t) + \beta_M \ln(M_t) + \omega_t + \eta_t,$$

where M_t denotes materials (or investment).[9] The error has two components: the transmitted productivity component given as ω_t and an error term that is uncorrelated with

[8] Costs of goods sold minus staff expenses; cf. Hejazi and Tang (2016).

[9] Levinsohn and Petrin (2003) suggest using intermediate inputs (materials, electricity, fuel consumption) as an instrument, rather than investment such as in Olley and Pakes (1996), arguing that investment is lumpy and often zero. For our dataset, however,

input choices, η_t. TFP is then calculated as the residual of the production function using materials (or investment) as an instrument:

$$\widehat{\omega} = \exp(ln(Y_t) - \widehat{\beta}_L \ln(L_t) - \widehat{\beta}_K \ln(K_t) + \widehat{\beta}_M \ln(M_t)_t.$$

We refer to this measure as *LP* (Levinsohn and Petrin). The distribution and summary statistics of all measures of productivity used can be found in Table 1; alternative measures are highly correlated.[10]

2.2. Firm-level and provincial data sources

At the firm level, we combine two main data sources. First, data on foreign greenfield investments of Canadian firms are obtained from *fDi Markets*, an online database maintained by fDi Intelligence (a division of the *Financial Times Ltd*.) that monitors cross-border greenfield investments covering all sectors and countries worldwide.[11] The data span 4,485 outward greenfield foreign investment projects undertaken by about 2,000 Canadian firms over the 2003–2014 period, and include information on the investment such as estimates of the dollar amount invested, employment created, the industry and main business activity involved in the project, the location of the investment (host country, regions and cities), the date the investment was initially announced, and the name and location of the Canadian-based investing company. About 900 of these investments are by public firms.

The database is widely accepted as one of the most exhaustive sources on greenfield FDI and is used in research and as the data source in UNCTAD's World Investment Report. We note however some caveats. First, some of the planned future greenfield investments may not actually be realized or may be realized in a different form with respect to what was originally announced. While the database is regularly updated and corrected retrospectively, data in the most recent years may not have been revised and thus capture announced rather than actual projects. We deal with this issue by dropping the latest three years of data. Second, the value of the project is allocated towards the first year of the investment (unless the company explicitly states a timeline for the project), potentially overstating the amount invested in that year. In addition, in cases where the dollar amount to be spent is unknown, the data provider estimates the values, which may introduce some

intermediate inputs are not reported, while investment is non-zero and relatively smooth across years. We thus use investment as the instrument.

[10] Ideally, nominal values should be deflated by the appropriate deflators. A lack of data does not allow such an approach.

[11] Data are collected from a daily search of investment projects from various publicly available information sources, including the *Financial Times* newswires, nearly 9,000 media, over 1,000 industry organizations and investment agencies, and information purchased from market research and publication companies. More information is available at http://fdimarkets.com/. The data do not include mergers and acquisitions or financial investments.

error. To circumvent these issues, we follow the literature (e.g., Castellani and Pieri, 2013) by also using the number of investments (versus the aggregate value) in macroeconomic regressions, which is correlated with the value of the greenfield investments.[12]

For the analysis at the firm level, we combine the *fDi Markets* database with firm-level financial statement data from a second source, Compustat, which includes variables such as sales, labour expense, capital stock, industry classification, employment and other expenses. These variables allow us to estimate firm level productivity (annually). Of note, data are only available for public firms; the firm–level analysis is thus restricted to the sample of publicly listed firms and does not include foreign investments by private companies.

We moreover restrict the firm-level estimation to firms that remain in the data sufficiently long to be observed two years after the first foreign investment.[13] We are left with roughly 130 observations of Canadian firms investing abroad for the first time, and another 1,800 firms in the control group (domestic firms).[14] Of note, in our base specification, we estimate the effect of *first* foreign investments only, not any foreign investment (cf. Barba Navaretti et al., 2010), because estimating the effects of subsequent investments is complicated by the fact that it is no longer clear whether changes in productivity are a result of the most recent investment or stem from earlier investment projects, especially when one project closely follows the other. Our robustness checks also include an estimation of the effect of investing abroad more generally (i.e., regardless of whether it is the first or a subsequent investment for the firm), which allows for a bigger sample (roughly 350 observations for investing firms).[15]

The provincial panel uses data from both Statistics Canada and *fDi Markets*. Inward and outward FDI are measured as the provincial aggregates from the *fDi Markets* database in terms of both the total value of projects and the number of projects, include investments

[12] As for the firm-level analysis, it does not rely on the value of the project, but merely compares investing firms with non-investors, regardless of the amount.

[13] We also restrict the analysis to firms headquartered in Canada, since foreign investment decisions of non-Canadian multinationals are likely taken by head offices outside Canada.

[14] While the size of our treatment group in the baseline specification is small, Imbens and Wooldridge (2009, p. 35) argue that the efficiency loss from even a very small number of matches is quite modest, and that concerns about the inefficiency of matching estimators may not be very relevant in practice. The size of our treatment group is larger than in Barba Navaretti et al. (2010), with roughly 50–100 treatment observations, but smaller than in other studies (Arnold and Javorcik, 2009: 200–600 observations; Chang et al., 2013: 400–1000).

[15] Note that Compustat reports data for the consolidated firm (i.e., sales and employment reports include both domestic and foreign activity); our measures thus capture productivity at the consolidated level of the firm, such as in related studies (e.g., Hejazi and Tang, 2016; Hijzen et al., 2007). It would be interesting to separate out the effect on the domestic operations of investing firms, but limited observations preclude such analysis: of the 400 time-x-firm observations on Canadian segments in the Compustat Segments database, most pertain to Canadian operations of foreign multinationals, whereas our analysis focuses on Canadian firms only.

by public and private firms, and span the period 2003–2014. Labour productivity is calculated using Statistics Canada's method of dividing value added (measured by real provincial GDP) by the total number of hours worked at all jobs (as measured by the Labour Force Survey). The regressions include several variables that have been shown to matter for productivity, including the capital-to-labour ratio, R&D expenditure, and trade openness measures and variables to control for labour force quality, among others, all sourced from Statistics Canada. Finally, we use data on foreign taxes and incomes of public Canadian firms by province as instrumental variables (derived from Compustat).

3. Estimation and Results

This section describes the methodology and results at the firm level, and describes the set-up of the macroeconomic regression and lays out panel regression results.

3.1. Evidence at the firm level

Empirical strategy: propensity score matching

The empirical set-up must account for reverse causality effects to address endogeneity concerns: evidence suggests that only the most profitable firms can afford the costs of entering foreign markets (Helpman et al., 2004). This means that more productive firms are more likely to engage in foreign investment to start with. Thus, when observing higher productivity among firms that invest abroad, we do not know whether this is a result of foreign investment or simply because these firms perform better independently of the decision to invest abroad. When attempting to measure the impact of outward investment on productivity, it is thus crucial to account for the direction of causality.

Propensity score matching allows us to address exactly this issue. The methodology involves comparing the performance of a given firm that becomes a multinational company through its first foreign investment with the performance it would have shown if it had kept all of its operations at home.[16] The hypothetical benchmark, or control group, is constructed from a sample of firms that remain domestic but are as similar as possible to the internationalizing firms.[17] The performance of this control group is the closest

[16] The methodology has previously been applied in international economics, for instance, to evaluate the effects of exporting, acquisitions or foreign ownership on firms' performance and returns to scale, as well as the impact of outward investment on firms' output and efficiency. See for instance Debaere et al. (2006); Chang et al. (2013); Hijzen et al. (2007); Barba Navaretti et al. (2010); and Imbriani et al. (2011).

[17] The control group effectively consists of domestic firms that have never invested outside the country, i.e., firms not reporting any investment in the *fDi Markets* database over the 2003–2014 period. To avoid including firms that may have invested before this period, we exclude firms reporting either foreign income or foreign income taxes, and keep only those flagged "domestic" in Compustat.

approximation of the benchmark of the hypothetical performance of the same firm had it not invested out of the country. The approach thus allows a comparison of the performance of the internationalizing firm with that of a comparable domestic firm, controlling for any ex-ante differences in productivity performance. A DID approach also allows us to account for unobserved heterogeneity between the two groups of firms that may matter for productivity performance, as any time-invariant differences would cancel each other out.

Before proceeding with propensity score matching, we compare some descriptive statistics for internationalizing firms that invest outside of Canada for the first time – i.e., the "switching firms" (or the "treatment group") – with firms in the control group. Consistent with theory and existing evidence,[18] firms that chose to become multinationals are, in the year of the first investment, larger in terms of head count; sales; and property, plant, and equipment (PP&E) than the average Canadian firm (Table 2). However, switching firms do not initially appear to be more productive than their domestic counterparts.[19]

The estimation proceeds in three steps. First, for every firm in each year, we estimate the propensity score, i.e., the probability of switching from being domestic to becoming a multinational firm (via a first foreign investment), conditional on a number of observable characteristics. The propensity score in a given year is calculated using a probit model:

$$p(x) = Pr(FDI = 1 | X = x),$$

where x is the set of controls of firm characteristics, including sectoral, annual, and provincial dummies, lagged productivity growth and log employment (as a proxy of firm size). As a robustness check, we explore using alternative or additional controls, e.g., variables such as investment, profitability, sales, investment and capital intensity (cf. Barba Navaretti et al., 2010; and Imbriani et al., 2011).[20]

Second, each firm investing abroad for the first time is matched with a similar domestic firm (from the control group), i.e., a firm with the closest possible propensity score. In the baseline specification, we use the one-to-one nearest neighbour matching, i.e., each investing firm is matched with one domestic firm.

[18] Cf. Dunning and Buckley (1977); Helpman et al. (2004); Head and Ries (2003); and Baldwin et al. (2005).
[19] This may be due to sectoral compositional effects: for instance, if there are industries that are less productive but show a high proportion of international firms, this would tend to lower the average overall productivity of internationalizing firms with respect to domestic firms.
[20] The literature provides little guidance on the choice of covariates to include in the propensity score estimation (Imbens and Wooldridge, 2009); we thus use different combinations of available and relevant covariates in our robustness analysis.

Third, we compare the performance of investing firms with that of matched domestic firms. In particular, we estimate the average treatment effect of the treated (ATT),

$$ATT = \bar{y}_{t+i}^{1} - \bar{y}_{t+i}^{0},$$

i.e., the difference between the mean performance of investing firms $\bar{y}_{t+i}^{1}$ and that of the matched counterfactual group $\bar{y}_{t+i}^{0}$. i denotes the different horizons at which we wish to compare productivity performance, i.e., *i*=0,1,2. We argue that it may take time for the firm to realize productivity gains, so that effects would not be evident in the year of investment, but rather in the following year (*i*=1) or the year after that (*i*=2). The estimation procedure then tests whether the ATT is statistically different from zero, i.e., whether investing firms show higher (or lower) productivity performance compared with firms that remain domestic.

While the probit model aims to account for firm–level characteristics, one disadvantage of the ATT is that it only accounts for observed characteristics. Factors that affect both the decision of the firm to invest and its performance but that cannot be observed cannot be accounted for in the matching procedure. A neat solution to this issue is the difference-in-difference (DID) estimator,

$$DID = \left(\bar{y}_{t+i}^{1} - \bar{y}_{t}^{1}\right) - \left(\bar{y}_{t+i}^{0} - \bar{y}_{t}^{0}\right),$$

which first calculates the *change* in productivity i years after the investment. The average gain over time in the control group (i.e., domestic firms) is then subtracted from the gain over time in the treatment group (i.e., the investing firms) (Chang et al., 2013; Barba Navaretti et al., 2010; and Imbriani et al., 2011). This measure thereby cancels out any ex-ante heterogeneity between switching and control group firms and thus accounts for endogeneity issues that may result because of unobserved variables not accounted for in the matching process. It also removes biases from comparisons over time in the investing group that could be the result of time trends unrelated to the investment (Imbens and Wooldridge, 2009). While we will present results for both the ATT and the DID, we thus lend more credence to the DID estimator, following the literature (Arnold and Javorcik, 2009; Chang et al., 2013). Finally, we also experiment with alternative estimation methods, but the feasibility and advantages of alternative approaches are limited.[21]

[21] First, we compare the growth in productivity of the same firm before and after it invests abroad, i.e., testing whether productivity growth increases after investment (an approach similar to Trefler, 2004). Yet, data limit the sample to an insufficient size (i.e., the small number of firms for which continuous data for several years before and after first investment are available). For this small sample, interestingly, productivity increases after investment, but productivity *growth* does not appear to increase after investment. Second, we attempted to calculate the contribution of foreign investment to firms' productivity in an approach similar to Brynjolfsson and Hitt (2003), a production function framework. Similarly, the data limitation (notably for the stock of foreign investment) precluded this approach. Another option would be to use simple regression analysis, i.e., regressing

Estimated effect on firm–level productivity

As laid out above, the first step to propensity score matching is a probit model, which regresses the treatment status (1 for a switching firm, and 0 for domestic firms) on a number of ex-ante firm and environmental characteristics. The results, presented in Table 2, indicate that firms deciding to become a multinational firm via a foreign greenfield investment differ systematically from firms that remain domestic: switching firms tend to be larger (as proxied by the number of employees; see first four columns, first line). More generally, the decision to undertake foreign investment (whether first or not) is correlated with size (last four columns, first line). As one would expect from theory, capital intensity and productivity growth are also positively associated with the decision to invest, as is profitability. Not surprisingly, firms that have larger total capital expenditures are also more likely to invest abroad than firms that invest little.

The predicted probability of engaging in a first greenfield investment estimated in Table 3 is the variable used in the second step, the matching procedure. Chart 1 displays the distributions of propensity scores for both the switching firms (in green) and the matched domestic firms (in blank), for all measures of productivity used in the analysis. The charts allow a visual inspection of the extent of common support; indeed, distributions in the treatment and comparison group overlap significantly for all major measures of productivity used in the analysis.

The third step estimates the effect of investing abroad. Table 4 reports the ATT for the year of investment and the two following years (first three columns), and the DID results (last two columns). Panel A shows that labour productivity is higher in the year of the investment (year one) for the newly multinational firms, though the difference is not statistically significant. Over time, however, the difference increases and becomes statistically significant. What is more, the gain in productivity for investing firms is significantly higher than that of firms that remain domestic (DID estimator). The estimated coefficient of 0.13 in year three suggests that productivity increases by about 13 per cent more for firms investing for the first time abroad than for similar domestic firms after three

productivity on a dummy variable for investing abroad and controls (such as in Desai et al., 2009; Hejazi and Tong, 2016; Falzoni and Grasseni, 2007). We believe that propensity score matching has important advantages over regression. First, because simple regression does not resolve endogeneity issues, a successful approach then hinges on finding appropriate instruments. Second, propensity score matching imposes common support (i.e., overlap of propensity score groups for firms in control group and investing firms), ensuring ex-ante comparability of investing and domestic firms (whereas regression would include all observations and potentially many control group observations that are not comparable that could bias the results). Finally, our approach allows us to trace the change in productivity performance following the investment as it evolves, whereas research using regression analysis only captures contemporaneous effects, ignoring any effects that may unfold over time. Propensity score matching does have some disadvantages. For example, there are many ways to do the matching, which may lead the researcher to choose arbitrarily. However, we have run a number of robustness checks, and the results do not appear to change qualitatively, lessening this concern.

years. The fact that the estimated coefficients using the DID estimator are lower than in the ATT suggests that unobserved heterogeneity is indeed adding an upward bias to our estimates in the ATT results. The Hotelling test results (Table 4) show that our matching is well balanced (Arnold and Javorcik, 2009; Chang et al., 2013).

The subsequent panels B to D in Table 4 repeat the exercise for the other measures of productivity; results are qualitatively similar. In most cases, the DID carries a positive and statistically significant coefficient, suggesting that investing firms see more important productivity gains than their domestic counterparts. In particular, panel D provides evidence that TFP (as measured by the Levinsohn and Petrin approach) increases with foreign investment.[22]

Results for our main measure of productivity (sales per employee) are largely robust to different model specifications and variations of the sample (Table 5): while the ATT measure is not significant in some specifications, our preferred measure, the DID, remains positive and statistically significant in most instances. First, we exclude outliers from the analysis (panel A), which leaves us with similar results, though the second year of the DID estimator is no longer significant. This may have several explanations. First, firms becoming multinationals may get a productivity boost from investing shortly after the investment, which fades after the second year.[23] Second, as we move away from the actual date of the investment, additional factors we do not control for may affect the productivity performance of both internationalizing firms and those not having invested, explaining the lack of a statistically significant divergence between the two groups. In particular, some firms internationalizing may not achieve expected benefits of their foreign operations and decide to *divest* them; this would tend to have a negative impact on productivity.

As a second set of robustness checks, we alternate the control variables used in the matching process: panel B adds the ex-ante level of investment;[24] this ensures that matches assigned on the basis of the propensity score will be homogenous with respect to general investment behaviour, and hence reduces the possibility that improvements observed after the foreign investment change may be due to general differences in the investment behaviour of the firm. Results for the DID are largely similar. Third, using different

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[22] We also estimate effects for the value-added measure of productivity, i.e. (sales-intermediate goods)/employees, though the sample becomes small because of data availability: 25 treatment observations versus 436 firms in the control group. Results are qualitatively similar (i.e., positive effects for both the ATT and the DID effect, and smaller for the DID than for the ATT), but not shown because their statistical significance is not robust to specification changes: results are not significant when using the baseline controls (employment, pre-year productivity, and sector, region and year dummies), but significant and similar to results presented above when smaller sets of controls are used.

[23] The results echo findings of some studies of *inward* foreign investment, where in some cases productivity gains are found to be transient (Merlevede et al., 2014). Our finding may suggest analogous effects for *outward* investment.

[24] We also use all other variables included in the probit model (Table 3). Results are qualitatively similar (not shown but available upon request).

matching techniques (e.g., 3:1 nearest neighbour matching in panel C, caliper matching in panel D) does not materially change our DID results.

Fourth, we alter the group of firms we are comparing with: our baseline control group includes both firms investing domestically and firms not investing at all. One may argue that productivity gains for firms investing abroad should be compared with gains of firms investing domestically.[25] We thus drop firms that do not invest at all from the control group to only compare firms that invest (panel E). This does not alter the size of the control group materially and results are qualitatively similar, but coefficients are somewhat smaller than in our baseline specification. This implies that the productivity gains of investing abroad compared with those of investing domestically are not as large compared with those not investing at all.

Finally, one may want to the capture effects not only of initial FDIs but also of subsequent FDIs.[26] We thus estimate the change in productivity following any foreign investment (whether first investment or not), which increases the number of treatment observations from roughly 130 to about 350. Results for all of our productivity measures are reported in Table 6. With the exception of the ATFP measure (coefficients insignificant), all estimated coefficients are positive, significant, and increasing over time, suggesting that foreign investment benefits the firm and that productivity gains grow in the years following the investment outside the country.

Our results are overall comparable with those reported in the literature. Estimated effects are similar to those found in Barba Navaretti et al. (2010) and slightly larger than in Imbriani et al. (2011). The size of coefficients is moreover comparable to studies of the productivity impacts of related topics of foreign direct investment (Arnold and Javorcik, 2009; Chang et al., 2013). While there is little evidence in the Canadian context, our results are qualitatively also in agreement with work by Hejazi and Tong (2016). The authors use regression analysis to show that productivity for investing firms is higher after investment. We view our results as complementary to theirs. First, our methodology allows us to follow individual firms' performance in the years *after* the initial foreign investment, directly tracing the effect of investment over time and thus the direction of causality. Second, our approach of combining matching techniques with a DID estimator allows us to control for

[25] In particular, firms investing domestically are also likely to see productivity gains compared with those that do not invest at all, which would bias our estimated effect of outward investment upward.

[26] One potential issue in this approach is the possible overlap in the periods used to evaluate productivity gains following an investment. For instance, if a firm invests in both 2009 and 2010, the approach considers productivity gains over both the 2009–2011 and the 2010–2012 periods, where any recorded productivity gains for the second (2010) project likely capture productivity gains resulting from the first (2009) project. However, the same applies for domestic investments (in the control group), which would tend to mitigate any upward bias in estimated effects.

unobserved differences between switching and domestic firms, addressing endogeneity issues and eliminating biases resulting from time trends in the performance of investing firms unrelated to the event of investing. Third, our analysis differs in that it is focused on greenfield investments only (as opposed to investment into an existing foreign firm, as in Hejazi and Tang, 2016), which may have more (or less) important implications for the productivity of the investing firm. Finally, of note, our analysis is more restricted than theirs in the sense that our database is limited to publicly listed firms (as opposed to both public and private firms).

Interestingly, the estimated effect we find is larger than what was found in a study estimating the effects of internationalizing by exporting on Canadian firms' productivity growth. Baldwin and Yan (2015) survey the empirical evidence of entering export markets on productivity. They show that exporting for the first time increases the productivity growth of Canadian manufacturing firms by 4.9 per cent on average for each year between 1990 and 1996. This is roughly half of the result we show from investing abroad for the first time.

3.2. Evidence at the provincial level

Empirical strategy: provincial panel

While the previous section provided some evidence that outward greenfield FDI has a positive effect on the productivity of Canadian firms, the impacts on the broader macro-economy are ambiguous. Shifts in the industrial mix or inter-firm spillovers may impact overall productivity, over and above the effect on firm-level productivity. In an extreme case, positive firm–level effects might be outweighed by an opposing effect at the macroeconomic level, which has been documented a few times in the literature.[27] This motivates our investigation of the impact of outward greenfield FDI on Canadian productivity at the macroeconomic level. We focus on the provincial level for several reasons. First, theoretical considerations suggest that effects of outward FDI are geographically confined, leading prior research to focus on sub-national impacts (Castellani and Pieri, 2013). Second, geographic proximity may enhance indirect effects: face-to-face communication is an important vehicle for transmitting knowledge, for example (Audretsch and Feldman, 2004; Mariotti et. al., 2014). Finally, using a provincial level of analysis allows us to take into account industrial and institutional similarities

[27] For example, at several periods, outward FDI from Sweden was focused in highly productive business processes, leaving less productive processes at home (cf. Blomström and Kokko, 2000). These periods coincided with high labour costs and a strong Swedish currency, and multinational companies naturally responded by moving work to other countries.

within provinces that are not shared across provinces, which may impact the ability of productivity spillovers to occur.

We use an annual panel setting for the 10 Canadian provinces over the 2003–2014 period to exploit cross-sectional variation.[28] Following the work of Castellani and Pieri (2013), we regress provincial productivity growth on outward greenfield investments, a proxy for the change in the stock of foreign capital held by Canadian companies, controlling for inward greenfield foreign investments and other regional characteristics:

$$\Delta \ln y_{i,t} = \alpha_i + \gamma_1 \mathrm{IHS}FDI^{out}_{i,t-1} + \gamma_2 \mathrm{IHS}FDI^{in}_{i,t-1} + \gamma_3 \mathrm{IHS}FDI^{out}_{i,t-2} + \gamma_4 \mathrm{IHS}FDI^{in}_{i,t-2}$$

$$+\beta \Delta \ln x_{i,t} + \tau_t + \varepsilon_{i,t}$$

where $y_{i,t}$ is labour productivity in the *i*th province in year t and $FDI^{out}_{i,t-j}$ ($FDI^{in}_{i,t-j}$) is the amount or number of outward (inward) greenfield investments, with j taking the value of 1 or 2. Following prior research, we include two lags of the greenfield FDI variables rather than contemporaneous investment, as the impact of foreign investment is likely to occur with some lag. This also helps to avoid contemporaneous endogeneity issues between the investment variables and labour productivity. $x_{i,t}$ is a vector of determinants of provincial productivity, as well as a period-specific control for positive and negative productivity shocks.[29] τ_t denotes a time trend. All variables except greenfield FDI are transformed using logs.[30] Summary statistics for these variables are presented in Table 7. The regression also includes regional fixed effects. Cluster robust standard errors are used throughout.

Results are presented in Table 8. Column A shows the regression results using the number of greenfield FDI projects. As theory would predict, the estimated coefficient on the number of inward FDI projects is positive and statistically significant, implying that Canadian productivity increases with foreign firms' investment in Canada.[31] The number

[28] Although the sample size is somewhat small, we are confident in the results because they remain stable for our variable of interest across different specifications, including the GMM IV model, the stepwise regression and the disaggregation of FDI destinations. Data availability does not allow us to add any further observations.

[29] Period-specific productivity shocks is a dummy that takes a value of one when labour productivity in a province is more or less than one standard deviation away from its mean, after accounting for national productivity shocks.

[30] Greenfield FDI project counts and dollar values are transformed using the inverse hyperbolic sine transformation (IHS), as these variables equal zero in a small number of observations.

[31] Caution must be taken when comparing the coefficient presented here with other studies of the impact of inward FDI on productivity. We present results only for greenfield FDI, which may be different than those of mergers and acquisitions and other types of FDI. In addition, we do not attempt to disaggregate impacts between horizontal and vertical spillovers, as our variable of interest is outward FDI. That said, for context, the size of the coefficient is somewhat smaller than reported by an international meta–analysis of impacts of inward FDI on productivity (Havránek and Iršová, 2011), which reports a 9 per cent increase in productivity from a 10 per cent increase in foreign presence for backward-linked firms. The smaller impact is likely the result of this paper including the impacts of horizontal and forward linkages, which are both found to have a modest to negligible impact on productivity (Iršová and Havránek, 2013). In addition, the meta–analysis contains some countries where firms likely have greater absorbative capacity, increasing impacts overall. The weaker results as compared to the meta–analysis are also likely a result of the Canadian context: Wang (2010) found that horizontal productivity impacts from FDI inflows in the manufacturing

of outward greenfield FDI projects also carries a statistically significant and positive coefficient, suggesting that foreign investments of multinational firms with headquarters in Canada lead to improvements in labour productivity in Canada. Specifically, a 10 per cent increase in the number of greenfield investment projects by Canadian firms abroad is associated with a 2 per cent increase in labour productivity growth. This result suggests that the domestic macroeconomy sees a positive, although somewhat modest, benefit from outward FDI through higher productivity and, therefore, that the impacts of firms' outward FDI are not concentrated solely on the foreign operations of the firm. The results corroborate Castellani and Pieri's (2011) finding that both inward and outward greenfield FDI have a positive impact on regional productivity growth.

Although the number of greenfield investment projects is our preferred measure of outward investment, we repeat the analysis using data on the *value* of greenfield foreign investments (Table 8, column B). The regression suggests that the value of outward FDI is positively correlated with labour productivity with a one-year lag; however, inward greenfield FDI does not show the expected positive impact on labour productivity, potentially the result of measurement error in the data (cf. section 2.2). Alternatively, since the value of foreign investments is presented in nominal terms, the lack of results may be due to changes in the price of investment goods over time. Given these caveats, we lend more credence to the results obtained using the number of projects (column A) rather than the project values, similar to other studies that use this data set (e.g., Castellani and Pieri, 2013).

Following Barba Navaretti et al. (2010), we next divide the sample of outward foreign direct investments by destination: outward projects destined to OECD member countries and to non-OECD member countries. This disaggregation is of interest, as investment to countries with differing levels of productivity and research intensity may show differing impacts in terms of technology spillovers. For example, Amann and Virmani (2014) find that FDI flows from a selection of non-OECD countries into more R&D-intensive OECD countries lead to technology spillovers in the non-OECD countries. In our greenfield data, Canadian outward projects destined to OECD member countries account for roughly 60 per cent of projects versus 40 per cent of projects destined to non-OECD member countries. Projects to OECD countries, predominantly to the United States and European countries, are more concentrated in logistics, headquarters and manufacturing. Projects to non-OECD countries, primarily China and India, are more likely to be concentrated in extraction, construction and electricity projects.

sector were limited, while impacts were roughly 4.3 per cent for backwards and forwards linkages, roughly in line with the results presented here for all sectors.

The results of this regression are presented in columns C and D of Table 8. Again, the results for FDI values (column D) are largely insignificant. Using project number counts, however, shows some interesting results (column C). Outward FDI to countries in the OECD is associated with a statistically significant increase in domestic productivity. This might suggest that distance to the technological frontier matters in terms of productivity spillovers, i.e., countries further from the technological frontier may not have as much potential for knowledge spillovers, like the results presented in Iršová and Havránek (2013) in their meta–analysis of productivity gains from outward foreign investment. Alternatively, it could indicate that cultural and institutional similarities between OECD countries may facilitate knowledge transfers and learning. Although outward investments to non-OECD countries are negatively correlated with growth in provincial labour productivity, the coefficient is not statistically significant, suggesting no impacts overall.

Robustness analysis

We proceed with several robustness checks. First, the literature on determinants of labour productivity points to a long list of potential explanatory variables (see Crawford, 2002, for the Canadian context and Syverson, 2011, for a review). We therefore use a stepwise regression to test for variables with the most explanatory power. The stepwise model is specified to include capital stock per worker and the greenfield foreign direct investment variables. Then, the model selects up to four other explanatory variables from a list that includes the following: ICT stock and IPP stock as a share of the total capital stock, trade openness as measured by exports plus imports as a share of output, the nominal bilateral and real trade-weighted (effective) exchange rate, inflation, the size of the public sector, an industry concentration ratio as measured by an Herfindahl-Hirschman Index of provincial GDP by industries, R&D expenditures, and the share of the population with advanced degrees. The list of potential explanatory variables moreover includes three lags of each of these variables, a time trend, and dummy variables for province-specific productivity shocks.

The stepwise regression retains negative province-specific productivity shocks, the Canadian dollar real effective exchange rate, and a time trend. The results of the regression are presented in Table 9, columns A and B. Overall, the results are not significantly different from the results presented in Table 8. Using the number of greenfield FDI projects as an explanatory variable, results suggest that outward investments are statistically significant determinants of productivity with a one–year lag (column A). The estimated coefficient for inward FDI is no longer statistically significant. Again, the dollar value of greenfield FDI investments does not carry statistically significant coefficients. Overall, the stepwise approach suggests that the coefficient of interest is not sensitive to the selection of alternative control variables.

We also employ an instrumental variable model to account for potential endogeneity. Although the greenfield FDI variables are lagged, there is a possibility that firms' foreign investments, foreign firms' investments in Canada, and provincial labour productivity may be endogenous. The instruments employed in our IV GMM model are the provincial population, as a larger population base should attract more foreign investment; the percentage of the workforce with a bachelor's degree or above, as a highly educated workforce should attract foreign investment; the share of intellectual property and patents and information communication technology in the capital stock, as much inward FDI is focused on research, design and development sectors; and finally the number of public companies headquartered in a province paying foreign taxes and generating foreign incomes, as these variables should be well correlated with Canadian firms' outward FDI, but should have no impact on productivity at home. Also included are two lags and one lead of each of these variables.

Results presented in Table 10 suggest that the above-mentioned endogeneity concerns are not material. The results from the Sanderson-Windmeijer tests presented in columns B and C suggest that there is neither a weak- nor an under-identification problem and the Hansen J statistic suggests that there is no over-identification. Taken together, these tests suggest that the instrumental variables included are valid. The estimated coefficients of the regression are presented in Table 10, column A. For the number of inward greenfield FDI projects, the coefficients are not significant. For outward greenfield FDI projects, the coefficients are statistically significant and in the expected direction—indeed, the effect is roughly twice as strong as presented under OLS.

The results of the endogeneity test suggest that the variables included as endogenous – i.e., the lagged values of greenfield inward and outward foreign direct investment – can be treated as exogenous. This result is in line with previous findings from the literature. For example, Castellani and Pieri (2011) find that, after controlling for country specific effects, inward and outward greenfield foreign direct investment are not endogenous to regional productivity. Data availability and the inclusion of leads and lags for the instrumental variables reduced the sample size. In addition, GMM estimates are known to be less precise than OLS when endogeneity is not an issue. Therefore, in line with previous research and the results of the endogeneity test, we suggest that the estimates presented in Table 8 are preferred over the GMM approach.

4. Conclusion

Whether and how global value chains increasingly affect the performance of Canadian firms and the Canadian economy overall remain largely unexplored. In this paper, we attempt to shed light on the impact of outward investment on Canadian productivity, both at the firm level and at the provincial level. Firms that turn into multinationals by investing outside of Canada experience about 10 per cent higher productivity growth than comparable firms that remain domestic one to two years after the initial investment. Provincial panel regressions moreover show that beneficial effects extend beyond the firm level: provinces with more outward greenfield investment tend to show stronger productivity growth. Interestingly, productivity gains are associated with outward investments to OECD countries rather than to non-OECD countries. This implies that learning effects and knowledge spillovers are only evident for outward investments to countries close to the technological frontier or that cultural and institutional similarities in OECD countries matter for spillover effects.

Our research contributes to the sparse evidence evaluating the effects of outward greenfield FDI on productivity. While it has often been argued that outward FDI generates benefits such as higher profitability, productivity, trade and competitiveness for the investing companies, there is little empirical evidence in the Canadian context to prove this hypothesis—a gap in the literature we attempt to fill. In addition, by examining firm-level and aggregate productivity growth, this work contributes a broad examination of the impacts of outward FDI on productivity that, to our knowledge, is unique in the literature. The results provide policy makers with reasonable confidence that outward investment does indeed have some of the hypothesized benefits. While drawing concrete policy implications goes beyond the scope of this paper, our results suggest that (governmental) support of companies going international could help boost the competitiveness and productivity of Canadian firms and improve aggregate productivity growth.

Our research leaves numerous investigations to future research. First, it would be interesting to examine the impact of outward FDI on other variables including employment, sales and profits of firms to obtain a more nuanced understanding of firms' motivation and the impacts from internationalizing on the sources or components of changes in productivity. Second, while our database is too small to allow such analysis, future research should examine whether the type of foreign investment (R&D, production, sales office, etc.) produces significantly different gains in productivity (Imbriani et al., 2011) in the Canadian context.[32] Our research also does not permit controlling for firms that internationalize but fail and consequently withdraw their foreign operations, potentially

[32] Such investigation could illuminate the question of whether FDI substitutes for exports (for instance, in the case of a foreign factory replacing prior domestic production), or whether foreign investment helps in fostering exports (e.g., a sales office abroad that facilitates the distribution and related service of goods produced at home) (Coiteux et al., 2014).

biasing our results downwards. Future work could try to complement our database with information on divestures.

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Appendix 1: Tables

Table 1: Characteristics and correlation of productivity measures

		Labour productivity			Total factor productivity	
		Labour productivity	Value added labour productivity**	Profit ratio	Approximate total factor productivity	Levinsohn and Petrin
	Definition	ln(sales/ employees)	ln(sales-interm. goods)/ employees))	ln(sales-COGS/employees)	ln(sales/employees)-1/3* ln(PPE/employees)	Residual of instrumental regression
Observations*	Total	8,453	2,018	7,680	8,255	8,218
	Treatment group	217	47	200	209	205
	Control group	2,069	529	1,929	2,069	2,069
Characteristics	Mean	12.66	12.15	11.64	8.47	14.74
	Standard deviation	1.41	0.86	1.56	1.15	1.53
	Min	4.25	10.67	2.13	-0.16	5.25
	Max	19.92	14.69	18.67	14.68	20.18
Correlations	Labour productivity	1.00				
	Value added labour productivity**	0.87	1.00			
	Profit ratio	0.84	0.94	1.00		
	Approximate total factor productivity	0.82	0.68	0.65	1.00	
	Levinsohn and Petrin	0.79	0.59	0.61	0.67	1.00

Notes: *Observations may include several observations per company in the control group (i.e., for different reporting years). Total observations include firms that have foreign operations or invest abroad but not for the first time. Since these firms are neither part of the treatment group (first–time investors) nor of the control group (purely domestic firms), the two do not add up to the total. Further, the table reports statistics on the full sample of observations; the propensity score matching is run on a smaller sub-sample of firms for which at least three consecutive years of data are available.

** Value added is defined as sales minus intermediate goods, where the latter are approximated by costs of goods sold minus staff expenses

Table 2: Summary statistics for switching and domestic firms

		Labour productivity			Means in millions CAD		
	Observations	**Mean**	**Median**	**Employees**	**Total Assets**	**Sales**	**PP&E**
Domestic firms	9,869	12.71	12.64	2994	1,645	767	938
Switching firms	340	12.39	12.48	3507	8,674	1,482	1,736

Table 3: Probit model of firms' decision to invest outside Canada

Variables (in logs)	First–time foreign investment							All foreign investments						
Employment	0.076***	0.082***	0.114***	0.072***	0.199***	0.17***	-0.013	0.267***	0.282***	0.287***	0.274***	0.393***	0.353***	0.093***
	(0.025)	(0.026)	(0.032)	(0.025)	(0.032)	(0.031)	(0.036)	(0.018)	(0.019)	(0.021)	(0.019)	(0.024)	(0.023)	(0.029)
Capital intensity (fixed assets/ employment)		0.005							0.1***					
		(0.033)							(0.026)					
Productivity growth (sales/employee)			0.114							0.101				
			(0.113)							(0.089)				
Productivity (sales/employee)				-0.042	0.181***						0.111***	0.305***		
				(0.042)	(0.06)						(0.034)	(0.044)		
Profit ratio (EBITDA/sales)					-0.001	0.039						0.054	0.112**	
					(0.063)	(0.062)						(0.049)	(0.048)	
Investment							0.102***							0.192**
							(0.031)							(0.025)
Sector dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Regional dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Pseudo R^2	0.128	0.132	0.119	0.129	0.152	0.143	0.136	0.245	0.25	0.26	0.249	0.318	0.296	0.262
Log likelihood	-530.503	-508.127	-385.249	-530.013	-402.252	-406.75	-510.197	-937.793	-894.771	-752.177	-932.293	-727.389	-751.512	-877.448
Observations	2,468	2,361	1,825	2,468	2,154	2,154	2,363	2,761	2,643	2,202	2,761	2,419	2,419	2,641

Note: Sample restricted to firms for which three consecutive years of data for matching model are available. ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level.

Table 4: Impact of outward investment on firm–level productivity

A. Dependent variable: labour productivity (sales/employee)

	Average treatment effect of the treated (ATT)			Difference in difference estimator (DID)	
	year1	year2	year3	year 2	year 3
Impact of investment on productivity	0.131	0.219*	0.264**	0.0884*	0.133**
	(0.129)	(0.126)	(0.131)	(0.0504)	(0.0658)
Observations	1,955	1,955	1,955	1,955	1,955
Matched observations	135	135	135	135	135

Hotelling test F=0.837 (p-value 0.714)

B. Dependent variable: gross profit per employee $ln\left(\frac{sales-cost\ of\ goods\ sold}{employees}\right)$

Impact of investment on productivity	0.313**	0.460***	0.409***	0.146*	0.0952
	(0.147)	(0.130)	(0.136)	(0.0770)	(0.103)
Observations	1,825	1,825	1,825	1,825	1,825
Matched observations	118	118	118	118	118

C. Dependent variable: approximate total factor productivity $ln\frac{sales}{employee} - \frac{1}{3}ln\frac{PPE}{employee}$

Impact of investment on productivity	-0.197*	-0.0829	-0.0911	0.114**	0.106*
	(0.106)	(0.101)	(0.102)	(0.0497)	(0.0563)
Observations	1,837	1,837	1,837	1,837	1,837
Matched observations	129	129	129	129	129

D. Dependent variable: total factor productivity (Levinsohn and Petrin)

Impact of investment on productivity	0.0384	0.145*	0.193**	0.117**	0.144**
	(0.0915)	(0.0792)	(0.0979)	(0.0508)	(0.0678)
Observations	1,821	1,821	1,821	1,820	1,820
Matched observations	129	129	129	129	129

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Method: propensity score matching, 1:1 nearest neighbour

Controls: (t-1) log productivity growth, log employment, industry, province, and year dummies

Table 5: Robustness analysis using different specifications and observation groups

Dependent variable: labour productivity (sales/employee)

A. Excluding outliers in dependent variable

	Average treatment effect of the treated (ATT)			Difference in difference estimator (DID)	
	year1	year2	year3	year 2	year 3
Impact of investment on productivity	0.172*	0.269***	0.222**	0.0964**	0.0500
	(0.0990)	(0.0894)	(0.0919)	(0.0457)	(0.0530)
Observations	1,912	1,912	1,912	1,912	1,912
Matched observations	128	128	128	128	128

B. Adding investment as a control variable

Impact of investment on productivity	-0.0503	0.0952	0.0862	0.145**	0.136**
	(0.0957)	(0.123)	(0.110)	(0.0578)	(0.0564)
Observations	2,363	2,363	2,363	2,363	2,363
Matched observations	162	162	162	162	162

C: Using 1:3 matching (nearest neighbours)

Impact of investment on productivity	-0.0174	0.0830	0.136	0.100**	0.153**
	(0.114)	(0.109)	(0.109)	(0.0448)	(0.0620)
Observations	1,955	1,955	1,955	1,955	1,955
Matched observations	135	135	135	135	135

D: Using caliper matching

Impact of investment on productivity	0.144	0.226	0.271*	0.0816	0.127*
	(0.143)	(0.142)	(0.145)	(0.0526)	(0.0730)
Observations	1,955	1,955	1,955	1,955	1,955

E: Smaller control group: only firms that invest domestically

Impact of investment on productivity	-0.113	-0.0289	-0.00810	0.0839*	0.105*
	(0.0996)	(0.106)	(0.110)	(0.0454)	(0.0538)
Observations	1,878	1,878	1,878	1,878	1,878
Matched observations	135	135	135	135	135

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Method: propensity score matching, 1:3 nearest neighbour

Controls: Unless otherwise specified, controls include (t-1) log productivity growth, log employment, industry, province, and year dummies

Table 6: Robustness analysis: using all foreign investments (first & subsequent) as treatment

Dependent variable: labour productivity (sales/employee)

	Average treatment effect of the treated (ATT)			Difference in difference estimator (DID)	
	year1	year2	year3	year 2	year 3
Impact of investment on productivity	0.132*	0.188**	0.222***	0.0560	0.0893*
	(0.0724)	(0.0764)	(0.0760)	(0.0424)	(0.0464)
Observations	2,202	2,202	2,202	2,202	2,202
Matched observations	382	382	382	382	382
Dependent variable: profit ratio: $ln\left(\frac{sales-cost\ of\ goods\ sold}{employees}\right)$					
Impact of investment on productivity	0.544***	0.666***	0.712***	0.122***	0.168**
	(0.0852)	(0.0910)	(0.103)	(0.0460)	(0.0678)
Observations	2,055	2,055	2,055	2,055	2,055
Matched observations	348	348	348	348	348
Dependent variable: approximate total factor productivity $ln\frac{sales}{employee} - \frac{1}{3}ln\frac{PPE}{employee}$					
Impact of investment on productivity	-0.102	-0.0932	-0.0823	0.00859	0.0195
	(0.0621)	(0.0600)	(0.0622)	(0.0255)	(0.0353)
Observations	2,075	2,075	2,075	2,075	2,075
Matched observations	367	367	367	367	367
Dependent variable: total factor productivity (Levinsohn and Petrin)					
Impact of investment on productivity	0.183***	0.245***	0.252***	0.0620**	0.0691*
	(0.0584)	(0.0545)	(0.0530)	(0.0268)	(0.0354)
Observations	2,051	2,051	2,051	2,051	2,051
Matched observations	359	359	359	359	359

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Method: propensity score matching, 1:1 nearest neighbour

Controls: (t-1) log productivity growth, log employment, industry, province, and year dummies

Table 7: Summary statistics (annual data)

	Mean	Standard deviation	Min	Max
Value of outward FDI projects	4053	5691	0	31273
Value of inward FDI projects	2547	3084	0	13836
Number of outward FDI projects	58	72	0	259
Number of inward FDI projects	41	50	0	204
Δ Log labour productivity	0.01	0.02	-0.10	0.09
Δ Log capital-to-labour	0.04	0.03	-0.04	0.14
R&D expenditure	6.1	1.4	2.9	8.5

Table 8: Provincial panel regressions

Dependent variable: Δ labour productivity

	A		B		C		D	
	Number of FDI projects		FDI investment values		Number of FDI projects		FDI investment values	
Inward FDI								
t-1	0.003	***	0.001		0.004	**	0.000	
t-2	0.000		-0.001		0.000		-0.002	
Outward FDI								
t-1	0.002	***	0.003	**				
t-2	-0.005		-0.001					
Outward FDI to OECD countries								
t-1					0.009	**	0.002	
t-2					0.003		-0.001	
Outward FDI to non-OECD countries								
t-1					-0.002		0.000	
t-2					0.000		0.001	
Δ log capital-to-labour	0.000	***	0.000	***	0.000	***	0.000	***
Log R&D expenditure	0.030	**	0.126	**	0.102	**	0.126	**
R^2	0.58		0.56		0.57		0.54	

Note: Regressions include time trend, control for province-specific productivity shocks, and provincial fixed effects. Panel regression covers 2003–2014 and the 10 Canadian provinces. Regression uses cluster robust standard errors. All variables are expressed in logs, except the FDI variables, which are transformed using inverse hyperbolic sines. ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level.

Table 9: Results from stepwise regression

Dependent variable: Δ log labour productivity

	A		B	
	Number of FDI projects		FDI investment values	
Inward FDI				
t-1	0.005		0.001	
t-2	-0.003		-0.001	
Outward FDI				
t-1	0.004	**	0.001	
t-2	-0.000		-0.001	
Δ log capital-to-labour	0.000	***	0.000	***
Canadian-dollar effective exchange rate index	-0.000		-0.001	*
R^2	0.61		0.56	

Note: Regressions include time trend, control for province-specific productivity shocks, and provincial fixed effects. Panel regression covers 2003–2014 and the 10 Canadian provinces. Regression uses cluster robust standard errors. All variables are expressed in logs, except the FDI variables, which are transformed using inverse hyperbolic sines. ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level.

Table 10: GMM regression and endogeneity test results

Dependent variable: Δ labour productivity

	A		B		C	
	GMM results		Sanderson-Windmeijer F-test (null: weak identification)		Sanderson-Windmeijer Chi squared-test (null: under identification)	
Inward FDI						
t-1	-0.001		2.95	**	229.39	***
t-2	-0.004		6.26	***	487.69	***
Outward FDI						
t-1	0.010	***	2.59	**	201.92	***
t-2	0.002		16.17	***	1258.47	***
Δ capital-to-labour	0.000	***				
R&D expenditure	0.128	***				
Hansen J statistic (null hypothesis: no overidentification)			24.846			
P-value			0.305			
Endogeneity test (null hypothesis: exogenous)			1.341			
P-value			0.854			

Note: Regressions include time trend, control for province-specific productivity shocks, and provincial fixed effects. All variables are expressed in logs, except the FDI variables, which are transformed using inverse hyperbolic sines. ***: significant at the 1% level; **: significant at the 5% level; *: significant at the 10% level.

Appendix 2: Chart

Chart 1: Distribution of measures of labour productivity, for switching firms and control group

Measures of labour productivity

Measures of total factor productivity