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Global Links: Multinationals, Foreign Ownership and Productivity Growth in Canadian Manufacturing

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Preface

This paper examines two potential benefits of foreign-controlled plants in the Canadian manufacturing sector: the superior performance of foreign-controlled plants and their productivity spillovers to domestic plants. The paper finds that foreign-controlled plants are more productive, more innovative, more technology intensive, pay higher wages and use more skilled workers. This foreign-ownership advantage is found to be a multinational advantage. What matters for economic performance is whether plants belong to multinational enterprises (MNEs) rather than ownership per se. Canadian multinationals are as productive as foreign multinationals. We also find that MNEs have accounted for a disproportionately large share of productivity growth in the last two decades. Finally, we find robust evidence for productivity spillovers from foreign-controlled plants to domestic-controlled plants arising from increased competition and greater use of new technologies among domestic plants.

Keywords: multinationals, productivity, externalities

Executive summary

This paper assesses the contribution that foreign-controlled plants make to the Canadian manufacturing sector—by examining both whether foreign-controlled producers exhibit superior performance and whether their productivity growth spills over to domestic plants. In order to assess the contribution that multinationals make to the Canadian economy, this paper asks six questions.

1) First, are there differences in the profiles of foreign-controlled plants and domestic-controlled plants?

In the first section, the performance of foreign-controlled plants is compared with domestic-controlled plants. This comparison is more comprehensive than most other Canadian studies. It uses a variety of measures that include value-added per worker, gross output per worker, worker wage, the share of non-production workers, research and development (R&D), innovation and technology used.

The paper finds that foreign-controlled plants are more productive than domestic-controlled plants. Foreign-controlled plants and firms are also more innovative, more R&D intensive and use more advanced technologies.

2) Second, is the difference between foreign-controlled and domestic-controlled plants the result of differences in international orientation?

To answer this question, the paper asks whether foreign-controlled plants differ from those domestic producers that have an international orientation—that have foreign operations. The paper finds that there is not much difference between foreign-controlled plants and domestic-controlled plants whose parent has an international orientation. For R&D and innovation, the results indicate that domestic producers with foreign operations (referred to here as domestic MNEs) actually have a slightly better performance.

3) Third, do the differences between foreign and domestic producers translate into differences in aggregate industry productivity growth?

The paper starts by measuring the contribution of foreign MNEs to labour productivity growth in the Canadian manufacturing sector. The results show that foreign-controlled plants account for most of labour productivity growth in Canadian manufacturing during the past three decades. U.S. MNEs make a more important contribution than other foreign MNEs to productivity growth in the Canadian manufacturing sector; but the relative importance of U.S. MNEs has declined slightly from 48 percent to 45 percent between the 1980s and the 1990s, while that of other foreign MNEs was about 20 percent for both periods.

The paper also compares the importance of the contribution made by foreign-controlled plants to productivity growth in the 1990s to their contribution in the 1980s. At issue here is whether the relative importance of Canada as a destination for foreign direct investment declined during the 1990s as a result of two free trade agreements: the Canada-U.S. Free Trade Agreement (CUFTA) and the North American Free Trade Agreement (NAFTA) and whether this has been associated with a deterioration in the relative performance of foreign-controlled plants in Canada.

Annual labour productivity growth in the Canadian manufacturing increased from 1.3 percent in the 1980-1990 period to 3.0 percent in the 1990-1999 period—an increase of 1.7 percentage points between the two periods. Both domestic- and foreign-controlled plants contributed to the acceleration. Of the 1.7 percentage-point increase in annual labour productivity growth, domestic-controlled plants contributed 0.6 percentage points, U.S. MNEs contributed 0.7 percentage points, and other foreign MNEs contributed 0.4 percentage points. MNEs therefore made a substantial contribution to the increased productivity growth of the 1990s.

4) Fourth, are there spillovers from foreign-controlled plants to domestic producers?

While foreign-controlled plants are therefore shown to directly generate benefits because of higher productivity growth with the foreign sector, they may also be indirectly responsible for performance in the domestic sector. This paper therefore examines whether foreign-controlled plants generate spillover benefits for productivity growth in domestic-controlled plants.

To investigate this, the paper examines whether the productivity growth of domestic producers is higher when the market share of foreign producers is larger. The results indicate that the share of foreign-controlled plants in total employment is related to labour productivity growth of domestic plants.

5) Fifth, the paper asks whether there is a subset of domestic plants that benefits more from spillovers originating in foreign-controlled plants.

In the first instance, the paper asks whether those domestic producers that are relatively more backward benefit more from the spillover. The paper finds that smaller and younger domestic plants capture larger positive spillover benefits than do older and larger domestic plants in industries where the share of foreign-controlled plants is higher.

In the second instance, the paper asks whether the absorptive capacity that is created by R&D activity is related to the degree of spillovers. The results suggest that R&D performers do not capture larger foreign direct investment (FDI) spillover benefits than do non-R&D performers.

6) Sixth, the paper investigates what mechanisms generate spillovers. It examines the presence of two such mechanisms: enhanced competition and the more intense use of advanced technologies by domestic firms.

The study finds that the share of foreign-controlled plants is positively linked both to the level of competition faced by the domestic sector and the number of technologies used in the domestic sector. This is consistent with the argument that the spillover benefits of foreign-controlled plants are due to increased competition and the increased use of advanced technologies in domestic plants.

In summary, the paper finds that foreign-controlled plants are more productive, more innovative, more technology intensive, pay higher wages and use more skilled workers. This foreign-ownership advantage is found to be a multinational advantage. What matters for economic performance is whether plants belong to multinational enterprises rather than ownership per se. Canadian multinationals are as productive as foreign multinationals. We also find that foreign-controlled MNEs have accounted for a disproportionately large share of productivity growth in the last two decades. Finally, we find robust evidence for productivity spillovers from foreign-controlled plants to domestic-controlled plants arising from increased competition and greater use of new technologies among domestic plants.

Chapter 1. Introduction

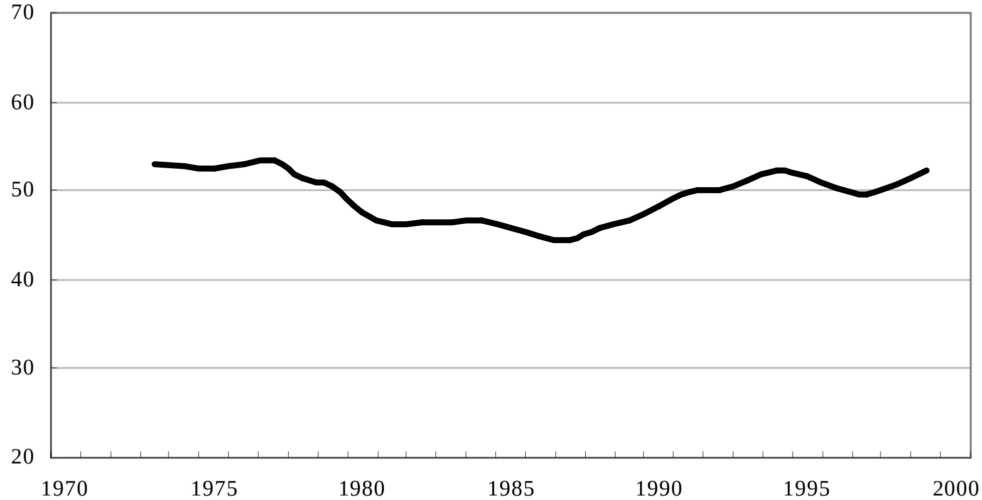
This paper examines two benefits that are derived from the presence of foreign multinational enterprises (MNEs) in the Canadian manufacturing sector: the superior performance of foreign MNEs and their spillover benefits to domestic-controlled firms. This issue has received an increasing amount of attention among researchers as countries around the globe compete for foreign direct investment.

This paper extends previous studies on the relative performance of foreign- and domestic-controlled plants in the Canadian manufacturing sector. First, we compare the differences between foreign and domestic firms using a large number of characteristics—one of which is the level of productivity. In doing so, we make a distinction between plant ownership and multinational status. We find that the foreign-ownership productivity advantage found in previous studies is a MNE advantage. Canadian-controlled multinationals have equally high labour productivity compared with foreign multinationals. Second, we provide a more comprehensive comparison between foreign- and domestic-controlled plants using various performance measures that include real value-added per worker, real gross output per worker, wage rates of workers, the share of non-production workers, research and development, innovation, and technology use. In most cases, multinationals are found to have superior performance.

We then ask whether these differences in characteristics are associated with differences in performance over time. The research study that only examines whether there are differences in productivity levels between multinationals and domestic firms leaves unanswered the question as to whether this matters to longer-run industry performance. Industries are heterogeneous. They are made up of small and large firms, domestic- and foreign-owned firms, more productive and less productive firms. The interesting question is not just the degree of heterogeneity in an industry (whether there are some firms that have a higher level of productivity) but the impact of heterogeneity on industry performance as a whole. We answer this question by asking whether the total amount of productivity growth that is generated in manufacturing comes more from multinationals than from the domestic sector. We find that MNEs generate a disproportionate amount of the growth—at least relative to their share of industry output and employment.

While multinationals are therefore shown to directly generate benefits, they may also be indirectly responsible for benefits passed on to the domestic sector. This paper therefore examines the mechanisms through which foreign multinationals exert spillover benefits on the productivity of domestic-controlled plants. It has been suggested that foreign

Figure 1. The output share of foreign-controlled plants in Canadian manufacturing



Source: Annual Survey of Manufactures (ASM).

multinationals stimulate competition and increase the incentives for domestic-controlled plants to adopt advanced technologies (Caves, 1974; Globerman, 1979). However, there is little empirical evidence for the hypothesis. This paper attempts to fill this gap, thus providing a better understanding of FDI spillover benefits than is reported in previous studies and their potential causes. It first provides evidence that the presence of foreign multinationals is linked to productivity growth of domestic-controlled plants. It then shows that FDI spillover benefits are related to more intense competition and increased rates of technology use among domestic-controlled plants.

The share of foreign-controlled MNEs in total output in the Canadian manufacturing sector increased after the mid-1980s. This coincides with the establishment of a more liberal regulatory framework towards foreign direct investment in the mid-1980s. During the 1987-1999 period, the share for foreign MNEs in Canadian manufacturing output rose from 44 percent to 52 percent (Figure 1).

As shown in Appendix Table A1, the increase in the output share of foreign-controlled plants was pervasive across manufacturing industries after the mid-1980s. Over the period 1987-1999, the output share of foreign-controlled plants increased in 13 of the 22 manufacturing industries. The beverage, food, and non-metallic mineral products industries had the biggest increase in foreign ownership, while the machinery equipment, electrical and electronic products, and other manufacturing industries experienced the sharpest decline.

There is a large variation in foreign ownership across industries. The rubber and transportation equipment industries had the highest foreign ownership with more than 80 percent of output accounted for by foreign-controlled plants in 1999. The clothing, printing and publishing and leather and allied industries and furniture and fixture, had the lowest foreign ownership with below 20 percent of output accounted for by foreign-controlled plants.

The rest of the paper is organized as follows. In section 2, we compare the performance of foreign multinationals, domestic multinationals and pure domestic plants. Our comparison is more comprehensive than most previous studies and is based on a variety of performance measures that include real value-added per worker, real gross output per worker, the share of non-production workers, R&D, innovation and technology use. In section 3, we estimate the contribution of foreign MNEs to labour productivity growth in Canadian manufacturing during the 1980s and 1990s. In section 4, we examine the spillover benefits emanating from foreign multinationals that flow to domestic plants. We also examine the source of the spillovers. Section 5 concludes the paper.

Chapter 2. Differences between multinationals and domestic firms

A number of previous studies have compared the performance at one point in time of foreign-controlled multinationals to domestic-controlled plants in Canada. Globerman, Ries and Vertinsky (1994) find that foreign-controlled plants tend to have higher value-added per worker than domestic-controlled plants in a sample of 21 out of the 236 Standard Industrial Classification (SIC) 4-digit manufacturing and logging industries.[1] The difference is found to be due to their difference in size, capital intensity and the share of non-production workers. After accounting for these differences, they find that foreign- and domestic-controlled plants have similar productivity performance. A number of more recent studies confirm the finding that foreign-controlled plants have higher labour productivity (e.g., Baldwin and Dhaliwal, 2001; Rao and Tang, 2004).

A growing number of studies in other countries have also used micro-level data to compare the performance of foreign-controlled and domestic-controlled plants. Theses studies find that foreign-controlled plants are more productive (e.g., Doms and Jensen, 1998 for the U.S.; Griffiths and Simpson, 2004 for the U.K.). Foreign-controlled plants tend to have higher labour and multifactor productivity. Several studies have also compared R&D and technology adoption and find that foreign-controlled plants are more R&D intensive, more innovative, and use more advanced technologies (Doms and Jensen, 1998; Griffiths, Redding and Simpson, 2004).

To provide a better understanding of the difference between foreign- and domestic-controlled plants, three recent studies have made a distinction between firm ownership and multinational status (Doms and Jensen 1998; Criscuolo and Martin, 2004; Baldwin and Hanel, 2003). These studies find that the foreign-ownership productivity advantage is a MNE advantage. What matters for plant performance is whether plants belong to a MNE rather than foreign ownership per se. Domestic-controlled plants that belong to MNEs and foreign MNEs both have high productivity compared with domestic firms without an international orientation. This is consistent with Vernon's view that distinguishing MNEs according to their national bases, while useful in the past, is less useful now (Vernon, 1993).

In this section, we compare the performance of foreign-controlled plants with domestically controlled plants. Our comparison is more comprehensive than most other studies in Canada. We use a variety of measures that include value-added per worker, gross output per worker, worker wage, the share of non-production workers, R&D, innovation and technology use. We divide foreign-controlled plants into U.S. plants and other foreign plants, and divide domestically-controlled plants into those that have international operations and those that do not. We call these four groups U.S MNEs, other foreign MNEs, Canadian MNEs and pure domestic plants.

There is overwhelming evidence from Canada, the U.S. and other countries that foreign-controlled plants are more productive than domestic-controlled plants (Baldwin and Dhaliwal, 2001 for Canada; Doms and Jensen, 1998 for the U.S.; Griffiths and Simpson, 2004 for the U.K.). However, at issue for Canada is the relative performance of Canadian MNEs compared with U.S. and other foreign MNEs. It has been argued that Canadian MNEs lag behind the U.S. MNEs in productivity performance. Martin and Porter (2001) argue that Canadian firms that compete internationally tend to focus on natural resources advantages or lower labour costs than other G-7 competitors instead of sophisticated products and processes. However, this evidence is based on case studies of selected Canadian manufacturing industries. This paper examines the productivity difference between Canadian MNEs and foreign MNEs in all Canadian manufacturing industries.

We then provide a comparison of worker wage, total employment and employment mix (production vs. non-production workers) between foreign MNEs, Canadian MNEs and pure domestic plants. It is well documented that foreign-controlled plants pay higher wages and use a higher proportion of non-production workers than domestic-controlled plants in Canada and most other countries. But little is known about the difference in wages and the labour mix between foreign and domestic MNEs.

The last part of the section compares R&D, innovation and technology use between foreign MNEs, Canadian MNEs and domestic plants. Few empirical studies have provided such a comparison. Doms and Jensen (1998) examine the difference in the use of advanced technologies between U.S. MNEs and foreign MNEs that operate in the U.S. They find that plants owned by U.S. MNEs are the most technology-intensive plants. Foreign MNEs that operate in the U.S. use fewer advanced manufacturing technologies than U.S. MNEs. Baldwin and Hanel (2003, chapter 10) compare R&D and innovation between Canadian MNEs, foreign MNEs and domestic plants. They show that Canadian MNEs and foreign MNEs are quite similar in terms of R&D and innovation activities. But they do not compare technology use.

2.1 Data sources, linked ASM-SIAT sample

In this study, we start by examining the difference in labour productivity of domestic as opposed to foreign plants. Differences in labour productivity are the result of many factors—inherent efficiency, capital intensity, economies of scale, organizational factors and other conditions. There is a tendency in some places to focus on a separate measure, multifactor productivity, as the measure of choice—primarily because it is seen to be closer to a ‘pure’ measure of efficiency. While some might prefer a total or multifactor productivity estimate to capture pure technical change, there are reasons for our preference of a labour productivity measure. First, the two are related in a simple way. Labour productivity growth is just the growth in multifactor productivity plus the share of capital times the rate of growth of capital intensity. Labour productivity then encompasses a broader concept than multifactor productivity. Labour productivity increases both because multifactor productivity increases and because capital intensity of a firm increases. And most firms grow from small to large entities by learning how to apply more capital to their operations as well as by increasing their efficiency. Therefore, to the extent we are interested in factors behind market-share growth, labour productivity growth is a more intuitive concept to employ. Second, labour productivity is more accurately measured than multifactor productivity—especially at the individual firm level. Multifactor productivity measures are difficult enough to measure accurately at the industry level because they need estimates of depreciation rates. At the firm level, these estimates are almost impossible to obtain. Nevertheless, we do move beyond just labour productivity measures in our analysis and ask whether an estimate that corrects for potential capital differences indicates that MNEs and domestic plants differ in terms of a broader productivity measure.

The data for the analysis in this section is drawn from the ASM longitudinal file over the period 1973-1999. The Annual Survey of Manufactures (ASM) provides information on plant ownership (foreign vs. domestic). But it does not allow us to identify whether a domestic-controlled plant is a MNE or non-MNE. To do this, we use the 1993 Survey of Innovation and Advanced Technology (SIAT). The SIAT provides information on whether firms have international operations (sales office, R&D unit, production unit, and assembly unit). We will define Canadian MNEs as Canadian-controlled plants that have international operations.

The 1993 SIAT was designed to randomly sample all plants in the manufacturing sector and their parent firms and to provide a coefficient of variation of around 5%. The sampling procedure was two-stage—focusing separately on larger and smaller plants and providing stratification at the 2-digit industry level. There were 1,954 plants of larger firms sampled and 2,180 small firms sampled in the SIAT. Of the 1,954 large plants, 1,880 were matched with the longitudinal file of manufacturing plants and form the sample for our analysis. For plants that belong to multi-plant firms, questions on innovation and R&D were sent to their head offices, and only questions on technology use were addressed to plant managers. As such, innovation and R&D activities for these plants represent those of their parent firms.

The share of domestic plants, Canadian MNEs, U.S. MNEs and non-U.S. MNEs in the linked ASM-SIAT sample is presented in Table 1. The statistics in Table 1 are calculated using sample weights in the SIAT. Most of the plants in the sample (68%) are pure domestic plants—that is domestically controlled and not operating outside of Canada. The share of domestic MNEs is smaller than U.S. MNEs and non-U.S. MNEs. Domestic MNEs account for 7 percent, U.S. MNEs for 15 percent, and other foreign MNEs for 10 percent of all plants.

As the plants in the linked sample consist of larger plants, the share of foreign MNEs in the sample is larger than the share in Canadian manufacturing, as calculated from the ASM file. Since the plants excluded from our sample tend to be small and non-MNEs, this generates a downward bias in our estimate of the difference between MNEs and non-MNEs. But it should have little effect on our comparison of Canadian MNEs and non-MNEs.

Table 1. Importance of MNEs				
	Number of plants	Shares	Employment share	Value-added share
	Linked ASM-SIAT sample			
Canadian non-MNEs	1,274	0.68	0.42	0.32
Canadian MNEs	129	0.07	0.11	0.09
U.S. MNEs	283	0.15	0.30	0.37
Non-U.S. MNEs	194	0.10	0.17	0.23
	ASM sample			
Canadian MNEs and non-MNEs	27,715	0.89	0.66	0.52
U.S. MNEs	1,968	0.06	0.23	0.33
Non-U.S. MNEs	1,502	0.05	0.11	0.15

Note: Authors' calculations from both samples for year 1993.
Source: Annual Survey of Manufactures (ASM).

2.2 Labour productivity

To examine the difference in labour productivity between various types of plants, we use a regression that expresses labour productivity in logarithmic form as a function of plant type, plant size, plant age, and industry fixed-effects.[2] Baldwin and Hanel (2003, chapter 10) show that foreign MNEs tend to be concentrated in those industries that are more knowledge-intensive and more productive. To compare MNEs with non-MNEs, it is essential to control for industry characteristics. Otherwise, the estimated difference between MNEs and non-MNEs could be due to an industry composition effect. Therefore, we will include fixed effects for 2-digit industries in all our regressions.

The regression results are shown in Table 2. We have used two measures of labour productivity. One is defined as value-added[3] per worker and the other as gross output per worker. The first three columns report results using the value-added measure. The last three columns present results from the gross output measure.

Column (1) of Table 2 compares foreign-controlled and domestic-controlled plants and confirms the findings of previous studies for Canada (Globerman *et al.*, 1994; Baldwin and Dhaliwal, 2001). Foreign-controlled plants have higher labour productivity (defined as value-added per worker) than domestic-controlled plants. Our results show that U.S.-controlled plants operating in Canada are 60 percent more productive than domestic-controlled plant. Other foreign-controlled plants are about 50 percent more productive. The difference between U.S.-controlled and other foreign-controlled plants is not statistically significant.

Globerman *et al.* (1994) find that the difference in value-added per worker between foreign- and domestic-controlled plants is due to differences in size, capital intensity and share of non-production workers. When we introduce these additional controls in our regression, we find that foreign-controlled plants are still 12 percent more productive than domestic-controlled plants.[4] That is in sharp contrast to the result in Globerman *et al.* (1994). This is due to the difference in the choice of industries for the analysis. Globerman *et al.* (1994) choose a sample of 21 4-digit SIC industries that have Japanese-owned plants.[5] We choose a sample of all manufacturing industries. There are a total of 236 SIC 4-digit industries in

Table 2. Difference in labour productivity between MNEs and non-MNEs, 1993						
	Value-added per worker			Gross output per worker		
	(1)	(2)	(3)	(4)	(5)	(6)
U.S. MNEs	0.595	0.059	0.036	0.531	0.076	0.060
	(9.34)	(0.74)	(0.46)	(11.22)	(0.94)	(0.76)
Other foreign MNEs	0.466	-0.067	-0.049	0.487	0.034	0.048
	(5.60)	(-0.71)	(-0.51)	(8.74)	(0.40)	(0.56)
MNEs	...	0.578	0.408	...	0.490	0.360
	...	(9.21)	(6.24)	...	(6.75)	(4.84)
Plant size	...	...	0.089	...	...	0.071
	...	...	(5.28)	...	...	(5.21)
Young plants	...	...	-0.103	...	...	-0.062
	...	...	(-2.14)	...	...	(-1.68)
R squared	0.164	0.187	0.219	0.349	0.369	0.392
Observations	1,820	1,820	1,820	1,830	1,830	1,830

Notes: Robust t-statistics are in parentheses. All regressions include 2-digit industry fixed effects. The omitted group in (1) and (4) is domestic-controlled plants, and the omitted group in other columns is domestic-controlled non-multinationals.

... not applicable

Source: Linked ASM-SIAT sample.

Canadian manufacturing. As such, the industries chosen in Globerman *et al.* (1994) represent a small share of Canadian manufacturing industries. Our results suggest that foreign-controlled plants tend to have higher labour and multifactor productivity (MFP) than domestic-controlled plants for most manufacturing industries.[6]

In Column 2, we divide domestic-controlled plants into those with international operations (Canadian MNEs) and those without (Canadian non-MNEs). The coefficient on the binary variable for MNEs measures the difference between Canadian MNEs and pure domestic plants. The coefficient on foreign MNEs measures the difference between foreign MNEs and Canadian MNEs. The results show that Canadian, U.S., and other foreign MNEs have equally high labour productivity. The difference between them is not statistically significant. On average, MNEs are about 60 percent more productive than pure domestic plants in the sample.

Part of the difference between MNEs and non-MNEs is due to differences in size and age, as shown in Column 3. Controlling for plant size (log employment), plant age (young plants of less than 7 years—median age in the sample), we find that the coefficient on MNEs becomes slightly smaller. The difference between Canadian MNEs, U.S. MNEs and other foreign MNEs remains non-significant.

When we compare labour productivity defined as gross output per worker, we find similar results (columns 4, 5, and 6). MNEs are the most productive, and there is little difference between domestic MNEs and foreign MNEs.

Table A2 in the Appendix includes the capital-labour ratio as an additional control variable in order to provide a comparison of productivity between foreign MNEs, domestic MNEs and pure domestic plants. As in Globerman *et al.* (1994), we use the ratio of energy costs to labour as a proxy for the capital-labour ratio. The share of non-production workers and the average wages of workers are included to account for the difference in labour skills and human capital between plants of various types. The results for Multi Factor Productivity (MFP) in Table A2 are similar to those for labour productivity in Table 2. We find that MNEs have the highest productivity, and there is little difference in productivity between domestic MNEs and foreign MNEs. We also find that the productivity difference between MNEs and non-MNEs is smaller than before. This suggests that the higher labour productivity of MNES relative to non-MNES is partly due to their higher capital intensity.

2.3 Wages, employment and share of non-production workers

Labour productivity can differ across plants for many reasons. Foreign plants may be larger; they may be more complex; they may employ workers who are more skilled and who receive higher wages. To investigate these issues, we examine whether there are differences in the type of workforce using the split of total employment between non-production and production workers, the average size of plant and the average wage rate of workers. Plants that are more complex use more non-production workers for management purposes. Plants that make use of an occupational mix with higher skilled workers are likely to pay higher average wages.

The results from regressions that compare the share of non-production workers, total employment per plant and wages per worker between Canadian MNEs, U.S. MNEs, other foreign MNEs, and domestic plants are contained in Table 3. The country of ownership is not related to the average wage among MNEs. Canadian MNEs, U.S. MNEs and other foreign MNEs pay similar wages to their production workers and to non-production workers.

But there is a large difference in the average wage of workers between MNEs and non-MNEs. The average wage of workers at MNEs is about 12 percent higher.

The wage differential between MNEs and non-MNEs is much larger for production workers than for non-production workers. The average wage of production workers at MNEs is 15 percent higher than at non-MNEs. The difference in the wage of non-production workers is not as large—only about 7%.[7] Doms and Jensen (1998) find similar results for the United States.

Table 3. Difference in employment and wages between MNEs and non-MNEs, 1993

Dependent variable	Foreign U.S.	Foreign other	MNEs	Observations
Log wages	-0.022	-0.020	0.122	1,831
	(-0.71)	(-0.58)	(3.81)	
Log non-production worker wages	-0.030	-0.023	0.069	1,725
	(-0.75)	(-0.54)	(1.75)	
Log production worker wages	-0.030	-0.012	0.145	1,815
	(-0.88)	(-0.35)	(4.56)	
Log employment	0.035	-0.202	1.468	1,831
	(0.22)	(-1.25)	(10.51)	
Share of non-production workers	0.069	0.044	-0.018	1,831
	(3.85)	(2.28)	(-1.19)	

Notes: Robust t-statistics are in parentheses. All regressions include plant size, plant age and 2-digit industry fixed effects. The omitted group is domestic-controlled non-multinationals.

Source: Linked ASM-SIAT sample.

There is little difference in total employment per plant between Canadian MNEs and foreign MNEs. But the composition of workers is different in the two groups. U.S. MNEs and other foreign MNEs have a larger share of non-production (skilled) workers than Canadian MNEs. Baldwin and Brown (2005) and Globerman *et al.* (1994) find similar results for Canada. When MNEs establish foreign subsidiaries to exploit proprietary assets, they make use of more white collar workers to handle the complex tasks related to management and marketing. This internalization of firm-specific knowledge assets via cross-border investment requires additional expertise in management, marketing and distribution. The evidence that foreign MNEs use a larger share of non-production workers is consistent with theories of MNEs based on the exploitation of firm-specific assets.

2.4 R&D and innovation

In the previous section, we have demonstrated that foreign plants have a higher labour productivity, pay higher wages and make use of more highly skilled white-collar workers. One of the reasons that has been posited for these differences is the greater likelihood that foreign plants are more innovative. Baldwin and Gu (2004b) show that those manufacturing plants in the 1993 SIAT that introduced innovations subsequently experienced greater productivity gains than non-innovators.

In this section, we examine the difference in R&D and innovation activities across foreign MNEs, Canadian MNEs and pure domestic plants. R&D is the primary input to the innovation process. Product and process innovations are the output. The SIAT allows us to ascertain which plants benefited from the R&D facilities of a parent, and which parents introduced process and product innovations.

There are two alternative models that can inform our understanding of the amount of R&D performed and innovation produced by the subsidiaries of multinationals in host countries (see, Baldwin and Hanel, 2003 for detailed discussions of these two models). The hub and spoke model of MNEs suggests that the R&D functions in Canadian subsidiaries should be relatively truncated. Canadian subsidiaries should operate much like branch plants, with the capacity to exploit the asset of their parent firms, but with little capacity to develop their own assets. If this view of the world is correct, foreign subsidiaries in Canada should invest less in research and development than domestic plants.

An alternative description of the R&D activities of foreign affiliates stresses the growing internationalization of R&D activities. As a result of advances in information and communication technologies and commercial policies towards more liberalized trade, multinationals are seen to be increasingly organizing their R&D activities around the globe to take advantage of local R&D capacities in host countries. Foreign affiliates are seen to compete with their sister companies for worldwide product mandates. R&D activities have become a key part of the activities of subsidiaries of multinationals. According to this view, foreign MNEs should be no less R&D intensive than domestic firms.

To discriminate between these two descriptions of the nature of R&D in multinational organizations, we examine the empirical evidence on differences in R&D and innovation

Table 4. Difference in R&D and innovation between MNEs and non-MNEs, 1993

	R&D			Innovation		
	(1)	(2)	(3)	(4)	(5)	(6)
U.S. MNEs	0.115	0.073	-0.106	0.101	0.030	-0.119
	(2.90)	(1.79)	(-1.87)	(2.56)	(0.75)	(-2.08)
Other foreign MNEs	0.091	0.073	-0.108	0.048	0.016	-0.131
	(1.94)	(1.52)	(-1.76)	(1.05)	(0.35)	(-2.19)
MNEs	...	...	0.226	...	...	0.193
	...	...	(4.17)	...	...	(3.47)
Plant size	...	0.062	0.055	...	0.102	0.096
	...	(4.60)	(4.07)	...	(7.44)	(7.03)
Young plants	...	0.006	0.013	...	0.007	0.014
	...	(0.18)	(0.35)	...	(0.21)	(0.40)
Log likelihood	-867.95	-853.51	-841.56	-861.85	-824.43	-815.64
Observations	1,410	1,410	1,410	1,410	1,410	1,410

Notes: Robust t-statistics are in parentheses. All regressions include 2-digit industry fixed effects. The omitted group in (1) and (4) is domestic-controlled plants, and the omitted group in other columns is domestic-controlled non-multinationals. The coefficients, which are estimated from a Probit model represent marginal effects evaluated at the sample means.

... not applicable

Source: Linked ASM-SIAT sample.

intensity. To do so, we estimate a Probit model that expresses whether a firm conducts R&D on an ongoing basis as a function of firm ownership (foreign vs. domestic), firm size, firm age, and fixed effects for 2-digit industries.[8] As we include industry fixed-effects in our regression, the estimated difference between foreign- and domestic-controlled firms with respect to R&D and innovation represents the difference between them in the same two-digit industry.

The results support the model that stresses the internationalization of R&D activities (Table 4). We find that the foreign-controlled firms are more likely to perform R&D on an ongoing basis. The probability that a foreign-controlled firm performs ongoing R&D is about 10 percentage points higher than that of a domestic-controlled firm. Part of this difference reflects the fact that foreign-controlled firms are larger than domestic-controlled plants. After controlling for firm size and firm age, the difference in probability of being a continuous R&D performer between foreign- and domestic-controlled firms is about 7 percent.[9]

The results presented in column (3) suggest that the foreign-ownership advantage in the performance of R&D is a multinational advantage. When we introduce in the regression an additional control indicating whether a firm is either a foreign or a domestic MNE, the coefficients on U.S. MNEs and other foreign MNEs become negative and statistically significant at the 10 percent level, thereby demonstrating that Canadian MNEs are more likely to perform R&D than foreign MNEs. The difference in the likelihood of being an ongoing R&D performer is large and is estimated to be about 10 percentage points.[10]

The last three columns compare the innovation rates of foreign MNEs, domestic MNEs and pure domestic firms. The results suggest that the difference in R&D activities of MNEs and domestic firms is reflected in their innovation rates. Canadian MNEs have the highest innovation rates, followed by foreign MNEs and pure domestic firms. This is consistent with the evidence from previous studies that R&D is an essential input for innovation. The firms that invest in R&D tend to have higher rates of introducing innovations (e.g., Baldwin and Gu, 2004b).

We also compare the rates of introducing product innovation, process innovation, and world-first innovations between the various types of firms using a dependent variable that measures whether an innovation was introduced just prior to the time of the Survey of Innovation and Advanced Technology (SIAT). We find that Canadian MNEs are the leaders in all these categories; domestic firms are the least innovative; foreign MNEs fall in between Canadian MNEs and purely domestic firms.

It has been argued that Canadian businesses are characterized by an innovation gap compared with those in other developed countries (OECD, 1995). Our finding suggests that the innovation gap reflects the poor innovation performance of domestically oriented firms in Canada. There is no evidence to suggest that Canadian firms with an international orientation have an innovation gap relative to foreign MNEs operating in Canada.

We have also compared export-market participation across foreign MNEs, Canadian MNEs and pure domestic plants. Export-market participation rate is highest at the MNEs. Among MNEs, the export-participation rate is similar and is not related to the country of ownership. There is no significant difference in the export intensity (export/shipment ratio) of exporters across foreign MNEs, Canadian MNEs and purely domestic plants.

2.5 Technology use

Another possible reason for the labour productivity advantages found in foreign-controlled plants is the type of technology that is being used. A number of previous studies have found that foreign-controlled plants use more advanced manufacturing technologies than domestic-controlled plants (Baldwin and Sabourin, 2003). However, little is known about the difference in technology use between foreign MNEs and domestic MNEs. This section examines this difference.

The SIAT asked whether plants use some 22 advanced technologies (e.g., flexible manufacturing systems, computer controlled machines, automated sensor-based equipment). The answers to the survey allow us to compare whether foreign plants were more likely to use any one of these advanced technologies than were domestic plants.

Table 5 contains results derived from a Probit model of the adoption of advanced manufacturing technologies. Foreign MNEs tend to have higher technology adoption rates than domestic-controlled plants. Among foreign MNEs, there is no significant difference in technology use between those based in the U.S. and those based in other foreign countries. The adoption rate at foreign-controlled plants is about 20 percentage points higher than domestic-controlled plants. Some of this difference is due to the fact that foreign-controlled plants are larger and larger firms tend to have a higher rate of technology adoption. When we control for plant size (column 2), the difference in the adoption rate is lower but still significant at the 10 percent level.

The results in column (3) provide a now familiar finding. The foreign-ownership advantage in technology adoption is a multinational advantage. When we divide domestic-controlled

Table 5. Difference in technology use between MNEs and non-MNEs, 1993

	(1)	(2)	(3)
U.S. MNEs	0.212	0.109	-0.045
	(5.28)	(2.44)	(-0.60)
Other foreign MNEs	0.169	0.132	-0.020
	(3.62)	(2.66)	(-0.26)
MNEs	...	...	0.182
	...	...	(2.81)
Plant size	...	0.211	0.206
	...	(13.32)	(13.00)
Young plants	...	-0.028	-0.025
	...	(-0.74)	(-0.66)
Log likelihood	-904.60	-776.28	-769.97
Observations	1,410	1,410	1,410

Notes: Robust t-statistics are in parentheses. All regressions include 2-digit industry fixed effects. The omitted group in (1) is domestic-controlled plants and the omitted group in other columns is domestic-controlled non-multinationals. The coefficients, which are estimated from a Probit model represent marginal effects evaluated at the sample means.

... not applicable

Source: Linked ASM-SIAT sample.

plants into those with an international orientation (or domestic MNEs) and those without an international orientation, we find that domestic plants with an international orientation are similar to foreign MNEs.

We have also examined the number of technologies used in the different types of plants. Our results show that foreign MNEs and domestic MNEs use more advanced technologies than domestic plants without an international orientation. There is little difference across Canadian MNEs, U.S. MNEs and other foreign MNEs.

To sum up, our finding confirms the evidence from previous studies that foreign-controlled plants and firms are more productive than domestic-controlled plants. Foreign-controlled plants and firms are also more innovative, more R&D intensive and use more advanced technologies. These foreign-ownership advantages are a MNE advantage. There is not much difference between foreign-controlled plants and domestic-controlled firms and plants with an international orientation. For R&D and innovation, our results indicate that domestic MNEs actually have a slightly better performance.

Endnotes

1. The 21 industries include 20 manufacturing industries and 1 logging industry. The sample accounts for a small share of 236 industries at the 4-digit SIC level in the Canadian manufacturing sector.
2. All regressions are weighted regressions using sample weights in the SIAT as weights.
3. Value added is defined as total production minus the value of intermediate goods purchased.
4. We use the ratio of fuel and electricity cost to employment to proxy capital intensity as in Globerman *et al.* (1994). To compare our results with that of Globerman *et al.* (1994), we have used shipments in logarithmic form to control for plant size for the estimation. When we use employment in log form to control for plant size as in our regressions in Table 3, the difference between foreign- and domestic-controlled plants is much larger. Foreign-controlled plants are about 34 percent more productive.
5. The industries include 20 manufacturing industries and 1 logging industry.
6. The data for Globerman *et al.* (1994) are drawn from the ASM 1986. When we estimate a regression similar to Globerman *et al.* (1994) using a sample of all manufacturing plants in 1986, we find that U.S. MNEs are 11 percent more productive than domestic-controlled plants and other foreign MNEs are 17 percent more productive. The differences are significant at the 1 percent level. When we use a sample of 20 manufacturing industries in Globerman *et al.* (1994), there is only a weakly significant difference in value-added per worker once capital intensity, plant size and share of non-production workers are controlled for.
7. Baldwin and Rafiquzzaman (1994) find that over time the differences in production worker wages across Canadian provinces are larger than the differences in the salaries of non-production workers.
8. Firm size is defined as the log of total employment. Firm age is defined as a binary variable indicating whether the firm is less than 10 years old when the SIAT was conducted in 1993.
9. We cannot reject the hypothesis that the coefficients on U.S. MNEs and other foreign MNEs are equal. When we include a binary variable indicating all foreign-controlled plants, the coefficient on the binary is 0.07 and is statistically significant at the 5 percent level.
10. Baldwin and Hanel (2003, chapter 10) find that there is no significant difference in R&D performance between foreign and Canadian MNEs. The difference between our results and that of Baldwin and Hanel is due to the fact we control for fixed effects for relatively detailed 2-digit SIC industries while Baldwin and Hanel do not. Foreign MNEs tend to be located in R&D intensive industries. As such, the part of R&D performance of foreign MNEs estimated in Baldwin and Hanel reflects the location of foreign MNEs in R&D intensive industries.

Chapter 3. Measuring the contribution of foreign multinationals to productivity growth

In the two previous studies, we demonstrate that there are substantial differences between MNEs and domestic firms. But this finding, in and by itself, only suggests that there is heterogeneity within the firm population. And heterogeneity by itself has few implications for overall industry performance. It may challenge the representative model of the firm that is used for pedagogical purposes. But finding that MNEs are more productive may simply inform us who is at the head of the class within an industry.

We need additional information to link MNE presence with overall industry performance if we are to argue that the differences in characteristics outlined in previous sections are meaningful. In this section, we start the process by examining whether MNEs contribute more to productivity growth than domestic firms. In the next section, we ask whether the presence of MNEs contributes to growth in the domestic sector—whether there are externalities from the foreign-controlled sector.

We start by measuring the contribution of foreign MNEs to labour productivity growth in the Canadian manufacturing sector. Our previous studies suggest that foreign-controlled plants account for most of labour productivity growth in Canadian manufacturing during the past three decades (Baldwin and Gu, 2003, 2004a). In this paper, we extend this work in two ways. First, we make a distinction between U.S. MNEs and other foreign MNEs. We find that U.S. MNEs are more important than other foreign MNEs for productivity growth of the Canadian manufacturing sector. But the relative importance of U.S. MNEs has declined slightly while that of other foreign MNEs has increased in the 1990s.

Second, we compare the importance of the contribution made by foreign-controlled plants to productivity growth in the 1990s with that in the 1980s. It has been argued that the relative importance of Canada as a destination for foreign direct investment declined during the 1990s as a result of two free trade agreements: the Canada-U.S. Free Trade Agreement (CUFTA) and the North American Free Trade Agreement (NAFTA) (Hejazi and Pauly, 2004). U.S. MNEs have increasingly accessed the Canadian market from the United States through exports rather than through FDI. In addition, the two trade agreements have not made Canada an important destination for non-U.S. companies wishing to service the North American market (Conference Board of Canada, 2004). Our decomposition results regarding the contribution of foreign MNEs to productivity growth attempt to shed light on this issue.

3.1 Data source

The data for our analysis come from a longitudinal file that was constructed from Statistics Canada's Annual Survey (Census) of Manufactures (ASM). These data are the most comprehensive available for the study of the Canadian manufacturing sector since the ASM covers the entire Canadian manufacturing sector using both survey and administrative data. It collects information on shipments, value added, inventories and employment for about 35,000 manufacturing plants in 1997. Gross output in the file is derived as shipments plus net inventory changes. The plants in the ASM are grouped into 231 manufacturing industries at the 4-digit 1980 SIC (Standard Industrial Classification, 1980) level.[11]

The longitudinal file developed from the ASM follows manufacturing plants over the period 1980-1999. Each plant in the file has a unique code that allows us to identify entering, exiting and continuing plants. Investigations have shown that this identifier is not unduly affected by ownership or control change and therefore captures 'true' births and deaths (Baldwin, 1995). For the purpose of this section, we will use the ASM longitudinal file over the period 1990-1999. We calculate labour productivity as real gross output per worker, where real gross output is derived from deflating nominal output of each plant by a price deflator for the four-digit level industry in which the plant is classified.[12]

3.2 Decomposition methods and results

The contribution of MNEs (or any group of plants in general) to aggregate labour productivity growth can be calculated as the change in employment-weighted average labour productivity of MNEs over a period. The contribution can be further decomposed into the contribution from productivity growth taking place within individual plants (the organic or within-plant component) and the contribution that comes from the reallocation of output shares across plants (the between-plant component).

For the purpose of decomposition, we make use of a counterfactual calculation. In the counterfactual calculation, we assume that there are no changes in the output shares of plants during the period. This assumption allows us to reallocate output at the end of the period across plants, using their output shares at the start of the period. This produces an estimate of labour productivity that would have occurred if there had been no change in market share and is different from the value of labour productivity that was actually observed. We attribute the difference between what was actually observed and this counterfactual to the reallocation of outputs across plants that come from the competitive process. The remainder of labour productivity growth that is not accounted for by the output reallocation is defined here as the contribution from 'within-plant' productivity growth. That is, it is the amount of organic productivity growth that comes from each plant increasing its productivity, but with no reallocation of market share across plants. Baldwin and Gu (2004a) provide a more detailed discussion of the decomposition method used here.

Previous studies have used various other decomposition methods. Two other decomposition methods are Griliches and Regev (1995), and Foster, Haltiwanger and Krizan (2001). These methods provide similar estimates of the total contribution to aggregate productivity growth

Table 6. Sources of labour productivity growth, 1980-1990 and 1990-1999 (% point contribution)

	Total	Within	Between	Net entry
1980-1990, average productivity growth 1.33% per annum				
Domestic plants	30.70	9.41	15.52	5.77
Foreign U.S. MNEs	48.43	27.80	7.73	12.90
Foreign other MNEs	20.87	5.44	9.01	6.42
1990-1999. average productivity growth 2.97% per annum				
Domestic plants	32.46	11.08	17.79	3.59
Foreign U.S. MNEs	45.10	27.26	10.49	7.35
Foreign other MNEs	22.44	10.29	8.25	3.90

Source: Authors' calculations from the ASM.

from a group of plants, but yield very different estimates on the relative importance of the within-plant and the between-plant reallocation components. Basically, the Baldwin-Gu approach treats firms as competing for product markets and the between-plant reallocation component to come from the shift of market share from one plant to another; the alternatives implicitly define the between-plant component to include part of the shifts of market share that we believe should be appropriately included in the between-plant component. Baldwin and Gu (2004a) provide a comparison of these alternate methods.

The results presented in Table 6 indicate that foreign MNEs are the most important driver of labour productivity growth in Canadian manufacturing during the 1980s and 1990s, accounting for about 70 percent of overall productivity growth for both periods. The contribution of MNEs is disproportionate to their size. It is much larger than their share of employment and output.

Among foreign MNEs, U.S. MNEs are more important for productivity growth compared to other foreign MNEs. Between the 1980-1990 and 1990-1999 periods, the contribution of U.S. MNEs to productivity growth declined slightly from 48 percent to 45 percent. The contribution of other foreign MNEs was about 20 percent for both periods.

During the 1990-1999 period, plant entry and plant exit accounted for 15 percent of labour productivity growth in manufacturing industries, 11 percentage points of which were due to foreign multinationals starting up and closing down plants. The results for the 1980-1990 period show a similar story. Entry and exit of foreign MNEs are much more important than that of domestic-controlled plants for overall labour productivity growth.

Annual labour productivity growth in the Canadian manufacturing increased from 1.3 percent in the 1980-1990 period to 3.0 percent in the 1990-1999 period—an increase of 1.7 percentage points between the two periods. Our results in Table 6 show that both domestic- and foreign-controlled plants contributed to the acceleration. Of the 1.7 percentage-point increase in annual labour productivity growth, domestic-controlled plants contributed 0.6 percentage points, U.S. MNEs contributed 0.7 percentage points, and other foreign MNEs contributed 0.4 percentage points.

Endnotes

11. There are a total of 236 SIC 4-digit industries. We have removed four industries from our sample (Publishing, SIC 2831 and 2839; and Publishing, SIC 2841 and 2849). These four industries are classified as service industries when the ASM switched from the SIC industry classification to NAICS in 1997, and are thus no longer surveyed by the ASM. We have also removed SIC 2593 (Wafer Board) as data are missing for that industry.
12. Alternate definitions using value added produce results that do not differ qualitatively than those reported here.

Chapter 4. Spillover effects of MNEs on productivity growth of domestic plants

While MNEs therefore contributed a disproportionate amount directly to overall productivity growth, they may also have had an indirect effect via spillover effects on the domestic sector. This issue is examined in this section.

The literature on the spillover effects of foreign direct investment in host countries can be divided into two groups on the basis of the type of data used. The first set of studies uses a cross-section of industries, plants or firms to examine FDI spillovers. Examples include Caves (1974) and Globerman (1979). More recent studies use panel data of plants or firms (Aitken and Harrison, 1999; Keller and Yeaple, 2003; Girma and Wakelin, 2001; Haskel, Pereira and Slaughter, 2002; Lileeva, 2003).[13] The second, and more recent, set of panel-data studies, has advantages over cross-sectional studies in that panel data are less likely to lead to spurious results due to unobserved heterogeneity across plants.

This section uses Canadian panel data to examine the existence of spillover benefits from foreign MNEs to domestic-controlled plants. The spillover benefit to domestic firms can come from a number of sources (Caves, 1974; Globerman, 1979; Aitken and Harrison, 1999). In the first instance, foreign subsidiaries can increase competition in domestic industries. In the second instance, they produce technological spillovers by providing domestic firms with exposure to new products, advanced production technologies, and superior marketing techniques and management practices. Foreign-controlled firms employ more skilled workers and the knowledge accumulated becomes available to domestic firms when workers leave foreign firms and move to domestic firms. Foreign-controlled firms also provide domestic firms with an access to new specialized intermediate inputs. Finally, foreign firms may also act as a source of demand for domestic suppliers. This relationship with foreign firms benefits domestic suppliers since customers serve as a main source of ideas for innovations (Baldwin and Hanel, 2003, chapter 10).

4.1 Empirical results on foreign direct investment (FDI) spillover benefits

To examine the effect of foreign-controlled plants on the productivity of domestic plants, we estimate an equation that relates a domestic plant's productivity growth to the share of foreign-controlled plants in the industry to which the plant belongs (FC), changes in foreign control (ΔFC), and certain other plant and industry characteristics (X):

$$lpchg_{pt} = \alpha FC_{it} + \beta \Delta FC_{it} + \gamma X_{pt} + \lambda_I + \lambda_t + \varepsilon_{it} \qquad (1)$$

Foreign-controlled plants tend to be located in those industries that are knowledge intensive and have high productivity growth. If this is not considered in the analysis, differences between foreign and domestic firms will arise from their varying presence across different industries. To adjust for this, we introduce a full set of industry binary variables (λ_I). We also introduce time fixed effects (λ_t) to allow for differences in productivity growth between periods.

If there are positive spillovers emanating from foreign-controlled plants, we should observe a positive relationship between productivity growth of domestic plants and some measure of foreign ownership. The precise measure of foreign ownership depends on our view of the mechanisms causing FDI spillovers. If the spillover benefit is due to human capital that workers at foreign firms accumulate over time, the share of foreign-controlled plants in total employment is the appropriate variable to include in the regression. If the FDI spillover benefit is due to increases in the intensity of competition, the share of foreign-controlled plants in total output should be a better measure. However, the two variables are closely correlated and separating the two effects is likely to be difficult.

In addition to the choice between the employment and output shares, we must decide whether to include a measure of the absolute importance of foreign ownership or its change over a period. If increased competition and technological spillovers are the sources of FDI spillovers, we should expect that the share of foreign-controlled plants matters most for productivity growth of domestic plants. The short-run changes in the share should matter less.

Data for estimating equation (1) come from the longitudinal ASM file for the period 1980-1999. We divide the period into four sub-periods: 1980-1985, 1985-1990, 1990-1995 and 1995-1999. Labour productivity of a plant is measured as real value added per worker. Plant characteristics X_{pt} include plant size (the log of total employment), an indicator for young plant (less than 7 years—medium plant age in the sample). We also include the Herfindahl index of concentration at the industry level in the regression. All industry variables are measures at the 4-digit level.

The results, which are presented in Table 7, indicate that the share of foreign-controlled plants in total employment is related to labour productivity growth of domestic plants. A 10 percentage point increase in the share of foreign-controlled plants is associated with 0.3 percentage point increase in annual labour productivity growth of domestic plants.

The coefficient on the *change* in the share of foreign-controlled plants is sensitive to specifications. The coefficient is not significant when the variable is introduced individually in column (2). But it is significant when introduced jointly with the share of foreign-controlled plants in column (3).

When we replace the employment share of foreign-controlled plants with the output share (columns 4-6), we find similar results: a positive effect from the share of foreign-controlled plants; and an ambiguous effect from short-run changes in the share of foreign-controlled plants.[14]

Table 7. Effect of foreign-controlled plants on productivity growth of domestic-controlled plants

	Measure of foreign presence					
	Employment share			Output share		
	(1)	(2)	(3)	(4)	(5)	(6)
Share of foreign MNEs	0.028	...	0.050	0.035	...	0.058
	(3.75)	...	(4.38)	(5.39)	...	(5.74)
Change in the share of foreign MNEs	...	-0.034	0.128	...	-0.060	0.123
	...	(-1.04)	(2.57)	...	(-2.08)	(2.84)
Concentration	0.045	0.058	0.047	0.039	0.054	0.042
	(2.39)	(3.06)	(2.45)	(2.09)	(2.83)	(2.24)
Plant size	0.013	0.013	0.013	0.013	0.013	0.013
	(28.23)	(27.68)	(27.80)	(28.23)	(27.67)	(27.80)
Young plants	0.013	0.013	0.013	0.013	0.013	0.013
	(11.25)	(10.90)	(10.86)	(11.25)	(10.90)	(10.86)
R squared	0.03	0.03	0.03	0.03	0.03	0.03
Observations	77,345	75,678	75,678	77,345	75,678	75,678

Notes: t-statistics in parentheses are heteroskedasticity-consistent. All regressions control for 4-digit industry fixed effects and period fixed effects. The coefficients are estimated from a pooled panel of plants over 1980-1985, 1985-1990, 1990-1995 and 1995-1999.

... not applicable

Source: Annual Survey of Manufactures (ASM).

We investigated a number of variants to test for the robustness of our results. Foreign ownership was measured at the 3-digit level instead of the 4-digit level. We have experimented with an empirical specification with a 3-year difference instead of a 5-year difference. We have used gross output per worker instead of real value-added per worker. We have also used lagged changes in the share of foreign-controlled plants as controls to adjust for potential simultaneity bias in the estimates. The same robust finding emerged from each variant: there was a positive link between the share of foreign-controlled plants and the productivity growth of domestic plants.

4.2 The role of spillover potential and absorptive capacity

In this section, we ask whether there is a subset of domestic plants that benefits more from foreign-controlled plants. The literature regarding knowledge spillovers and convergence at the country- and industry-level often reports that there is a relationship between the relative backwardness of a country (industry) and the speed of convergence. One measure of relative backwardness is provided by the distance from the technological frontier. Using this measure, the literature finds that the country and the industry that lags further behind the leader often catches up at a faster rate. The importance of relative backwardness suggests that younger and smaller plants in our sample, which are less productive, should capture larger spillover benefits from MNEs than older and larger plants.

To examine the importance of the catch-up potential for FDI spillover benefits, we introduce into regression (1) interaction terms between the share of foreign-controlled plants and binary variables defined for smaller plants and younger plants.[15]

The resulting parameter estimates (Table 8) confirm the importance of the catch-up potential. The coefficients on the interaction terms with smaller and younger plants are positive and significant at the 10 percent level. Smaller and younger domestic plants capture larger positive spillover benefits than do older and larger domestic plants in industries where the share of foreign-controlled plants is higher.[16]

Table 8. Difference in FDI spillover benefits between plants (effect on productivity growth of domestic plants)

	(1)	(2)
Share of foreign MNEs in employment	0.023	0.022
	(2.92)	(2.86)
X small plants	0.008	...
	(1.67)	...
X young plants	...	0.011
	...	(1.85)
X young plants X small plants	...	...
	...	...
Concentration	0.045	0.045
	(2.41)	(2.41)
Plant size	0.014	0.013
	(24.33)	(28.22)
Young plants	0.013	0.011
	(11.15)	(6.64)
R squared	0.03	0.03
Observations	77,345	77,345

Notes: t-statistics in parentheses are heteroskedasticity-consistent. All regressions control for 4-digit industry fixed effects and period fixed effects. The coefficients are estimated from a pooled panel of plants over the 1980-1985, 1985-1990, 1990-1995 and 1995-1999.

... not applicable

Source: Annual Survey of Manufactures (ASM).

It has been argued that R&D increases the absorptive capacity for foreign technologies. If that is true, we should observe that domestic firms performing R&D capture higher FDI spillover benefits than those domestic firms not doing so. Empirical studies from other countries have produced mixed results on this issue. Kinoshita (2001) finds evidence for positive spillovers from FDI to local firms that are R&D intensive using a panel of firms in the Czech Republic. Barrios and Strobl (2002) find no such evidence from a panel of firms in Spain.

To examine the importance of R&D for FDI spillovers, we use the linked ASM-SIAT sample that we have discussed earlier. We employ a regression that includes as additional controls a binary variable indicating whether a plant's parent firm is a continuous R&D performer[17] and its interaction with the share of foreign-controlled plants. The R&D variables represent the activities during the reference period 1989-1991 for the SIAT. The share of foreign-controlled plants in total employment represents the share at the 4-digit SIC level in 1988, and the change in the share of foreign-controlled plant is calculated over the period 1988-1993. The dependent variable is defined as annual growth in labour productivity (real value added per worker) of domestic plants over the 1993-1999 period.

We have a single panel of plants for examining the importance of R&D for FDI spillovers. As such, the regression is not identifiable if we include a full set of industry fixed effects at the 4-digit SIC level. Instead, we will include industry fixed effects at the 2-digit SIC level to adjust for the bias from a positive correlation between the industry location of foreign-controlled plants and the productivity growth of domestic plants. We will also use a lagged share of foreign-controlled plants in the regression. That is, we examine the effect of the share of foreign-controlled plants in 1988 and its changes over the period 1988-1993 on productivity growth of domestic plants over the subsequent period 1993-1999.[18]

Table 9. The role of R&D as absorptive capacity for FDI spillover (effect on productivity growth of domestic plants in the 1993-1999 period)				
	(1)	(2)	(3)	(4)
Share of foreign MNEs in employment	0.089	...	0.095	0.095
	(2.35)	...	(2.54)	(3.01)
Changes in the share of foreign MNEs	...	-0.067	0.336	...
	...	(-0.17)	(1.00)	...
R&D	...	...	...	-0.017
	...	...	...	(-1.15)
R&D X share of foreign MNEs	...	...	...	-0.061
	...	...	...	(-0.61)
Concentration index	-0.018	0.020	-0.019	-0.023
	(-0.32)	(0.26)	(-0.32)	(-0.41)
Plant size	0.013	0.014	0.013	0.014
	(6.14)	(6.37)	(6.95)	(7.42)
Young plants	0.005	0.004	0.005	0.004
	(0.43)	(0.37)	(0.39)	(0.39)
R square	0.11	0.10	0.11	0.11
Observations	968	955	955	968

Notes: t-statistics in parentheses allow for heteroskedasticity across plants and clustering within 2-digit industries. All regressions include 2-digit industry fixed effects.

... not applicable

Source: Linked ASM-SIAT sample.

The results from the linked ASM-SIAT sample are presented in Table 9. The estimates reported in the first three columns confirm our previous findings contained in Table 7 that were obtained from the ASM sample alone. The share of foreign-controlled plants is positively related to productivity growth of domestic-controlled plants and its change is not. This is reassuring as the sample and empirical specification used for the results in the Tables 7 and 9 are different.

In column (4), we introduce a variable that captures whether the firm is performing R&D continuously that is interacted with the share of foreign-controlled plants. The coefficient on the interaction variable is not significant, thereby indicating that R&D performers do not capture larger FDI spillover benefits than non-R&D performers.

The results in Table 9 are obtained from a sample of all domestic-controlled plants—both domestic MNEs and non-MNEs. Since our earlier results indicate that Canadian MNEs have a labour productivity level that is similar to foreign MNEs, we exclude domestic MNEs and use a sample of only domestically-oriented plants for the estimation. The results are similar to those reported in Table 9.

4.3 Mechanisms for foreign direct investment (FDI) spillovers

The evidence points to positive spillover effects from multinationals to domestic plants. The mechanisms that generate the spillovers merit investigation. This section examines two such mechanisms: enhanced competition and the more intense use of advanced technologies by domestic firms.

Previous studies have discussed a number of potential mechanisms for FDI spillovers (see our discussion at the start of section 4). The linked ASM-SIAT sample allows us to examine

Table 10. The effect of foreign-controlled plants on competition, technology use of domestic plants in the 1989-1991 period

Dependent variable	Without controls (1)	With controls (2)	Observations (3)
Significant competition	0.320	0.256	1, 246
	(3.70)	(2.50)	
The number of technologies	3.208	2.195	1, 325
	(2.98)	(2.25)	
Incidence of technology use	0.207	0.119	1 ,325
	(1.68)	(1.25)	

Notes: t-statistics in parentheses allow for heteroskedasticity across plants and clustering within 2-digit industries. All regressions include 2-digit industry fixed effects. Column (2) with controls also include as controls variables industry concentration index, plant size and plant age.

Source: Linked ASM-SIAT sample.

two of these here. The first is whether foreign-controlled firms are associated with increases in the level of competition facing domestic plants. The second is whether foreign-controlled firms provide domestic plants with an exposure to new technologies, which leads to an increased rate of technology adoption among domestic plants.

To examine the importance of increased competition, we estimate a regression that relates the significance of competition facing a domestic plant during the SIAT reference period 1989-1991 to the share of foreign-controlled plants in employment at the 4-digit SIC level in 1988. The SIAT asked firms to provide a ranking (on a Likert scale of 1 to 5) of the degree of competition that they faced. For this purpose, we define a firm as facing intense competition if it scored a 4 or 5. We also include plant size, plant age, an industry concentration index at the 4-digit level, and industry fixed effects at the 2-digit level in the regression. The results (Table 10, row 1) provide support for the view that the presence of foreign-controlled plants increases the level of competition facing domestic plants. The coefficient on the share of foreign-controlled plant is positive and significant at the 5 percent level in all specifications.

The SIAT also allows us to measure both the intensity and the incidence of advanced technology use at the plant level. Plants in the survey are asked whether they use some 22 advanced technologies (e.g., flexible manufacturing systems, computer controlled machines, automated sensor-based equipment).[19] We define two variables—the incidence of technology use (whether the plant used any of these technologies) and the number of technologies used. The results in Table 10 also show that there is a positive link between the share of foreign-controlled plants and the number of technologies used in domestic plants. This is consistent with the view that foreign-controlled plants increase the number of technologies used among domestic plants. However, we find little evidence to suggest that the importance of foreign-controlled plants in an industry is related to the incidence of a domestic plant's use of advanced technologies.

Endnotes

13. Rao and Tang (2004) also used a panel of firms to examine FDI spillovers, using data from Compustat. Unlike this paper and the paper by Lileeva (2003) that cover all continuing plants in the Canadian manufacturing sector, Rao and Tang has a sample of only 359 Canadian-controlled firms and 49 foreign-controlled firms. Therefore, their results may not apply to the Canadian manufacturing sector.
14. The finding from column (5) that the change in the share of foreign MNEs has a negative coefficient is consistent with the evidence in Lileeva (2003). She interprets this as evidence that foreign-controlled plants gain market shares from domestic plants and thus drive up the cost of the domestic plants (see also Aitken and Harrison, 1999).
15. Small plants are defined as those plants with less than 20 workers. Younger plants are defined as those less than 7 years old (median age in the sample).
16. We have also estimated a regression that includes the share of foreign-controlled plants interacted with the dummy variables for small plants, for young plants and for small and young plants in the same equation. The results show that the young plants that are relatively large, received the largest FDI spillover benefits.
17. We use a binary variable that indicates whether a plant had access to continuous R&D (as opposed to occasionally performed R&D). Baldwin and Hanel (2003) report that firms thought they were much more competitive with regard to R&D if they performed continuous R&D.
18. When we define labour productivity growth over the period 1993-1997 or 1993-1998, the results are almost identical.
19. See Baldwin and Hanel (2003) for a list of the technologies included in the survey.

Chapter 5. Conclusion

Foreign-controlled firms have a large presence in the Canadian manufacturing sector. Their importance increased after the mid-1980s as the Canadian government adopted a more liberal regulatory framework towards foreign direct investment. Over the 1987-1999 period, the share of foreign-controlled plants in total output in the Canadian manufacturing sector increased from 40.5 percent to 52.2 percent. In this paper, we have examined two potential benefits of foreign-controlled plants in the Canadian manufacturing sector: better performance of foreign-controlled plants and the productivity spillovers affecting domestic plants.

We find that foreign-controlled plants are different than domestic-controlled plants. Foreign-controlled plants are more productive than domestic-controlled. The productivity advantage of foreign-controlled plants is reflected in their R&D investment, innovation, and technology use. We find that foreign-controlled plants are more R&D-intensive, more innovative and more technologically advanced. We also find that foreign-controlled plants pay higher wages and use more skilled workers.

To further investigate the difference between foreign- and domestic-controlled plants, we drew a distinction between plant ownership and multinational status. We find that the foreign-ownership advantage in economic performance is a multinational advantage. Canadian MNEs and foreign MNEs have equally superior performance. Compared with foreign MNES, Canadian MNEs are as productive, as technologically advanced, pay similar wages, and have similar size. They are more innovative and more R&D-intensive than foreign MNEs.

Our finding that MNES are different from purely domestic plants is not new. Similar findings have been reported elsewhere. These previous studies generally have just involved an examination of whether there are differences in productivity levels between multinationals and domestic firms without asking what the implications of these differences are. Most previous studies assume that differences in characteristics such as the level of productivity imply that these differences somehow affect the long-run performance of the industry.

They need not do so. Industries are heterogeneous. They are made up of small and large firms, domestic- and foreign-owned firms, more productive and less productive firms. The critical question is not the degree of heterogeneity in any population of firms but the impact of heterogeneity on industry performance as a whole.

Heterogeneity develops because some firms manage to become more efficient. But overall, industry performance depends on the weighted average of the productivity of all producers. Two industries can differ in terms of their heterogeneity with regards to levels of productivity. That is, the more productive firms in one industry can be much more productive relative to those less productive than is the case in another industry. But if the productivity of all firms in both industries grows at the same rate, the productivity growth rate of each industry will be the same.

If heterogeneity is of interest, we need to understand the dynamics of different groups. To do so, we can ask whether the more productive firms are growing more rapidly than the less productive. For the process of displacement of the less productive by the more productive will increase the overall productivity of the industry (Baldwin, 1995; Baldwin and Gu, 2004a). Or we can ask whether the organic growth within the group of more productive plants is faster than that in the less productive plants.

We investigate these questions jointly here by asking whether the total amount of productivity growth that is generated in manufacturing comes more from multinationals than from the domestic sector. We find that MNEs generate a disproportionate amount of the growth—at least relative to their share of industry output and employment. This occurs both because their productivity growth has been faster than domestic plants and because MNEs have been expanding at the expense of the domestic sector.

In addition to this direct impact of MNEs on productivity growth, we also ask whether there is an indirect impact on the domestic sector in terms of spillovers. We do so in two steps. In the first instance, we find that the share of foreign-controlled plants is linked to productivity growth of domestic-controlled plants. This is consistent with the view that foreign-controlled plants have positive spillover effects on domestic-controlled plants. Our estimate implies that a 10 percentage point increase in the share of foreign-controlled plants is associated with 0.5 percentage point increase in annual labour productivity growth of domestic plants. In contrast to previous studies, our results show that what matters for productivity growth of domestic plants is the cumulative change in foreign presence or the share of foreign-controlled plants. The short-run change in foreign presence has little effect on domestic plants.

We also investigate the avenue through which these spillovers might occur. We find that the share of foreign-controlled plants is positively linked both to the level of competition faced by the domestic sector and the number of technologies used in the domestic sector. This is consistent with the argument that spillover benefits coming from foreign-controlled plants are due to increased competition and the increased use of advanced technologies in domestic-plants (Caves, 1974; Globerman, 1979).

We have also examined the importance of catch-up potential and the role of R&D for FDI spillover benefits. We find that smaller and younger plants capture larger spillover benefits from foreign-controlled plants than older and larger plants. This suggests that the importance of FDI spillovers depends on the catch-up potential of domestic plants. The further these plants are behind MNEs, the greater the impact of FDI spillovers. We find no evidence that the plants that invest in R&D benefit more from FDI spillovers. This result is in contrast to the belief that R&D in Canada increases a firm's absorptive capacity for foreign technologies.

Appendix

Table A1. The output share of foreign-controlled plants by industry (%, ranked by the output share in 1999)

Industry	1987	1999	Change 1987-1999
Rubber	88.60	83.47	-5.12
Transportation equipment	84.19	81.43	-2.76
Chemical and chemical products	70.46	75.85	5.39
Beverage	41.78	63.11	21.33
Non-metallic mineral products	51.57	62.98	11.40
Refined petroleum and coal	62.98	60.95	-2.03
Primary textile	45.26	49.96	4.71
Electrical and electronic products	59.10	48.58	-10.52
Textile products	32.99	43.27	10.27
Other manufacturing	49.54	43.21	-6.33
Machinery	55.19	42.16	-13.03
Food	25.68	40.67	14.99
Plastic	33.38	39.34	5.97
Paper and allied	30.65	38.20	7.56
Primary metal	22.23	27.74	5.51
Wood	20.03	21.01	0.98
Fabricated metal	22.97	20.90	-2.07
Leather and allied	12.00	18.64	6.64
Furniture and fixture	18.31	17.48	-0.83
Printing and publishing	10.62	15.98	5.36
Clothing	10.99	13.66	2.67
Total manufacturing	47.02	52.31	5.29

Source: Authors' calculations from the ASM.

Table A2. Difference in multifactor productivity between MNEs and non-MNEs		
	(1)	(2)
U.S. MNEs	0.294	0.081
	(5.11)	(1.18)
Other foreign MNEs	0.213	-0.002
	(2.75)	(-0.02)
MNEs	...	0.250
	...	(4.34)
Capital intensity	0.079	0.071
	(2.28)	(2.04)
Share of non-production workers	-0.139	-0.134
	(-0.93)	(-0.90)
Average wages	0.856	0.847
	(7.60)	(7.60)
Plant size	0.027	0.019
	(1.69)	(1.17)
Young plants	-0.051	-0.049
	(-1.12)	(-1.09)
R squared	0.354	0.358
Observations	1,785	1,785

Notes: Robust t-statistics are in parentheses. All regressions include 2-digit industry fixed effects. The omitted group in (1) is domestic-controlled plants and the omitted group in column (2) is domestic-controlled non-multinationals. The capital intensity is proxied by the ratio of energy costs to labour.

... not applicable

Source: Linked ASM-SIAT sample.

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