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Participation in export markets and productivity performance in Canadian manufacturing

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Abstract

In this paper, we explore the linkages between export-market participation and productivity performance in Canadian manufacturing plants. We also examine differences in the effect of exporting on productivity between foreign-controlled and domestic-controlled plants, and between young and older plants. We find that export participation improves productivity. The effect is much stronger for domestic-controlled plants than for foreign-controlled plants. We interpret this as evidence that it is the international orientation or globalization of a firm rather than ownership per se that is important for productivity growth. We also find that exporting matters more for young businesses than for older businesses.

Keywords: Exports, Productivity, Multinationals, Self-selection

JEL classification: *F1; O4*

Executive Summary

This paper examines the relationship between productivity of a manufacturing plant and its participation in exporting activities. There are two possible explanations for a positive relationship between the two. First, higher productivity and higher efficiency may be required if plants are to enter export markets. Second, by exporting, plants may learn of superior technologies and management techniques and increase their productivity. The paper examines both possibilities.

It makes use of a longitudinal database for the Canadian manufacturing sector that allows us to track plants over the period from 1974 to 1996 and the size of their exports for select years during this period. During this period, the share of plants that export increased from 16 percent to 24 percent. The mean export/shipments ratio for this group increased from 24 percent to 33 percent.

To examine the relationship between productivity and exporting, we divide plants into four groups for each of four periods—1974-79, 1979-84, 1984-89, and 1990-96. The four groups are plants that continuously export over a period, that enter export markets during a period, that exit export markets during a period, and those that never export during a period.

In the first part of the paper, we show that more productive plants participate in export markets. Of nonexporters, we find that the more productive ones expand into export markets and the less productive remain nonexporters. Of the plants that are in export markets, the more productive ones are more likely to remain there.

In the second part of the paper, we show that participation in export markets improves productivity. We find that productivity growth is higher for the plants that enter export markets than those that do not. We also find that productivity growth is lower for the plants that exit export markets than those that stay there. Moreover, some of these changes have become larger over the last three decades as trade liberalization has intensified.

We also examine whether productivity gains of export participation differ between domestic-controlled and foreign-controlled plants, and between young and older plants. We find that the productivity gains from exporting are greater for domestic-controlled plants and for young plants. Increasing export intensity is found to improve productivity performance for both domestic- and foreign-controlled plants.

Finally, to illustrate the importance of exporting, we ask how much of the productivity growth in Canadian manufacturing came from the plants that were exporters. We find that these plants accounted for almost three-quarters of productivity growth in the 1990s, even though they accounted for less than 50 percent of employment.


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1. Introduction

Productivity growth results from a number of fundamental factors. It can occur as a result of capital accumulation, the adoption of new technologies, and changes in the organization of a firm. In turn, these underlying determinants may be stimulated by major changes in the environment facing a firm. One of the changes that has received considerable attention is the trend towards trade liberalization (Tybout, 2001).

In the last quarter of a century, there has been a considerable increase in the openness of the Canadian economy. The rate of participation of Canadian plants in export markets has been rising, particularly after the mid-1980s as the pace of trade liberalization increased. This paper uses the Canadian experience with trade liberalization, one that has involved a considerable increase in trade orientation over the last three decades to examine the relationship between export-market participation and productivity performance at the plant level in Canadian manufacturing.

There is widespread evidence that exporters differ from nonexporters. Exporters tend to be more capital intensive, more innovative, and more productive than their domestically oriented counterparts (e.g. Tybout, 2001; Baldwin and Hanel, 2000). However, the forces at work that are associated with the difference between exporters and nonexporters are less clear (see, Clerides, Lach, and Tybout, 1998; Bernard and Jensen 1999; Aw, Chung, and Roberts, 2000; Delgado, Fariñas and Ruano, 2002). On the one hand, the productivity difference between exporters and nonexporters may reflect the self-selection of more efficient plants into export markets. It has been argued that there exist additional costs of selling in foreign markets, such as the costs of transportation and distribution or costs of learning about regulations and consumer tastes in foreign markets. Due to these extra costs, the more efficient plants enter export markets. On the other hand, participation in export markets may improve production efficiency as exporters acquire new knowledge from their international contacts. Of course, both explanations may be at work. Plants that participate in export markets may be more competitive and their very participation may engender further improvements in relative efficiency.

A number of recent studies have examined the importance of these two explanations for the difference between exporters and nonexporters (Clerides, Lach and Tybout, 1998; Bernard and Jensen, 1999; Aw, Chung and Roberts, 2000; Delgado, Fariñas and Ruano, 2002). These papers focus on two key questions. Do more productive firms become exporters? Does exporting lead to better productivity performance. Clerides, Lach, and Tybout (1998) address these two questions using micro data of manufacturing plants for Columbia, Mexico, and Morocco; Bernard and Jensen (1999) for the U.S.; Aw, Chung, and Roberts (2000) for Taiwan and Korea, and Delgado, Fariñas and Ruano (2002) for Spanish firms. All of these studies find the importance of self-selection in export markets, that is, it is the more productive firms that become exporters. However, these studies find little evidence to suggest that becoming an exporter improves productivity performance.

In this paper, we examine the linkages between exporting and productivity among Canadian manufacturing plants. We examine the experience of a country that has undergone dramatic trade liberalization using a proven longitudinal database developed by Statistics Canada that has

been used extensively to investigate the dynamics of the manufacturing population (see Baldwin, 1995). We ask the same two questions that were addressed by others who have studied the issue. But, we make two extensions.

First, we ask whether there is a subset of plants that benefit more from export-market participation. In particular, we examine differences between foreign-controlled and domestic-controlled plants, and between young and older plants. Foreign-controlled firms, it has been posited, transfer information efficiently from one country to another (Caves, 1982; McFetridge and Corvari, 1986). They might therefore be expected to gain less, ceteris paribus, from participation in export markets. Young and older plants may also benefit differentially as the young plants have more to gain from taking advantage of new knowledge acquired in export markets.

Second, we extend the previous studies by not just considering the effect of export-market participation, but also the effect of increasing export intensity on productivity growth. Productivity gains may accrue not just to those who become exporters, but also to those who increase their export intensity because the latter are likely to be penetrating new markets that give them additional information on new technologies.

Third, we ask not just whether the transition from non-exporter to exporter results in productivity gains, but we place this event in context. Productivity comes from a number of different sources. It occurs as entrants replace exits, as incumbents trade market share, as productivity grows generally across the general population. We ask how much of aggregate productivity growth can be attributed to plants entering the export market and from those already in the export market.

Our interest in the linkages between exporting and productivity in Canadian manufacturing arises from several considerations. First, productivity growth has been slow in the 1990s, despite large increases in Canadian exports during the period. This casts doubt on the view that exporting raises productivity in Canadian manufacturing. Second, after reviewing studies on the productivity benefits of the Canada-U.S. Free Trade Agreement (FTA), Head and Ries (2001) conclude that the best explanation for the productivity gains that came from the FTA is that trade serves as a conduit for the transfer of knowledge and an incentive to innovate. This paper examines the empirical evidence for this claim.

Our empirical results confirm previous findings that more productive plants become exporters. We find that the plants that become exporters are more productive than those that do not. Of those plants that break into export markets, the more productive succeed and the least productive exit export markets. However, contrary to previous findings in other countries, our empirical results show that export-market participation has a positive effect on productivity in Canadian manufacturing. The effect is much stronger for domestic-controlled plants than for foreign-controlled plants. Becoming an exporter has a greater effect on younger than on older plants. Increasing export intensity also has a positive effect on productivity growth for both foreign and domestic plants.

The paper is organized as follows. In the following section, we outline the empirical models of export participation and productivity performance. In Section 3, we discuss the source data for

our analysis. In Section 4, we provide empirical evidence on the linkages between export-market participation and productivity performance. We measure the contribution of exporters to productivity growth in aggregate manufacturing in Section 5. Section 6 provides concluding remarks.

2. Empirical Models of Export Participation and Productivity Performance

In this section, we present empirical models that address the two main questions of the paper. Do more productive plants self-select into export markets? Does participation in export markets lead to better productivity performance?

2.1 An Empirical Model of Effects of Exporting on Productivity

To examine the effect of exporting on productivity, we estimate a panel specification of labour productivity (LP) that includes the capital/labour ratio (KL) and export participation (Export):

$$L\,\mathrm{n}(LP_{it}) = \alpha_t + \beta \ln(KL_{it}) + \alpha_{xt} Export_{it} + \mu_i + \varepsilon_{it}, \qquad (1)$$

where i indexes plants, t indexes time period, the variable "*Export*" takes the value of 1 if the plant is an exporter and zero otherwise, μ is an unobserved (random) plant-specific effect, and ε is the disturbance. Labour productivity and capital/labour ratios are measured in logarithms. The coefficient α_{xt} measures the effect of export participation on productivity performance. It should be positive if export participation has a positive effect on productivity.

The plant-effects variable (μ) captures persistent unobserved plant characteristics such as managerial ability that make some plants consistently more productive and that, in turn, make them more prone to exporting. Consequently, plant effects are potentially correlated with the export participation variable "*Export.*" The cross-sectional regression that ignores plant-specific effects will likely yield biased estimates of the effect of exporting on productivity.

To identify the effect of export participation on productivity performance, we use longitudinal data of plants over a period of time. We difference equation (1) across periods to remove plant-specific effects. After augmenting the first-differenced equation with additional explanatory variables Z, we have:

$$\Delta \ln(LP_{it}) = \alpha_t - \alpha_{t-1} + \beta \Delta \ln(KL_{it}) + \gamma Z_{it-1} + \alpha_{xt} Export_{it} - \alpha_{xt-1} Export_{it-1} + \varepsilon_{it} - \varepsilon_{it-1}, \qquad (2)$$

where Δ denotes the first difference between two periods.

Alternatively, we can write equation (2) in terms of transitions in export markets:

$$\Delta \ln(LP_{it}) = \alpha_t - \alpha_{t-1} + \alpha_{xt} Entrant_{it} - \alpha_{xt-1} Exiter_{it} + (\alpha_{xt} - \alpha_{xt-1}) Continuer_{it} + \beta \Delta \ln(KL_{it}) + \gamma Z_{it-1} + \eta_{it}, \quad (3)$$

or

$$\Delta \ln(LP_{it}) = \delta_o + \delta_1 Entrant_{it} + \delta_2 Exiter_{it} + \delta_3 Continuer_{it} + \beta \Delta \ln(KL_{it}) + \gamma Z_{it-1} + \eta_{it}, \quad (4)$$

subject to the constraint $\delta_3 = (\delta_1 + \delta_2)$, where $\delta_o = \alpha_t - \alpha_{t-1}$, $\delta_1 = \alpha_{xt}, \delta_2 = -\alpha_{xt-1}$, $\delta_3 = \alpha_{xt} - \alpha_{xt-1}$. The dummy variables *Entrant*, *Exiter* and *Continuer* represent different transitions in export markets between the two periods. They are defined as:

Entrants: plants that do not export in period t-1 ($Export_{it-1} = 0$), but export in period t ($Export_{it} = 1$);

Exiters: plants that export in period t-1 ($Export_{it-1} = 1$), but do not export in period t ($Export_{it} = 0$); and

Continuers: plants that export in both periods ($Export_{it-1} = 1$, and $Export_{it} = 1$).

The omitted plant type in Equation (4) is nonexporters, which is defined as:

Nonexporters: plants that do not export in either period ($Export_{it-1} = 0$), and $Export_{it} = 0$).

The set of additional explanatory variables Z varies across specifications. The most comprehensive specification includes as additional controls 4-digit industry dummies and plant size.[1]

The estimated coefficients on the transition dummies provide three comparisons between different types of plants. First, the coefficient on the variable "*Entrant*" (δ_1) provides a comparison of productivity growth between entrants and nonentrants in export markets. If export participation raises productivity, δ_1 on the variable "*Entrant*" should be positive as $\delta_1 = \alpha_{xt}$ (>0). Plants that enter export markets experience faster productivity growth than nonentrants.

[1] The variable industry effects in Equation (4) is equivalent to including industry-specific time effects in Equation (1).

Second, the difference between the two coefficients δ_3 and δ_2 gives a comparison of productivity growth of exiters and continuers in export markets. If exporting has a positive effect on productivity, $\delta_3 - \delta_2$ should be positive as $\delta_3 - \delta_2 = (\alpha_{xt} > 0)$. We should observe that plants that remain in export markets experience faster productivity growth than exiters.

Third, the coefficient on the variable "*Exiter*" (δ_2) compares the productivity growth of exiters and nonparticipants in export markets. The coefficient should be negative as $\delta_2 = -\alpha_{xt-1}$ (< 0). If exporting matters, those that stop exporting should have lower productivity growth that nonparticipants.[2]

2.2 An Empirical Model of Self-Selection in Export Markets

To address the question of whether more productive plants become exporters, we use a panel data set consisting of plants over two periods t and t-1 to run the regression:[3]

$$Ln(LP_{it-1}) = \beta_o + \beta_1 Entrant_{it} + \beta_2 Exiter_{it} + \beta_3 Continuer_{it} + \beta_4 \ln(KL_{it-1}) + \gamma Z_{it-1} + \varepsilon_{iT} . \quad (5)$$

Equation (5) expresses labour productivity in period t-1 as a function of transitions in export markets between periods t-1 and t, capital/labour ratios in period t-1, and an additional set of controls in period t-1. The omitted transition variable is nonexporters. The additional set of controls Z_{it-1} includes 4-digit industry dummies and plant size.

The coefficient β_1 measures the productivity difference between entrants and nonentrants in export markets. A positive coefficient suggests that more productive plants enter export markets. A test on the difference between the coefficients β_3 and β_2 indicates whether more productive plants are more likely to remain in export markets.

3. Data Source and Descriptive Statistics

The data for our analysis comes from a longitudinal file developed from the Annual Surveys of Manufactures (ASM) that has been developed and used extensively for longitudinal analysis of dynamic change. The ASM covers the entire Canadian manufacturing sector, using survey data for the larger plants (accounting for over 95% of shipments) and administrative data from tax records for the remainder. It collects information on shipments, value added,[4] inventories and employment. The plants in the ASM are classified into 236 manufacturing industries at the 4-digit 1980 SIC (Standard Industrial Classification, 1980) level.

[2] Aw, Chung and Roberts (2000) and Delgado, Fariñas and Ruano (2002) make similar comparisons to examine the effect of export participation on productivity performance.
[3] Alternatively, we could estimate discrete choice models for export market participation decisions.
[4] Real value added is calculated using corresponding industry deflators.

The longitudinal file used for this paper is developed from the cross-sectional files from the ASM over the 1973-1997 period. The file has data on exports for individual plants for the years 1974, 1979, 1984, 1990, 1993 and 1996. In this paper, we will use the file to examine the linkages between exporting and productivity over the four periods: 1974-1979, 1979-1984, 1984-1990, and 1990-1996.

In this paper, we focus on labour productivity, defined as Census value-added[5] per employee, where employees are defined as the sum of production and non-production workers. Previous research on growing plants (Baldwin and Johnson, 1995, 1998) demonstrates that faster growing plants differ from slower growing plants in many dimensions. More successful firms do many things better than their less successful counterparts—and it is extremely difficult to distinguish which one of the activities makes the most difference. In this study, we chose one easily measured variable, labour productivity, as a proxy for a large number of activities that are associated with success.

In this paper, we examine whether those manufacturing plants that moved to export markets saw their labour productivity increase faster than those who had remained nonexporters. Labour productivity can increase either because of improvements in efficiency or increases in capital intensity. The movement to export markets is expected to affect both. Exporters are hypothesized to have to be more efficient. They probably also increase capital requirements.

Because the productivity literature places so much emphasis on the differences in the two causes of labour productivity change, we try to take into account the impact of changing capital intensity of this study. But we argue that for our purposes, the distinction between pure efficiency effects and capital deepening is not as useful for our purpose as the focus in traditional productivity literature would suggest.

The growth strategy of most firms involves capital deepening. Large firms differ from small firms in that they employ more capital per worker than small firms do. Growth requires that firms master the process whereby capital is substituted for labour. This is not easy to do. Firms that grow large master this process, while firms that lose market share do not. The capital deepening process then is something that requires special skills. It is as much interest to us to know that becoming an exporter requires capital deepening process as it is to learn that it leads to pure efficiency gains.

Clerides, Lach and Tybout (1998), and Bernard and Jensen (1999) use annual data on export status to examine the relationship between exporting and productivity. The annual data in their studies provide more accurate identification of the time when plants switch export status. But it suffers from the problem that the value-added measure is sometimes highly volatile in the short run. By focusing on longer periods than others have done, we reduce the effect of transitory shocks and measurement errors that affect our ability to detect linkages between exporting and productivity across plants.[6]

[5] Census value added includes purchased services.

[6] This strategy has been used in previous studies on firm dynamics in order to separate longer run trends from transitory changes (Baldwin and Gorecki, 1990; Baldwin 1995).

There are limitations to our data. The data on exports are only available for the plants that received detailed "long-form" questionnaires. These are the larger plants and account for over 98% of shipments in 1973 and 93% in 1997. No information on exports is collected for small plants that received a "short-form" questionnaire, except for 1974. In this paper, we will use the entire sample from the ASM and include both plants with long forms and plants with short forms. As plants given short forms are the small plants and the majority of them do not export,[7] we will assume that they are nonexporters.[8] We nevertheless check the robustness of our results using only the sample of plants with long forms.

The other limitation relates to the lack of data on capital stock and investment expenditures in the ASM. In this paper, we use capital cost (defined as nominal value added less wages and salaries) and energy costs to proxy capital stock. Capital costs serve as a proxy for capital stock if the difference between capital costs and capital stock or the rental price of capital shows similar changes over time across industries. Energy costs have been used as a proxy in a number of previous studies and we experiment with this as a proxy as well.

To check the coverage of exports in the ASM file, we have compared the ASM exports with those from two additional sources: custom documents and the Exporter Registry (Statistics Canada, 2001; Rupnik, 1999). We find that the exports from the ASM are lower than those from the other two data sources: around 25 percent for the custom documents and 10 percent for the Exporter Registry. We suspect that a number of factors have contributed to the difference. First, the coverage of exports in the ASM is less than 100 percent, as small plants given short forms do not report exports. Second, the valuation of exports differs. The ASM exports exclude freight charges while the exports from the customs data and Exporter Registry include freight charges (Rupnik, 1999). Third, the ASM exports include only those produced by manufacturing plants, exports from custom documents also include those produced outside of the manufacturing sector but nonetheless classified as manufacturing exports, such as those in the fishery, agricultural, and wholesale sectors (Rupnik, 1999).

3.1 Export-market Participation in Canadian Manufacturing

Table 1 shows that a large fraction of the manufacturing plants are exporters. The fraction of exporting plants increased after the mid-1980s. It rose from 14 percent in 1984 to 24 percent in 1996. Among the larger plants given long forms, the share increased from 31 percent to 55 percent over the period.

Exporters are also becoming more export-intensive. The average share of shipments exported for the exporters increased from 22 percent in 1974 to 33 percent in 1996. The share of exporters with medium to high export/shipment ratios rose from 33 percent in 1974 to 48 percent in 1996.

[7] In 1974, both short and long-forms were queried about their exports. Only 0.4 percent of small manufacturing plants with short forms (34 out of 8215) reported exports.

[8] If we leave out this group, we omit the group that is generally non-exporters. If we include them, we treat all as nonexporters when some will have moved into export status. If the latter generally have the highest rate of productivity increase (as our analysis later shows is the case for the youngest plants), then the rate of productivity increase of nonexporters is biased upwards and the rate of exporters is biased downwards and our test procedure will risk finding less effect of becoming an exporter.

Table 1. Export Participation in Canadian Manufacturing (%)

	1974	1979	1984	1990	1996
The proportion of exporters					
Of all plants	15.98	14.09	14.06	22.29	23.73
Of the plants with long forms	22.40	29.58	31.08	47.97	55.28
Mean export/shipment ratios of exporters	24.39	27.45	29.00	26.10	33.16
The distribution of exporters by % of shipments exported					
Low export share: <.25	67.45	62.84	59.77	63.78	52.03
Medium export share: .25-.75	21.95	24.57	27.62	25.62	33.46
High export share: > .75	10.60	12.59	12.61	10.60	14.51

Source: Authors' compilation from the ASM data.

Foreign-controlled plants account for the bulk of exports in Canadian manufacturing. The share of exports produced by foreign-controlled plants remained around 60 percent during the 1974-1996 period (Table 2).

The export participation rate was higher for foreign-controlled plants than for domestic-controlled plants. Both types of plants showed large increases in export participation rates after the mid-1980s. But the increase was more pronounced in the foreign-controlled sector. Over the 1984-1996 period, the share of foreign-controlled plants that were exporters rose from 42 percent in 1984 to 59 percent in 1996—a 17 percentage point increase. For the same period, the share of domestic-controlled plants that were exporters rose from 11 percent to 20 percent—a 9 percentage point increase.

The foreign-controlled exporters have become more export-intensive than their domestic-controlled counterparts in the 1990s. Prior to the mid-1980s, the export intensity was similar between the two types of exporters. But it diverged afterwards. In 1996, the share of shipments exported was 38 percent for foreign-controlled exporters, compared with 32 percent for domestic-controlled exporters.

Table 2. Export Participation in Canadian Manufacturing by Control (%)

	1974	1979	1984	1990	1996
The share of exports by foreign-controlled plants	62.79	57.66	61.17	64.14	58.34
The proportion of exporters by control:					
Foreign-controlled plants	40.27	40.65	41.61	56.27	59.36
Domestic-controlled plants	12.07	10.38	10.86	18.71	19.95
Mean export-shipment ratios of exporters by control:					
Foreign-controlled exporters	25.71	27.22	28.27	29.78	37.61
Domestic-controlled exporters	23.68	27.58	29.33	24.94	31.76

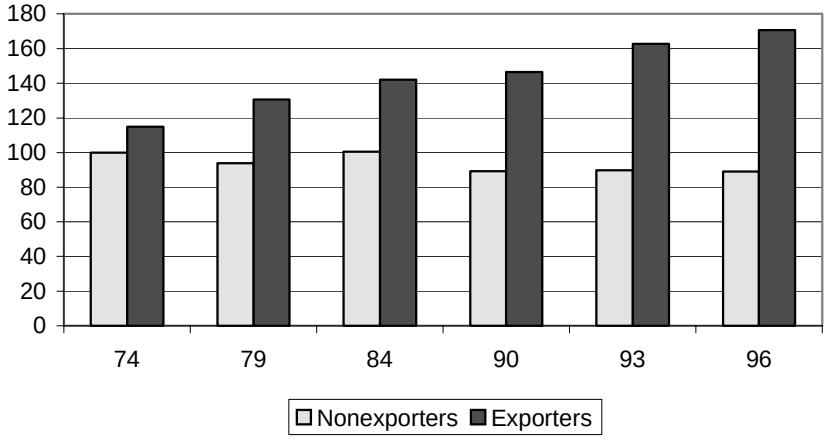
Source: Authors' compilation from the ASM data.

3.2 Productivity Differentials between Exporters and Nonexporters

We have calculated the average labour productivity of exporters and nonexporters for select years over the 1974-1996 period, shown in Figure 1. The results in Figure 1 confirm the previous findings for other countries – exporters tend to be more productive than nonexporters. Moreover, the productivity difference between exporters and nonexporters widened over the period. It rose from 24 percent in 1974 to 90 percent in 1996.

The difference between exporters and nonexporters in Figure 1 may reflect the concentration of exporters in more productive industries. Figure 2 presents the difference that is purged of the industry effects. It shows the percentage point difference between exporters and nonexporters in labour productivity and total factor productivity (TFP) within the same 4-digit industry. The difference in labour productivity is obtained from labour productivity regressions that include a dummy for export status and dummies for the 4-digit industries. The difference in TFP is calculated from productivity regressions that include capital/labour ratios as an additional control variable, using capital cost as a proxy for capital stock.[9]

Figure 1. Average Labour Productivity of Exporters and Nonexporters in Canadian Manufacturing
(sample mean from the ASM)

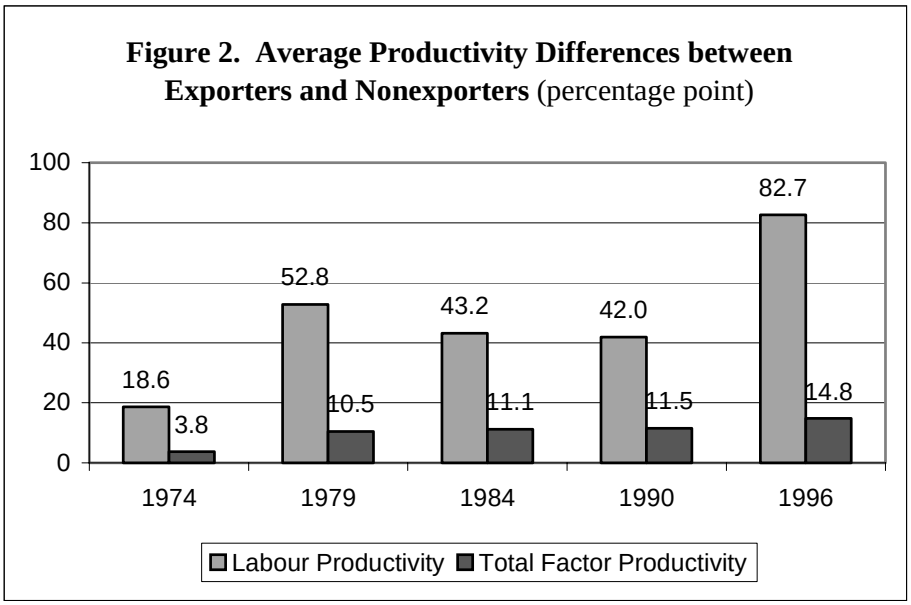


The results in Figure 2 show that exporters have higher labour productivity and TFP than nonexporters within the same 4-digit industry. The difference widened in the 1990s. The difference in labour productivity rose from 40 to 83 percentage points between 1990 and 1996. The difference in TFP increased from 12 to 15 percentage points. Moreover, exporters have become more capital intensive relative to nonexporters in the 1990s, as reflected by the fact that the increase in the TFP difference between them is less than the increase in labour productivity difference during the period.

[9] If capital cost/labour ratios were good proxy for capital/labour ratios, the estimated coefficient on the variable should equal the elasticity of capital with respect to output or the share of capital income in value added in a competitive market. Our estimate of the coefficient is about 0.3 in all specifications, which is close to the share of capital income in value-added.

Plants given short forms do not report exports in the ASM and are categorized as nonexporters in Figures 1 and 2. When we restrict our sample to the plants with long forms, we find similar results. Exporters tend to be more productive than nonexporters. We also find that the plants with short forms are the least productive.

Figure 2. Average Productivity Differences between Exporters and Nonexporters (percentage point)



3.3 Transition in Export Markets

Table 3 presents the transition of Canadian manufacturing plants into and out of export markets over the four periods: 1974-1979, 1979-1984, 1984-1990, and 1990-1996. Two stylized facts emerge from the table. First, entry into export markets is difficult. Of the nonexporters in 1990, only 9 percent broke into export markets during the 1990-1996 period, while the rest of the plants either remained nonexporters (53 percent) or ceased operation (38 percent). Second, of the plants that entered export markets, a large number failed and exited in the subsequent period. Of the exporters in 1990, more than a quarter exited export markets during the 1990-1996 period and another 25 percent ceased operation.

As an aside, the results in Table 3 show that new plants are much more likely to expand into foreign markets after the mid-1980s. During the 1984-1990 and 1990-1996 periods, 10 to 15 percent of the new plants started exporting by the end of the periods, compared with six percent for the 1974-1979 and 1979-1984 periods.

Table 3. Transition in Export Markets in Canadian Manufacturing (%)

	End Year Status			
Beginning Year Status	Plants with no exports	Plants with exports	Exiting plants	All
1974-1979 Period				
Plants with no exports	64.88	5.68	29.44	100
Plants with exports	33.17	53.47	13.36	100
New plants	93.42	6.58		100
1979-1984 Period				
Plants with no exports	59.72	5.85	34.43	100
Plants with exports	28.76	56.58	14.67	100
New plants	94.04	5.96		100
1984-1990 Period				
Plants with no exports	47.35	12.09	40.56	100
Plants with exports	18.96	62.77	18.27	100
New plants	88.20	11.80		100
1990-1996 Period				
Plants with no exports	52.64	9.39	37.97	100
Plants with exports	25.95	45.92	28.13	100
New plants	85.04	14.96		100

Source: Authors' compilation from the ASM data.

Table 4 summarizes the productivity performance of plants with different transitions in export markets between the period 1990-1996. The evidence in Table 4 is consistent with the view that the more productive plants self-select into export markets. We find that entrants to export markets are 15 percentage points more productive than nonentrants in 1990. The exiters from export markets are 13 percentage points less productive than continuers. In addition, the evidence in Table 4 suggests that export participation leads to better productivity performance. We find that entrants to export markets had faster productivity growth than nonentrants. Exiters from export markets had slower productivity growth than continuers and nonparticipants. We also find that entrants to export markets have faster productivity growth than exiters.

Table 4. Average Labour Productivity of Plants with Different Export-market Transitions in the 1990-1996 Period

	1990	1996	Growth (% per year)
Nonexporters	56.49	54.04	-0.74
Entrants to export markets	71.62	89.18	3.65
Exiters from export markets	87.18	72.73	-3.02
Continuing exporters	100.00	117.42	2.68

Note: Average labour productivity is calculated as an unweighted average across plants. It is set to 100 for continuing exporters in 1990.

We have also calculated the average productivity of the plants with various export statuses in the 1970s and 1990s (shown in Appendix Table A1). Overall, the results are consistent with those for the 1990-1996 period.

4. Empirical Evidence

In this section, we empirically examine two main issues. Do more productive plants become exporters? Does export participation lead to better productivity performance? We also address the issue of whether there are subsets of plants that gain more from export participation: young vs. older plants and foreign-controlled vs. domestic-controlled plants? Finally, we present evidence on the effects of increasing export intensity on productivity growth.

4.1 Do More Productive Plants Become Exporters?

Using a sample of continuing plants in the 1990-1996 period, we have estimated the empirical model of self-selection (Equation 5) in export markets. The results are shown in Table 5.

Table 5. Productivity Levels of Plants with Different Export-market Transitions, 1990-1996 (Dependent variable: log of value added per worker in 1990)

	(1)	(2)	(3)
Nonexporters	---	---	---
Entrants to export markets	0.2028*	0.1885*	0.0678*
	(0.0110)	(0.0112)	(0.0063)
Exiters from export markets	0.2786*	0.2733*	0.0618*
	(0.0142)	(0.0141)	(0.0078)
Continuers in export markets	0.4815*	0.4402*	0.1237*
	(0.0108)	(0.0122)	(0.0066)
Log of capital cost/labour ratios			0.3395*
			(0.0033)
Firm size			
Small		---	---
Medium		0.0989*	0.0490*
		(0.0142)	(0.0076)
Large		0.1421*	0.0741*
		(0.0229)	(0.0110)
R Squared	0.2835	0.2859	0.7564

Note: Heteroscedasticity-consistent standard errors are in parentheses. One asterisk denotes statistical significance at the 5 percent level. All regressions control for fixed effects for 243 four-digit SIC industries.

We are interested in two comparisons: entrants vs. nonentrants in export markets, and exiters vs. continuers in export markets. The coefficient on the binary variable for entrants shows the log difference in productivity between entrants and nonentrants. The coefficients on exiters and continuers provide a comparison between them.

In Specifications (1) and (2), we do not control for capital/labour ratios. The coefficients on the transition variables thus provide a comparison of labour productivity. In Specification (3), we control for capital/labour ratios. The coefficients on transitions in the latter specification give a comparison of TFP. To control for size differences, we use employment in 1990 to group plants into three size categories: small (1-100 workers), medium (100-250 workers), and large (250 workers or above).

The results from Specification (2) show that the plants that choose to start exporting have higher labour productivity than nonexporters. Exporters that stop exporting have lower labour productivity than continuers. The differences are substantial. Our results show that entrants to export markets are 21 percent more productive than nonentrants.[10] Exiters from export markets are 15 percent less productive than continuers.

The results in Specification (3) show that entrants to export markets have higher TFP than nonentrants and exiters have a lower TFP than continuers. We find that entrants are 7 percent more productive than nonentrants. Exiters are 6 percent less productive than continuers in export markets.

The difference in TFP between various types of plants is less than the difference in labour productivity. This suggests that entrants to export markets tend to be more capital intensive than nonentrants, and exiters are less capital intensive than continuers.

Overall, the findings in Table 5 support the view that the more productive plants self-select into export markets. Of nonexporters, the more productive and capital intensive ones expand into export markets. Of the plants that export, the more productive and capital intensive ones remain in export markets.

To address the issue of whether the importance of self-selection has changed over time, we have estimated the empirical model of self-selection for the other three periods: 1974-1979, 1979-1984, and 1984-1990. The results, as shown in Appendix Tables A2-A4, indicate that self-selection in export markets is pervasive in all periods.

We have also estimated the empirical model of self-selection using data from all four periods 1974-1979, 1979-1984, 1984-1988, and 1988-1997. The results are consistent with the view that more productive plants self-select into export markets (Appendix Table 5).

[10] The log difference between them is 0.18.

4.2 Does Export-market Participation Improve Productivity Performance?

To examine the effect of exporting on productivity, we have estimated Equation (4) using a sample of continuing plants for the 1990-1996 period.[11] The results are shown in Table 6. We are interested in three comparisons: entrants vs. nonentrants in export markets, exiters vs. continuers, and exiters vs. nonparticipants. The results from the comparisons show that export participation has a positive effect on productivity. We find that the plants that enter export markets have higher productivity growth than nonentrants. The plants that exit export markets have lower productivity growth than continuers and nonparticipants.

Table 6. Productivity Growth of Plants with Different Export-market Transitions, 1990-1996 (Dependent variable: annual log changes in value added per worker over the 1990-1996 period)

	(1)	(2)	(3)
Nonexporters	---	---	---
Entrants to export markets	.0519*	0.0487*	0.0060*
	(.0024)	(0.0025)	(0.0014)
Exiters from export markets	-.0308*	-0.0321*	-0.0041*
	(.0029)	(0.0029)	(0.0017)
Continuers in export markets	.0328*	0.0235*	0.0041*
	(.0022)	(0.0025)	(0.0013)
Annual log changes in capital cost /labour ratios			0.3284*
			(0.0032)
Firm Size			
Small		---	---
Medium		0.0242*	0.0083*
		(0.0030)	(0.0015)
Large		0.0290*	0.0105*
		(0.0043)	(0.0021)
R Squared	0.1257	0.1290	0.6706

Note: Heteroscedasticity-consistent standard errors are in parentheses. One asterisk denotes statistical significance at the 5 percent level. All regressions control for fixed effects for 243 four-digit SIC industries.

Productivity Growth Differentials between Entrants and Nonentrants. The positive coefficient on entrants in Specification (1) shows that entrants to export markets had faster labour productivity growth than nonentrants. The difference is large. On average, annual labour productivity growth was 5.2 percentage points higher for entrants than for nonentrants.

The difference in productivity growth between plants may reflect differences in plant competencies. To control for these differences, we include plant size in Specification (2) since it has been found to be correlated with a range of competencies—technological development, innovation, financing, and training (Baldwin and Hanel, 2000). The results from this specification shows that the difference in productivity growth between entrants and nonentrants

[11] In our estimation, we do not impose the constraint that the coefficients on the entrant and exiter dummies sum up to the coefficient on the continuer dummy. The constraint does not hold if the coefficient attached to export status is different for entrants as opposed to continuers.

is smaller after we control for plant size. Entrants to export markets are found to have annual labour productivity growth that was 4.9 percentage points higher.

In Specification (3), we include capital cost /labour ratios. The coefficient on entrants provides an estimate of the difference in TFP growth between entrants and nonentrants. We find that TFP grew faster for the plants that entered export markets. The difference in TFP growth was 0.7 percentage points per year.

The difference in TFP growth between entrants and nonentrants was found to be much smaller than the difference in labour productivity growth. We interpret this as evidence that the plants that export increase the pace of capital accumulation relative to nonentrants. A number of changes occur among entrants to export markets that cause their labour productivity to increase. New technologies are implemented. Operations become more capital intensive. And production becomes more efficient as plants learn about new production techniques.

Productivity Growth Differentials between Exiters and Continuers. The coefficients on exiters and continuers show that productivity growth was slower for the plants that exit export markets. The difference was 5.6 percentage points per year for labour productivity growth and 0.8 percentage points for TFP growth. In addition, our results show that the plants that leave export markets fall behind their previous compatriots in terms of capital accumulation, as reflected in the large difference in labour productivity growth relative to TFP growth. It should also be noted that exiters productivity growth also falls behind that of entrants. Plants that cannot stay in export markets fall behind both those that stay and those that in a sense supplant them.

Productivity Growth Differentials between Exiters and Nonparticipants. A comparison of exiters and nonparticipants provides a last piece of evidence in favour of the view that exporting leads to better productivity performance. The plants that exit export markets are found to have slower productivity growth than nonparticipants. They also appear to have lower capital accumulation.

Productivity Growth Differentials between Entrants and Continuers. Productivity growth is higher for entrants than for continuers in all periods. If relative productivity growth reflects differential learning effects in foreign markets, our finding suggests that entrants are more successful at acquiring or benefit more from new productivity enhancing information than existing exporters. A threshold or discontinuous learning effect appears to exist that favours recent arrivals, perhaps because they have more catching up to do.

To examine the effect of exporting on productivity in other periods, we have estimated Equation (4) for the 1974-1979, 1979-1984, and 1984-1990 periods. Overall, the results, as shown in Appendix Tables A6, A7 and A8, are similar to those reported for the 1990-1996 period.

We have also estimated Equation (4) using pooled data over four periods: 1974-1979, 1979-1984, 1984-1988, and 1988-1997. The results, as shown in Appendix Table A9, support the view that export participation improves productivity performance.

4.3 Robustness Checks

In this section, we provide a number of robustness checks on our findings. First, we examine the effect of selection bias on the estimated effect of exporting induced by plant exits. Second, we check the robustness of our findings to an alternative measure of productivity that is based on gross output. We also check the robustness of our findings to using energy costs as a proxy for capital stock. Third, we address the issue of simultaneity in our estimation of the effects of export participation on productivity performance. Fourth, we re-examine the effects of exporting on productivity using a sample of plants given long-form questionnaires.

In examining the effect of exporting on productivity, we have used a sample of continuing plants that are in operation during a period. This may introduce a selection bias on the estimated effect of exporting on productivity growth induced by plant exit. To address the problem of selection bias, we have re-estimated Equation (4) using Heckman's two-step procedure. In that procedure, we have modeled the probability that a plant exits during a period as a function of export status, plant size and labour productivity at the start of the period, a dummy variable indicating domestic vs. foreign-controlled plant, and a full set of industry dummy variables. The results for the 1990-1996 period are shown in Table 7. Overall, the results with correction for selection bias are consistent with those without correction. These results suggest that export participation makes a positive contribution to productivity performance. As exiting plants tend to be nonexporters and less productive, we find that the estimated productivity growth of nonexporters relative to participants in export markets (exiters, entrants and continuers) declined after we adjust for selection bias.[12]

Table 7. Productivity Growth of Plants with Different Export-market Transitions, 1990-1996, with Correction for Selection Bias (Dependent variable: annual log changes in value added per worker over the 1990-1996 period)

	(1)	(2)	(3)
Nonexporters	---	---	---
Entrants to export markets	0.0738*	0.0666*	0.0169*
	(0.0061)	(0.0100)	(0.0025)
Exiters from export markets	0.0063	0.0223	0.0101*
	(0.0083)	(0.0136)	(0.0034)
Continuers in export markets	0.1044*	0.0882*	0.0276*
	(0.0079)	(0.0130)	(0.0032)
Annual log changes in capital cost /labour ratios			0.2914*
			(0.0037)
Firm Size			
Small		---	---
Medium		0.1409*	0.0415*
		(0.0182)	(0.0043)
Large		0.2271*	0.0637*
		(0.0280)	(0.0065)
Mills Ratio	0.4186*	0.6870*	0.1600*
	(0.0231)	(0.0457)	(0.0078)

Note: One asterisk denotes statistical significance at the 5 percent level. All regressions control for fixed effects for 243 four-digit SIC industries.

[12] The results from Probit equation for plant exit show that the probability of plant exit tend to be higher for the plants that are small, nonexporters, less productive, and foreign-controlled.

Next we check that our results are robust to using an alternative measure of productivity that is based on gross output. In the analysis thus far, we measure productivity based on value added. When we use gross output per worker to measure labour productivity, we obtain similar findings.

Our empirical analysis thus far assumes that capital costs serves as a reasonable proxy for capital stock. To check the robustness of our findings, we have included the log of energy costs / labour ratios instead in the productivity regressions. Our findings are robust to this alternative measure of capital stock.[13]

Due to a lack of information on export status on a more frequent basis, we have used a panel of plants between two periods and estimated a model that relates export participation to productivity performance in the same period. Therefore, our estimates of effects of exporting on productivity may suffer from potential simultaneity problems and be biased.

To reduce potential simultaneity problems, we use an empirical specification with dynamic structures, using export status lagged one period as a regressor in the productivity regressions. To estimate such models, we need data on a more frequent basis, which is available in the 1990s as the ASM collects information on exports for three years 1990, 1993, and 1996.

The dynamic model we will estimate is:[14]

$$\begin{aligned} &L\,\mathrm{n}(LP_{it}) = \alpha_t + \beta_1 \ln(LP_{it-1}) + \beta_2 \ln(KL_{it}) + \beta_3 Size_{it} + \gamma E\,\mathrm{xp}\,ort_{it-1} + \mu_i + \varepsilon_{it}, \\ &\text{for } i = 1, 2, ..., N; t = 2, 3. \end{aligned} \tag{6}$$

The three periods in the equation correspond to the years 1990, 1993, and 1996.

We proceed in several steps. First, we first-difference the equation to eliminate unobserved plant-specific effects.

$$\begin{aligned} &\Delta L\,\mathrm{n}(LP_{it}) = \alpha_t - \alpha_{t-1} + \beta_1 \Delta \ln(LP_{it-1}) + \beta_2 \Delta \ln(KL_{it}) + \beta_3 \Delta Size_{it} + \gamma \Delta E\,\mathrm{xp}\,ort_{it-1} \\ &+ \varepsilon_{it} - \varepsilon_{it-1}, \text{ for } i = 1, 2, ..., N; t = 3. \end{aligned} \tag{7}$$

This new specification introduces a problem of simultaneity as the error term $\varepsilon_{it} - \varepsilon_{it-1}$ is now correlated with the regressor $\Delta \ln(LP_{it-1}) = \ln(LP_{it-1}) - \ln(LP_{it-2})$. Therefore, we use the lagged variable $\ln(LP_{it-2})$ as an instrument.

Blundell and Bond (1998) show that this standard Generalized Method of Moments (GMM) estimator can produce large finite sample biases (see also Griliches and Mairesse, 1998). They propose an extended GMM estimator in which lagged first-differences of dependent variables are used as instruments for equations in levels, in addition to lagged levels as instruments for equations in first-differences. We report the results from the System GMM (SYS-GMM)

[13] The estimated coefficient on the variable in the 1990-1996 period is about 0.15 and statistically significant at the one percent level.

[14] Cleridas, Lach and Tybout (1998) have estimated a similar model but used more lagged values of dependent and independent variables.

estimation in Table 8. For a comparison, we also report results from a random-effects estimation model.

The results from the SYS-GMM and random-effects estimations show that export participation has a positive effect on productivity performance. The effect is much larger for labour productivity than for TFP. The results from the SYS-GMM estimation show that the log difference in labour productivity between exporters and nonexporters is 11 percentage points. The TFP difference is one percentage point. This suggests once again that much of the effect of exporting on labour productivity came from its effect on capital accumulation.

Table 8. Estimation of a Dynamic Model of Exporting and Productivity

	SYS-GMM	RE	SYS-GMM	RE
	(1)	(2)	(3)	(4)
$Ln(LP)_{-1}$	0.2617*	0.4531*	0.1268*	0.1527*
	(0.0097)	(0.0045)	(0.0052)	(0.0029)
$Export_{-1}$	0.1173*	0.1652*	0.0110*	0.0276*
	(0.0082)	(0.0071)	(0.0046)	(0.0042)
$Ln(K/L)_{-1}$	---	---	0.3496*	0.3317*
			(0.0015)	(0.0013)
Firm Size:				
Small	---	---	---	---
Medium	0.1657*	0.1843*	0.0403*	0.0414*
	(0.0124)	(0.0104)	(0.0070)	(0.0062)
Large	0.2915*	0.2919*	0.0819*	0.1055*
	(0.0196)	(0.0151)	(0.0110)	(0.0093)

Note: Standard errors are in parentheses. All coefficient estimates are statistically significant at the 5 percent level. SYS-GMM denotes System GMM estimation. RE denotes random effects estimation.

Table 9. Estimation of a Dynamic Model of Exporting and Productivity from a Sample of Plants with Long Forms

	SYS-GMM	RE	SYS-GMM	RE
	(1)	(2)	(3)	(4)
$Ln(LP)_{-1}$	0.2719*	0.5581*	0.1789*	0.1588*
	(0.0188)	(0.0071)	(0.0082)	(0.0045)
$Export_{-1}$	0.0714*	0.0797*	0.0084	0.0132*
	(0.0115)	(0.0098)	(0.0060)	(0.0055)
$Ln(K/L)_{-1}$	---	---	0.4507*	0.4494*
			(0.0029)	(0.0027)
Firm Size				
Small	---	---		
Medium	0.0045	0.0334*	-0.0031	-0.0011
	(0.0154)	(0.0120)	(0.0078)	(0.0069)
Large	0.0451*	0.0933*	0.0224*	0.0486*
	(0.0222)	(0.0157)	(0.0112)	(0.0093)

Note: Standard errors are in parentheses. All coefficient estimates are statistically significant at the 5 percent level. SYS-GMM denotes System GMM estimation. RE denotes random effects estimation.

The results in Table 8 are obtained using a sample of all plants. When we restrict our sample to the plants with long forms, we get similar results: the log difference in labour productivity between exporters and nonexporters from the SYS-GMM estimation is 7 percentage points, and the log difference in TFP is small (Table 9).

4.4 Are There Differences in the Effects of Exporting on Productivity between Plants?

If exporting improves information flows and increases productivity, it may not affect all participants equally. The ability of firms to acquire and digest information differs by firm type. Foreign-controlled plants have well-developed mechanisms for transferring information across national boundaries. Therefore, they are less likely to improve the flow of information that they receive from entering export markets. On the other hand, domestic-controlled plants are more likely to add to their sources of technological information after they begin to export.

In this section, we ask who benefits most from participation in export markets. We compare foreign- and domestic-controlled plants and find that entry to export markets is associated with higher productivity growth for domestic-controlled plants, but that this is not the case for foreign-controlled plants. This is consistent with the view that domestic-controlled plants have the most to gain from participating in export markets as these are the plants with more limited access to information on international best practices.

We also divide plants into young and older plants. Young plants generally have fewer new technologies (Baldwin and Diverty, 1995) and for this reason might be expected to benefit somewhat more than older plants from entry into foreign markets. In addition, young plants have had less time to develop information networks (especially for technology surveillance programs) that allow them to acquire external information for enhancing their productivity. Young plants might therefore be expected to gain more from entering export markets.

Differences between Young and Older Plants. To examine the differences, we allow coefficients on the transition dummies in Equation (4) to differ between young and older plants and then reestimate the equation over the 1990-1996 period. We will call the plants that started up after 1984 "young" plants. We call those that started up before 1984 "older" plants. The results are summarized in Table 10.

Table 10. Differences in Effects of Exporting on Productivity Growth between Young and Older Plants, 1990-1996

	Labour productivity growth (% per year)	TFP growth (% per year)
Differences among young plants		
• Entrants vs. Nonentrants	6.43*	0.83*
• Exiters vs. Continuers	-5.09*	-1.22*
Differences among older plants		
• Entrants vs. Nonentrants	4.01*	0.52*
• Exiters vs. Continuers	-5.60*	-0.70*

Note: One asterisk denotes statistical significance at the 5 percent level. Productivity growth differentials control for size and industry effects. TFP growth differentials also control for capital/labour ratios.

Both young and older plants show increases in productivity when they start exporting. They both show declines in productivity when they stop exporting.[15] Differences exist in the benefit that each group obtains. Perhaps the most striking finding is that young plants gain significantly more in labour productivity from entering export markets for the first time.[16]

Differences between Foreign- and Domestic-Controlled Plants. Table 11 summarizes the results in the differences in productivity gains associated with exporting between foreign-controlled and domestic-controlled plants for the 1990-1996 period.[17] The evidence shows that export participation has a positive effect on productivity performance for domestic-controlled plants. But for foreign-controlled plants, export participation has virtually no effect.[18]

Table 11. Differences in Effects of Exporting on Productivity Growth between Foreign- and Domestic-Controlled Plants, 1990-1996

	Labour productivity growth (% per year)	TFP growth (% per year)
Differences among domestic-controlled plants		
• Entrants vs. Nonentrants	5.29*	0.62*
• Exiters vs. Continuers	-5.51*	-0.84*
Differences among foreign-controlled plants		
• Entrants vs. Nonentrants	No change	No change
• Exiters vs. Continuers	-5.73*	No change

Note: One asterisk denotes statistical significance at the 5 percent level. "No change" indicates that productivity differentials are not statistically significant at the 5 percent level. Productivity growth differentials control for size and industry effects. TFP growth differentials also control for capital/labour ratios.

For domestic-controlled plants, our results show that entrants have annual productivity growth that was 5.3 percentage points faster than nonentrants. They also have TFP growth that was 0.6 percentage points faster. In addition, our results show that domestic-controlled exiters have lower productivity growth than the continuers in export markets.

We have further divided foreign- and domestic-controlled plants into young and older plants. For domestic-controlled plants, we find that both younger and older plants gain from export participation. For foreign-controlled plants, we find that neither category benefits from exporting.

To examine the effects of raising export intensity on productivity growth, we divide exporters in the 1990-1996 period into those that increased export intensity and those that did not. Specifically, we group exporters into three categories: low export intensity (with less than 25% of shipments exported), medium intensity (between 25 and 75%), and high intensity (75% or above). Plants are defined to show increases in export intensity if they move from the low export intensity category to the medium-high export intensity category. Otherwise, they are defined to show declines in export intensity. Our results in Table 12 show that raising export intensity has a

[15] The results in other periods are similar.
[16] Gains in TFP growth are higher for young plants, but not statistically significant.
[17] As shown in Table 2, 40 percent of foreign-controlled plants are nonexporters in 1996 vs. 20 percent for domestic-controlled plants.
[18] The results for the 1970s and 1980s are similar.

positive effect on productivity growth. That is true for both foreign- and domestic-controlled plants. The difference between them is not statistically significant at the 10 percent level.

Table 12. Effects of Increasing Export Intensity on Productivity Growth, 1990-1996

	Labour productivity growth (% per year)	TFP growth (% per year)
All plants	1.80*	1.07*
Foreign-controlled plants	2.04*	0.87*
Domestic-controlled plants	1.68*	1.17*

Note: One asterisk denotes statistical significance at the 5 percent level.

In sum, our results suggest that domestic-controlled plants benefit from participation in export markets, both from entry into export markets and from increasing their export intensity. Foreign-controlled plants gain only if they do the latter. Exposure to export markets matters, but more so for domestic than for foreign-controlled plants.

These results about the effect of international exposure on productivity are consistent with the findings of a recent paper on innovation. Baldwin and Hanel (2000) define domestic-controlled firms with an international orientation as those that have either foreign production/R&D facilities or foreign sales. They find that domestic-controlled firms with substantial foreign sales are often as innovative as foreign-controlled firms. But domestic firms with no international orientation were much less innovative. They interpret this as evidence that it is the international orientation or globalization of a firm rather than ownership per se that is important for innovativeness.

5. Decomposing Productivity Growth in Aggregate Manufacturing

The previous sections have demonstrated that participation in export markets improves productivity performance. But it only shows that becoming an exporter increases productivity. The importance of this group needs to be evaluated in a more systematic way.

This section develops a method of evaluating the importance of export markets, and asks how much of the growth in aggregate productivity came from the plants that were involved in export markets.

To measure the contributions of various types of plants, we decompose changes in labour productivity from periods $t-\tau$ to t into the contribution from continuing plants (plants that are in operation in both periods) and the proportion due to entering and exiting plants (for details, see Baldwin and Gu, 2002):

$$\Delta P_t = \sum_{i \in C} \bar{s}_i \Delta p_{it} + \sum_{i \in C} (\bar{p}_i - P_{Xt-\tau}) \Delta s_{it} + \sum_{i \in N} s_{it} (p_{it} - P_{Xt-\tau}), \quad (8)$$

where:

ΔP_t: changes in labour productivity in aggregate manufacturing;
C: subset of continuing plants that are in operation in both periods;
N: subset of entering plants: plants not in operation in period $t-\tau$, but in operation in t;
$\overline{s}_i$: average employment share of continuing plants in the two periods;
Δs_{it}: changes in employment shares of plant i during the two periods;
s_{it}: employment shares of plant i in period t;
$\overline{p}_i$: average labour productivity of plant i during the two periods;
Δp_{it}: changes in labour productivity of plant i during the two periods; and
$P_{Xt-\tau}$: average labour productivity of exiting plants in period $t-\tau$, where X denotes the subset

of exiting plants that are in operation in period $t-\tau$ but not in operation in period t.

The first term in this decomposition is categorized as the within-plant component and measures the contribution of productivity growth within continuing plants holding their employment shares fixed. The second term is referred to as the between-plant component and captures the effect of the compositional shift in employment shares among continuing plants. The between-plant component contributes positively to productivity as employment shifts toward plants that are more productive than the average. The last term is taken to represent the contribution of net entry (entering and exiting plants).

The method for decomposing aggregate productivity growth is not unique. The contribution of entry and exit in Equation (8) involves a comparison of the average productivity of entrants and exiters. Alternative methods compare entrants with average plants (see Baldwin and Gu, 2002 for details). Baldwin (1995) and Baldwin and Gu (2002) argue that the decomposition method in Equation (8) is appropriate if we assume that entrants displace exiting plants, an assumption that has considerable empirical support.

To examine the importance of export participation for aggregate productivity growth, we also group plants into several classes based on their export status. We divide continuing plants into four groups: continuers, entrants, exiters and nonparticipants in export markets. New plants are divided into exporters and nonexporters.

The decomposition results for the 1990-1996 period are reported in Table 13, which aggregates the results for 236 individual industries using average employment shares as weights. We find that continuing exporters provide the dominant source of labour productivity growth in aggregate manufacturing, contributing 74 percent. New plants that participate in export markets are second important source, contributing 17 percent. The continuing plants that start exporting account for 10 percent. The exiters and nonparticipants in export markets contribute a mix of small productivity gains and losses that offset each other. In conclusion, the focus of much of the literature on plants that make a transition to export markets is somewhat misplaced. While these plants contribute to productivity growth, the proportion of the total that they account for is relatively small. Instead, it is existing exporters that account for most of the productivity growth.

The contribution of continuing exporters is disproportionate to their size. It is much greater than their share of employment in aggregate manufacturing (46 percent in 1996).

We have also carried out the decomposition for the 1974-1979, 1979-1984, and 1984-1990 periods. The results are shown in Appendix Table A10. The dominant source of productivity growth is continuing exporters in all three periods. Perhaps what is more important, we find that the importance of export markets for productivity growth has increased over time. The contribution of nonexporters for aggregate productivity growth falls. The importance of continuing exporters increases by over 35 percentage points over time. The contribution of entrants to export markets increases but only marginally. Trade liberalization over the last three decades has changed the nature of the universe in several ways. It has increased the amount of activity that benefits from exports. The employment in continuing exporters increased from about 40 to 45% over the period; but it has increased the relative productivity of plants in the export market even more dramatically, since these plants increased their share of productivity growth from about 40% to over 75% in the period

Table 13. Decomposition of Labour Productivity Growth in Canadian Manufacturing for the 1990-1996 Period

	Employment Share (%)	Percentage Contribution		
		With-plant	Between-plant	Overall
Continuing plants				
Nonexporters	20.98	5.69	-1.99	3.70
Entrants to export markets	12.02	9.95	0.37	10.32
Exiters from export markets	7.38	-4.99	-0.13	-5.11
Continuing exporters	45.90	76.45	-3.07	73.38
All	86.28	87.10	-4.82	82.29
New plants				
Nonexporters	7.69			-0.93
Exporters	6.02			18.65
All	13.71			17.72

6. Conclusion

In this paper we have examined the relationship between the productivity of a manufacturing plant and its participation in export markets. We recognize that there are two possible explanations for a positive relationship between the two. First, higher productivity and higher efficiency may be required if plants are to become exporters. Second, by exporting, plants may learn of superior technologies and management techniques and improve their productivity.

To examine the relationship between productivity and exporting, we have divided plants into four groups. The four groups are plants that continuously export over a period, that enter export markets during a period, that exit export markets during a period, and those that never export during a period.

In the first part of the paper, we show that more productive plants participate in export markets. Of nonexporters, we find that the more productive ones expand into export markets and the less productive remain nonexporters. Of the plants that are in export markets, the more productive ones are more likely to remain there. We conclude that there is a selection process at work that causes the most productive plants to enter export markets and to stay there. Productivity is used here not as the definitive marker that is behind exporting—but as a proxy for a range of characteristics that distinguish small from large firms, the less successful from the more successful.

In the second part of the paper, we show that participation in export markets improves productivity. There is a learning process at work that builds on existing plant history. We find that productivity growth is higher for the plants that enter export markets than nonentrants. Plants that are more productive are more likely to enter export markets—but having done so, the more successful ones learn and improve their productivity even further relative to their colleagues.

It is important to understand that the process is not unidirectional. While history matters, it is not the overriding factor. Not all entrants succeed. There is a regression-to-the-mean taking place. Some plants will not succeed at export markets and will withdraw back to domestic markets. Productivity growth is lower for the plants that exit export markets than for those continuing in export markets and considerably lower than for entrants to export markets.

This process of entry and exit to export markets then reflects in large part what has been previously described (Baldwin and Gorecki, 1991; Baldwin (1995); Baldwin and Gu, 2002) as the general entry and exit process to the manufacturing sector as a whole. The exception is that in the general process, new plants are not generally the most productive—though they do increase their productivity relatively quickly after entry or they fail. A better analogy would be the set of entrants who come from another industry and enter a second. These plants in general start at higher levels of productivity and exhibit an advantage when they enter related markets.

We have also shown that the learning process associated with entry to export markets has become larger over the last three decades as trade liberalization has intensified. Our results support the view of Head and Ries (2001) that trade serves as a conduit for the transfer of

knowledge contributing to productivity growth. Moreover, they suggest that trade liberalization has increased the benefits associated with the learning process.

We have also examined whether productivity gains associated with entry to export markets differ between domestic-controlled and foreign-controlled plants, and between young and older plants. Much of the trade literature has focused only on entrants as a general group. If learning is the explanation for the gain in productivity, we would expect to find differences across plant types. In particular, we would expect to find larger gains where plants are more likely to be in a position to either take advantage of information gained from trade. We find that the productivity gains from entry to export markets were greater for domestic-controlled plants and for young plants. Increasing export intensity is found to improve productivity performance for both domestic- and foreign-controlled plants. Both younger plants and domestic plants are more likely to benefit from information gained during exposure to foreign markets because their information acquisition systems are less fully developed than either older or foreign-owned plants.

Finally, to illustrate the importance of exporting, we ask how much of the productivity growth in Canadian manufacturing came from the plants that were exporters. The emphasis in the trade literature has been on entrants to export markets. But continuing plants can change their exposure to export markets and might gain additional benefits from doing so. We confirm that this took place in Canada. Moreover, we find that these plants accounted for almost three-quarters of productivity growth in the 1990s, even though they accounted for less than 50 percent of employment. While entry has a positive impact on productivity, it is much less important.

While the paper has demonstrated that participation in export markets improves productivity, it does not fully answer how this is brought about—though at least one source of the improvement appears to be capital accumulation. Since there is substantially more improvement in labour productivity than in TFP when a plant commences exporting, part of the increase in labour productivity is due to increased capital intensity. Exporting activities are, therefore, associated with a transformation of production processes from being less to being more capital intensive.

There are other mechanisms for the productivity improvement to occur that have not been investigated here. Exporting plants may be able to grow more quickly and exploit scale economies; or they may specialize in fewer product lines to exploit product line scale economies; or they may adopt more advanced technologies. The sources of productivity gains from exporting will be the focus of future studies.

Appendix Table A1. Average Labour Productivity of Plants with Different Export-market Transitions in the 1970s and 1980s

	Start of Period	End of Period	Growth (% per year)
1974-1979 period			
Nonexporters	85.31	81.88	-0.82
Entrants to export markets	99.23	110.59	2.17
Exiters from export markets	95.66	94.29	-0.29
Continuing exporters	100	106.74	1.31
1979-1984 period			
Nonexporters	75.09	77.96	0.75
Entrants to export markets	90.85	109.91	3.81
Exiters from export markets	101.44	98.79	-0.53
Continuing exporters	100	104.25	0.83
1984-1990 period			
Nonexporters	69.36	63.12	-1.57
Entrants to export markets	85.61	94.73	1.69
Exiters from export markets	89.51	80.77	-1.71
Continuing exporters	100	107.11	1.15

Note: Average labour productivity is calculated as an unweighted average across plants. It is set to 100 for continuing exporters for the start of a period.

Appendix Table A2. Productivity Levels of Plants with Different Export-market Transitions, 1974-1979 (Dependent variable: log of value added per worker in 1974)

	(1)	(2)	(3)
Nonexporters	---	---	---
Entrants to export markets	0.1626*	0.1516*	0.0213*
	(0.0142)	(0.0144)	(0.0081)
Exiters from export markets	0.1148*	0.1055*	0.0047
	(0.0143)	(0.0145)	(0.0085)
Continuers in export markets	0.2332*	0.2094*	0.0504*
	(0.0125)	(0.0135)	(0.0077)
Log of capital cost/labour ratios			0.3805*
			(0.0046)
Firm size			
Small		---	---
Medium		0.0397*	-0.0129
		(0.0123)	(0.0073)
Large		0.0725*	0.0223*
		(0.0160)	(0.0099)
R Squared	0.4090	0.4096	0.7938

Note: Heteroscedasticity-consistent standard errors are in parentheses. One asterisk denotes statistical significance at the 5 percent level. All regressions control for fixed effects for 243 four-digit SIC industries.

Appendix Table A3. Productivity Levels of Plants with Different Export-market Transitions, 1979-1984 (Dependent variable: log of value added per worker in 1979)

	(1)	(2)	(3)
Nonexporters	---	---	---
Entrants to export markets	0.1878*	0.1668*	0.0439*
	(0.0168)	(0.0170)	(0.0080)
Exiters from export markets	0.3635*	0.3340*	0.0724*
	(0.0158)	(0.0161)	(0.0090)
Continuers in export markets	0.4093*	0.3555*	0.0978*
	(0.0132)	(0.0145)	(0.0082)
Log of capital cost/labour ratios			0.3562*
			(0.0039)
Firm size			
Small		---	---
Medium		0.1347*	0.0173*
		(0.0135)	(0.0072)
Large		0.1190*	0.0213*
		(0.0180)	(0.0104)
R Squared	0.3521	0.3554	0.8005

Note: Heteroscedasticity-consistent standard errors are in parentheses. One asterisk denotes statistical significance at the 5 percent level. All regressions control for fixed effects for 243 four-digit SIC industries.

Appendix Table A4. Productivity Levels of Plants with Different Export-market Transitions, 1984-1990 (Dependent variable: log of value added per worker in 1984)

	(1)	(2)	(3)
Nonexporters	---	---	---
Entrants to the export market	0.1613*	0.1490*	0.0462*
	(0.0123)	(0.0123)	(0.0064)
Exiters in the export market	0.2875*	0.2615*	0.0703*
	(0.0200)	(0.0203)	(0.0097)
Continuing Exporters	0.3420*	0.2873*	0.0870*
	(0.0136)	(0.0148)	(0.0081)
Log of capital cost/labour ratios			0.4072*
			(0.0054)
Firm size			
Small		---	---
Medium		0.1363*	0.0451*
		(0.0145)	(0.0076)
Large		0.1755*	0.0715*
		(0.0212)	(0.0109)
R Squared	0.2683	0.2722	0.7635

Note: Standard errors are in parentheses. One asterisk denotes statistical significance at the 5 percent level. All regressions control for fixed effects for 243 four-digit SIC industries. Standard errors are adjusted for heteroscedasticity with Huber-White method.

Appendix Table A5. Productivity Levels of Plants with Different Export-market Transitions, All Periods (Dependent variable: log of value added per worker at the start of a period)

	(1)	(2)	(3)
Nonexporters	---	---	---
Entrants to the export market	0.1760*	0.1628*	0.0490*
	(0.0067)	(0.0068)	(0.0039)
Exiters in the export market	0.2668*	0.2525*	0.0540*
	(0.0081)	(0.0082)	(0.0048)
Continuing Exporters	0.3808*	0.3421*	0.0981*
	(0.0064)	(0.0070)	(0.0042)
Log of capital cost/labour ratios			0.3652*
			(0.0021)
Firm size			
Small		---	---
Medium		0.0971*	0.0182*
		(0.0070)	(0.0042)
Large		0.1063*	0.0258*
		(0.0101)	(0.0062)
R Squared	0.2756	0.2775	0.7228

Note: Standard errors are in parentheses. One asterisk denotes statistical significance at the 5 percent level. All regressions include period dummy variables and fixed effects for 243 four-digit SIC industries. Standard errors are adjusted for heteroscedasticity with Huber-White method.

Appendix Table A6. Productivity Growth of Plants with Different Export-market Transitions, 1974-1979 (Dependent variable: annual log changes in value added per worker over the 1974-1979 period)

	(1)	(2)	(3)
Nonexporters	---	---	---
Entrants to export markets	0.0391*	0.0345*	0.0089*
	(0.0031)	(0.0032)	(0.0018)
Exiters from export markets	0.0109*	0.0069*	0.0024
	(0.0034)	(0.0034)	(0.0019)
Continuers in export markets	0.0359*	0.0274*	0.0069*
	(0.0028)	(0.0031)	(0.0018)
Annual log changes in capital cost/labour ratios			0.3277*
			(0.0038)
Firm size			
Small		---	---
Medium		0.0237*	0.0060*
		(0.0027)	(0.0016)
Large		0.0168*	0.0020
		(0.0036)	(0.0020)
R Squared	0.0868	0.0898	0.6459

Note: Heteroscedasticity-consistent standard errors are in parentheses. One asterisk denotes statistical significance at the 5 percent level. All regressions control for fixed effects for 243 four-digit SIC industries.

Appendix Table A7. Productivity Growth of Plants with Different Export-market Transitions, 1979-1984 (Dependent variable: annual log changes in value added per worker over the 1979-1984 period)

	(1)	(2)	(3)
Nonexporters	---	---	---
Entrants to export markets	0.0218*	0.0213*	0.0046*
	(0.0037)	(0.0038)	(0.0020)
Exiters from export markets	-0.0236*	-0.0247*	-0.0007
	(0.0039)	(0.0039)	(0.0020)
Continuers in export markets	-0.0116*	-0.0141*	-0.0015
	(0.0030)	(0.0032)	(0.0018)
Annual log changes in capital cost /labour ratios			0.3345*
			(0.0042)
Firm size			
Small		---	---
Medium		0.0009	0.0084*
		(0.0031)	(0.0017)
Large		0.0116*	0.0144*
		(0.0041)	(0.0023)
R Squared	0.0720	0.0723	0.6287

Note: Heteroscedasticity-consistent standard errors are in parentheses. One asterisk denotes statistical significance at the 5 percent level. All regressions control for fixed effects for 243 four-digit SIC industries.

Appendix Table A8. Productivity Growth of Plants with Different Export-market Transitions, 1984-1990 (Dependent variable: annual log changes in value added per worker over the 1984-1990 period)

	(1)	(2)	(3)
Nonexporters	---	---	---
Entrants to export markets	0.0191*	0.0190*	-0.0013
	(0.0023)	(0.0023)	(0.0013)
Exiters from export markets	-0.0144*	-0.0147*	-0.0058*
	(0.0040)	(0.0040)	(0.0021)
Continuers in export markets	0.0094*	0.0086*	-0.0050*
	(0.0026)	(0.0028)	(0.0015)
Annual log changes in capital cost/ to labour ratios			0.3287*
			(0.0037)
Firm size			
Small		---	---
Medium		0.0005	0.0005
		(0.0029)	(0.0015)
Large		0.0051*	0.0052*
		(0.0037)	(0.0021)
R Squared	0.0822	0.0822	0.6381

Note: Heteroscedasticity-consistent standard errors are in parentheses. One asterisk denotes statistical significance at the 5 percent level. All regressions control for fixed effects for 243 four-digit SIC industries.

Appendix Table A9. Productivity Growth of Plants with Different Export-market Transitions, All Periods (Dependent variable: annual log changes in value added per worker over the 1984-1990 period)

	(1)	(2)	(3)
Nonexporters	---	---	---
Entrants to export markets	0.0329*	0.0311*	0.0032*
	(0.0014)	(0.0014)	(0.0008)
Exiters from export markets	-0.0194*	-0.0214*	-0.0032*
	(0.0018)	(0.0018)	(0.0011)
Continuers in export markets	0.0178*	0.0124*	-0.0001
	(0.0013)	(0.0014)	(0.0009)
Annual log changes in capital cost/ to labour ratios			0.3247*
			(0.0019)
Firm size			
Small		---	---
Medium		0.0130*	0.0063*
		(0.0015)	(0.0009)
Large		0.0158*	0.0093*
		(0.0020)	(0.0012)
R Squared	0.0367	0.0378	0.5715

Note: Heteroscedasticity-consistent standard errors are in parentheses. One asterisk denotes statistical significance at the 5 percent level. All regressions include period dummy variables and fixed effects for 243 four-digit SIC industries.

Appendix Table A10. Decomposition of Labour Productivity Growth in Canadian Manufacturing for the 1970s and 1980s

	Employment Share (%)	Percentage Contribution		
		With-plant	Between-plant	Overall
1974-1979 period				
Continuing plants				
Nonexporters	30.64	16.56	5.96	22.52
Entrants to export markets	10.74	13.46	1.83	15.29
Exiters from export markets	8.43	3.11	-1.48	1.62
Continuing exporters	39.58	33.45	5.77	39.22
All	*89.39*	*66.58*	*12.08*	*78.65*
New plants				
Nonexporters	7.35			7.58
Exporters	3.26			13.77
All	*10.61*			*21.35*
1979-1984 period				
Continuing plants				
Nonexporters	30.34	11.57	-0.37	11.20
Entrants to export markets	9.02	13.75	1.78	15.54
Exiters from export markets	9.47	5.64	-2.78	2.86
Continuing exporters	40.20	47.14	0.28	47.42
All	*89.03*	*78.1*	*-1.09*	*77.02*
New plants				
Nonexporters	7.71			6.39
Exporters	3.25			16.60
All	*10.96*			*22.99*
1984-1990 period				
Continuing plants				
Nonexporters	22.49	-26.44	2.23	-24.22
Entrants to export markets	14.35	40.23	-5.00	35.23
Exiters from export markets	5.14	2.88	-2.55	0.33
Continuing exporters	39.31	85.57	-11.83	73.74
All	*81.29*	*102.24*	*-17.15*	*85.08*
New plants				
Nonexporters	13.06			-34.21
Exporters	5.66			49.13
All	*18.72*			*14.92*

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