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Export Market Dynamics and Plant-level Productivity: Impact of Tariff Reductions and Exchange Rate Cycles

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- . not available for any reference period
- .. not available for a specific reference period
- … not applicable
- 0 true zero or a value rounded to zero
- 0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- ^{p} preliminary
- ^{r} revised
- x suppressed to meet the confidentiality requirements of the *Statistics Act*
- ^{E} use with caution
- F too unreliable to be published

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Abstract

This paper examines how trade liberalization and fluctuations in real exchange rates affect export-market entry/exit and plant-level productivity. It uses the experience of Canadian manufacturing plants over three separate periods that feature different rates of bilateral tariff reductions and differing movements in bilateral real exchange rates. The patterns of entry and exit responses as well as the productivity outcomes differ markedly in the three periods. Consistent with much of the recent literature, the paper finds that plants self-select into export markets—that is, more efficient plants are more likely to enter and less likely to exit export markets. The reverse also occurs: entrants to export markets improve their productivity performance relative to the population from which they originated and plants that stay in export markets do better than comparable plants that exited, lending support to the thesis that exporting boosts productivity. Finally, we find that overall market access conditions, including real exchange rate trends, significantly affect the extent of productivity gains to be derived from participating in export markets. In particular, the increase in the value of the Canadian dollar during the post-2002 period almost completely offset the productivity growth advantages that new export-market participants would otherwise have enjoyed.

Key words: tariff reduction, real exchange rate, export participation, productivity growth

JEL No.: F1, F3, L1, O4

Executive summary

Ascertaining whether entry to export markets leads to productivity gains has recently engaged the attention of researchers. In Canada, entry to export markets in the 1990s has been found to be associated with higher growth (Baldwin and Gu, 2003). Studies for other countries have not produced uniform results. The cross-country differences may be the result of variations in the trading environments facing different countries.

In order to ascertain the impact of different trading environments on the dynamics of participation in export markets, this study examines how the relationship between export-market participation and plant-level productivity growth in the Canadian manufacturing sector evolved over three separate periods (the late 1980s, the early 1990s and the period post-2000) that featuring different rates of Canada/U.S bilateral tariff reductions and differing movements in bilateral real exchange rates. We find:

- The more productive a plant is, the more likely it is to make a transition to export markets, and the less likely it is to leave them.

- Entrants to export markets improve their productivity performance relative to the population from which they originated and plants that stay in export markets do better than comparable plants that exited, lending support to the thesis that exporting boosts productivity. This finding is robust to the estimation technique used.

- The productivity growth advantage that in normal circumstances is enjoyed by export-market participants is reinforced or attenuated by macroeconomic events such as exchange rate fluctuations. Export-market participants gain more in productivity growth from currency depreciation than non-participants. The superior performance of Canadian export-starters or continuing exporters was reinforced in the 1990-1996 period, when the Canadian dollar depreciated. The advantage, however, was reduced in periods (1984-1990 and 2000-2006) when the Canadian dollar appreciated. In particular, the dramatic increase in the value of the Canadian dollar during the post-2000 period almost completely offset the advantages enjoyed by export-market participants. Our counterfactual exercise shows that fluctuations in real exchange rates explain almost all the shifts in productivity growth gaps between export-market participants and non-participants in this latter period.

The paper also examines aspects of the entry and exit dynamics of exporters and finds:

- Plants self-select into export markets – that is, a select group of plants with superior chances of succeeding choose to buy the option to experiment in these markets: more efficient plants are more likely to enter and less likely to exit export markets.

- The trading environment impacts on the degree of experimentation. A tariff reduction and currency depreciation increase the probability that more efficient non-exporters will enter export markets. Currency depreciation also increases the likelihood that less efficient exporters will stop exporting.

1 Introduction

Ascertaining whether entry into export markets leads to productivity gains has engaged the attention of a large number of researchers since the first micro-study by Bernard and Jensen (1995). In Canada, entry to export markets in the 1990s was associated with higher productivity growth (Baldwin and Gu, 2004). Studies for other countries have not produced uniform results. A similar outcome has been reported for countries such as Colombia, Indonesia, Korea, Morocco, Slovenia, Taiwan, Turkey and UK. But contrary results exist for countries such as Chile, China, Germany, Mexico, the United Kingdom, and the United States[1].

These cross-country differences may be the result of variations in the trading environments facing different countries. In particular, new opportunities offered by trade liberalization as well as currency depreciation vary across countries and time periods. The positive results for Canada during the 1990s came from a period when the country experienced dramatic new export opportunities in its principal market, the United States, as a result of currency depreciation as well as implementation of the Canada-U.S. Free Trade Agreement (CUSFTA) starting in 1989 and its successor, the North American Free Trade Agreement (NAFTA) starting in 1994.

In order to investigate the impact of different trading environments on the dynamics of participation in export markets, this study examines how the relationship between export-market participation and plant-level productivity growth in the Canadian manufacturing sector evolved over three time periods—the late 1980s, the early 1990s, and the period post-2000. These periods varied sharply in terms of the incremental export opportunities available in the U.S. market. In the first period, from 1984 to 1990, average tariffs in the manufacturing sector between Canada and the United States declined by 0.3 percentage points per year because of reductions negotiated in the Tokyo Round but Canadian exporters had to contend with an appreciation of the Canadian dollar from US$0.77 in 1984 to US$0.86 in 1990, an average annual nominal appreciation of 1.4 percentage points. In the second period, from 1990 to 1996, tariffs declined by 0.6 percentage points per year due to the FTA and NAFTA and export opportunities were further improved by a depreciation of the Canadian dollar to US$0.73, an annual average depreciation of 2.1 percentage points. The trading environment post-2000 was very different. Most of the tariff reductions pursuant to the Canada-U.S. free trade treaties had already been implemented; at the same time, trade costs rose due to post-9/11 border frictions. Moreover, the Canadian dollar appreciated steeply from US$0.67 in 2000 to US$0.88 in 2006, an average annual appreciation of 3.5 percentage points, powered by the world-wide resource boom which led to a dramatic expansion of the resource-based Western Canadian economy.

The second purpose of the study is to set export-market entry/exit into a broader context of firm renewal that is accomplished through experimentation with new activities. The focus of most studies in the literature has been on the impact of entry to export markets[2]. This study focuses on how *both* entry and exit to export markets affect productivity growth. The entry and exit process to export markets is part of a larger turnover process that occurs as firms renew themselves. As part of its investigation of entry and exit dynamics, the paper also revisits the

1. See Wagner (2007) for a survey of the literature. Based on a review of 54 studies for 34 countries published between 1995 and 2006, he concluded “exporters are found to be more productive than non-exporters, and the more productive firms self-select into export markets, while exporting does not necessarily improve productivity.” For other recent surveys, see López (2005) and Greenaway and Kneller (2007).
2. Studies that have looked at the productivity performances of firms entering export markets as well as exiting include Baldwin and Gu (2003) for Canada, Clerides et al. (1998) for Colombia, Bernard and Wagner (1997) for Germany, and Girma, Greenaway and Kneller (2003) for the United Kingdom. For a complete list, please refer to Table A1 in Wagner (2007).

question of whether export-market participation leads to better productivity performance. The entry and exit process is intrinsically interesting because of what it reveals about experimentation with new markets but also because of how movements into and out of exporting lead to improvements in productivity, either due to the exploitation of simple economies of scale, or due to the learning-by-exporting effect. Export markets offer new opportunities for entrepreneurs to grow and use new technologies and thus improve their productivity. In the case of small economies like Canada, the U.S. offers scope for expansion into a larger market. Expansion offers opportunities to exploit traditional scale or scope economies that come with the ability to grow. Export markets also offer opportunities to learn about and to develop new technologies and products and to become more innovative (Baldwin and Gu, 2004). The innovation process transfers ideas for improvements from customers to suppliers (Baldwin and Hanel, 2003). Expansion of firms into export markets puts firms in touch with a broader set of producers who are likely to contain new ideas. Baldwin and Gu (2004) report that entry to export markets leads firms to adopt advanced technologies. The adoption of new advanced technologies has been associated with productivity growth in Canadian firms (Baldwin, Sabourin and Smith, 2003; Baldwin and Sabourin 2004).

To evaluate the impact of exporting on productivity performance, we use two econometric techniques to address non-random sample selection problems: a standard OLS regression that compares productivity growth between exporters and non-exporters and that also takes into account plant characteristics, and a propensity-score matching technique along with the differences-in-differences method.

We focus on two sets of questions.

First, which firms enter new export markets and which firms exit export markets? Do good plants self-select into export markets and, conversely, do the weakest exporters self-select out of export markets? Most entry studies in the industrial organization literature suffer the disadvantage that the provenance of new firms is difficult to specify. That is not the case here because data on the pre-entry/pre-exit performance are available.

Second, how well do firms perform post-entry/post-exit? Does exporting improve productivity growth and to what extent are productivity improvements associated with exporting retained if firms subsequently exit from export markets (consistent with the notion that they reflect “learning by exporting”)? Many entry studies in the industrial organization literature have focused on the extent to which entrants perform relatively well; however, much of this attention has focused on whether they grow relatively quickly compared to existing firms, not the group from which they came. The former comparison bears on the question whether there is evidence that entry should be considered as the purchase of an option[3] on ability—for then, those who find out they have the requisite ability will invest heavily after entry and grow rapidly in order to exploit this information. The existing trade literature focuses more on the notion that entry to export markets provides new opportunities—though the literature in the two areas can be merged. Entry to export markets does provide new opportunities but it probably involves the same type of options that are discussed in the traditional entry literature. The difference is that the export trade literature focuses on an additional phenomenon—whether growth not only is rapid post-entry but is fast relative to pre-entry conditions. That is, it asks whether entry itself stimulates progress because it provides a wider opportunity set.

3. As Dixit (1989) explained, drawing on the financial market literature on options pricing, given uncertainty about future tariffs and real exchange rates, the decision of firms to enter export markets is equivalent to a select group of plants with superior chances of succeeding in export markets choosing to exercise the option to experiment in these markets.

Section 2 outlines the analytical framework that is used to investigate how changing market access conditions, as characterized by changes in tariffs and real exchange rates, impact on export-market entry/exit process and on the relative productivity performances of exporters and non-exporters. Section 3 introduces the data used in the study. Section 4 provides a preliminary comparison of productivity performance across three decades of adaptation. It finds that the productivity growth advantage enjoyed by export-participants in the earlier periods disappeared in the post-2000 period. Section 5 presents multivariate results. An important finding is that exchange-rate shifts explain almost all of the difference in the relative productivity performance across periods and that, after allowance is made for changes in tariffs and real exchange rates, export-market participants enjoy faster productivity growth than non-participants. Using matching techniques, section 6 further examines two sources of the superior productivity performance of exporters: the self-selection and learning-by-exporting effects. Section 7 concludes.

2 Analytical framework

This section sets out the analytical framework that informs the subsequent analysis of the impact of trade liberalization and changes in the exchange rate on export market dynamics and productivity growth.

2.1 The impact of symmetric tariff cuts

In the heterogeneous-firm models of international trade (e.g., Bernard *et al*., 2003; Melitz, 2003; Bernard, Jensen and Schott, 2005; Das, Roberts and Tybout, 2007; Melitz and Ottaviano 2008; and Baldwin and Gu 2009), the existence of sunk costs associated with breaking into export markets (such as initial marketing, setting up distribution networks, and addressing foreign regulatory requirements) means that firms will enter export markets only if the present value of their expected profits from exporting to those markets exceeds the fixed costs of entry. Therefore, only the more productive firms within a given population of firms will tend to enter export markets.

These models all generate the equilibrium property that a symmetric reduction in bilateral tariffs forces the least efficient domestic plants to exit altogether (i.e., close down), while simultaneously inducing an expansion of exports in two ways. Those firms already exporting expand sales due to the reduction in marginal costs of servicing the export market; at the same time, some firms that previously were just below the threshold of export profitability now can profitably enter the export market. Both the domestic-market selection effect (closure of the least productive firms) and the export-market selection effect (new entry of more productive plants into export markets and the additional export sales gained by existing exporters) reallocate market shares from less productive to more productive plants, contributing to an aggregate productivity gain.

Besides productivity gains generated by inter-firm reallocations within an industry, there are also within-plant productivity gains from trade liberalization. Bernard *et al*. (2003) adapt the Ricardian model to incorporate firm-specific comparative advantage. They calibrate their model to U.S. plant-level statistics and U.S trade data and simulate the impact of globalization and dollar appreciation on productivity and plant entry and exit in the U.S. manufacturing sector. A decline in tariffs leads to an increase in aggregate productivity. This is mainly the result of productivity gains within surviving plants: as prices of imported intermediates decline, surviving plants replace domestically produced inputs with cheaper imported inputs, which brings about within-plant productivity gains. Whether exporters benefit more than non-exporters depends on their differential ability to substitute cheaper intermediates for workers.

Another possible channel of within-plant productivity gain from trade liberalization (Krugman, 1979) is the link between market size and productivity growth. Trade liberalization expands growth opportunities leading to improvements in productivity. Both Kaldor (1966, 1975, 1978) and Verdoorn (1949, 1980) stress the connection between industry growth and productivity growth, primarily because of the existence of economies of scale. Exploiting the lower unit costs of a larger plant involves learning how to organize production on a larger scale—a process that requires more than simply scaling up factor inputs. Large firms differ from small firms in their organizational structure, in the amount of capital per worker employed, in the amount of intangible investments applied to the production process. Growth comes from being able to solve the problems that prevent firms from exploiting the benefits of scale. Scott's (1989) theory of economic growth focuses on how investment facilitates learning. In turn, growth facilitates experimentation with new techniques that can then be applied to infra-marginal production. Lileeva and Trefler (2007) find that market size matters for innovation and hence productivity.

The entry process involves experimentation with opportunities in new markets that result in entry but also exit. Studies on the dynamics of change in firms emphasize that differences in ultimate success—measured in such basic terms as survival or relative size (in terms of market share) are related to the success of firms in finding ways to adapt to change. More successful firms are differentiated from the less successful in terms of their innovativeness (Baldwin and Gellatly, 2003). Innovation in these studies is measured in terms of the ability to adopt new advanced technologies, or new products or new organizational methods. But ultimately being innovative requires a broader set of capabilities—flexibility and the ability to learn about new markets and new techniques. Entrepreneurship is at the heart of this dynamic process. Entrepreneurs have to be able to solve a host of problems—not the least of which is the choice of products and markets. This study focuses on one such new market for domestic firms—export markets. The study recognizes that not all forays into new products or new markets will be successful and asks what characteristics are related to success—that is, it examines both entry and exit.

Finally, improved access to foreign markets created by trade liberalization encourages firms not only to export but also to invest in order to raise productivity (Lileeva and Trefler 2007). Firms that enter export markets gain access to technical expertise, such as new product design and new process methods derived from new competitors, buyers and customers (Baldwin and Gu, 2004). Furthermore, the intense competition in international markets forces plants to operate more efficiently. Firms new to export markets are forced to grow more rapidly or face elimination.

2.2 The impact of exchange rate fluctuations

The heterogeneous-firm models of international trade also generate predictions regarding the impact of exchange rate changes on firm dynamics and productivity. Bernard *et al.* (2003) estimate their model using U.S. data and find that U.S. dollar appreciation raises aggregate U.S. manufacturing productivity. This gain is realized through several channels. Declining relative prices of imported intermediates lead to substitution of intermediates for labour and result in productivity growth in surviving plants. Reallocation is also important: the gain from the exit of less productive domestic producers is only partially offset by the loss due to reallocation of production away from the most productive firms (who lose export markets). Bernard *et al* (2003) illustrate, how even in a very large market such as the United States, changes in global access (from declining tariff rates or favourable exchange rate shifts) can substantially reshuffle production and have an important impact on manufacturing productivity.

Compared to the United States, Canada is not only more trade-dependent, but also more resource-dependent. Canada's economy relies heavily on the export of natural resource commodities such as natural gas, oil, metals and minerals, and forest and agricultural products to the United States. Commodities such as these represent almost 40 percent of Canadian exports. This results in a close association between swings in commodity prices and fluctuations in the Canadian dollar (Chart 1). When international commodity prices rose post-2002, the Canadian dollar appreciated substantially. Both the rising commodity prices and the increased value of the dollar led to gains in the terms of trade (lower import prices and higher export prices), which further stimulated the post-2002 resource-led domestic boom (MacDonald, 2008).

The relationships among the exchange rate, commodity prices, terms of trade, gross domestic income, personal expenditure and investment variables are summarized in Table 1. During the periods 1984-1990 and 2000-2006 when the Canadian dollar appreciated, there were simultaneous increases in commodity prices, the terms of trade, gross domestic income, and domestic expenditure; in particular, personal expenditure on semi-durable goods and investment in residential and non-residential structures. The opposite was true during the 1990-1996 period, when the Canadian dollar depreciated and all these variables experienced slower growth.

Periods when the Canadian dollar appreciates on the basis of global commodity prices, therefore, would be expected to feature at least two effects: reduced export sales as the rising dollar makes Canadian exports more expensive in U.S. markets; coupled with expanded domestic markets due to a resource-led domestic boom on the other. If growth is associated with productivity (either because of increasing returns to scale or because of increasing incentives to invest and to increase efficiency), we would expect domestic-oriented plants to perform relatively better than export plants during periods when the Canadian dollar appreciates.

2.3 Hypotheses

On the basis of the foregoing discussion, we derive two testable hypotheses:

Hypothesis 1 (export-market selection effect): tariff cuts or a depreciation of the Canadian dollar (which has an effect equivalent to raising home tariffs and lowering foreign tariffs) make export markets more profitable, and hence increase the entry of more productive plants to export markets and decrease the exit rate from export markets.

Hypothesis 2 (plant-level productivity effect): The impacts of tariff cuts and exchange rate movements on relative productivity performances of export market participants vs. non-participants are unclear. It depends on the model used. If plants substitute cheaper imported imports for labour as in model developed in Bernard *et al* (2003), we expect tariff cuts and currency appreciation to generate within-plant productivity gains. Whether exporters benefit more than non-exporters depends on their differential ability in substituting cheaper intermediate inputs for workers. On the other hand, if productivity growth is positively associated with market growth, either due to increasing returns to scale or to growth-related behavioral changes such as increasing investment, we expect tariff cuts and currency depreciation to generate faster growth and more within-plant productivity gains for export market participants than for non-participants.

3 Data

3.1 Data source

The plant-level data used in this study come from Statistics Canada's Annual Survey of Manufacturers (ASM), a longitudinal database that tracks Canadian manufacturing plants over time. We use the entire sample from the ASM and include both plants with long forms and short forms[4]. Information on export status is available in 1979, 1984, 1990, 1993, 1996, 1997, 1998 and 1999 for plants that filled out the long form, and annually from 2000 onwards for all plants[5]. We therefore assume that small plants for the 1984-1990 and 1990-1996 periods (who filled in the short-form questionnaires) are non-exporters[6].

The ASM database has information on shipments, value-added, employment, age of plants, exports, and industry affiliation. Industry affiliation is at the 1980 four-digit Canadian Standard Industrial Classification (SIC) level from 1979 to 1997, and at the six-digit North American Industry Classification System (NAICS) level from 1997 onwards. The paper uses the SIC version of the ASM for the 1984-1990 and 1990-1996 periods, and the NAICS version of the ASM for the post-2000 period (2000-2006). In the post-2000 micro dataset, some records are imputed. These imputed micro records have problematic measures of relative value-added and employment. They are therefore generally excluded from this analysis[7]. Labour productivity is defined as real value-added output[8] per employee, where the total number of employees is the sum of production and non-production workers.

Bilateral tariffs between Canada and the United States are available from 1980 to 1996 for 236 four-digit manufacturing industries. The data are constructed based on import duties by commodity. Commodities are linked to their primary industries of production. Average industry tariffs are then calculated using import values as weights[9].

The industry-specific real exchange rate (e_i) is constructed as the normal exchange rate (*NER*, expressed in terms of U.S. dollars per Canadian dollar) deflated by relative U.S. (p^u_i) and Canadian industry (p^c_i) prices. That is: $e_{it}=NER_t\ (p^c_i/p^u_i)$. The nominal exchange rate is taken from Statistics Canada's CANSIM database. Canadian industry prices are drawn from a database maintained by the Economic Analysis Division at Statistics Canada. They are gross output prices from the Input/Output system and cover 236 four-digit Canadian manufacturing industries from 1973 to 1997. The U.S. gross output prices are derived from the U.S. NBER-CES productivity databases. The NBER database covers 459 U.S. manufacturing industries

4. The survey data are derived from long-form questionnaires (often given to larger plants) and short-form questionnaires (often given to smaller plants). The long-form questionnaires contain much more detailed information than the short-form questionnaires.
5. For the post-2000 period, plants used in the analysis consist of those that fill in the long form and those whose data are from tax records. The former are typically larger plants, while the latter smaller ones.
6. According to a 1974 survey that collected export data for all plants, only 0.4% of plants that filled in the short-form questionnaires reported exports (Baldwin and Gu, 2003).
7. More specifically, they are excluded except in section 4.1, where we calculate the total entry and exit rate, and the total export participation rate.
8. Real value-added is calculated using corresponding industry deflators.
9. We are grateful to Alla Lileeva for providing us with the tariff data. For details on the sources and construction of the tariff data, see the Appendix in Trefler (2004).

from 1958-1996. They are matched and aggregated to the 236 Canadian manufacturing industries[10].

3.2 Three episodes of adaptation

To examine the linkages between exporting and productivity growth, we use three panels of continuing plants that differ in terms of the trading environment that each faced: the first covers the period 1984-1990; the second, the period 1990-1996; and the third, the period 2000-2006.

The three panels cover the period prior to, during, and after the implementation of the FTA between Canada and the United States. Tariff rates fell in both of the first two periods, but reductions became larger in the second period, following the FTA. In the 2000-2006 period, tariff reductions between Canada and the United States were completed. More importantly, this period was marked by an appreciation of the Canadian dollar against the U.S. dollar that made exporting to the U.S. market less advantageous.

Tariff reductions between Canada and the United States were large in the first two periods, with an annual average rate cut of 0.3 percentage points during 1984-1990 and 0.6 percentage points during 1990-1996 (Table 2). The Canadian dollar depreciated at an average annual rate of 2.1 percentage points in nominal terms from 1990 to 1996. It appreciated at an annual average rate of 1.4 percentage points from 1984 to 1990 and 3.5 percentage points from 2000 to 2006. The standard deviations for the real exchange rates across industries are large, indicating substantial variation in export market conditions across industries. The middle period, which featured relatively steep tariff cuts and exchange rate depreciation, was thus more conducive to exporting than the other two periods, which featured smaller declines or no change in tariffs coupled with exchange rate appreciation.

3.3 Plant groupings by export transition

To examine the implications of export-market participation for productivity growth, we classify continuing plants over a period into four groups according to their transitions in export markets:

- continuing non-exporters (plants that do not export at the beginning and the end of a period).
- entrants to export markets (plants that do not export at the beginning of a period, but export at the end of the period).
- exiters from export markets (plants that export at the beginning of a period, but do not export at the end of the period).
- continuing exporters (plants that export at both the beginning and the end of a period).

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10. Other studies have used an alternative industry-specific real exchange rate, generated by calculating the weighted average of exchange rates between Canada and its trading partners, with weights being countries' trade shares for each industry (Baggs *et al.,* 2009). There are two problems with this approach. First, for Canada, trade-weighted industry-specific real exchange rates show little variability across industries since the U.S. trade weight dominates across manufacturing industries. Secondly, this approach assumes the same price adjustments to nominal exchange-rate movements across industries. However, Baldwin and Yan (2007, 2008) find a high degree of heterogeneity in industries' responses. The price-adjusted real exchange rate is a better indicator of an industry's international competitiveness. It measures the price spread between an industry's product price and the landed price charged by industries in other countries.

We compare the productivity performance of two groups; first, continuing non-exporters to entrants into export markets, and second, continuing exporters to exiters from export markets. If export-market participation implies better productivity performance, we expect higher productivity growth for entrants as opposed to continuing non-exporters, and for continuing exporters as opposed to exiters.

4 Preliminary comparison of productivity performance

4.1 Export-market dynamics

The transition of Canadian manufacturing plants into and out of export markets over the three periods is presented in Table 3. Three facts emerge. First, of non-exporters at the beginning of a period, only about 10 percent broke into export markets during the period, while the rest of the plants either remained non-exporters (around 50 percent) or ceased operation (around 40 percent). These ratios were similar across the three periods. Second, of plants that were exporters at the beginning of a period, a large number exit from export markets and/or fail and the proportion of failing plants increases over time. Of exporters in 1984, around 19 percent exited export markets and became non-exporters by 1990. This increased to 26 percent and 28 percent for the 1990-1996 and 2000-2006 periods, respectively. More strikingly, of exporters in 1984, around 18 percent ceased operations altogether during the 1984-1990 period; the failure rate rose to 28 percent and 41 percent for the 1990-1996 and 2000-2006 periods, respectively. Third, an increasing percentage of start-up firms are active in export markets from their inception (i.e., they are "born global"): 11 percent of plants enter directly into export market during the 1984-1990 period; this increases to 14 percent and 38 percent for the 1990-1996 and 2000-2006 periods, respectively.

These data indicate that there have been considerable shifts over time in the nature of the export market entry/exit process. An increasing proportion of new plants have entered directly into export markets and an increasing proportion of exporters have ceased operations completely. The entry/exit process among continuing plants has remained relatively stable. This paper only focuses on the entry/exit process of continuing plants.

4.2 Which plants participate in export market?

The average productivity performance of plants with different transitions to export markets is summarized in Table 4. The results (column 1 of Table 4) are consistent with a self-selection process: over all three periods, entrants to export markets are significantly more productive than non-exporters, and exiters from export markets are significantly less productive than continuing exporters. Only the more productive plants enter and remain in export markets.

4.3 Is exporting associated with better productivity growth?

Export participants do not always have higher productivity growth than non-participants (column 2 of Table 4). Productivity growth is higher for entrants than for continuing non-exporters for the first two periods (1984-1990 and 1990-1996), but the difference becomes statistically insignificant for the 2000-2006 period. Moreover, the magnitude of the difference varies across the first two periods.

On average, annual labour productivity growth was around 5.0 percentage points faster for entrants over the period 1990-1996, when tariffs were falling and the exchange rate was depreciating. This compares to only 2.0 percentage points faster over the period 1984-1990, when tariffs were falling but the exchange rate was appreciating. Similar patterns emerge when we compare exiters and continuing exporters.

Thus, the size of the gap in productivity growth between export participants and non-participants varies depending on the period examined. The gap is largest in the early 1990s when new opportunities in export markets were greatest due to the size of tariff cuts and the coincident depreciation in the exchange rate. The superior performance is diminished in the late 1980s when appreciation of the Canadian dollar partially offsets the decline in tariffs. But significantly, the difference in performance becomes statistically insignificant in the post-2000 period (2000-2006), when the primary external influence on competitiveness was an appreciating dollar. Chart 2 plots the average annual change in the US/Canada nominal exchange rate and the productivity growth gaps between export participants and non-participants. The performance gaps become larger as the value of the Canadian dollar drops.

5 Multivariate results

To understand the forces behind these differences, we turn to multivariate analysis and examine the impact of tariff changes and exchange rate movements on plant dynamics. Two panels of continuing plants, one over the period of 1984-1990 and the other over the period of 1990-1996, are pooled. The 2000-2006 panel data are excluded since we do not have tariff data for this period. Tariff changes between Canada and the United States during this period were close to zero during this post-FTA and post-NAFTA period.

5.1 Impact on entry/exit dynamics in the export market

The probability of entering and exiting export markets is estimated as a function of industry-wide tariff changes ($\Delta\tau_{it}$), real exchange-rate changes (Δe_{it}), industry-level real gross output growth (ΔlnQ_{it})[11], and plant-specific characteristics (ΔZ_{pt0}) at the start of a period. To examine how the efficiency level of a plant affects these relationships, we interact changes in tariffs and real exchange rates with initial labour productivity (LP_{pt0}) and plant size (L_{pt0}). The probit model also controls for 3-digit industry-specific fixed effects (α_i) and period-specific fixed effects (α_t):

$$\begin{aligned}\text{Prob}\left(\mathrm{D_{pt}}=1\right) &= \Phi(\alpha_{\mathrm{i}}+\alpha_{\mathrm{t}}+\beta_1\Delta\tau_{\mathrm{it}}+\beta_2\Delta\mathrm{e_{it}}+\beta_3\Delta\mathrm{e_{it}}*\mathrm{LPpt0} \\ &+\beta_4\Delta\mathrm{e_{it}}*\mathrm{L_{pt0}}+\beta_5\Delta lnQ_{it}+Z_{pt0}) \end{aligned} \quad (1)$$

where D_{pt} is a dummy variable which takes the value of one if a plant *p* enters export markets during the period and zero if it remains a non-exporter. Similarly D_{pt} equals one if a plant *p* exits export markets during the period and zero if it remains an exporter. The variables, $\Delta\tau_{it}$, Δe_{it}, ΔlnQ_{it}, are all 4-digit industry-wide average annual changes. Plant-level characteristics (Z_{pt0}) include relative productivity (LP_{pt0}, relative to the mean productivity of plants in the same SIC 4-digit industry), relative employment (L_{pt0}, relative to mean employment), age, and nationality of ownership (domestic vs. foreign-controlled) at the start of a period.

Two econometric issues need to be addressed. First, the inclusion of interaction terms in non-linear models, such as the probit model, makes the evaluation and interpretation of the results difficult and in the past has resulted in many incorrect estimates. Ai and Norton (2003) and Norton, Wang and Ai (2004) find that among 72 articles published between 1980 and 1999 in 13

11. To prevent possible endogeneity, we measure industry-specific real gross output as the sum of real shipments at the 4-digit SIC level minus the real shipment of the plant itself.

economics journals listed on JSTOR that used interaction terms in nonlinear models, none of the studies interpreted the coefficient on the interaction term correctly[12]. We focus on the marginal effects when presenting results. Marginal effects for interaction terms are calculated according to the following formulae:

$$\frac{\partial^2 \Phi}{\partial(x_1)\partial(x_2)} = \Phi^{'}(x\beta)\frac{\partial^2(x\beta)}{\partial x_1 \partial x_2} + \Phi^{''}(x\beta)\frac{\partial(x\beta)}{\partial x_1}\frac{\partial(x\beta)}{\partial x_2} \tag{2}$$

The overall marginal effect of a variable is:

$$\frac{\partial \Phi}{\partial(x)} = \Phi^{'}(x\beta)\frac{\partial(x\beta)}{\partial(x)} \tag{3}$$

All marginal effects are evaluated at mean values of covariates.

The probability of a non-exporter entering export markets and the probability of an exporter exiting export markets are reported in Table 5. There are four significant findings. First, plants that are more productive, larger, and older are more likely to enter export markets, and less likely to exit export markets. This is consistent with the self-selection process described in previous sections: the more productive and larger plants become successful exporters.

Second, whether a plant shifts its export-status following declines in tariffs and real exchange rates depends on the efficiency level of the plant: non-exporters that are more efficient, as measured either by size or by labour productivity, are more likely to start exporting (significant negative interaction terms); while exporters that are less efficient are more likely to stop exporting (significant positive interaction terms). Thus, the trading environment impacts on the degree of experimentation.

Third, Canadian tariff reductions, on average, increase the likelihood that non-exporters enter export markets (overall average marginal effects). A one percentage point decline in Canadian tariffs increases the probability that a non-exporter will start exporting by around 1 percentage point. This is consistent with the view that import competition as well as cheaper imported intermediate inputs due to lower tariffs improve the competitive advantage of Canadian manufacturing plants and facilitate their entry into world markets. The overall impact of tariff cuts (as measured by Canadian tariff cuts or U.S tariff cuts or average tariff cuts) on exit is statistically insignificant[13].

Fourth, a real depreciation of the Canadian dollar increases the likelihood that non-exporters will start exporting: a 1 percentage point decline in the real exchange rate increases the likelihood by around 1 percentage point (overall average marginal effects). This is similar to the marginal impact of the reduction in tariffs. Similarly, a real appreciation of the Canadian dollar increases the likelihood that exporters will stop exporting: a 1 percentage point rise in the real exchange rate increases the likelihood by around 1 percentage point.

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12. This is because the statistical software packages, such as STATA's *mfx* and *dprobit* commands, do not know that a variable is an interaction term and thus do not take the full derivative. As a result, when a variable is interacted with another (or has higher order terms) in a nonlinear model, *mfx* and *dprobit* will give the wrong marginal effect of the interaction term. Instead, the marginal effect of the interaction term requires computing the cross derivative or cross difference as defined in equation (2).
13. Baldwin and Yan (2010) find a tariff reduction increases the probability that plants will close down completely, in particular for exporters. Here we further show that tariff reduction does not impact on the decision of an exporter to become a non-exporter among continuing plants.

5.2 Impact on within-plant productivity growth

To examine if plants with varying export transitions perform differently when the trading environment changes, we model plant-level productivity growth as a function of tariff changes ($\Delta\tau_{it}$), real exchange rate changes (Δe_{it}), a dummy variable indicating export transition status (D_{pt}), and their interactions. We also control for industry-level real gross output growth (ΔlnQ_{it}), and plant-specific characteristics (Z_{pt0}).

$$\Delta\ln\left(\mathrm{LP_{pt}}\right)= \alpha_{\mathrm{i}} +\alpha_{\mathrm{t}} +\beta_1\Delta\tau_{\mathrm{it}} +\beta_2\Delta\mathrm{e_{it}} +\beta_3\mathrm{D_{pt}} +\beta_4\mathrm{D_{pt}}*\Delta\mathrm{e_{it}} +\beta_5\mathrm{D_{pt}}*\Delta\tau\mathrm{it} \\ +\beta_6\ \Delta\ln\mathrm{Q_{it}} +\gamma\mathrm{Z_{pt0}} \tag{4}$$

where $\Delta ln\ (LP_{pt})$ is the average annual log growth of labour productivity for plant *p* during period *t*. All other variables are defined as in equation (1).

Regression results are reported in Table 6. Four conclusions are noteworthy. First, plants that have a higher initial level of productivity have slower productivity growth, suggesting reversion to the mean. Plants that are larger and foreign-controlled have faster productivity growth. These findings are robust across specifications, and significant at the 5 percent level.

Second, had there been no changes in tariffs and real exchange rates, plants that enter export markets would have had an average of 4.0 percentage points faster productivity growth than that of non-exporters (significant positive coefficient on the dummy variable for entrants), and plants that exit export markets would have had on average 5.7 percentage points slower productivity growth than that of continuing exporters (significant negative coefficient on the dummy variable for exiters). The results are robust across specifications.

Third, tariff reductions (U.S. tariffs, Canadian tariffs or average tariffs) have no impact on the average productivity performance of plants, whether they are export market participants or non-participants. This is in contrast to Trefler (2004) and Lileeva (2008) who use the same plant level dataset (Canadian Annual Survey of Manufacturers) and tariff rates, but find that U.S. tariff cuts lead to plant-level productivity gains. The difference lies in the sample periods used. Their papers examine continuing plants between 1980 and 1996. This is more likely to capture long-run benefits of trade liberation, and in particular, the benefits on a small sub-group of a population who are typically large and successful and able to survive more than 15 years. This paper examines plant performance over 5-year periods. It is therefore more likely to capture short-run impacts. More importantly, it includes many small and less successful plants. Our sample size (about 20,000 plants per period) is twice as large as theirs (about 10,000 plants). Small plants may be impacted by trade liberation differently than large plants. As Lileeva and Trefler (2007) show, Canadian plants that gain from tariff cuts are those that engage in innovation. It is the large plants that tend to be more innovative: large plants are associated with greater financial, informational and technology-absorptive capabilities (Baldwin and Gu, 2004; Baldwin, Hanel and Sabourin, 2000; and Baldwin and Diverty, 1995). Tariff cuts therefore raise plant-level productivity only for some plants.

Fourth, fluctuations in real exchange rates have a significant impact on the relative productivity performances of export-market participants and non-participants. A real appreciation of the Canadian dollar decreases productivity growth for both non-exporters and entrants, but significantly more so for the latter. On average, a one percentage point appreciation in the real exchange rate decreases productivity growth of non-exporters by 0.7 percentage points, compared to 1.3 percentage points for plants that entered export markets. This suggests a narrowing of the productivity growth gap between non-exporters and entrants when the Canadian dollar appreciates against the U.S. dollar. The dramatic increase in the real value of the Canadian dollar during the 2000-2006 period (an average annual rate of 5.5 percentage points) explains why the difference in productivity growth between entrants and non-exporters becomes smaller and statistically insignificant during this period. If the exchange rate had appreciated by 6.7 percentage points annually, then the superior performance of entrants over non-exporters would have diminished to zero.

Similarly, a real appreciation of the Canadian dollar decreases productivity growth for both exiters and continuing exporters, but significantly more for the latter. On average, a one percentage point appreciation in the real exchange rate decreases productivity growth of continuing exporters by 0.8 percentage points, compared to only 0.2 percentage points for plants that exited export markets. When the Canadian dollar appreciates against the U.S. dollar, the productivity growth gap between continuing exporters and exiters is diminished. In the post-2000 period, the real exchange rate appreciated by 5.5 percentage points; this was enough to close the gap between continuing exporters and exiters by 3.0 percentage points.

To evaluate whether these impacts have economic significance, we conduct a counterfactual experiment (Table 7), which proceeds as follows. First, we assume there were no changes in tariffs and real exchange rates. Under this scenario, results from Table 6 indicate that entrants would have enjoyed an advantage of 4.1 percentage points over non-exporters in terms of average annual labour productivity growth, while exiters would have lagged behind continuing exporters by 5.7 percentage points. These productivity growth gaps reflect factors other than changes in tariffs and real exchange rates, indicating either inherent differences between export-market participants and non-participants or a possible learning-by-exporting effect. Second, we calculate predicted gaps induced by changes in tariffs and real exchange rates. The predicted gaps are estimated using the marginal impacts reported in Table 6 and actual changes in tariffs and real exchange rates from Table 2. Since marginal impacts of tariffs are not statistically different from zero, the predicted gaps due to tariff cuts are assumed to be zero. Third, we compare the predicted with the actual growth gaps, which includes both the in-sample comparison (1984-1990 and 1990-1996 periods) and out-of-sample comparison (2000-2006 period).

We find that fluctuations in real exchange rates explain almost all the shifts in the productivity growth gaps between export-market participants and non-participants over the three decades. In the case of export-market entrants and non-exporters, the real exchange rate depreciation increased the relative advantage of entrants by 1.2 percentage points during the 1990-1996 period, but the superior productivity performance of entrants was offset partially during the 1984-1990 period and almost entirely during the post-2000 period when the Canadian dollar appreciated. In the case of exiters and continuing exporters, a depreciation of the real exchange rate increased the growth gap by 1 percentage point during the 1990-1996 period, but the appreciation during the 1984-1990 and 2000-2006 periods closed the gap by 0.85 percentage points and 2.96 percentage points respectively.

6 Self-selection or learning-by-exporting effects?

While the difference in productivity growth of export-market participants and non-participants varies systematically across the periods, it is nevertheless positive after allowance is made for changes in tariffs and real exchange rates. Plants that successfully enter export markets do better.

The literature suggests that there are at least two theoretical explanations why exporting is positively correlated with productivity growth. One is the self-selection hypothesis: larger, more productive and more innovative plants self-select into export markets. These plants are more likely to be successful and have higher productivity growth in general, both before and after entry. The other is the learning-by-exporting hypothesis. Exporting may improve productivity, since expansion to foreign markets offers opportunities to expand plant size and to learn how to exploit scale economies as well as opportunities to learn about new technologies and products and to become more innovative (see Baldwin and Gu, 2004). Intense international competitive pressure also forces plants to improve efficiency. In this case, productivity performance increases because of various learning effects.

Section 5.2 shows that exporters enjoy higher productivity growth even after accounting for plant characteristics like size and productivity. But the regression analysis used for this purpose may suffer from a selection bias problem. The binary variable that accounts for the differences between the two samples is essentially calculated as the effect at the mean of the population—both exporters and non exporters. Comparing the average of the exporters to the average of the entire population may yield biased estimates of the effect of exporting if the exporter group is selected in a non-random way.

In this section, we make use of the propensity-score matching approach to choose a sample for the control group to reduce the potential effects of selection bias. This approach has recently been applied to the analysis of exporting and firm performance (Wagner 2002; Girma *et al.,* 2004; and De Loecker, 2007) to test for a causal relationship between export participation and productivity.

6.1 Methodology

We need to estimate the difference between the productivity growth of plants that changed their export status (entered or exited export markets) and the outcome for the same plants had they not changed their status. The latter outcome is, however, an unobserved counterfactual.

Propensity-score matching is a way of constructing the counterfactual. From a pool of continuing non-exporters or continuing exporters, the technique selects plants that share similar characteristics with plants that changed export status, and calculates the productivity growth difference between the two groups—those plants that changed status ("treated" plants) and those that did not (control or "untreated" plants)[14]. If the matching process is successful, a causal interpretation can be given to the average difference in productivity growth between treated and control groups.

The control group is created on the basis of observable plant characteristics such as size, labour productivity, age, ownership status, as well as other factors that potentially influence the outcome of interest in the treated group such as industry-wide changes in tariffs, real exchange rates, output and industry-specific effects. Technically this is done by matching treated plants to control plants with the same or a very similar propensity score in order to identify a set of similar plants in the control group to those who received the treatment, defined here as entry to or exit from export markets. The propensity score is the predicted probability of entering or exiting export markets. It collapses the set of characteristics that determine whether a plant entered or exited export markets to a single composite number that is used to identify plants in the control group that are similar in all respects to those treated except that they did not receive the treatment (i.e., did not change export status).

14. The "treatment" terminology derives from medical experiments assessing the effects of new drugs or medical procedures using randomly assigned treated and control groups to allow accurate identification of the effect of the drug or procedure being tested. In the present application, given the absence of a randomly assigned control group, propensity scoring is used to construct such a control group.

Propensity-score matching controls for selection bias by restricting the comparison to differences between treated and control plants with similar observable characteristics. This method, however, is still vulnerable to problems of non-random selection bias due to potential unobservable characteristics in the treated group. To address this, we further use a difference-in-differences method that controls for time-invariant unobservable characteristics.

The combination of matching and difference-in-differences approach allows us to assess whether there is a divergence in the paths of productivity growth between plants that changed export status and the matched control plants that have similar observable and unobservable, but constant, attributes.

6.2 Results

To avoid conflating the effects of export market entry and exit, we exclude plants that have changed export status in some earlier periods. Exporter starters and non-exporters are defined as follows: plants that did not export during the 1984-1990 period, but did start exporting during the 1990-1996 period are classified as export starters; non-exporters are those that did not export either during the 1984-1990 period or during the 1990-1996 period. Similarly, exporter stoppers and continuing exporters are defined as follows: plants that were exporters during the 1984-1990 period, but stopped exporting during the 1990-1996 period are classified as export stoppers; continuing exporters exported during both the 1984-1990 and the 1990-1996 periods.

Probit results that are used in the propensity-score approach to determine the probability of entry and exit from export markets during the 1990-1996 period are presented in Table 12[15]. The probability of entering and exiting export markets during the 1990-1996 period depends on plant characteristics at the beginning of the period and the changes in tariffs, exchange rates and industry real-shipment growth during the period. These equations are then used to determine a score to be used to choose a set of matching plants in the control group.

To assess how well the propensity-score matching performs, we check to see if there is a significant difference in each predictor used in the probit model between the treated and the control group. Before matching, differences are expected, but after matching, no significant differences should be found, if the covariates are balanced. If the tests for any predictor turn out to be significantly different between treated and control units, we modify the probit model by adding higher order terms of the covariate. Table 8 shows that all the differences after matching are small and statistically insignificant.

Of the population of 7,539 non-exporters, 1,410 are found to be good matches for the 1,410 export starters. Similarly, of the population of 1,853 continuing exporters, 402 are found to be good matches for the 403 export stoppers. Thus, about one in five non-exporters (or continuing exporters) is deemed to display observable characteristics that are similar to those that subsequently entered (or exited) the export market (Tables 9 and 10).

The primary results of interest are the average differences in labour productivity growth in the matched samples, net of the average initial differences before changes in export status (column 3 of Tables 9 and 10). The results reveal a causal effect of export-market participation on productivity growth. Productivity in plants entering export markets grew by 3.2 percent, while

15. We use one-to-one nearest neighbour matching without replacement and with common support (i.e., there are both treated and non-treated plants for each characteristic which we want to compare. If the common support is not satisfied in the treatment group, then these plants are dropped from the sample).

productivity in similar plants that remained in the domestic market experienced negative growth of -0.8 percent (Table 9). Plants that start exporting therefore enjoyed a productivity growth advantage over the control group of 4 percentage points. Plants that exit experienced slower productivity growth than plants that had an equivalent probability of exiting export markets but did not. Notably, productivity growth is much slower in the period when exit occurred. Plants that exit export markets experienced a loss in productivity of 6.8 percent, while similar plants that remained in export markets had productivity growth of 0.3 percent (Table 10). This results in a disadvantage of 7.1 percentage points for plants that stopped exporting compared to the control group. The differences are all statistically significant at a 5 percent level.

Conclusion

Productivity growth in a globalized economy is affected by the nature of the reaction of different producers to events that affect the world trading system, including changes in tariffs associated with trade liberalization and movements in exchange rates. This paper looks at how entry into and exit from export markets affects productivity growth, and how entry and exit are affected by changes in the trading environment as characterized by changing tariff rates and real exchange rates. It examines the experience of Canadian manufacturing firms over three separate periods, which featured different combinations of changing tariff rates and real exchange rate trends.

The paper confirms previous findings. Plants self-select into export markets—that is, more efficient plants are more likely to enter and less likely to exit export markets. But the trading environment is found to impact on the degree of experimentation. Tariff reductions and currency depreciation increase the probability that more efficient non-exporters will enter export markets. Currency depreciation also increases the likelihood that less efficient exporters will stop exporting.

The paper also finds that entrants to export markets improved their productivity performance relative to the population from which they originated. This finding is robust to the estimation technique used. The first was an OLS regression of productivity growth that takes into account plant characteristics. The second was a propensity-score matching technique and difference-in-differences method. Both find that plants that enter export markets have higher productivity growth (by about 4 percentage points in both cases) than those not doing so. Similarly, plants that exited export markets had slower growth than similar firms that stayed in the export markets (a difference of 5.7 percentage points in the multivariate analysis and 7.1 percentage points in the propensity-score matching analysis).

This difference stems from a number of sources. The self-selection effect arises from the fact that it is the better plants that participate in export markets and they may be more adept at learning after entry. The learning-by-doing effect (export-participation facilitates growth) may also engender productivity improvements. And, of course, export markets may be more competitive in that they demand successful plants make more progress in closing the gap between themselves and established firms in those markets to avoid being eliminated from those markets.

The productivity growth advantage that in normal circumstances is enjoyed by export-market participants is reinforced or attenuated by macroeconomic events such as exchange rate fluctuations. Export-market participants gain more in productivity growth from currency depreciation than non-participants. The superior performance of Canadian export-starters or continuing exporters was reinforced in the 1990-1996 period, when the Canadian dollar depreciated. The advantage, however, was reduced in periods (1984-1990 and 2000-2006) when the Canadian dollar appreciated. In particular, the dramatic increase in the value of the Canadian dollar during the post-2000 period almost completely offset the advantages enjoyed by export-market participants. Our counterfactual exercise shows that fluctuations in real exchange rates explain almost all the shifts in productivity growth gaps between export-market participants and non-participants in this latter period.

Table 1
Average annual growth in exchange rate, commodity prices and expenditures

	1984 to 1990	1990 to 1996	2000 to 2006
		percent	
Nominal exchange rate	1.7	-2.6	4.5
Commodity prices			
Including energy	0.3	0.5	8.8
Excluding energy	3.4	1.3	5.7
Terms of trade	0.3	-0.3	1.7
Real gross domestic product	3.1	1.7	2.6
Personal expenditure	3.6	1.5	3.3
Durable goods	5.1	1.4	4.9
Semi-durable goods	2.3	0.5	4.2
Non-durable goods	1.4	1.1	1.6
Services	4.7	2.0	3.5
Business gross fixed capital formation	5.5	-0.3	5.6
Residential structures	4.8	-2.6	6.8
Non-residential structures	2.6	-1.5	5.0
Machinery and equipment	8.8	2.6	5.6

Note: Average annual growth is calculated as differences in the log of the variables between the first and last years, divided by the number of years.
Source: Authors' compilation from Statistics Canada's CANSIM tables 176-0001, 176-0064 and 380-0002.

Table 2
Average annual changes in tariff rates and real exchange rates

	1984 to 1990		1990 to 1996		2000 to 2006	
	percent	standard deviation	percent	standard deviation	percent	standard deviation
Nominal US/Canada exchange rate	1.4	…	-2.1	…	3.5	…
Real US/Canada exchange rate	1.6	1.5	-1.9	1.5	5.5	3.1
Canadian tariff against U.S.	-0.4	0.3	-0.8	0.4	…	…
U.S. tariff against Canada	-0.2	0.5	-0.4	0.7	…	…
Average tariff between Canada and U.S.	-0.3	0.3	-0.6	0.5	…	…

Note: Average annual changes are calculated as differences in the variables between the first and last years, divided by the number of years.
Source: Authors' compilation from various data sources: Statistics Canada's CANSIM Table 176-0064, NBER productivity database, Statistics Canada's gross output deflator, and Trefler's (2004) tariff rates.

Table 3
Transition in export markets

Beginning year status	End year status: Non-exporters	Exporters	Exiting plants	All
	percent			
1984 to 1990				
Plants with no exports	48.0	11.3	40.7	100
Plants with exports	19.2	62.8	18.1	100
New plants	88.8	11.2	…	100
1990 to 1996				
Plants with no exports	52.1	8.9	39.0	100
Plants with exports	26.2	45.9	27.9	100
New plants	86.1	13.9	…	100
2000 to 2006				
Plants with no exports	48.0	12.1	39.9	100
Plants with exports	28.4	31.0	40.6	100
New plants	61.6	38.4	…	100

Source: Authors' compilation from the Canadian ASM data (Annual Survey of Manufacturers).

Table 4
Differentials in productivity performance

	Labour productivity level [1]	Labour productivity growth [2]
	percentage points	
Mean differences between entrants and non-exporters		
1984 to 1990	0.18 *	2.00 *
1990 to 1996	0.22 *	5.29 *
2000 to 2006	0.06 *	0.13
Mean differences between exiters and continuing exporters		
1984 to 1990	-0.05 *	-3.06 *
1990 to 1996	-0.20 *	-6.87 *
2000 to 2006	-0.17 *	-0.16

1. Log of real value-added per worker at the beginning of a period.
2. Annual log changes in real value-added per worker during a period.
Note: * significant at the 5 percent level. Mean differences are computed from regressions in the form of Y= $\alpha_i+\beta_1 D_{pt}$ where Y is the level or growth of labour productivity, and D_{pt} is a dummy variable which takes the value of one if a plant *p* enters export markets during the period and zero if it remains a non-exporter. Similarly D_{pt} equals one if a plant *p* exits export markets during the period and zero if it remains an exporter. The regression is run with industry-specific fixed effects (α_i).
Source: Authors' compilation from the Canadian ASM data (Annual Survey of Manufacturers).

Table 5
Probability of entering and exiting export markets (marginal impact)

	Entry								Exit							
	Specification (1)				Specification (2)				Specification (1)				Specification (2)			
	estimate		standard error		estimate		standard error		estimate		standard error		estimate		standard error	
Marginal effect of interaction terms																
Average tariff changes × relative labour productivity	-0.024	**	0.009		…		…		0.034	**	0.017		…		…	
Average tariff changes × relative employment	-0.022	**	0.005		…		…		0.068	**	0.033		…		…	
Canadian tariff changes × relative labour productivity	…		…		-0.013	**	0.006		…		…		0.019		0.022	
Canadian tariff changes × relative employment	…		…		-0.001		0.003		…		…		0.056	**	0.022	
US tariff changes × relative labour productivity	…		…		-0.015		0.010		…		…		0.014		0.039	
US tariff changes × relative employment	…		…		-0.038	**	0.007		…		…		-0.004		0.033	
Real exchange rate changes × relative labour productivity	0.003	*	0.002		0.003		0.002		0.004		0.004		0.004		0.004	
Real exchange rate changes × relative employment	-0.007	**	0.001		-0.007	**	0.001		0.010	**	0.005		0.010	**	0.005	
Overall marginal impact																
Average tariff changes	-0.007		0.007		…		…		-0.004		0.023		…		…	
Canadian tariff changes	…		…		-0.009	*	0.005		…		…		0.012		0.016	
U.S tariff changes	…		…		0.009		0.010		…		…		-0.029		0.026	
U.S/Canada real exchange rate changes	-0.010	**	0.002		-0.010	**	0.002		0.012	**	0.004		0.011	**	0.004	
Relative labour productivity	0.031	**	0.003		0.032	**	0.003		-0.041	**	0.008		-0.041	**	0.008	
Relative employment	0.043	**	0.002		0.043	**	0.002		-0.106	**	0.012		-0.107	**	0.012	
Age	0.002	**	0.000		0.002	**	0.000		-0.004	**	0.001		-0.004	**	0.001	
Foreign-control	0.004		0.007		0.003		0.007		-0.071	**	0.012		-0.071	**	0.012	
Industry real-gross-shipment growth	0.000		0.000		0.000		0.000		-0.001		0.001		-0.001		0.001	

Note: ** and * significant at the 5 percent and 10 percent levels, respectively. Specification (1) uses average tariff changes between Canada and the United States in the probit regression, while specification (2) uses Canadian tariff changes and U.S. tariff changes. Marginal effects for interaction terms are calculated according to equation (2), and overall marginal impacts according to equation (3). They are based on estimated probit coefficients from Table 11 and evaluated at mean values of covariates.
Source: Authors' calculations.

Table 6
Impact of tariff and real exchange rate on labour productivity growth

	Entrants versus continuing non-exporters						Exiters versus continuing exporters					
	Specification (1)			Specification (2)			Specification (1)			Specification (2)		
	estimate		standard error	estimate		standard error	estimate		standard error	estimate		standard error
Average tariff changes	0.255		0.269	…		…	0.090		0.448	…		…
Canadian tariff changes	…		…	0.278		0.181	…		…	0.163		0.324
U.S tariff changes	…		…	-0.249		0.358	…		…	-0.228		0.559
U.S/Canada real exchange rate changes	-0.694	**	0.068	-0.706	**	0.068	-0.774	**	0.122	-0.777	**	0.122
Dummy	4.149	**	0.356	4.148	**	0.357	-5.696	**	0.370	-5.686	**	0.371
Dummy × average tariff changes	0.375		0.398	…		…	-0.291		0.554	…		…
Dummy × Canadian tariff changes	…		…	0.048		0.324	…		…	0.024		0.531
Dummy × U.S tariff changes	…		…	0.485		0.520	…		…	-0.442		0.863
Dummy × real exchange rate changes	-0.694	**	0.074	-0.687	**	0.074	0.539	**	0.122	0.534	**	0.123
Relative labour productivity	-4.359	**	1.408	-4.359	**	1.408	-5.370	**	0.821	-5.369	**	0.820
Relative employment	0.381	**	0.094	0.381	**	0.094	0.450	**	0.081	0.449	**	0.081
Age	-0.060	**	0.014	-0.060	**	0.014	0.005		0.025	0.005		0.025
Foreign-control	2.812	**	0.969	2.815	**	0.970	1.200	**	0.284	1.201	**	0.284
Industry real-gross-shipment growth	0.046	**	0.009	0.046	**	0.009	0.021		0.014	0.021		0.014

Diagnostic statistics	Specification (1)	Specification (2)	Specification (1)	Specification (2)
Number of observations	34,243	34,243	10,030	10,030
R-squared	0.20	0.20	0.24	0.24

Note: ** and * significant at the 5 percent and 10 percent levels respectively. Specification (1) uses average tariff changes between Canada and the United States in the regression, while specification (2) uses Canadian tariff changes and U.S. tariff changes. "Dummy" is a dummy variable which takes the value of one if a plant enters export markets during the period and zero if it remains a non-exporter. Similarly "Dummy" equals one if a plant exits export markets during the period and zero if it remains an exporter.
Source: Authors' calculations.

Table 7
Contribution to productivity growth gaps, a counterfactual exercise

	1984 to 1990	1990 to 1996	2000 to 2006
		percentage points	
Entrants versus continuing non-exporters			
Actual average gaps	2.00	5.30	0.10
Predicted gaps	3.00	5.40	0.30
Gaps if no changes in tariffs and real exchange rates	4.10	4.10	4.10
Gaps due to tariff changes	0.00	0.00	0.00
Gaps due to real exchange rate changes	-1.10	1.30	-3.80
Exiters versus continuing exporters			
Actual average gaps	-3.10	-6.90	-0.20
Predicted gaps	-4.90	-6.70	-2.70
Gaps if no changes in tariffs and real exchange rates	-5.70	-5.70	-5.70
Gaps due to tariff changes	0.00	0.00	0.00
Gaps due to real exchange rate changes	0.80	-1.00	3.00

Note: Actual average gaps are from Table 4. Gaps when there had been no changes in tariffs and real exchange rates are from Table 6. Gaps due to tariff changes and real exchange rate changes are calculated using marginal impacts from Table 6 and actual changes of the variables from Table 2. Gaps due to tariff changes are set to zero, since marginal impacts of tariffs are not statistically different from zero.
Source: Authors' calculations.

Table 8
Balancing test, comparisons of means for unmatched and matched samples

	Export starters versus non-exporters			Export stoppers versus continuing exporters		
	Export starters	Non-exporters	T-test of differences	Export stoppers	Continuing exporters	T-test of differences
	mean	mean	p-value	mean	mean	p-value
Unmatched samples						
Sample size	1,410	7,539	…	403	1,853	…
Relative labour productivity	1.33	1.03	0.00	0.99	1.03	0.33
Relative employment	2.57	0.93	0.00	0.76	1.53	0.00
Relative employment (squared)	15.68	5.56	0.15	1.61	4.77	0.00
Age	14.05	12.90	0.00	15.43	15.39	0.81
Foreign-controlled	0.13	0.05	0.00	0.26	0.37	0.00
Canadian tariff changes	-0.81	-0.74	0.00	-0.57	-0.53	0.24
U.S tariff changes	-0.34	-0.29	0.00	-0.29	-0.26	0.04
Real exchange rate changes	-1.97	-1.92	0.16	-1.43	-1.45	0.79
Real industry shipment changes	0.88	0.63	0.19	3.02	2.79	0.58
Matched samples						
Sample size	1,410	1,410	…	402	402	…
Relative labour productivity	1.33	1.29	0.29	0.99	0.99	0.92
Relative employment	2.57	2.33	0.10	0.76	0.88	0.15
Relative employment (squared)	15.68	26.90	0.49	1.62	2.42	0.43
Age	14.05	14.22	0.23	15.42	15.38	0.84
Foreign-controlled	0.13	0.12	0.43	0.26	0.26	0.81
Canadian tariff changes	-0.81	-0.81	0.93	-0.56	-0.58	0.66
U.S tariff changes	-0.34	-0.35	0.51	-0.29	-0.30	0.51
Real exchange rate changes	-1.97	-2.00	0.41	-1.43	-1.40	0.84
Real industry shipment changes	0.88	0.84	0.90	3.02	2.82	0.74

Source: Authors’ calculations.

Table 9
Comparison of export starters and non-exporters

Means	Labour productivity growth: Pre-entry (1984 to 1990)	Post-entry (1990 to 1996)	Difference
	percentage points		
Unmatched sample			
Plants that changed export status (export starters, 1,410 observations)	-0.9	2.3	3.2
Plants that did not change export status (non-exporters, 7,539 observations)	-1.4	-2.4	-1.0
Difference between exporters and non-exporters	0.5	4.7 *	4.2 *
Matched sample			
Plants that changed export status (export starters, 1,410 observations)	-0.9	2.3	3.2
Plants that did not change export status (non-exporters, 1,410 observations)	-0.8	-1.6	-0.8
Difference between exporter starters and non-exporters	-0.1	3.9 *	4.0 *

Note: * significant at the 5 percent level.
Source: Authors' calculations.

Table 10
Comparison of export starters and non-exporters

Means	Labour productivity growth: Pre-entry (1984 to 1990)	Post-entry (1990 to 1996)	Difference
	percentage points		
Unmatched sample			
Plants that changed export status (export stoppers, 403 observations)	1.1	-5.7	-6.8
Plants that did not change export status (continuing exporters, 1,853 observations)	1.2	2.1	0.9
Difference between export stoppers and continuing exporters	-0.1	-7.8 *	-7.7 *
Matched sample			
Plants that changed export status (export stoppers, 403 observations)	1.1	-5.7	-6.8
Plants that did not change export status (continuing exporters, 402 observations)	1.0	1.3	0.3
Difference between export stoppers and continuing exporters	0.1	-7.0 *	-7.1 *

Note: * significant at the 5 percent level.
Source: Authors' calculations.

Table 11
Probit coefficient estimates of entering and exiting export markets

	Entry				Exit			
	Specification (1)		Specification (2)		Specification (1)		Specification (2)	
	estimate	standard error	estimate	standard error	estimate	standard error	estimate	standard error
Average tariff changes	0.154 **	0.056	…	…	-0.317 **	0.113	…	…
Canadian tariff changes	…	…	0.005	0.036	…	…	-0.183 *	0.097
U.S tariff changes	…	…	0.275 **	0.067	…	…	-0.130	0.165
U.S/Canada real exchange rate changes	-0.043 **	0.011	-0.040 **	0.011	-0.005	0.020	-0.005	0.020
Average tariff changes x relative labour productivity	-0.095 **	0.04	…	…	0.102 **	0.051	…	…
Average tariff changes x relative employment	-0.087 **	0.022	…	…	0.205 **	0.095	…	…
Average Canadian tariff changes x relative labour productivity	…	…	-0.049 *	0.028	…	…	0.055 *	0.066
Average Canadian tariff changes x relative employment	…	…	0.005	0.014	…	…	0.163 *	0.065
Average US tariff changes x relative labour productivity	…	…	-0.068 *	0.040	…	…	0.046	0.117
Average US tariff changes x relative employment	…	…	-0.168 **	0.030	…	…	-0.003	0.095
Average real-exchange-rate changes x relative labour productivity	0.019 **	0.007	0.018 **	0.007	0.012	0.012	0.012	0.012
Average real-exchange-rate changes x relative employment	-0.019 **	0.005	-0.020 **	0.005	0.028 **	0.015	0.027 *	0.015
Relative labour productivity	0.094 **	0.026	0.090 **	0.025	-0.077 **	0.026	-0.077 *	0.026
Relative employment	0.143 **	0.015	0.142 **	0.014	-0.223 **	0.061	-0.220 *	0.060
Age	0.009 **	0.002	0.009 **	0.002	-0.013 **	0.003	-0.013 *	0.003
Foreign-control	0.017	0.031	0.014	0.031	-0.219 **	0.038	-0.219 *	0.038
Industry real-gross-shipment growth	0.000	0.001	0.000	0.001	-0.003	0.002	-0.003	0.002

Diagnostic statistics	Specification (1)	Specification (2)	Specification (1)	Specification (2)
Number of observations	36,683	36,683	10,137	10,137
Log pseudo-likelihood	-14,974	-14,978	-5,428	-5,427

Note: Specification (1) uses average tariff changes between Canada and the U.S in the probit regression, while specification (2) uses Canadian tariff changes and U.S tariff changes.
** and * significant at the 5 percent and 10 percent levels, respectively; standard errors are corrected for clustering at the plant level.
Source: Authors' calculation.

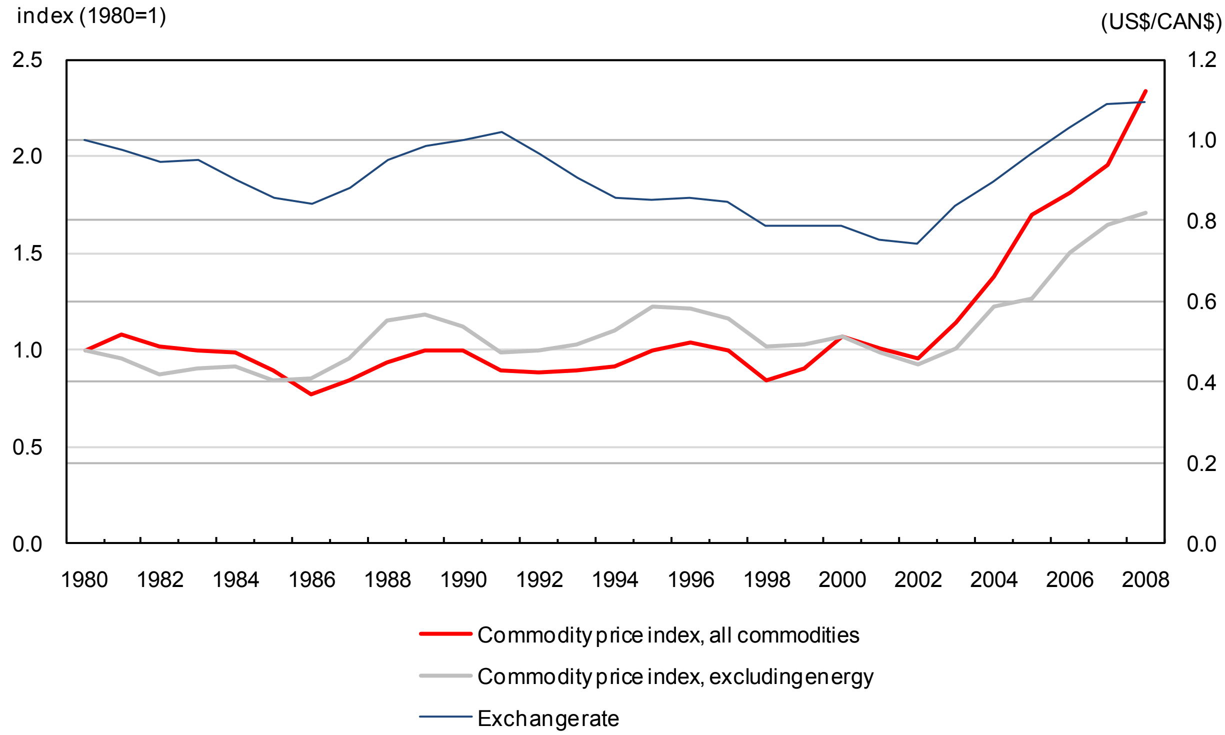
Table 12
Propensity-score matching, probit results

Dependent variable	Entry equals 1			Exit equals 1		
	coefficient		standard error	coefficient		standard error
Relative labour productivity	0.150	**	0.019	-0.140	**	0.060
Relative employment	0.390	**	0.015	-0.700	**	0.059
Relative employment (squared)	-0.010	**	0.001	0.040	**	0.005
Age	0.010	**	0.005	0.030	**	0.011
Foreign-controlled	0.030		0.071	-0.180	**	0.083
Canadian tariff changes	0.130		0.083	-0.340	*	0.209
U.S tariff changes	-0.180		0.142	0.220		0.321
Real exchange rate changes	-0.010		0.033	0.010		0.031
Real industry shipment changes	0.000		0.003	0.010		0.005

Diagnostic statistics	Entry equals 1	Exit equals 1
Number of observations	8,949	2,256
Log likelihood	-3,200.7	-872.5
Pseudo R-squared	0.180	0.180

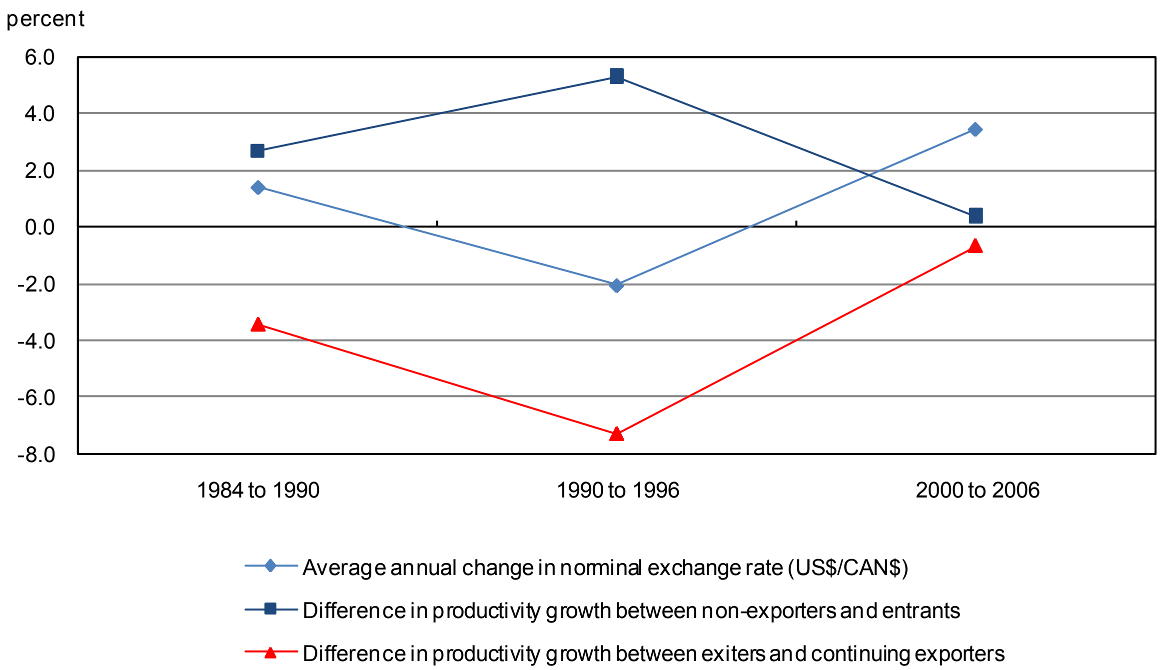
Note: ** and * significant at the 5 percent and 10 percent levels, respectively.
Source: Authors' calculations.

Chart 1
Exchange rate and commodity prices



Source: Statistics Canada's CANSIM Tables 176-0001 and 176-0064.

Chart 2
Differential productivity growth and exchange rate



Source: Authors' calculations.

References

Ai, C. and E.C. Norton, 2003, "Interaction terms in logit and probit models," *Economics Letters* 80, 123-129.

Baldwin, John R. 1995. *The Dynamics of Industrial Competition*. Cambridge: Cambridge University Press.

Baggs, Jan, Eugene Beaulieu, and Loretta Fung. 2009. "Firm survival, performance, and the exchange rate," *Canadian Journal of Economics* 42(2), 393-421.

Baldwin, John R. and Brent Diverty. 1995. "Advanced Technology Use in Canadian Manufacturing Establishments," Analytical Studies Branch Research Paper Series. Statistics Canada Catalogue no. 11F0019MPE No.85.

Baldwin, John R. and Guy Gellatly. 2003. *Innovation Strategies and Performance in Small Firms,* Cheltenham, UK and Northhampton, Mass.: Edward Elgar Publishing Ltd.

Baldwin, John R and Wulong Gu. 2003. "Export Market Participation and Productivity Performance in Canadian Manufacturing," *Canadian Journal of Economics* 36(3): 634-657.

Baldwin, John R and Wulong Gu. 2004. "Trade Liberalization: Export-market Participation, Productivity Growth, and Innovation," *Oxford Review of Economic Policy* 20(3), Autumn: 372-392.

Baldwin, John R. and Wulong Gu. 2004. "Innovation**,** Survival and Performance of Canadian Manufacturing Plants," *Economic Analysis Research Paper Series*. Statistics Canada Catalogue number 11F0027MIE no. 022**.**

Baldwin, John R. and Wulong Gu. 2009. "The impact of trade on plant scale, production-run length and diversification," in Timothy Dunne, J. Bradford Jensen and Mark J. Roberts (eds.) *Producer Dynamics: New Evidence from Micro Data*. Chicago: University of Chicago Press.

Baldwin, John R. and Petr Hanel. 2003. *Innovation and Knowledge Creation in an Open Economy*. Cambridge: Cambridge University Press.

Baldwin, John R., Petr Hanel and David Sabourin. 2000. "Determinants of innovative activity in Canadian manufacturing firms: the role of intellectual property rights," *Analytical Studies Branch – Research Paper Series*. Statistics Canada Catalogue no. 11F0019MPE no. 122.

Baldwin, John R. and David Sabourin. 2004. "The Effect of Changing Technology Use on Plant Performance in the Canadian Manufacturing Sector*," Economic Analysis Research Paper Series.* Statistics Canada Catalogue no. 11F0027MIE no. 20.

Baldwin, John R., David Sabourin and David Smith, 2003, "Impact of Advanced Technology Use on Firm Performance in the Canadian Food Processing Sector," *Economic Analysis Research Paper Series.* Statistics Canada Catalogue no. 11F0027MIE—012.

Baldwin, John R. and Beiling Yan, 2008, "Domestic and Foreign Influences on Canadian Prices," *International Review of Economics and Finance*, 17: 546-557.

Baldwin, John R. and Beiling Yan, 2007, "Exchange Rate Cycles and Canada/US Manufacturing Prices," *Review of World Economics (Weltwirtschaftliches Archiv)*, 143(3).

Baldwin, John R. and Beiling Yan. 2010. "The death of manufacturing plants: heterogeneous responses to changes in tariffs and real-exchange-rates," *Economic Analysis Research Paper Series*. Statistics Canada (forthcoming).

Bernard, Andrew B., and J. Bradford Jensen. 1995. "Exporters, jobs, and wages in U.S. manufacturing: 1976-1987," *Brookings Papers on Economic Activity: Microeconomics*: 67-119.

Bernard, Andrew B., Jonathan. Eaton, J. Bradford Jensen and Samuel Kortum. 2003. "Plants and productivity in international trade," *American Economic Review* 93(4): 1268-1290.

Bernard, Andrew B., J. Bradford Jensen and Peter K. Schott. 2006. "Trade Costs, Firms and Productivity," *Journal of Monetary Economics* 53(5), July: 917-937.

Bernard, Andrew B. and Joachim Wagner. 1997. "Exports and success in German manufacturing," *Weltwirtschaftliches Archiv / Review of World Economics* 133(1) March: 134-157.

Clerides, Sofronis K., Saul Lach, and James R. Tybout. 1998. "Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico and Morocco," *Quarterly Journal of Economics* 113(3): 903-947.

Costantini, James A. and Marc J. Melitz. 2007. "The Dynamics of Firm-Level Adjustment to Trade Liberalization," mimeo, CEPR.

Das, Sanghamitra, Mark J. Roberts, and James R. Tybout. 2007. "Market Entry Costs, Producer Heterogeneity, and Export Dynamics," *Econometrica* 75(3), May: 837–873.

De Loecker, Jan K. 2007. "Do exports generate higher productivity? Evidence from Slovenia," *Journal of International Economics* 73(1), September: 69-98.

Dixit, Avinash. 1989. "Exit and Entry Decisions Under Uncertainty," *Journal of Political Economy* 97(3): 620-638.

Girma, Sourafel, David Greenaway and Richard Kneller. 2003, "Export market exit and performance dynamics: a causality analysis of matched firms," *Economics Letters* 80(2), August: 181-187.

Girma, Sourafel, David Greenaway and Richard Kneller. 2004 "Does exporting increase productivity? A microeconometric analysis of matched firms," *Review of International Economics* 12(5), November: 855-866.

Greenaway, David, Joakim Gullstrand and Richard Kneller. 2007. "Firm heterogeneity, exporting and foreign direct investment," *Economic Journal* 117: 134-161.

Kaldor, Nicholas. 1966. *Causes of the Slow Rate of Economic Growth of the United Kingdom*," London: Cambridge University Press. Reprinted in Nicholas Kaldor. 1978. *Further Essays in Economic Theory*. London: Duckworth.

Kaldor, Nicholas. 1975, "Economic Growth and the Verdoorn Law—A Comment on Mr Rowthorn's Article," *Economic Journal* 85(340), December: 891-896.

Kaldor, Nicholas. 1978, *Further Essays on Economic Theory*. London: Duckworth.

Krugman, Paul R., 1979, "Increasing returns, monopolistic competition, and international trade," Journal of International Economics 9, 469-79.

Lileeva, Alla and Daniel Trefler. 2007. "Improved Access to Foreign Markets Raises Plant-Level Productivity ... for Some Plants," *NBER Working Paper no. 13297*.

Lileeva, Alla. 2008. "Trade liberalization and productivity dynamics: evidence from Canada," *Canadian Journal of Economics* 41(2), May: 360-390.

López, Ricardo A. 2005. "Trade and growth: reconciling the macroeconomic and microeconomic evidence," *Journal of Economic Surveys* 19(4), September: 623-648.

Macdonald, Ryan. 2008. "The terms of trade and domestic spending," *Canadian Economic Observer*. Statistics Canada Catalogue no. 11-010-XIB.

Melitz, Marc J. 2003. "The impact of trade on intra-industry reallocations and aggregate industry productivity," *Econometrica* 71(6), November: 1695-1725.

Melitz, Marc J. and Giancarlo I. P. Ottaviano. 2008. "Market size, trade and productivity," *Review of Economic Studies* 75(1): 295-316.

Norton, Edward C., Hua Wang and Chunrong Ai. 2004. "Computing interaction effects and standard errors in logit and probit models," *The Stata Journal* 4(2): 154-167.

Rosenbaum, Paul R. and Donald B. Rubin. 1983. "The central role of the propensity score in observational studies for causal effects," *Biometrika* 70(1): 41-55.

Scott, Maurice F. 1989. *A New View of Economic Growth*. Oxford and New York: Oxford University Press.

Trefler, Daniel. 2004. "The long and short of the Canada-U.S. Free Trade Agreement," *American Economic Review* 94(4): 870-895.

Verdoorn, P. J. 1949. "Fattori che regolano lo sviluppo della produttività del lavoro," L'Industria: 45-53. Translated as "On the Growth of Labour Productivity," in L.L. Pasinetti (ed.). 1993. *Italian Economic Papers*, vol. 2, Oxford: Oxford University Press: 59-68.

Verdoorn, P. J. 1980, "Verdoorn's Law in Retrospect: a comment," *Economic Journal* 90(358): 382-385.

Wagner, Joachim. 2002. "The causal effect of exports on firm size and labour productivity: first evidence from a matching approach," *Economics Letters* 77(2): 287-292.

Wagner, Joachim. 2007. "Exports and productivity: a survey of the evidence from firm-level data," *The World Economy* 60(1): 60-82.