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Short-Term and Long-Term Margins of International Trade: Evidence from the Canada-Chile Free Trade

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Short-Term and Long-Term Margins of International Trade: Evidence from the Canada-Chile Free Trade Agreement *

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Abstract

We investigate the impact of the Canada-Chile Free Trade Agreement (CCFTA) on Canadian exports to Chile, particularly the dynamic effects of the agreement on extensive and intensive margins of trade. Consistent with the literature, we find that the extensive margin effects occurred later than the intensive margin effects and became more prominent in the long-term. Surprisingly, the intensive margin effects died off in the long-term. A theoretical model is constructed to show that our results can arise in a standard setting of intra-industry trade.

Key Words: Preferential Trade Agreements; Margins of International Trade, Canada-Chile Trade, Nonparametric Decompositions, Regression Discontinuity.
JEL Classification: F12, F13.

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1 Introduction

The Canada-Chile Free Trade Agreement (CCFTA), signed in December 1996 and implemented in July 1997, is a comprehensive agreement that covers trade in goods and services, as well as the bilateral investment relationship. Since its implementation, the value of Canadian merchandise exports to Chile more than doubled to reach $819 million in 2011 from $392 million in 1997, growing at an annual rate of 5.4 percent. In comparison, Canadian merchandise exports to the whole Latin American region over the same period increased only by 1.7 percent. This propelled Chile from being the seventh-most important market in Latin America for Canadian exports in 1997 to the third-most important in 2011 (Foreign Affairs and International Trade Canada 2013).

The objective of this paper is to investigate the impact of the CCFTA on Canadian exports to Chile, particularly the short-term and long-term effects of the agreement on extensive and intensive margins of trade. We first use the Regression Discontinuity approach to estimate the treatment effects of the CCFTA on Canadian exports to Chile. We then decompose the growth in Canadian exports after the CCFTA into extensive margin and intensive margin over the period from 1997 to 2008. The use of firm-level data enables us to measure the margins of trade in terms of products and firms, respectively.

Our analysis indicates that the CCFTA boosted Canadian exports to Chile by approximately $54 million dollars per year. In the short-term, the effects of the CCFTA were driven mainly by the intensive margin. But the extensive margin effect became more prominent in the long-term, and it was particularly pronounced for firms and products that entered the Chilean market after 2002. Surprisingly, the intensive margin effect died off in the long-term. To our knowledge, this is the first empirical evidence that the intensive margin effect of trade liberalization could vanish in the long-term.

The last finding is particularly striking given the common belief among economists that trade liberalization would expand both the extensive margin and intensive margin of trade. To explain our finding, we construct a theoretical model of intra-industry trade, in which we show that the fall in prices resulted from entry of new firms and products can indeed drive the intensive margin effect to zero in the long-term. This suggests that our empirical finding can arise in a standard framework of intra-industry trade and hence is not necessarily an anomaly.

Our theoretical analysis identifies two opposing forces that drive the intensive margin of trade. On the one hand, trade liberalization enables existing exporters to expand their exports in the short-term (during which the number of competitors is fixed). On the other hand, the reduction in trade costs induces entry of additional competitors into the export market, which lowers the marginal revenues of the existing exporters and causes them to decrease their exports. Consequently, the overall impact of trade liberalization on the intensive margin is ambiguous in the long-term. In our model, the expansion of the intensive margin in the short-term is

exactly offset by the impact of entry of additional exporters, leaving the intensive margin of trade unchanged in the long-term.

In the literature, formal analysis of preferential trade agreements (PTAs) dates back to Viner (1950) and Meade (1955). Examination of PTAs in terms of their effects on extensive and intensive margins is, however, much more recent. They include Hillberry and McDaniel (2002), Kehoe and Ruhl (2013), and Baier et al. (2014).[1] Hillberry and McDaniel (2002) provide a decomposition of trade growth into the intensive margin and extensive margin since the implementation of the North American Free Trade Agreement (NAFTA). Their analysis reveals both a widening effect (extensive margin) and a deepening effect (intensive margin) of international trade on U.S. industries. Kehoe and Ruhl (2013) study the margins of trade associated with a number of large-scale trade liberalizations, including the NAFTA and the Canada-U.S. Free Trade Agreement, and find significant evidence of growth in both the extensive margin and the intensive margin. Baier et al. (2014) examine, among other things, the timing of the extensive and intensive margin responses to various types of economic integration agreements (EIAs) that include one-way and two-way PTAs, FTAs, and deeper EIAs (i.e., customs unions, common markets, and economic unions). They show that the shorter-term effects of EIAs on trade flows are more at the intensive margin and longer-term effects are more at the extensive margin.

It should be pointed out that in all three studies, the intensive margin of trade growth is found to be substantially larger than the extensive margin. Kehoe and Ruhl (2013), for example, demonstrate that the extensive margin accounted for 11.7 percent and the intensive margin accounted for the other 88.3 percent of the growth in total exports from Canada to the U.S. over the period from 1989 to 1999. In Baier et al. (2014), while the magnitude of the intensive margin tends to become smaller in the longer-term, it remains much larger than that of extensive margin. Indeed, their estimates imply that the long-term extensive margin effect of a free trade agreement is 15.6 percent while the corresponding intensive margin effect is 8.8 percent.[2]

Our analysis of the CCFTA, in contrast, reveals that the intensive margin effect actually vanishes in the long-term, and this observation holds for trade margins measured by products and by firms. Indeed, the most significant contributions of this paper are the empirical finding of the vanishing long-term intensive margin and the development of a theory that accounts for this finding.

This paper is organized as follows. Section 2 discusses the data. Section 3 estimates the

[1] In addition, there is a larger and broader literature that considers the extensive and intensive margins of international trade in general, not specifically tied to any trade agreements. See, for example, Hummels and Klenow (2005), Felbermayr and Kohler (2006), Eaton et al. (2008), Helpman et al. (2008), Bernard et al (2009), Besedes and Prusa (2011).

[2] These numbers are calculated using the estimated coefficients of $Lag\Delta FTA$ in Table 1 of Baier et al. (2014).

overall effects of the CCFTA on Canadian exports to Chile, while section 4 examines the extensive and intensive margins in the short-term and long-term. Section 5 presents a theoretical model that rationalizes our empirical findings. Section 6 concludes.

2 Data

The data used in this study is from Canada's Export Registry (1993-2005) and covers the universe of Canadian exporting firms that have at least one shipment to a foreign market from 1993 to 2005. The Export Registry is linked with the Longitudinal Employment Analysis Program (LEAP) data and the Corporate Tax Statistical Universal File (T2SUF). The LEAP database is an administrative database created by the Business and Labour Market Analysis (BLMA) division at Statistics Canada that provides longitudinal data on the employment levels of Canadian businesses (Baldwin, et al. 1992). It covers the period from 1984 to 2008, and makes use of administrative tax records from the Business Register and from the Survey of Employment, Payrolls and Hours (SEPH) to generate employment profile of businesses over time. The T2SUF file includes all incorporated firms that file a T2 tax return with the Canada Revenue Agency (CRA). The T2 file provides data on sales, gross profits, equity and assets for all incorporated firms in Canada. The linked data provided to us, however, contain only the information of sales. Finally, the length of the linked data is asymmetric with respect to the time of the CCFTA agreement, as more years of data are available post agreement than prior to the agreement.

The final data set contains the following information:

- Firm characteristics on a yearly basis. They include size (number of employees) and labour productivity (sales per worker), which have been found to be important drivers of firms export decisions (Bernard and Jensen 1999 and 2004). The age of a firm, which is an important variable for this study, can be determined from the LEAP data. Another firm-specific variable important for the study is the country of ownership.

- Product characteristics on yearly basis. The information is obtained from a product code classified at 8-digit Harmonized Schedule (HS8). As the data do not provide product-specific characteristics, these characteristics need to be identified in order to distinguish between core products and marginal products.

- Industry characteristics. The database provides information with regard to the industry to which an exporter is classified at 6-digit North American Industry Classification Code (NAICS6).

For firms that entered the market before 1993, the data cannot identify the first year of a firm's entry into and exit out of a foreign market (here Chile), number of years it exported or

its value of exports, number of exporting destinations if different than Chile, and number of products exported in each year. This information can be only identified for firms that entered the market after 1993.

The linked data provided by Statistics Canada covers a high proportion of the firms. However, the linking is not done uniformly for all available years. The most recent years are better linked than the earlier years. We checked to see if the unlinked data may bias the trade effects. We did so by plotting the data for the number of firms and products for the linked and unlinked data over the period of interest (see Figure 1). The graph shows that the unlinked firms and products move in a proportional way with the linked firms and products. Therefore, the data available for this study should enable us to pin down the trade effects if present.[3]

[insert Figure 1 here]

The dynamics of the number of industries, firms and their products are presented in Tables 1 and 2. As can be seen from Table 1, after 1997 there was a rapid growth in entry by Canadian firms into the Chilean market and an increase in the number of new products sold in the Chilean market associated with these entrants. Furthermore, the decomposition of the export values by old and new products in Table 2 show an increased contribution of the new products in the total value of exports to Chile after the CCFTA.

[insert Table 1 and Table 2 here]

3 Overall Effects of the CCFTA

Prior to the CCFTA, Canadian exports to Chile were subject to an 11-percent tariff. When the CCFTA came into effect in July 1997, 75 per cent of Canadian exports gained duty-free access to the Chilean market immediately. For most of the remaining industrial and resource-based goods, the 11-percent tariffs were eliminated over five years (Foreign Affairs and International Trade Canada 1997). As some of the tariff changes were not sharp but decreased in a continuous way until it became zero, the method to be used to evaluate the CCFTA needs to be able to capture these dynamics.

Consequently, to estimate the impact of these tariff changes on exports by Canadian firms, we use a regression discontinuity (RD) approach based on Lee and Lemieux (2010). The main idea behind the RD design is that firms that were just below the cutoff (who did not receive the treatment and entered Chile's market before trade agreement) were good comparisons to firms just above the cutoff (who did receive the treatment and enter Chile's market after the trade agreement).

[3] If, on the other hand, no parallel trends were observed, the results obtained with the linked data would be biased.

To help determine the design of our RD analysis, we plot in Figure 2 the number of products exported to Chile and in Figure 3 the value of exports to Chile by windows of years. In Figure 2, we see that the increase in the number of products started one year before the implementation of the CCFTA and continued thereafter, indicating a relatively fuzzy discontinuity for the number of products around the time of the CCFTA implementation. Figure 3, on the other hand, shows a sharp rise in export values in the year of the implementation and the change in export values continued to be visible thereafter. A similar pattern is obtained if we plot the total number of firms exporting to Chile and their total sales. An interesting finding is that indirect effects of subsequent trade agreements between Chile and the European Union (signed in 2002) and between Chile and the United States (signed in 2003) are observed. However, these effects are not sharp in nature.

[insert Figure 2 and Figure 3 here]

Taking the above observations into consideration, we use different window lengths around the cutoff point to see how robust is the estimation of the potential jump in the treated outcome around the trade agreement date. The same methodology is adopted to assess the indirect effect on the Canadian exporters of other agreements Chile signed with the EU and USA. Both the sharp and the fuzzy discontinuity designs are used in the analysis.

3.1 Methodology

The identification of the trade effects in the neighborhood of the free trade agreement can be explained with the following reduced form specification

$$y_i = \beta_0 + \beta_1 Treatment_i + \delta(Tariff_i) + \epsilon_i, \tag{1}$$

where y_i denotes the value of export to Chile by Canadian firm i during the window period (specified below), $Treatment_i = 0$ if $Tariff_i >= 11$, which is the Chilean tariff on imports from Canada before the CCFTA and $Treatment = 1$ if $Tariff_i < 11$, which is the Chilean tax after the implementation of the trade agreement. The underlying assumption for the identification of the treatment effect is that the $\delta(Tariff_i)$ is continuous around the cutoff. The estimation is performed at 1-year, 2-year and 3-year windows around the cutoff point.

According to Hahn et al. (2000) the treatment effect is identified as

$$\beta(z_0) = \frac{\lim_{z \to z_0^+} E(y_i | z_i = z) - \lim_{z \to z_0^-} E(y_i | z_i = z)}{\lim_{z \to z_0^+} prob(z) - \lim_{z \to z_0^-} prob(z)}, \tag{2}$$

where z is tariff value and z_0 is the cut-off tariff value at the time of CCFTA. The estimation of the above treatment parameter is done using local polynomial regression to the left and to the

right of the discontinuity point as follows:

$$\min_{\beta(.)} E(y_i - \alpha - \beta(z_i))^2 K(\frac{z_i - z_0}{h}), \tag{3}$$

where $K\left(\frac{z_i - z_0}{h}\right)$ is a Kernel function that gives more weight to the observations close to the discontinuity point and less weight to those further away from the discontinuity point.

It is important to note that RD evaluation provides an answer to a specific question: what is the treatment effect of the CCFTA for the Canadian exporters when we evaluate their exports and total sales values (the Average Treatment Effect on the Treated, or ATT)? The advantage of this method over other methods for the evaluation of the ATT (propensity score matching, for example) is that it provides a clean evaluation with minimal assumptions and bypasses many of the questions related to different parametric model specifications, questions that may be related to which variables to include in the model and their functional forms. One limitation associated with this method is that other aspects of the impact distribution may be of interest in an evaluation of the treatment effects of any given policy. However, we consider this method fit for this analysis for its superior advantages and due to the specificity of our question of interest.

3.2 Results from the Regression Discontinuity Analysis

The RD analysis requires a sharp design evaluation at the CCFTA and a fuzzy design evaluation at the subsequent free trade agreements between Chile and EU/USA. The results of this analysis will provide a measure of the Average Treatment Effects on the Treated (ATT). In this case we will evaluate the ATT effects for the Canadian exporters to Chile of their export values.

[insert Table 3 here]

The results from the RD analysis are presented in Table 3. The most important takeaway from Table 3 is that the CCFTA significantly increased the exports to Chile by Canadian firms. Its long-term impact is estimated to be 54 million dollars per year. In addition, the subsequent trade agreements signed by Chile with the EU and USA had a direct negative impact on Canadian exports (11 million dollars) in the first year, but they did not have a statistically significant effect on the exports in the longer term. In other words, Chile's trade agreements with the EU and USA had no lasting impact on the values of Canadian exports to Chile.

Robustness checks were also performed using conditional RD analysis where the control variables were firm size and firm productivity. The conditional RD analysis do not change the results for the ATT, which means that the unconditional results are not endogenously driven.

The fact that we did not observe significant effects of the subsequent trade agreements suggests that the ATT obtained for the CCFTA was not altered by those agreements. Moreover,

the fact that the ATT was stable over different window lengths and no other discontinuity was identified for the period of investigation and that controlling for different other factors did not change the results of the analysis indicate that the ATT measure was consistently estimated.

[insert Figures 4 and 5 here]

Figures 4 and 5 demonstrate the above analyses graphically. In Figure 4, we observe a visible discontinuity in the value of Canadian exports to Chile around 1997, the year the CCFTA went into effect. Figure 5 shows the export value around 2002, the year Chile signed the free trade agreement with the European Union. It shows a less apparent discontinuity than in Figure 4.

Test of discontinuities around these dates of interest were performed and the results confirm the existence of these discontinuities. As the graphical representations suggest, a sharp regression discontinuity design should be applied when the trade effects on new firms and products is tested around the implementation of the CCFTA.

4 Effects of the CCFTA on the Margins of Trade

4.1 Methodology

In the literature, there are a number of ways to decompose the margins of international trade. Here we follow Besedes and Prusa (2011) and consider three channels of export growth: entry, survival and deepening, with the first channel being the extensive margin and the latter two the intensive margin. To be more specific, let X_t denote the value of exports from Canada to Chile in period t, n_t the number of exporting relationships in period t, v_t the average value of exports per relationship. Then $X_t = n_t v_t$. Export relationships in period t consist of those that survive from $t-1$ to t, denoted by n_t^s, and new relationships, denoted by n_t^e, so that $n_t = n_t^s + n_t^e$.

Using these notations, we can write the change in export values between period t and period $t+1$ as:

$$X_{t+1} - X_t = n_{t+1}v_{t+1} - n_t v_t = n_{t+1}^e v_{t+1} + n_{t+1}^s(v_{t+1} - v_t) - (n_t - n_{t+1}^s)v_t. \tag{4}$$

On the right-hand side of equation (4), the first term represents the change in export value due to new relationships (the entry channel), and the second term measures the change due to the increase in the average value of the surviving relationships (the deepening channel). The third term expresses the decrease in export value caused by the relationships that end between the two periods, thus indicating the change in export value through the survival channel. As pointed out by Besedes and Prusa (2011), the first term (entry) measures the extensive margin, and the sum of the second and third term (deepening and survival) gauges the intensive margin.

Margins of international trade can be measured in terms of countries, products or firms. Since we study a particular pair of countries (Canada and Chile), our decomposition of trade margins are conducted in terms of products and firms. Specifically, let p_t be the number of products exported by a Canadian firm to Chile, n_t the number of Canadian firms that exports to Chile, and x_t the average value of exports per firm-product. Then $X_t = p_t f_t x_t$. In the case of product margins of trade, an export relationship is the exports of a product from Canada to Chile. Accordingly, the number of export relationships is the number of products exported by Canada to Chile, i.e., $n_t = p_t$, and thus $v_t = f_t x_t$.

Similarly, in the case of firm margins of trade, the number of export relationships is measured by the number of firms that exports from Canada to Chile, i.e., $n_t = f_t$. Accordingly, the average export value per relationship is given by $v_t = p_t x_t$.

4.2 Results

We start by examining what happened with the distribution of industries before and after the CCFTA. Figure 6 shows the number of Canadian firms that exported to Chile (displayed along the vertical axis) for various industies between 1993 and 2008. It identifies the Canadian industries that experienced growth in exports to Chile after the CCFTA. In particular, a number of manufacturing industries witnessed growth in the number of exporting firms to Chile, including Chemical Manufacturing (NAICS 325), Plastic and Rubber Products Manufacturing (NAICS 326), Fabricated Metal Products (NAICS 332), Machinery Manufacturing (NAICS 333), Computer and Electronic Products (NAICS 334), and Transportation Equipment (NAICS 336). Other growth industries included wholesale trade of machinery equipment and supply (NAICS 417) and professional, scientific and technical services (NAICS 541).

[insert Figures 6 here]

Next, we display in Figure 7 the dynamics of the old and new firms that entered the Chilean market before and after the CCFTA (the dynamics of the new and old products is similar). The graph shows that over the long-term the incumbent firms were slowly exiting the market after the agreement while new firms were entering at an increasing rate.

[insert Figure 7 here]

Most importantly, we want to measure the margins of trade associated with the entry of new firms, new products and their effects relative to the old firms and old products. To start the analysis, we do a decomposition and compare the dynamics of the export values of the old firms with old products and old firms with new products versus the new firms with old products and new firms with new products. In particular, we do the decomposition as in Equation (4) and

show the contribution of the intensive margin and extensive margin of trade. These results are presented in Tables 4–5 and Figure 8.

[insert Table 4, Table 5 and Figure 8 here]

From these two tables and Figure 8, we make the following observations:

- The effect of CCFTA was driven by the intensive margin associated with the older products initially, but changed with time.
- When we mix the margins of trade between firms and products, the result becomes very interesting. The new firms brought in more older products than older firms bringing in new products immediately after the free trade agreement.
- However, if we look at a longer horizon after the free trade agreement came into effect, the contributions of the new firms with new products increased almost exponentially towards the end of the observed period.

Based on the above findings, we conclude that new firms and new products drove the long-term effects of the CCFTA, while older firms and products were the driver of the short-term effect. In other words, while the intensive margin played an important role in the short-term, it died off and the extensive margin took the center stage in the long-term.[4]

5 A Theoretical Model

A surprising finding from our empirical analysis is the fading of the CCFTA effect on the intensive margin of trade in the long-term. This is in sharp contrast to the prediction from trade models à la Melitz (2003) that trade liberalization should have a positive effect on both the extensive margin and the intensive margin of trade. The purpose of this section is to reconcile our empirical findings with theory. We will proceed in two steps. First, we will study a generic optimization problem by an exporter to demonstrate that while trade liberalization has a positive effect on the intensive margin of trade in the short run, its effect is ambiguous in the long run. Second, we present a specific model to support our empirical finding that the effect on the intensive margin can be zero in the long run.

Our theory is based on the premise that there is a delay for new firms or new products to enter a new country. This could either be due to the entry costs that new exports have to incur (Ruhl 2008) or the source adjustment friction that prevents buyers from switching to lower-cost

[4]Using a different measure of margins of trade, a study by Foreign Affairs and International Trade Canada (2013) also find a gradual decline of intensive margins four years after the implementation of CCFTA.

sources of supply instantaneously (Arkolakis et al 2011). Accordingly, new products or new firms enter export markets with a lag after a trade agreement.

Consider the quantity decision of a firm that exports to a foreign market. Let $MR(x, N)$ denote the firm's marginal revenue in the foreign market, which depends on its quantity of exports (x) and the number of competitors in the market (N). It is reasonable to assume that the marginal revenue is a decreasing function in the quantity and in the number of competitors; that is, $\partial MR/\partial x < 0$ and $\partial MR/\partial N < 0$. On the cost side, the firm incurs marginal costs of production c and trade costs t for each unit of exports. To maximize its profit, the firm chooses the quantity of exports in such a way that

$$MR(x, N) = c + t. \tag{5}$$

Now suppose that the magnitude of t is reduced as a result of a trade agreement. Conducting comparative statics on (5), we find that

$$\frac{\partial x}{\partial t} = \frac{1}{\partial MR/\partial x} < 0, \tag{6}$$

which implies that holding the number of competitors constant, a decrease in trade costs raises the quantity of exports by this firm. Thus, the short-run effect of the trade agreement on the intensive margin of trade is positive.

In the long run, the extensive margin of trade expands as additional firms enter the export market. Accordingly, we assume that $\partial N/\partial t < 0$. Taking into account this change in the extensive margin, we can write the long-run effect on the intensive margin as,

$$\frac{dx}{dt} = \frac{\partial x}{\partial t} + \frac{\partial x}{\partial N}\frac{\partial N}{\partial t} = \frac{1}{\partial MR/\partial x} - \frac{\partial MR/\partial N}{\partial MR/\partial x}\frac{\partial N}{\partial t}. \tag{7}$$

The sign of (7) is ambiguous because the two terms on its right-hand side represent two opposing forces. On the one hand, the trade agreement lowers the per unit cost of exports, thus inducing the firm to expand exports when the number of competitors is held constant (in the short run). On the other hand, the entry of additional competitors reduces the marginal revenue of this firm, causing it to reduce the quantity of exports. Therefore, the effect of trade liberalization on the intensive margin is ambiguous in the long run.

In the existing theoretical literature, the effect of trade liberalization on the intensive margin is typically positive because these models are constructed in such a way that the short-run effect dominates the long-run effect. For example, consider the standard monopolistic competition model of international trade, in which each firm faces a constant-elasticity demand function. Let σ denote the (constant) elasticity of demand and f the fixed cost associated with exports.

It is well-known that a firm in such a model sets a price that is proportional to its marginal cost, specifically, $p = \sigma(c+t)/(\sigma-1)$. Then the firm's profit from exporting is $\pi = (c+t)x/(\sigma-1)-f$. In the long run, free entry and exit drives the profit of the firm to zero, implying that the quantity of exports by the firm in the long run is,

$$x = \frac{(\sigma-1)f}{c+t}. \tag{8}$$

In this case, a lower trade cost t necessarily raises the quantity of exports by the firm, even in the long run. But our preceding analysis suggests that this definite sign for the long-run effect on the intensive margin is due to the specific features of the model.

Next, we present a more elaborate model that will support our empirical finding that the long-run effect on the intensive margin of trade can indeed be zero. Suppose there are two countries, A and B. Firms in these two countries manufacture differentiated products for domestic consumption and (possibly) exports. We use x and y to denote the quantity of a firm located in country A and country B, respectively. To be more specific, let x_{ik} be the output of a firm i in country A destined for country k, and y_{jk} be the output of a firm j in country B destined for country k, where $k = A$ or B. Similarly, p_{ik} and q_{jk} denote the prices of a product sold in country k originated from a firm in country A and country B, respectively. Let n and m be the number of firms located in country A and B, respectively. Some of these firms in each country will export their products to the other country. We use $n_e(\leq n)$ and $m_e(\leq m)$ to denote the number of exporters in country A and country B, respectively.

Assume that the two countries are symmetric in all aspects. In what follows, we will specify the model for country A only, with the understanding that country B is completely symmetric. Suppose that the demand in country A for the good produced by a domestic firm i (=1,2,...n) is represented by

$$p_{iA} = \alpha - x_{iA} - \theta \sum_{j \neq i} x_{jA} - \delta \sum_{j=1}^{m_e} y_{jA}. \tag{9}$$

The demand in country A for the good produced by a foreign firm j (=1,2, ...m_e) is represented by

$$q_{jA} = \alpha - y_{jA} - \theta \sum_{i \neq j} y_{iA} - \delta \sum_{i=1}^{n} x_{iA}. \tag{10}$$

In (9) and (10), $\delta < \theta < 1$. This implies a good is a closer substitute for the other goods produced in the same country than for those produced in a different country.

In country A, there are $n+m_e$ competitors. Each firm that sells in country A incurs marginal costs of production c and fixed costs f. Moreover, a firm that exports to country A from country B incurs trade costs t per unit of output. Firms compete in quantity.

Given the demand and cost functions, we can examine the firms' quantity decisions for

country A independent of those for country B. The optimization problem of a domestic firm in country A is

$$\max_{x_{iA}} \pi_A = (p_{iA} - c)x_{iA} - f = (\alpha - x_{iA} - \theta \sum_{j \neq i} x_{jA} - \delta \sum_{j=1}^{m_e} y_{jA} - c)x_{iA} - f. \tag{11}$$

Similarly, the optimization problem of an exporting firm in country B is

$$\max_{y_{jA}} \pi_B = (q_{jA} - c - t)y_{jA} - f = (\alpha - y_{jA} - \theta \sum_{i \neq j} y_{iA} - \delta \sum_{i=1}^{n} x_{iA} - c - t)y_{jA} - f. \tag{12}$$

The first-order conditions associated with (11) and (12) are

$$\alpha - c - 2x_{iA} - \theta \sum_{j \neq i} x_{jA} - \delta \sum_{j=1}^{m_e} y_{jA} = 0 \quad (i = 1, 2, \ldots n); \tag{13}$$

$$\alpha - c - t - 2y_{jA} - \theta \sum_{i \neq j} y_{iA} - \delta \sum_{i=1}^{n} x_{iA} = 0 \quad (j = 1, 2, \ldots m_e). \tag{14}$$

Noting that all domestic firms (and respectively, all exporters from country B) are symmetric, we solve (13) and (14) to obtain:

$$x_{iA}^{SR} = \frac{(\alpha - c)[2 - \theta + (\theta - \delta)m_e] + \delta m_e t}{(2 - \theta)(2 - \theta + \theta n + \theta m_e) + (\theta^2 - \delta^2)n}; \tag{15}$$

$$y_{jA}^{SR} = \frac{(\alpha - c)[2 - \theta + (\theta - \delta)m_e] - (2 - \theta + \theta n)t}{(2 - \theta)(2 - \theta + \theta n + \theta m_e) + (\theta^2 - \delta^2)n}. \tag{16}$$

Equations (15) and (16) are the short-run equilibrium quantities given the number of competitors (n and m_e) in country A. In the long run, the number of competitors is determined by the free entry condition, $\pi_A = \pi_B = 0$.

Now consider the effects of a trade liberalization agreement between the two countries that reduces trade costs t. Our interest is in the effects of the agreement on the intensive margin and extensive margin of trade. Specifically, we want to find out how the reduction in t affects the quantity exported to country A by a firm in country B, y_{jA} (i.e., the intensive margin) and the number of firms in country B that export to country A, m_e (i.e., the extensive margin).

In the short run, the number of competitors in a country is fixed. From (16), we find

$$\frac{\partial y_{jA}^{SR}}{\partial t} = -\frac{2 - \theta + \theta n}{(2 - \theta)(2 - \theta + \theta n + \theta m_e) + (\theta^2 - \delta^2)n} < 0. \tag{17}$$

This reaffirms our earlier finding from (6) that, in the short run, a reduction in trade costs

increases the quantity of exports by each firm.

It can be verified that the reduction in t raises the profit of an exporter in country B. This induces additional firms in country B to enter the market in country A, thus expanding the extensive margin of trade. At the same time, the entry of additional exporters into country A has the effect of offsetting the expansion of intensive margin of trade, as implied by $\partial y_{jA}^{SR}/\partial m_e < 0$.

To find the long-run effects of trade liberalization on the intensive margin and extensive margin of trade, we use the free entry condition, along with (15) and (16), to find the long-run equilibrium:

$$m_e = \frac{(\theta - \delta)[\alpha - c - (2-\theta)\sqrt{f}] - \theta t}{(\theta^2 - \delta^2)\sqrt{f}}; \tag{18}$$

$$n = \frac{(\theta - \delta)[\alpha - c - (2-\theta)\sqrt{f}] + \delta t}{(\theta^2 - \delta^2)\sqrt{f}}; \tag{19}$$

$$x_{iA}^{LR} = y_{jA}^{LR} = \sqrt{f}. \tag{20}$$

From (18), it is easy to see that $\partial m_e/\partial t < 0$; that is, a reduction in t increases the number of exporters from country B and thus enlarges the extensive margin of trade.

Furthermore, from (20) we see that the long-run quantity of exports by a firm in country B, y_{jA}^{LR}, is independent of t. In other words, a change in trade costs has no impact on the intensive margin of trade in the long run. While the reduction in trade costs causes the intensive margin to expand when the number of competitors is fixed, this effect is offset by the increase in the number of exporters, leaving the intensive margin of trade unchanged in the long run. This is consistent with what we have found in our empirical analysis of the CCFTA.

6 Conclusions

The paper makes two contributions to the literature on the impact of preferential trade agreements on the margins of trade. First, we observe an interesting phenomenon regarding the short-term and long-term effects of a PTA (namely, the CCFTA). Specifically, we find that in the short-term, the effects of CCFTA on Canadas exports to Chile were driven mainly by the intensive margin. But in the long-term the intensive margin died off while the extensive margin effect picked up. Firm-level and product-level analyses show that the short-term impact of the trade agreement was mainly driven by the intensive margins associated with the old products and old firms. Over time, the extensive margins associated with the new firms and new products become more prominent, with the contribution of the new firms with new products increasing almost exponentially towards the end of the sample period.

Second, this paper contributes to the theoretical literature by pointing out that the long-term impact of trade liberalization on the intensive margin is, in principle, ambiguous. Our

theoretical model highlights the two opposing forces of a trade liberalization agreement. On the one hand, it induces existing exporters to expand exports in the short-term. On the other hand, it brings about entry of additional competitors into the export market. This lowers the marginal revenues of existing exporters and causes them to reduce their quantities of exports. In the literature, the impact of trade liberalization on the intensive margin is typically positive because the existing models are constructed in such a way that the short-term effect dominates the long-term effect. In our model, on the other hand, while the reduction in trade costs causes the intensive margin to expand in the short-term, this effect is offset by the increase in the number of exporters, leaving the intensive margin of trade unchanged in the long-term.

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8 Appendix

8.1 Tables

Table 1: Industries, Firms and Products - Exporters to Chile - Linked Data (2008)

Year	No. Industries	No. Firms	No. Products
1993	56	128	279
1994	71	155	347
1995	78	201	327
1996	110	398	490
1997	119	470	543
1998	126	568	605
1999	123	527	638
2000	124	567	656
2001	128	594	661
2002	131	645	738
2003	147	849	942
2004	160	986	1108
2005	166	1018	1171
2006	154	1056	1218
2007	160	1076	1153
2008	176	1171	1231

Table 2: Value of Exports by Old and New products

Year	Export Value	Old Products	New Products
1993	7.48E+07	7.48E+07	0
1994	1.61E+08	3.30E+07	1.28E+08
1995	1.47E+08	1.03E+07	1.37E+08
1996	1.50E+08	6.41E+07	8.61E+07
1997	1.96E+08	2.80E+07	1.68E+08
1998	1.41E+08	3.49E+07	1.06E+08
1999	2.04E+08	1.50E+07	1.89E+08
2000	2.33E+08	2.04E+07	2.12E+08
2001	1.88E+08	6642421	1.82E+08
2002	1.53E+08	1.34E+07	1.40E+08
2003	1.56E+08	1.22E+07	1.43E+08
2004	1.96E+08	1.91E+07	1.77E+08
2005	2.04E+08	5381432	1.99E+08
2006	2.71E+08	1.35E+07	2.57E+08
2007	4.60E+08	2.67E+07	4.33E+08
2008	4.30E+08	1.70E+07	4.13E+08

Table 3: ATT Effects (in thousands of dollars) on Export Values

Treatment Year	Window	Outcome	Coef	Std Error	p-value
1997	1 year	exports	27385.88	8717.32	0.002
1997	2 years	exports	53858.5	15782.3	0.001
1997	3 years	exports	54712.8	15667.4	0.000
1997	all years	exports	54427.8	15700.3	0.001
2002	1 year	exports	-11363.2	6339.5	0.073
2002	2 years	exports	-7657.97	11131.5	0.491
2002	3 years	exports	-7486.4	11141	0.502

Table 4: Export Values by Type of Firm and Type of Product

Year	OF-OP	OF-NP	NF-OP	NF-NP
1993	74,800,000	0	0	0
1994	161,000,000	0	0	0
1995	147,000,000	0	0	0
1996	150,000,000	0	0	0
1997	128,000,000	n.a.	40,700,000	n.a.
1998	42,000,000	15,800,000	51,800,000	31,300,000
1999	40,300,000	n.a.	67,300,000	n.a.
2000	91,000,000	35,500,000	34,500,000	70,800,000
2001	65,600,000	20,200,000	39,500,000	61,200,000
2002	28,400,000	10,900,000	69,200,000	43,600,000
2003	30,300,000	17,700,000	57,300,000	48,400,000
2004	32,500,000	29,100,000	54,200,000	78,500,000
2005	29,900,000	24,100,000	59,000,000	88,200,000
2006	29,600,000	33,700,000	65,000,000	141,000,000
2007	50,800,000	25,400,000	58,900,000	325,000,000
2008	87,600,000	15,400,000	77,800,000	217,000,000

Note: OF-OP = Old Firms with Old Products; OF-NP = Old Firms with New Products; NF-OP = New Firms with Old Products and NF-NP= New Firms with New Products

Table 5: Intensive and Extensive Margin of Trade

Year	Deepening	Survival	IM	EM	Total Change in EV
1996	150,000,000		150,000,000		150,000,000
1997	128,000,000		128,000,000		128,000,000
1998	42,000,000	15,800,000	26,200,000	31,300,000	57,500,000
1999	40,300,000	42,000,000	-1,700,000	n.a.	n.a
2000	91,000,000	40,300,000	50,700,000	70,800,000	121,500,000
2001	65,600,000	91,000,000	-25,400,000	61,200,000	35,800,000
2002	28,400,000	65,600,000	-37,200,000	43,600,000	6,400,000
2003	30,300,000	28,400,000	1,900,000	48,400,000	50,300,000
2004	32,500,000	30,300,000	2,200,000	78,500,000	80,700,000
2005	29,900,000	32,500,000	-2,600,000	88,200,000	85,600,000
2006	29,600,000	29,900,000	-300,000	141,000,000	140,700,000
2007	50,800,000	29,600,000	21,200,000	325,000,000	346,200,000
2008	87,600,000	50,800,000	36,800,000	217,000,000	253,800,000

Note: IM = Intensive Margin, EM = Extensive Margin, EV = Export Value

8.2 Figures

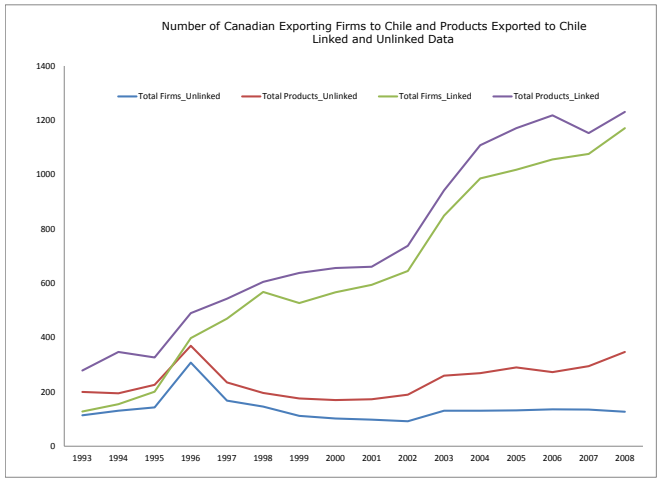

Figure 1: Firms and Products - Linked and Unlinked Data

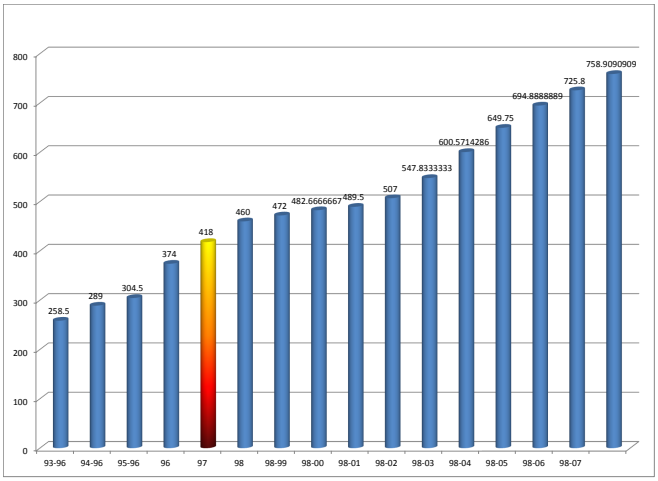

Figure 2: Number of Products Exported to Chile by Windows

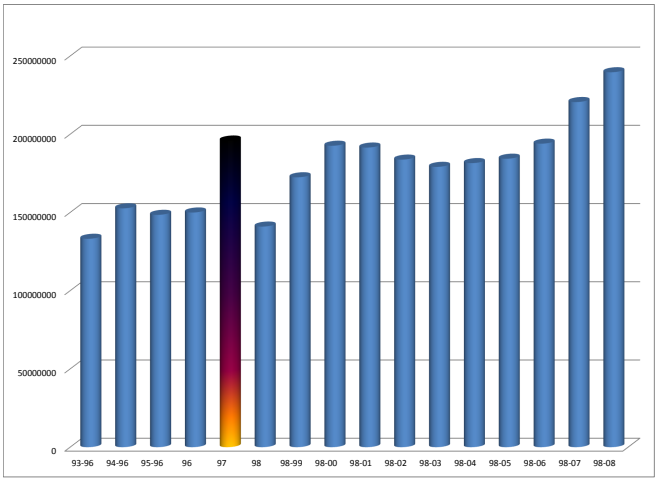

Figure 3: Value of Exports to Chile by Windows

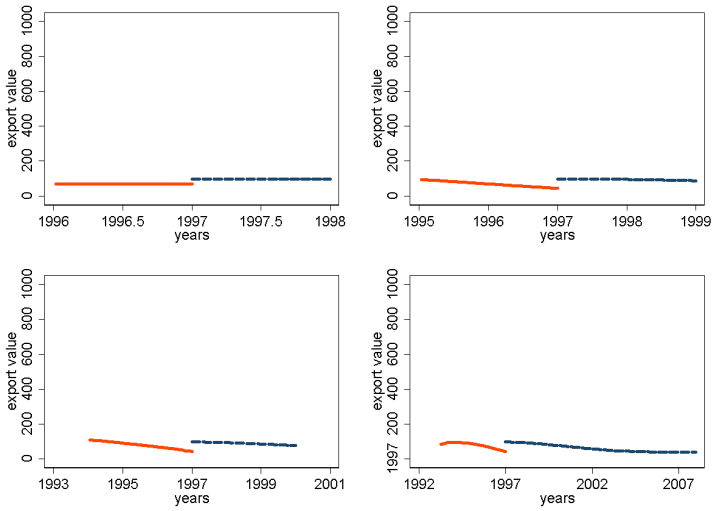

Figure 4: Export Values - Benchmark 1997

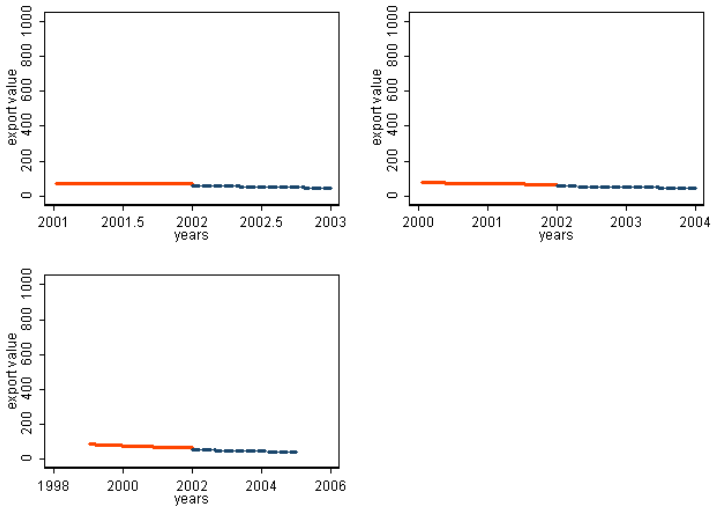

Figure 5: Export Values - Benchmark 2002

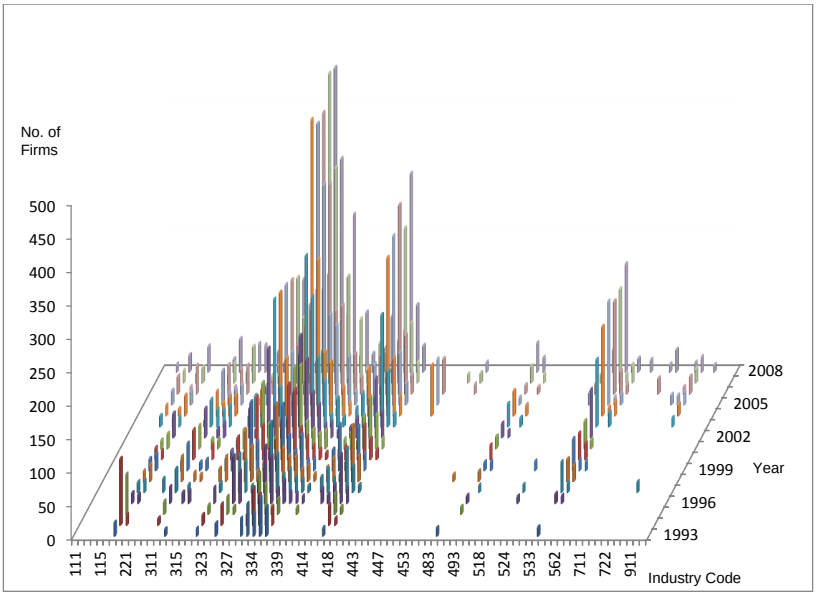

Figure 6: Distribution of Industries Before and After CCFTA

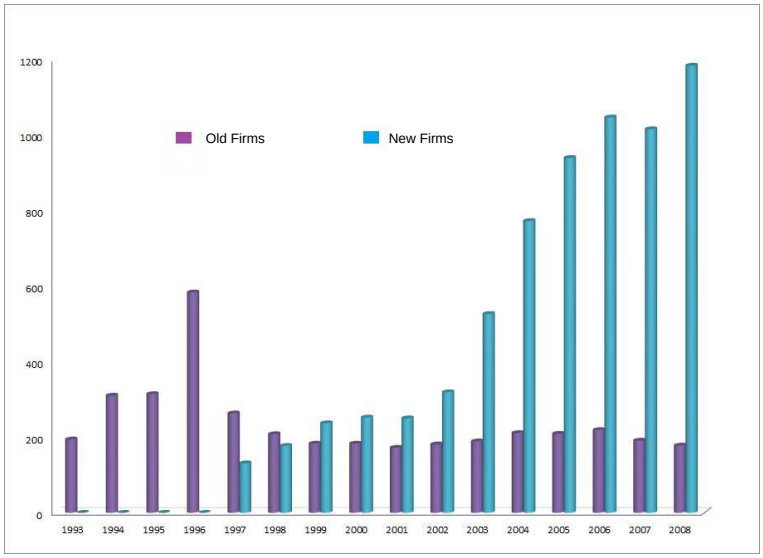

Figure 7: Numbers of Old and New Firms

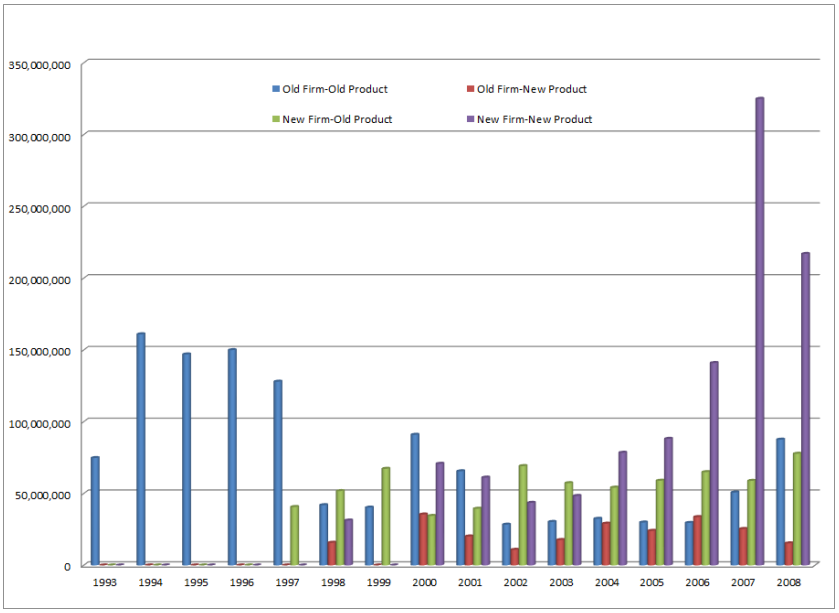

Figure 8: Export Values of Old Firms with Old and New Products and of New Firms with New and Old Products