Market Penetration Costs and the New Consumers Margin in International Trade*

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Abstract

This paper develops a novel theory of marketing costs within a trade model with product differentiation and heterogeneity in firm productivities. A firm enters a market if it is profitable to incur the marginal cost to reach a single consumer. It then faces an increasing marginal penetration cost to access additional consumers. The model, therefore, can reconcile the observed positive relationship between entry and market size with the existence of many small exporters in each exporting market. Comparative statics of trade liberalization predict a large increase in trade for goods with positive but low volumes of previous trade.

1 Introduction

A recent literature has exploited firm- and plant-level data to uncover a set of stylized facts for exporters. At this level of analysis, the monopolistic competition model with product differentiation, Dixit-Stiglitz demand, and Pareto distribution of productivities has arisen as an extremely useful quantitative tool. The assumption of a market-specific fixed entry cost allows this model to explain the fact reported by Eaton, Kortum, and Kramarz (2004) that the number of exporters systematically increases with market size.[1] Nevertheless, the nature of these entry costs remains largely unexplained, and the model predictions are at odds with the data in some key dimensions, such as the size and growth of exporters to individual destinations.

This paper provides formal foundations for these entry costs. The basic idea put forward is that firms reach individual consumers rather than the market in its entirety. Paying higher costs allows firms to reach an increasing number of consumers in a country. Yet, once a consumer is reached, the costs remain fixed with respect to the amount sold per consumer. I formulate these market penetration costs as marketing costs that consist of two main elements. The cost to reach a certain number of consumers in a market decreases with the population size of the market. This assumption is supported by evidence that I have collected on the cost of advertising in markets with different population. Moreover, I assume that, within a given market, the marginal cost of marketing increases with the number of consumers reached. This assumption is in line with evidence on the decreasing returns to scale of advertising spending within a market.

The model provides a generalization of the constant elasticity of substitution (CES) demand model of Melitz (2003) and Chaney (2008). In particular, with constant marginal costs to reach additional consumers it is observationally equivalent to the Melitz-Chaney framework. Moreover, I show that with increasing marginal costs it has two key implications for international trade.

First, the model can reconcile the robust positive association between firm entry and market size with the existence of many small exporters in each exporting destination reported

[1] Hummels and Klenow (2005) report related findings for the number of exported goods.

by Eaton, Kortum, and Kramarz (2010) (henceforth, EKK10). The uniform fixed cost model requires large fixed costs to explain firm entry patterns, which contradicts the existence of many small exporters. The new model reconciles these two facts owing to its distinct implications of marketing costs for firm entry and sales patterns. On the one hand, in larger markets the cost to reach the very first consumer is lower, because of returns to scale of marketing with respect to population size. Thus, whereas more firms enter into markets with larger population size, the per-consumer marketing cost excludes firms with very low productivity from an individual export market, if their per-consumer revenue is not sufficient to cover the cost to reach the very first consumer there. Assuming also that marketing costs are partially incurred in the destination country, this model explains the relationship between the number of entrants and the overall size of the exporting markets. On the other hand, because of the increasing cost to reach additional consumers, relatively unproductive firms (yet productive enough to reach the very first consumer in the market) choose to reach only a few consumers in the market and, thus, export tiny amounts.

Second, the model predicts that firms/goods with low volumes of trade prior to a trade liberalization episode grow more when trade costs decline. The CES model since it implies a uniform elasticity of substitution between goods it predicts equal growth rates of trade for all previously traded goods. In my framework, I assume that the number of consumers reached with each additional marketing effort becomes smaller at some geometric rate. This assumption allows for an increasing convexity of the marginal cost function to reach additional consumers. In turn, the increasing convexity implies that the elasticity of sales with respect to variable trade costs declines with firm size in a market and asymptotically tends to the CES demand elasticity for the largest firms.

To test this prediction, I use data on disaggregated product categories for the US-Mexico NAFTA liberalization episode in the '90s. I extend the methodology of Kehoe and Ruhl (2003) to data on goods that were positively traded before the liberalization. Consistent with the theory, I find that the growth rate of the volume of trade is larger the lower the initial sales of goods.

To quantitatively assess the model, I assume that the productivities of firms are Pareto distributed and calibrate its parameters to match data on French firms from Eaton, Kortum, and Kramarz (2004) (henceforth, EKK04) and EKK10. In particular, the parameters that relate entry costs to market size are chosen to match the average sales of French firms in each exporting market. The parameters that determine the relative sales of different firms are calibrated to match the average sales advantage in France and the median exporting intensity for firms that are able to penetrate less popular destinations relative to other firms. The calibrated model with endogenous market penetration costs is able to quantitatively generate a number of key facts in international trade theory.

First, I look at the sales distribution to a given market. In both the model and the data, the sales of firms that sell large amounts to that market are Pareto distributed whereas the sales of firms that sell small amounts exhibit large deviations from that distribution. As a result, the calibrated model quantitatively accounts for the small amounts exported by a large proportion of the French firms in each market, but it still predicts that most French firms do not export.

I also perform a comparative statics analysis of trade liberalization. I use the parameters calibrated to the French data and a symmetric change in the variable trade costs across goods calibrated to match the overall increase in trade following the US-Mexico liberalization episode. The model quantitatively captures the higher growth rate in trade for goods with positive but little previous trade. Thus, it offers a resolution to the critique of Kehoe (2005) of models with CES demand regarding their predictions of trade patterns in the case of the North American Free Trade Agreement (NAFTA) episode. Kehoe points out the inability of the CES models to predict the high growth rates of sales, especially for goods with little trade prior to the trade liberalization.

Finally, I study a new margin of response of aggregate trade flows to decreases in trade costs. This "new consumers" margin is meant to capture the higher growth rate of small existing exporters after a trade liberalization. In particular, I decompose "new trade" into three margins: the new consumers margin, the "intensive margin" of growth in per-consumer sales, emphasized by Anderson (1979) and Krugman (1980); and the "new firms" –new goods– margin, analyzed by Eaton and Kortum (2002), Melitz (2003), and Chaney (2008). In the model, a considerable amount of new trade is generated by new firms and by sales of previously exporting firms to new consumers. However, for small changes in variable trade costs, the contribution of the new consumers margin to new export sales is larger than the contribution of the new firms margin. New firms entering a market, although numerous, sell a tiny amount. Consistent with this prediction, I find that in the US-Mexico NAFTA episode goods with little previous trade had a significant impact to new trade while the contribution of new goods was small.

EKK10 find that in order to account for a variety of recently uncovered exporting facts the export costs have to take the form of both variable costs, which rise in proportion to the amount shipped, and fixed marketing costs as in Melitz (2003) and Chaney (2008).[2] The modeling of marketing costs that I propose generates a demand system that departs from the CES demand specification, with constant marginal costs of production, while retaining the desirable properties of the Melitz-Chaney framework at the aggregate level. In essence, this modeling of marketing costs is a metaphor of market penetration costs as CES demand is for variety-loving preferences or productivity is a stylized description of things that allow firms to sell more. In turn, the new model substantially improves the quantitative predictions on the size and growth of exporters of the Melitz-Chaney framework.

The outline of the rest of the paper is as follows. In Section 2, I describe the model and the new formulation of marketing costs. In Section 3, I discuss the theoretical predictions of the model and relate them to stylized facts on firm entry and sales. In Sections 4 and 5, I calibrate the model, assess its quantitative predictions, and perform counterfactual exercises. Section 6 concludes.

2 Model

The model is based on the monopolistic competition framework proposed by Melitz (2003) and augmented by Chaney (2008). Goods are differentiated, and each good is produced by a firm. Firms are heterogeneous in their productivity and use a constant returns to scale production technology. The main departure from the previous literature is that firms incur marketing costs to reach individual consumers in each country. I start with a description of

[2] See, for example, Bernard and Jensen (1995), Clerides, Lach, and Tybout (1998), Aw, Chung, and Roberts (2000), and Tybout (2001) for a review.

these costs and then incorporate them into the monopolistic competition framework.

2.1 A Theory of Marketing Costs and The Market Penetration Technology

Marketing costs are incurred by a firm during the process of promoting its product, identifying and reaching consumers, and establishing the related distribution channels.[3] All of these costs are incurred in both the domestic and the exporting markets. Estimates of marketing costs (reviewed in Appendix A) indicate that the amount of marketing spending in a certain market is 4 to 5% of GDP or even as high as 7.7% when broader definitions of marketing are used.

Starting from first principles, I derive a marketing technology that is a generalization of a simple theory of informative advertisement by Butters (1977) and Grossman and Shapiro (1984). Independently of other firms, each firm uses this technology to send advertisements (ads) to consumers. Each ad is essentially a posting that contains information about the presence of a good in a market and its price. Consumers are aware of the good only if they observe the ad. Denote by S the number of ads sent by a firm and by L the number of consumers, where both S and L are continuous variables. The term $n(S)$ is the probability that a particular consumer sees the ad at least once after S ads have been sent, where $n(0) = 0$. The variable S will be endogenously chosen by each firm in the optimization problem that I will set up later on. For convenience, I formulate that problem and the marketing technology below in terms of the probability, $n(S)$.

Three simple assumptions are made for the specification of the marketing technology. The first assumption allows for the possibility that the marketing technology exhibits increasing returns to scale with respect to the population size of the market:

A 1 *The number of consumers who see each ad is given by*

$$L^{1-\alpha}, \ \alpha \in [0,1] \ .$$

[3] Evidence about these activities for the case of exporting is provided by Keesing (1983) and Roberts and Tybout (1997).

Intuitively, the case $\alpha = 1$ corresponds to the example of advertising with flyers, where each flyer is read by one consumer. To reach a given number of consumers, the total number of ads that a firm has to send is independent of the size of the market. The case $\alpha = 0$ can be described with the example of TV ads, which reach a given fraction of consumers in any given market. In this case, a firm can reach twice the number of consumers in a country that is twice as large using the same number of ads.

Evidence suggests that returns to scale are present in the operation of advertising media, such as TV, newspapers, and radio (Mathewson (1972)). Thus, the cost to reach a certain number of consumers can be lower in markets with a larger population. To provide support for assumption A.1, I also collected evidence regarding the effective cost of *reaching* a thousand consumers, the so-called CPM. The CPM is typically constructed by dividing the cost of ads by a measure of their viewership and multiplying by a thousand. The evidence was collected for TV, newspapers, and radio advertising across different regions or countries and is summarized in Appendix A. The main finding is that the CPM is systematically lower in markets with larger population size, even accounting for income per capita of the market.[4] The coefficients estimated indicate that CPM drops with an elasticity around $.10 - .65$ with respect to the population size of the market. The magnitude of this negative relationship corresponds, in the theory, to an α that lies approximately in the range of .35 to .90.

The second assumption states that within a given market, the cost per consumer may differ depending on how many consumers have already been reached.

A 2 *The probability that a new ad is seen by a consumer for the first time is given by*

$$[1 - n(S)]^{\beta}, \ \beta \in [0, +\infty) .$$

Assumption A.2 captures the idea that initial search efforts use the most efficient marketing methods, but as marketing expenditures increase, efficiency declines. Notice that higher values of β correspond to more intense diminishing returns. Mostly by using advertising

[4] To the best of my knowledge, a comprehensive analysis of the effects of population on CPM has not been performed. Some evidence suggests that CPM drops with the population for individual media (see, for example, the correlations reported in Table II in Campbell and Hopenhayn (2005)).

data, previous literature has provided ample evidence that supports this assumption. For instance, Bagwell (2007) reviews the literature on the economics of advertising and concludes that most of the studies find that advertising's effectiveness is subject to diminishing returns.[5]

Under assumptions A.1 and A.2, the marginal change in the number of consumers reached through new ads, $n'(S)L$, is

$$n'(S)L = L^{1-\alpha}[1-n(S)]^{\beta} \ . \tag{1}$$

Solving this differential equation subject to the initial condition $n(0)=0$ implies that

$$n(S) = 1 - \left(1-(1-\beta)\frac{S}{L^{\alpha}}\right)^{1/(1-\beta)} \ .$$

Inverting the last expression and solving for S gives the amount of advertising required by a firm aiming to reach a fraction n of consumers in a market of size L. Assuming that the labor requirement for each ad is $1/\psi$, the amount of labor required to reach these consumers becomes

$$f(n,L) = \begin{cases} \frac{L^{\alpha}}{\psi}\frac{1-(1-n)^{1-\beta}}{1-\beta} & \text{if } \beta \in [0,1) \cup (1,+\infty) \\ -\frac{L^{\alpha}}{\psi}\log(1-n) & \text{if } \beta = 1 \ . \end{cases} \tag{2}$$

The function is always 0 at $n=0$.[6]

[5] Sutton (1991) (p. 51), Jones (1995), and Simon and Arndt (1980) share a similar view. For a discussion on diminishing returns to marketing expenditures, see Saunders (1987).

[6] Diminishing returns can also be modeled by assuming a concave production function for advertisements as in Stigler (1961) and Dinlersoz and Yorukoglu (2008). Bagwell (2007) points out that "advertising often entails diminishing returns beyond a threshold level, where the threshold level varies across circumstances and may be small". Interpreting this statement within my model would suggest adding an extra fixed cost of entry in the proposed specification. A fixed cost that is small in magnitude will not affect my results. Assuming that this fixed cost is substantial is in contrast to the existence of many small French exporters in the data.

For $\beta > 0$ the crucial properties of this function are as follows:

$$f_1(n, L) > 0, \ \forall n \in [0, 1] \tag{P.1}$$

$$f_{11}(n, L) > 0, \ \forall n \in [0, 1] \tag{P.2}$$

$$\lim_{n \to 1} f_1(n, L) = \infty \ . \tag{P.3}$$

To provide an insight into what these properties entail notice that P.1 implies that the marginal cost to penetrate any fraction of consumers in the market, even the very first ones, is positive. In turn, P.1 implies that only those firms that generate enough revenue will enter a market. Additionally, given P.2, conditional on entering a market, firms with varying levels of revenues will make different marketing decisions. Finally, P.3 implies that no firm can saturate the market, $n = 1$, since the marketing cost will be prohibitively high.

The case of $\beta \to 1$ and $\alpha = 1$ is of special interest. This case corresponds to the example in which flyers are randomly thrown to consumers. The probability that a consumer is reached is simply $n(S) = 1 - \exp\{-S/L\}$. The cost function (2) with $\beta \to 1$ and $\alpha = 1$ results by inverting this function.[7] Another interesting case is when $\beta = 0$ and the costs to reach additional consumers remain constant. I prove later on that, in this case, the problem of the firm in my model corresponds to that of the fixed cost model of Melitz (2003). Thus, the theory of entry costs proposed in this study is a generalization of the fixed cost structure considered by the previous literature.

The third assumption implies that firms originating from different markets may pay different marketing costs for the same number of consumers reached in a given market.

A 3 *The production of marketing requires a Cobb-Douglas bundle of labor services from source country i, l_i, and destination country j, l_j. Formally,*

$$S = l_j^{\gamma} l_i^{1-\gamma}, \ 0 \leq \gamma \leq 1 \ .$$

[7] This is essentially the seminal case explored by Butters (1977) and Grossman and Shapiro (1984). It can also be thought of as a discrete "urn-ball" example, where urns are the mailboxes of the consumers and flyers are the balls that are assigned to the urn with equal probability.

Sanford and Maddox (1999) provide evidence that exporters use foreign advertising agencies, and Leonidou, Katsikeas, and Samiee (2002) review some direct evidence of the use of domestic labor for foreign advertising. For simplicity, I assume that γ is the same across countries. Empirically, this will not turn out to be a bad approximation. Combining assumption A.3 with expression (2), the total marketing cost for a firm from i reaching consumers with probability n in a country with population size L_j can be written as $w_j^{\gamma} w_i^{1-\gamma} f(n, L_j)$, where w_i denotes the wage rate of country i.[8]

2.2 Consumer Demand

I denote the source country by i and the destination country by j, where $i, j = 1, ..., N$. Country j is populated by a continuum of consumers of measure L_j. Each consumer $l \in [0, L_j]$ has access to a potentially different set of goods Ω_j^l. In each source country i, there is a continuum of firms of measure J_i that ex ante differ only in their productivity level, ϕ. I consider a symmetric equilibrium where all firms of type ϕ from country i choose to charge the same price in j, $p_{ij}(\phi)$, and also reach consumers there with a certain probability, $n_{ij}(\phi) \in [0, 1]$. The existence of a large number of firms implies that every consumer from country j faces the same distribution of prices for goods of different types. The existence of a large number of consumers in country j implies that the fraction of consumers reached by a firm of type ϕ from i is $n_{ij}(\phi)$ and the total measure of consumers reached is $n_{ij}(\phi) L_j$.[9]

Each consumer from country j consumes a composite good that is made by combining a continuum of differentiated commodities according to a CES aggregator with elasticity $\sigma > 1$. The consumer earns labor income, w_j, by selling her unit labor endowment in the labor market and earns profits, π_j, from the ownership of domestic firms. These assumptions

[8] I redefine per-unit advertisement costs $1/\psi$ to incorporate an extra term $\gamma^{\gamma}(1-\gamma)^{1-\gamma}$.

[9] This statement is essentially an implication of the Glivenko-Cantelli theorem, which is a direct application of the Law of Large Numbers (LLN) for i.i.d. random variables. In order to apply the LLN, I assume that firms reach consumers independently of each other. When applying the LLN to the case of a continuum of i.i.d. random variables, technical problems may arise (see, for example, the discussion in Hopenhayn (1992)). Various remedies have been suggested by different authors (see, e.g., Uhlig (1996)). As is usual in the economics literature, I assume the applicability of the LLN without proving the exact conditions under which it applies. This proof is a highly technical issue beyond the scope of this paper.

result in the demand for each individual variety (conditional on buying it):

$$c_{ij}(\phi) = \frac{p_{ij}(\phi)^{-\sigma}}{P_j^{1-\sigma}} y_j \ , \tag{3}$$

where $y_j = w_j + \pi_j$ and

$$P_j^{1-\sigma} = \sum_{\upsilon=1}^{N} J_\upsilon \int_0^{+\infty} p_{\upsilon j}(\phi)^{1-\sigma} n_{\upsilon j}(\phi) g_\upsilon(\phi) \, d\phi \ , \tag{4}$$

with $g_i(\phi)$ being the probability density of productivities of firms in i.[10] The previous results imply that the total effective demand in country j for a firm of type ϕ from i is

$$q_{ij}(\phi) = n_{ij}(\phi) L_j \frac{p_{ij}(\phi)^{-\sigma}}{P_j^{1-\sigma}} y_j \ . \tag{5}$$

2.3 Firm Problem

Firms use a constant returns to scale production technology with productivity ϕ. Labor is the only factor of production. I make the standard iceberg cost assumption that delivering one unit of a good from i to destination j requires $\tau_{ij} > 1$ units of the good to be produced and shipped. Without loss of generality, I assume that $\tau_{ii} = 1$.[11] Conditional on entering market j, a firm ϕ that chooses the price, p, and the fraction of consumers to be reached, n, earns profits,

$$\pi_{ij}(p, n; \phi) = nL_j y_j \frac{p^{1-\sigma}}{P_j^{1-\sigma}} - nL_j y_j \frac{p^{-\sigma}\tau_{ij} w_i}{P_j^{1-\sigma}\phi} - w_j^{\gamma} w_i^{1-\gamma} \frac{L_j^{\alpha}}{\psi} \frac{1-(1-n)^{1-\beta}}{1-\beta} \tag{6}$$

Total profits of a firm are given by the sum of the profits from its sales in all the $j = 1, ..., N$ countries (or a subset thereof). I now turn to characterize the profit maximization choices of the firm.

[10] As I will show later, $n_{ij}(\phi) = 0$ endogenously for some productivities ϕ, limiting the types of varieties available to a consumer.

[11] I further assume $\tau_{ij} \leq \tau_{i\upsilon}\tau_{\upsilon j} \ \forall (i, \upsilon, j)$ to exclude the possibility of transportation arbitrage.

Firm Optimization The optimal pricing decision of the firm is given by:

$$p_{ij}(\phi) = \tilde{\sigma}\frac{\tau_{ij}w_i}{\phi}\ ,\ \tilde{\sigma} = \frac{\sigma}{\sigma-1}\ . \tag{7}$$

Given this markup rule, the optimal market penetration decision for a firm with productivity ϕ, $n_{ij}(\phi)$, can be determined. If $\beta > 0$, this rule is given by the first order condition (FOC) with respect to n_{ij}, provided that the firm can make positive profits from entering market j. Thus, for $\phi \geq \phi^*_{ij}$, the optimal n_{ij} solves[12]

$$\underbrace{\frac{y_j}{\sigma}\frac{\left(\tilde{\sigma}\frac{\tau_{ij}w_i}{\phi}\right)^{1-\sigma}}{P_j^{1-\sigma}}}_{\substack{\text{marginal revenue (net}\\ \text{of labor production}\\ \text{cost) per consumer}}} = \underbrace{\frac{w_j^{\gamma}w_i^{1-\gamma}}{\psi L_j^{1-\alpha}}\frac{1}{\left[1-n_{ij}\right]^{\beta}}}_{\substack{\text{marginal cost}\\ \text{per consumer}}}\ , \tag{8}$$

where the entry threshold ϕ^*_{ij} is defined by setting $n_{ij} = 0$ and solving the previous equation for ϕ:

$$\left(\phi^*_{ij}\right)^{\sigma-1} = w_j^{\gamma}w_i^{1-\gamma}L_j^{\alpha-1}/\left[\frac{y_j}{\sigma}\frac{\left(\tilde{\sigma}\tau_{ij}w_i\right)^{1-\sigma}}{P_j^{1-\sigma}}\psi\right]\ . \tag{9}$$

To understand how entry is determined notice that a firm compares the marginal revenue received from the very first consumer (LHS of (8)) to the corresponding marginal cost of reaching her (RHS of (8) for $n_{ij} = 0$). In fact, due to elastic demand, more productive firms charge lower prices and extract higher marginal revenue per consumer so that they choose higher levels of marketing, conditional on entering. The case of $\beta = 0$ is special in that the marginal cost to reach additional consumers is constant. Therefore, firms with $\phi \geq \phi^*_{ij}$ choose to enter the market and always set $n_{ij} = 1$. This outcome is observationally equivalent to assuming a fixed cost of entry as in Melitz (2003). For means of exposition, I will indicate the model with $\beta > 0$ as the endogenous cost model and the model with $\beta = 0$ as the fixed cost model. Proposition 1 summarizes these results.

[12] In order to interpret the LHS and RHS of expression (8) as marginal revenue and marginal cost per consumer, the derivative with respect to $n_{ij}L_j$ has to be applied.

Proposition 1 (Firm entry and market penetration decisions)

(a) If $\beta > 0$, then there exists a ϕ_{ij}^* such that

$\phi \leq \phi_{ij}^* \implies n_{ij}(\phi) = 0$, *and* $\phi_1 > \phi_2 \geq \phi_{ij}^* \implies n_{ij}(\phi_1) > n_{ij}(\phi_2) \geq 0$.

(b) If $\beta = 0$, then there exists a ϕ_{ij}^* such that

$\phi \leq \phi_{ij}^* \implies n_{ij}(\phi) = 0$, *and* $\phi > \phi_{ij}^* \implies n_{ij}(\phi) = 1$.

Proof. See Appendix B. ■

Inverting expression (8) to solve for $n_{ij}(\phi)$, where $\phi \geq \phi_{ij}^*$, and using Proposition 1 together with (9) implies that the optimal market penetration choice of a firm for $\beta \geq 0$ can be written as a function of ϕ and ϕ_{ij}^*,

$$n_{ij}(\phi) = \max\left\{1 - \left(\frac{\phi_{ij}^*}{\phi}\right)^{\frac{\sigma-1}{\beta}}, 0\right\} . \tag{10}$$

The marginal cost of reaching the first consumer can be expressed as the cost of sending the first ad, divided by the expected number of people that see this first ad,

$$\frac{\text{cost of the first ad}}{\text{expected number of people that see the ad}} = \frac{w_j^{\gamma} w_i^{1-\gamma}/\psi}{L_j^{1-\alpha}} . \tag{11}$$

For $\alpha < 1$, the cost to reach the first consumer falls with population size, since the denominator in expression (11) increases. Equation (8) implies that this lower cost allows firms with lower productivities and smaller per-consumer sales to enter markets with larger population size. Thus, for $\alpha < 1$, these markets will attract more firms. Moreover, as I will show later, in equilibrium, the per capita income of a destination, y_j, is a linear function of worker's income, w_j. All else equal, if $\gamma < 1$, the cost to reach the first consumer would increase more slowly than the increase in the expected revenue from that consumer, implying that more firms enter richer markets. In my analysis, I do allow for the values typically assumed in the literature. That is, $\gamma = 0$, in terms of the exporting country's wages only, as in Ghironi and Melitz (2005), or $\gamma = 1$, in terms of the importing country's wages only, as is implicit in EKK10.

2.4 Equilibrium

To derive stark predictions from the equilibrium of the model, I specify the distribution of firm productivities following Helpman, Melitz, and Yeaple (2004) and Chaney (2008). In particular, I assume that the productivity of firms in country i is drawn from a Pareto distribution with shape parameter $\theta > \sigma - 1$, pdf $g_i(\phi) = \theta b_i^\theta / \phi^{\theta+1}$, cdf $G_i(\phi) = 1 - b_i^\theta/\phi^\theta$, and support $[b_i, +\infty)$, where b_i can be interpreted as the level of technology.[13] This assumption allows the model to generate the empirically observed distribution of sales of firms (see Axtell (2001)).[14]

The probability that a firm operates in a market j corresponds to the probability that a firm has a productivity ϕ such that $\phi \geq \phi_{ij}^*$, namely, $1 - G_i\left(\phi_{ij}^*\right)$. Thus, the measure of entrants from i to j, M_{ij}, is given by

$$\begin{aligned} M_{ij} &= J_i \left[1 - G_i\left(\phi_{ij}^*\right)\right] \\ &= J_i b_i^\theta / \left(\phi_{ij}^*\right)^\theta \ . \end{aligned} \tag{12}$$

Furthermore, the pdf of the conditional distribution of firms is given by

$$\mu_{ij}(\phi) = \begin{cases} \theta \frac{\left(\phi_{ij}^*\right)^\theta}{\phi^{\theta+1}} & \text{if } \phi \geq \phi_{ij}^* \\ 0 & \text{otherwise.} \end{cases} \tag{13}$$

Using equations (5), (7), (9), and (10), the sales of a firm with productivity ϕ to country j can be expressed as

$$r_{ij}(\phi) = p_{ij}(\phi)\, q_{ij}(\phi) = \begin{cases} \sigma \frac{L_j^\alpha w_j^\gamma w_i^{1-\gamma}}{\psi} \left(\frac{\phi}{\phi_{ij}^*}\right)^{\sigma-1} \left(1 - \left(\frac{\phi_{ij}^*}{\phi}\right)^{(\sigma-1)/\beta}\right) & \text{if } \phi \geq \phi_{ij}^* \\ 0 & \text{otherwise.} \end{cases} \tag{14}$$

Conditional on entry, more productive firms sell more at the intensive margin and also at

[13] Notice that I also assume that parameters of the model are such that $b_i \leq \min_j \phi_{ij}^*$, which effectively requires ψ to be low enough.

[14] See Kortum (1997), Gabaix (1999), Luttmer (2007), Eaton, Kortum, and Kramarz (2010), and Arkolakis (2009) for theoretical justifications of using this distribution of productivities.

the extensive margin of consumers, the second parenthetical term of expression (14). When $\beta \to 0$ that term approaches 1 allowing adjustments only at the intensive margin of firm adjustment, as in the Melitz-Chaney setup. In general that term is naturally bounded above by 1, which means that adjustments in that margin will play a dominant role for smaller firms.

Total exports to country j equal average sales, obtained by integrating the expression (14) across the pdf (13) for productivities that exceed the threshold level ϕ^*_{ij} , multiplied by the number of entrants, M_{ij}:

$$X_{ij} = M_{ij} \underbrace{\frac{\sigma L_j^{\alpha} w_j^{\gamma} w_i^{1-\gamma} \theta}{\psi} \left(\frac{1}{1 - 1/\tilde{\theta}} - \frac{1}{1 - 1/\left(\tilde{\theta}\tilde{\beta}\right)} \right)}_{\text{av. sales per firm}} , \tag{15}$$

where I define for simplicity

$$\tilde{\theta} = \frac{\theta}{\sigma - 1}, \ \tilde{\beta} = \frac{\beta}{\beta - 1} \ .$$

In Appendix B I illustrate that the Pareto distribution assumption implies that marketing spending is a constant share of firm sales:

$$m = \left[\theta - (\sigma - 1)\right] / \left(\theta\sigma\right) \ . \tag{16}$$

I also illustrate that using assumption A.3, profits and wages can be expressed as a constant share of income:

$$\pi_i = \eta y_i \ , \ w_i = (1 - \eta) \, y_i \ , \tag{17}$$

where $\eta = (\sigma - 1) / (\theta\sigma)$. Finally, using this result, the labor market clearing condition takes the form

$$w_i L_i = (1 - \eta) \sum_{\upsilon=1}^{N} X_{i\upsilon} \ . \tag{18}$$

I can now define an equilibrium in this economy. Given τ_{ij}, J_i, $g_i(\phi)$, and the definitions (12), (13), $\forall i, j = 1, ..., N$, an equilibrium is a set of wages $\hat{w}_i$, allocations for the representative consumer, $\hat{c}_{ij}(\phi)$, prices and allocations for the representative firm, $\hat{p}_{ij}(\phi)$, $\hat{n}_{ij}(\phi)$, such that (i) equation (3) is the solution of the representative consumer optimization program,

(ii) equations (7) and (10) solve the firm profit maximization programs, (iii) P_j, ϕ^*_{ij} jointly satisfy equations (4) and (9), and y_i is given by equation (17), $\forall i, j = 1, ..., N$, and (iv) the labor market clearing condition (18) holds for each i.

3 Qualitative Predictions and Empirical Regularities

Although the model just described is simple, it yields a number of analytical and rather intuitive results regarding firm behavior. In this section, I discuss these predictions and compare them with evidence on the cross-sectional sales and growth of firms and goods. The data used here are detailed in Appendix A.

3.1 Exporting Participation and Firm Sales

I first discuss how the cross-sectional predictions of the model connect to the empirical regularities in the French data reported by EKK10. These data provide information on the entry and sales of French manufacturing firms in 113 destinations, including France. I will set $i = F$ for the rest of this subsection since France is always the exporting country.

Firm Entry Notice that total French exports to country j, X_{Fj}, can be written as

$$X_{Fj} = \lambda_{Fj} L_j y_j \ , \tag{19}$$

where λ_{Fj} is defined as the market share of France in j,

$$\lambda_{Fj} = \frac{X_{Fj}}{\sum_{\upsilon} X_{\upsilon j}} = \frac{\left(\tau_{Fj}\right)^{-\theta} J_F \left(b_F\right)^{\theta} w_F^{(1-\gamma)\left(1-\tilde{\theta}\right)-\theta}}{\sum_{\upsilon=1}^{N} \left(\tau_{\upsilon j}\right)^{-\theta} J_{\upsilon} \left(b_{\upsilon}\right)^{\theta} w_{\upsilon}^{(1-\gamma)\left(1-\tilde{\theta}\right)-\theta}} \ , \tag{20}$$

computed using equations (15), (12), and (9).

Combining this definition of total export sales with expressions (15) and (17) I obtain a relationship between the number of French firms exporting to a country, normalized by

French market share, to the population and income per capita of that country:

$$\frac{M_{Fj}}{\lambda_{Fj}} = L_j^{1-\alpha} y_j^{1-\gamma} \left[(y_F)^{1-\gamma} \frac{1}{\tilde{\psi}} \left(\frac{1}{1-1/\tilde{\theta}} - \frac{1}{1-1/\left(\tilde{\theta}\tilde{\beta}\right)} \right) \right]^{-1}, \tag{21}$$

where $\tilde{\psi} = \psi / [\sigma (1-\eta)]$.

The flip side of relationship (21) is the relationship between average sales and market size:

$$\bar{X}_{Fj} = \frac{\lambda_{Fj} L_j y_j}{M_{Fj}} = L_j^{\alpha} y_j^{\gamma} \left[(y_F)^{1-\gamma} \frac{1}{\tilde{\psi}} \left(\frac{1}{1-1/\tilde{\theta}} - \frac{1}{1-1/\left(\tilde{\theta}\tilde{\beta}\right)} \right) \right]. \tag{22}$$

An increase in market size, L_j or y_j, leads to an increase in the sales of exporters when $\alpha, \gamma > 0$. However, as long as $\alpha < 1$ and $\gamma < 1$, new entry implies that this increase in the sales of incumbents is less than proportional to the increase in market size.[15] Notice that the model is parsimonious in that it delivers predictions on aggregate bilateral sales (equations 15 and 22) and entry (equation 21) based on three parameters α, γ and ψ. In the case of the Melitz-Chaney framework as many fixed costs as destinations would have to be specified.[16]

Assumptions A.1 and A.3 allow the model to generate the robust relationship between French entry and market size, pointed out by EKK04. In fact, as suggested by equation (21), the logarithm of the normalized French market share is positively correlated with both the logarithm of the population, L_j, and the logarithm of income per capita, y_j. Empirically, the corresponding correlations for French firms are .49 and .80.[17] Figure 1 illustrates that there is also a tight association between the logarithm of average sales and the logarithm of population and income per capita. The correlations in this case are .62 and .57, respectively.

[15] The mechanism implies that sales of firms increase in larger markets, but their market shares decline. This intuition is reminiscent of the analysis of Sutton (1991). Sutton states that a given firm's market share might increase or decrease with market size. In the trade data, across all industries, average sales of firms always increase less than proportional with market size (in a very systematic way), as EKK04 argue. This result indicates a decline in their market shares due to entry.

[16] The term $1/\tilde{\psi}$ incorporates $1/\psi$, which corresponds to the fixed cost of entry in the case where $\beta = 0$.

[17] I approximate income per capita using manufacturing absorption from EKK04 divided by country population. Notice that the correlation between log population and log absorption per capita is very close to 0 (-.03).

Firm Sales Distribution The assumption that firm productivities follow a Pareto distribution implies that $\phi/\phi^*_{Fj} = [1 - \Pr_{Fj}]^{-1/\theta}$, where $\Pr_{Fj}$ denotes the sales percentile of a French firm in market j relative to other French firms in that market (see Appendix B). Substituting this expression and equation (17) into (14), sales can be written as

$$r_{Fj}(\Pr_{Fj}) = L_j^{\alpha} y_j^{\gamma} y_F^{1-\gamma} \frac{1}{\tilde{\psi}} (1 - \Pr_{Fj})^{-1/\tilde{\theta}} \left[1 - (1 - \Pr_{Fj})^{1/(\tilde{\theta}\beta)}\right] . \tag{23}$$

Thus, in the model, the distribution of exporting sales is robust across markets and changes only with the population, L_j, and income per capita, y_j, of the market. For the largest exporters in market j, as $\Pr_{Fj} \to 1$, the second parenthetical term tends to 1 and their sales follow a Pareto distribution with slope coefficient $-1/\tilde{\theta}$. The sales distribution of small exporters varies considerably with the parameter β. For $\beta > 0$, the distribution of sales exhibits deviations from the Pareto distribution. In particular, low productivity firms sell less per consumer and (endogenously) reach fewer consumers. The same mechanism also induces the sales of the smallest firms to tend towards 0, since for these firms, $n_{Fj}(\phi) \to 0$. In contrast, if $\beta \to 0$, the sales are bounded below by $L_j^{\alpha} y_j^{\gamma} y_F^{1-\gamma}/\tilde{\psi}$, since $n_{Fj}(\phi) = 1$ for all entrants.

Figure 2 depicts the sales distribution across markets for the 25th, 50th, 75th, and 95th percentiles. Conditional on the systematic increase with market size for each percentile, the distribution is markedly similar across markets (except for the 25th percentile, which is less responsive to market size). In terms of the size distribution of exporters within each destination market EKK10 point out that it exhibits Pareto tails for the relatively larger exporters in the market. Consistent with the endogenous cost model ($\beta > 0$) the authors also point out deviations from the Pareto distribution due to the existence of a large proportion of French exporters in each market that sell small amounts.

Productivity and Systematic Size Variation Guided by the data of EKK10, I consider the average sales in France of French firms selling to market j and the exporting intensity of the sales of firms selling to j to their sales in France.

I first define the average sales in France of firms selling to location j, as $\bar{X}_{FF|j}$. This statistic is computed by integrating the expression for sales (14) for France above the threshold of entry in country j, ϕ^*_{Fj}. The normalized average sales in France of firms selling to j are given by dividing by average sales in France, $\bar{X}_{FF}$:

$$\frac{\bar{X}_{FF|j}}{\bar{X}_{FF}} = \frac{\frac{\left(\frac{M_{Fj}}{M_{FF}}\right)^{-1/\tilde{\theta}}}{1-1/\tilde{\theta}} - \frac{\left(\frac{M_{Fj}}{M_{FF}}\right)^{-1/\left(\tilde{\beta}\tilde{\theta}\right)}}{1-1/\left(\tilde{\theta}\tilde{\beta}\right)}}{\frac{1}{1-1/\tilde{\theta}} - \frac{1}{1-1/\left(\tilde{\theta}\tilde{\beta}\right)}} \ . \tag{24}$$

The value of this expression for $j = F$ is 1. In addition, it is decreasing in M_{Fj}/M_{FF}, since the less productive firms sell only to the more popular destinations. The parameters $\tilde{\theta}$ and β affect this relationship in the same manner that they affect the sales distribution. The parameter $\tilde{\theta}$ determines the advantage in the sales per consumer in France of more productive firms. If $\beta > 0$, these firms also reach more consumers in France, which implies that the second parenthetical term is positive, adding curvature to the relationship for high M_{Fj}/M_{FF}.

I now compute the export intensity of firms normalized by the domestic sales intensity. For a firm that sells in both the domestic market and destination j, its relative percentiles in the two markets are related through the equation

$$1 - \Pr_{FF} = (1 - \Pr_{Fj}) \frac{M_{Fj}}{M_{FF}} \ .$$

Using this equation, and equation (23), the normalized export intensity of a French firm that belongs in percentile $\Pr_{Fj}$ in market j can be written as:

$$\frac{r_{Fj}(\Pr_{Fj})}{\bar{X}_{Fj}} \Big/ \frac{r_{FF}(\Pr_{FF})}{\bar{X}_{FF}} = \frac{1 - (1 - \Pr_{Fj})^{1/\left(\tilde{\theta}\beta\right)}}{\left(\frac{M_{Fj}}{M_{FF}}\right)^{-1/\tilde{\theta}} - (1 - \Pr_{Fj})^{1/\left(\tilde{\theta}\beta\right)} \left(\frac{M_{Fj}}{M_{FF}}\right)^{-1/\left(\tilde{\theta}\beta\right)}} \ . \tag{25}$$

The relationship is an identity for $j = F$. It is increasing in M_{Fj}/M_{FF}, since for high productivity firms a lower share of sales is of domestic origin. When $\beta > 0$, additional curvature is added to the relationship since the extensive margin of consumers is always greater in the domestic market. Finally, if $\beta \to 0$ there are no differences in the exporting intensity across different percentiles. This result merely reflects that, when $\beta \to 0$, the demand is of constant price elasticity.

Figure 3 depicts the normalized average sales in France as a function of how many firms sell to market j. The normalized average sales are decreasing in the number of firms selling to a market. The relationship is roughly log-linear for these destinations, but there is curvature as more popular destinations are included. The shape of the relationship is consistent with the endogenous cost model.

In Figure 4, I plot the normalized export intensity of the 25th, 50th, and 75th percentiles for all the destination markets. The values that the normalized exporting intensity takes are significantly below one, implying a large degree of sales heterogeneity (lower $\tilde{\theta}$) or additional curvature (higher values of β). Figure 4 also shows the distinct shift in the exporting intensity values for higher percentiles in each destination market, as the model with $\beta > 0$ would predict.

3.2 Trade Costs and Trade Growth

I now analyze the responses of firm sales to variable trade cost changes. Two important features of the endogenous cost model are crucial to understanding the growth of firms in this setting: the demand is asymptotically elastic, and the elasticity of exports is higher for firms with lower sales. The first feature implies that after a trade cost reduction, the largest firms in a market grow at a positive rate that (asymptotically) depends only on the price elasticity of demand, $\sigma - 1$. The second feature implies that firms with little previous trade will achieve higher growth when variable trade costs fall. In the endogenous cost model, these firms face a marginal cost to reach additional consumers which is increasing slowly.[18] Thus,

[18] In the online Theory Appendix, I show that the main results regarding cross-sectional firm sales and entry, related to Proposition 1, will hold using any function that satisfies properties P.1-P.3. For the results of proposition 2 to hold, i.e. small exporters to have a higher elasticity of demand than the large ones, a sufficient condition is that the rate of increase of the convexity of the marketing cost function is larger than the rate of increase of its marginal cost, $f_{111}/f_{11} > f_{11}/f_1$. Another function that satisfies all these properties is $f(n, L) = L^{\alpha}(1/(1-n)-1)/\psi$. As I show in the online Theory Appendix a similar result can be achieved by assuming a convex production cost function in the case of perfect competition. The restrictions on the production cost function required are exactly the same as the ones required for the micro-founded marketing cost function that I introduce. Additionally, a destination specific production function is required, which is clearly unrealistic.

a small decrease in variable trade costs brings about a large expansion of their consumer base. The following proposition formalizes this argument.

Proposition 2 (Elasticity of trade flows and firm size)
The partial elasticity of a firm's sales in market j with respect to variable trade costs, $\varepsilon_{ij}(\phi) = \left|\partial \ln r_{ij}(\phi) / \partial \ln \tau_{ij}\right|$, is decreasing with firm productivity, ϕ, i.e. $d\varepsilon_{ij}(\phi)/d\phi < 0$ for all $\phi \geq \phi^*_{ij}$.

Proof. I use equation (14) to compute the partial elasticity of trade flows $r_{ij}(\phi)$ with respect to a change in τ_{ij}, namely $\left|\partial \ln r_{ij}(\phi) / \partial \ln \tau_{ij}\right| = |\zeta(\phi)| \times \left|\partial \ln \phi^*_{ij} / \partial \ln \tau_{ij}\right|$, where

$$\zeta(\phi) = \underbrace{(\sigma - 1)}_{\substack{\text{intensive margin} \\ \text{of per-consumer} \\ \text{sales elasticity}}} + \underbrace{\frac{\sigma-1}{\beta}\left[\left(\frac{\phi}{\phi^*_{ij}}\right)^{(\sigma-1)/\beta} - 1\right]^{-1}}_{\substack{\text{extensive margin of} \\ \text{consumers elasticity}}}.$$

Notice that $\zeta(\phi) \geq 0$ for $\phi \geq \phi^*_{ij}$. $\zeta(\phi)$ is also decreasing in ϕ and thus decreasing in initial export sales. In fact, as $\beta \to 0$ then $\zeta(\phi) \to (\sigma - 1)$ for all $\phi \geq \phi^*_{ij}$. ■

The proposition implies that trade liberalization benefits relatively more the smaller exporters in a market. The parameter β governs both the heterogeneity of exporters cross-sectional sales and also the heterogeneity of the growth rates of sales after a trade liberalization.

In recent years, increased attention has been devoted to the growth of aggregate trade due to new exporters (or new goods), namely, the "new firms" (goods) margin. This attention stems partly from the fact that models with this feature can explain the large increases in trade due to trade costs reductions, without assuming unrealistically high elasticities of substitution. The mechanism that I propose has drastic effects on the importance of small exporters to overall trade growth, the "new consumers" margin, compared to the importance of new exporters. In particular, the first order effect of the new consumers margin is larger than the one of new firms. Notably, whereas the channels of trade growth are different, the partial elasticity of relative import flows, X_{ij}/X_{jj}, with respect to trade cost changes depends only on the heterogeneity parameter, θ, exactly as in the Melitz-Chaney framework.

Proposition 3 (Trade elasticities in the endogenous cost model)
If $\beta > 0$,
(a) To a first order approximation, the elasticity of the new consumers margin with respect to changes in variable trade costs, τ_{ij}, *is larger than the elasticity of the new firms margin.*
(b) The partial elasticity of relative import flows, X_{ij}/X_{jj}, *with respect to variable trade costs,* τ_{ij}, *is* θ, *i.e.* $\left|\partial \ln\left(X_{ij}/X_{jj}\right)/\partial \ln \tau_{ij}\right| = \theta$.

Proof. I perform a decomposition using Leibnitz's rule to separate the three margins. The change in total export sales of country i to country j due to a small change in variable trade costs can be decomposed into three margins:

$$\begin{aligned}\frac{dX_{ij}}{d\tau_{ij}} \;=\; & \underbrace{J_i \int_{\phi_{ij}^*}^{\infty} n_{ij}(\phi) \frac{d\left(p_{ij}(\phi) x_{ij}(\phi)\right)}{d\tau_{ij}} g_i(\phi)\, d\phi}_{\text{Intensive margin growth}} + \underbrace{J_i \int_{\phi_{ij}^*}^{\infty} \frac{dn_{ij}(\phi)}{d\tau_{ij}} p_{ij}(\phi)\, x_{ij}(\phi)\, g_i(\phi)\, d\phi}_{\text{New consumers margin}} + \\ & + \underbrace{J_i n_{ij}(\phi_{ij}^*) p_{ij}(\phi_{ij}^*) x_{ij}(\phi_{ij}^*) g_i(\phi_{ij}^*) \frac{d\phi_{ij}^*}{d\tau_{ij}}}_{\text{New firms margin}}. \qquad (26)\end{aligned}$$

Using equation (26), I can compute the following decomposition in terms of percentage changes (see Appendix B):

$$\frac{d\ln X_{ij}}{d\ln \tau_{ij}} = \underbrace{(1-\sigma)\frac{d\ln \phi_{ij}^*}{d\ln \tau_{ij}} + (1-\gamma)\frac{d\ln w_i}{d\ln \tau_{ij}}}_{\text{Intensive margin growth changes}} + \underbrace{(-\theta+\sigma-1)\frac{d\ln \phi_{ij}^*}{d\ln \tau_{ij}}}_{\substack{\text{New consumers} \\ \text{margin changes}}} + \underbrace{0}_{\substack{\text{New firms} \\ \text{margin changes}}} \qquad (27)$$

where w_j is chosen as the numeraire. For part (a), the new consumers margin elasticity is the absolute value of the second term of the decomposition. Given the assumption $\theta > \sigma - 1$, equation (27) implies that this elasticity is generically positive. Moreover, since $n_{ij}\left(\phi_{ij}^*\right) = 0$, expression (26) implies that, to a first order, the new firms margin elasticity is 0. As for part (b), the decomposition obtained in part (a) can be used to obtain the result that the partial elasticity of relative import flows, X_{ij}/X_{jj}, is only a function of θ, as discussed in the Appendix. ■

The model implies that the first order contribution of the new consumers margin of consumers to trade is significant. Now, I show the model's welfare implications by adapting the methodology of Arkolakis, Costinot, and Rodríguez-Clare (2009) to compute the first order effects of a change in trade costs to welfare. Thus, I compute the negative of the changes of the ideal price index defined in (4) using the Pareto distribution assumption (derivations in the Appendix):

$$-\frac{d\ln P_j}{d\ln \tau_{ij}} = \underbrace{-\sum_{\upsilon}\lambda_{\upsilon j}\left(\frac{d\ln w_\upsilon}{d\ln \tau_{ij}}+1\right)}_{\text{Intensive margin}} \underbrace{-\sum_{\upsilon}\lambda_{\upsilon j}\left(\tilde{\theta}-1\right)\frac{d\ln \phi^*_{\upsilon j}}{d\ln \tau_{ij}}}_{\text{New consumers}} + \underbrace{0}_{\text{New firms}} .$$

Proposition 3 implies that the welfare changes due to trade costs, to a first order, are coming only through the intensive and the new consumers margin. Notice that although the new consumers margin affects welfare, the shape of the marketing cost function, governed by β, does not. This effect is precisely because the overall trade elasticity does not depend on β. In fact, as shown in Arkolakis, Costinot, and Rodríguez-Clare (2009), the overall gains from trade can be computed as a function of the market share of domestic goods before and after the trade costs changes, λ_{jj} and λ'_{jj}. The formula for the welfare changes is given by $\left(\lambda'_{jj}/\lambda_{jj}\right)^{-1/\theta}-1$ and thus, conditional on trade shares, the normative predictions of the model regarding overall gains from trade are independent of β and σ.[19] This formula can be derived using the price index, the definition of the cutoff productivity (9), and the equation for market shares (20).

3.3 Evidence on Trade Growth and Trade Margins

To test Propositions 2 and 3, I need to distinguish firms or goods that were positively traded or not traded before a trade liberalization episode. To do so, I extend the methodology of Kehoe and Ruhl (2003).

Evidence Using Product-Level Data I first look at product-level data by making

[19] However, as long as $\gamma < 1$, the predictions of the model for changes in trade shares due to a given decline in trade costs will depend on σ as equation (20) indicates. This point is elaborated in Arkolakis, Costinot, and Rodríguez-Clare (2009).

use of the strict mapping that the model implies, namely that each firm produces only one good. The liberalization experiment discussed is the US-Mexico NAFTA trade liberalization episode, which went into effect on January 1^{st} 1994. In this analysis, I use the International Trade by Commodity database of the OECD.[20] These data cover a period of 11 years, 1990-2000, which encompasses 1994, the year that NAFTA went into effect. The data are recorded at the 6-digit Harmonized System (HS) encoding and cover all the imports and exports of OECD countries.

During the decade of reference, the share of manufacturing imports of the United States originating from Mexico increased from 5.2% to 10.3%. The growth of this share in the years before NAFTA was moderate, around $4.1 - 5.5\%$ per year, whereas the establishment of NAFTA was associated with faster growth from 1994 to 1997, at a rate of $9.0 - 12.5\%$. As Romalis (2007) points out, the increase was slower during 1998-2000, ranging around $3.5 - 4.9\%$.

Next, I construct a classification of the goods. I call the goods traded throughout the years 1991-93 "previously traded" goods. I classify the previously traded goods into 10 categories, each composed of an equal number of goods. These categories include goods in an increasing order of volume of trade: category 1 includes the previously traded goods that were on average least traded in 1991-93, and category 10 the most traded ones. The goods that were traded in 1998-2000 (at least once in these three years) but not throughout the years 1991-93 are referred to as "newly traded" goods. According to this classification, there are 2195 previously traded goods and 1640 newly traded in the HS-6 digit data during that period.

Finally, to alleviate issues of mean reversion, taking averages of the growth rate over a set of years is also appropriate. I compute the ratio of trade for each decile of goods

[20] The OECD data, to the best of my knowledge, provide the most detailed classification of goods that is consistent over time. Inconsistencies may arise in other datasets because of the continuous introduction of new subcategories of goods, which need to be reclassified to the old ones. This reclassification was done in the OECD data at the 6-digit level (see Appendix for discussion), but it is much harder at lower levels of dissagregation. For example, using the 10-digit data of Feenstra, Romalis, and Schott (2002) for the United States I was not able to reassign more than one-third of the new categories appearing after NAFTA to categories that existed before.

between 1991-98, 1992-99, and 1993-2000 and take the average of these numbers. The ratio of imports of the 10 categories of previously traded goods is illustrated in Figure 5. This figure also shows the relevant numbers for imports of the US from France, Germany, and the United Kingdom. During the decade of reference, the United States did not experience any major trade liberalization episodes with these three major trade partners. In line with the theory, the fact that stands out for the US-Mexico episode is the very large growth of trade, especially in the deciles with low initial trade.[21] The related shares of imports to total and new trade for each category of goods are reported in Table 2. I now illustrate two facts for the US-Mexico NAFTA liberalization that offer support to the predictions of the model.

O 1 ***Among the previously traded goods, there is a reallocation of trade shares toward the goods with less trade before the NAFTA liberalization.***

The top left panel of Figure 5 implies that the growth rate of trade is higher for the categories of goods with lower initial volume of trade. Figure 6 illustrates the reduction in the ratio of trade costs to total imports for each decile of previously traded goods in 1991-93, using HS-6 digit data on imports, duties paid, and insurance and freight costs from Feenstra, Romalis, and Schott (2002). The reduction of the ratio of trade costs to total imports is very similar across deciles (except the ratio of charges and freights to total imports for the first decile where it declined the most and for the last decile where it effectively remained constant). Thus, even though the drop in tariffs is associated with trade growth, as Romalis (2007) finds, trade growth depends also on initial trade, as Figure 5 suggests. The higher growth rates of the deciles of goods with little previous trade directly implies a reallocation of market shares in total and new trade after NAFTA. Table 2 illustrates the initial and final imports shares for each decile. Notice that the market share of the first 8 deciles grew

[21]Kehoe and Ruhl (2003) report similar findings by comparing a large number of country pairs with and without major trade liberalizations. The fact that the goods with little trade grow faster than the most traded goods is a feature of the endogenous cost model for symmetric changes in trade costs. In addition, consistent with the model, the absolute difference in growth rates between these sets of goods increases with the magnitude of the trade cost declines. In the Online Theory Appendix I provide more details on the predictions of the model in the case of the trade of the US with France, Germany, and the United Kingdom.

from 6.8% before the NAFTA to 14.8% after. Their share to the trade accounted by all the 10 previously traded deciles also more than doubled. Finally, these 8 deciles accounted for 18.5% of new trade. Overall, the HS-6 goods evidence offers strong support to Proposition 2.

O 2 ***The contribution of the new goods to the overall increase in trade is small.***

I can now look at the contribution of newly traded goods to new trade and overall trade after the NAFTA liberalization. Table 2 implies that after NAFTA newly traded goods have only a small share in new trade as well as in overall trade. The level of this contribution amounts to 4.5% and 3.3%, respectively. This finding offers direct evidence for Proposition 3 and implies that the modeling of the extensive margin of consumers is crucial for understanding trade flows of goods during a trade liberalization episode.

Robustness: Firm-Level Data Overall, the results of Propositions 2 and 3 are strongly supported by the product-level data. In Appendix A, I discuss related findings using the firm-level data of Molina and Muendler (2008). The liberalization episode that I study there is the gradual elimination of Argentinian tariffs to Brazil, between 1991-94, following the Mercosur agreement.

Fact O.1 still stands out in the firm-level data as the growth of the total trade in the least traded of these deciles is still higher. However, the firm-level data show that a disproportionate amount of firms exporting to Argentina after the emergence of the Mercosur were not trading before the agreement. This fact is the result of a combination of a large attrition of previously trading firms but also of the fact that many new firms started exporting after the agreement.[22] The findings indicate that the fact O.2 for NAFTA may not be robust to the analysis using firm data.

An analysis of firm-level dynamics seems to be more appropriate to study firm-level data for a trade liberalization episode. Such an analysis is beyond the scope of this paper. An extension of this model that allows both for higher growth of smaller firms as well as high levels of attrition is undertaken by Arkolakis (2009). Instead, in the next section, I will

[22] Such attrition is not present in the product-level data were more than 95% of the "previously traded" goods are traded at least once during 1998-00.

investigate the quantitative predictions of the model for the growth of individual goods in the NAFTA liberalization.

3.4 Discussion of the Results

To offer a better understanding for the importance of my assumptions, I summarize the main predictions of the model in relation to these assumptions.

Firm Entry Patterns To deliver the positive relation between firm entry and market size, monopolistic competition is arguably a key assumption. Monopolistic competition allows the number of varieties consumed in a country to be endogenous and directly related to market size. By using a tractable formulation of market-specific entry costs and appropriately choosing their parameters, α and γ, the monopolistic competition model with CES demand can generate the correct relationship between firm entry and the size of the market. Alternatively, the CES demand could be replaced by a non-homothetic demand system. Assuming that demand system would imply that entry is related to income per capita but not necessarily to the population of the market. Intuitively, in a model without entry costs, the benefit of dividing such a cost across a larger number of consumers does not exist. In the online Theory Appendix, I illustrate this fact for the linear demand case of Melitz and Ottaviano (2008). I also argue that there is little chance for a simple non-homothetic demand structure to deliver the correct relationship of entry with income per capita.

CES Demand, Sales Distribution, and Trade Growth I have argued that this model can provide a justification of the higher elasticity of sales of small firms/goods that sell in a market. Alternatively, demand structures such as the one proposed by Melitz and Ottaviano (2008) depart from the assumption of a CES aggregator by assuming an asymptotically inelastic demand. However, the demand that I propose combines, for the first time, deviations from the CES demand with an asymptotically elastic demand. This model is consistent with the observed distribution and growth of sales of both small and large firms: because of the asymptotically elastic demand, differences in productivity translate to differences in sales even for the largest firms. The elastic demand also implies that a reduction in trade costs induces the largest firms to grow. These facts cannot be captured by a model that assumes an asymptotically inelastic demand.[23]

Discussion of the Market Penetration Costs Story So far, I have focused on a marketing story based on a theory of informative advertising. However, the theory as presented lends itself to a variety of different interpretations of what these market penetration costs are. The key assumption is that each extra dollar spent in a "marketing" activity, whatever this activity might be, leads to decreasing additional revenues either because of decreasing returns into the marketing technology or because of decreasing revenues accrued from sales. Regardless of the source of this reduction, the effect on the overall sales of the firm is the same. For example, a direct reinterpretation of the informative advertisement is that of persuasive advertisement, where it is increasingly more difficult to "convince" potential buyers to purchase more of a firm's good. A different interpretation would be one in which consumers have different (random) evaluations for each firm's good and the firm pays the same fixed cost to reach additional consumers. The firm can make more revenue from consumers with a higher evaluation, so it will reach these consumers first.[24] Both isomorphisms are developed and discussed in the online Theory Appendix. Finally, a partial isomorphism, discussed in Arkolakis and Muendler (2010), is to allow each firm to introduce additional varieties (multiproduct firms) where each variety would yield decreasing revenues.

[23] Of course, postulating a demand structure that is asymptotically elastic inevitably involves a modeling of demand similar to CES, as the subsequent work of Simonovska (2009) and Wiseman (2009) has shown. Additionally, the framework that I propose is extremely tractable, making it valuable for quantitative applications.

[24] A similar behavior might be generated by a model where firms have random access costs for each consumer. Thus, some consumers will be more remote for a given firm than others. Another possible story would be the existence of foreign trade intermediaries, which are used only by small firms. Large firms would pay higher entry costs to set-up their own marketing technology such as foreign wholesale trade affiliates. Evidently, intra-firm exports of foreign firms to their US wholeshale trade affiliates accounts for a dominant part of intra-firms exports to the US as Zeile (1997) points out. Thus, this type of intra-firm trade could be an important part of global intra-firm trade which in turn amounts to roughly one third of total trade according to Antras (2003). An intermediaries theory is discussed, in order to model dynamic marketing frictions, in Drozd and Nosal (2008).

4 Quantitative Analysis

I calibrate the model to match the patterns of aggregate bilateral entry and average sales/exporting intensity of French firms. I look at the predictions of the calibrated model for the size distribution of exporters.

4.1 Calibration

The calibration conditions on the actual population, L_j, income per capita, y_j, and the number of French entrants for each of the 112 exporting destinations of French firms. To calibrate the model, I look at the predictions of the model regarding (a) the relationship between the average sales of French entrants in each exporting country as a function of the population and income per capita of that country, equation (22), which will allow me to determine parameters α, γ, independently of the other parameters of the model, and (b) the relationship between the number of firms selling to a market and their normalized average sales in France, and their exporting intensity, equations (24) and (25). Relationships (b) only involve parameters $\tilde{\theta}$ and β and thus can be used to independently calibrate these parameters as well. All these relationships in the model are largely independent of idiosyncratic sources of variation.[25] Thus, they are appropriate to identify how overall productivity advantage translates into more entry and higher sales.

Parameters Determining Firm Entry and Average Size The first objective is to pick α, γ so that, given the observed y_j and L_j, the predictions of the model regarding average sales are as close to the data as possible. The logarithm of equation (22) will be used to estimate α, γ using an OLS regression. To substantiate an error term that is orthogonal to the regressors in the RHS of relationship (22), I assume that there is classical measurement error in the trade data. Additionally, to address potential endogeneity or measurement error concerns in income, I also use a 2SLS methodology, instrumenting for y_j. In particular, the

[25] In the online Theory Appendix, I show that equations (22) and (24) are not affected by idiosyncratic entry shocks. I also argue that the specification of idiosyncratic entry shocks affects (25) only insofar it affects the absolute value of each of the percentile terms in that relationship. Heterogeneous entry costs are considered by Ruhl (2005) and EKK10.

model implies that the technology of country j, i.e. the parameter b_j, only affects average sales through its effect on y_j. Thus, as suggested by the model, I use a proxy of technology, namely the average years of education, as an instrument for y_j (again, see Appendix for data description).[26]

The OLS regression on all French exporting destinations delivers $\alpha = .43$ and $\gamma = .29$ with R^2 of .70. The 2SLS estimates are of similar magnitude ($\alpha = .43$, $\gamma = .28$). The coefficients are statistically significant at the 1% level, of the correct sign and lie between 0 and 1, as predicted by the theory. The coefficients of this regression also predict the logarithm of relationship (21) in the best mean square sense with $R^2 = .89$. Since the estimates of the OLS and the 2SLS are very similar I use the OLS estimates in what follows. The value of $\alpha = .43$ falls within the lower values of the estimates reported in section 2 using data on advertising costs.

The constant of the regression is used to determine ψ given the estimates of the rest of the parameters below and the details are discussed in the Appendix A.

Parameters Determining Firm Sales Advantage I now turn to determine β and $\tilde{\theta} = \theta / (\sigma - 1)$ by looking at the advantage of prolific exporters uncovered by equations (24) and (25). Notice that parameters θ and σ affect equations (24) and (25) (and (23)) only insofar they affect $\tilde{\theta}$. Higher θ implies less heterogeneity in firm productivities (and thus in firm sales), whereas higher σ translates the same heterogeneity in productivities to larger dispersion in sales.

For the calibration, I use a simple method of moments estimator. In particular, I pick β and $\tilde{\theta}$ so that the mean of the left-hand side is equal to the mean of the right-hand side for both equation (24) and equation (25) evaluated at the median percentile in each market j. The solution delivers $\beta = .915$ and $\tilde{\theta} = 1.65$.[27] This value of β has the appeal of being close

[26] See Anderson and Van Wincoop (2004) for a discussion of measurement error in the trade data and the instruments typically used for total income. The choice of my instrument of years of education is adapted by Eaton and Kortum (2002) since this is the best proxy for technology that is available across a large number of countries.

[27] EKK10 estimate a $\beta \simeq 1.1$. They allow for firm idiosyncratic sales and entry shocks. Using more moments from the French data, the authors are able to identify how much of the variation in entry and sales is attributed to efficiency and how much from idiosyncratic shocks. In the online Theory Appendix, I

to the theoretical value of 1. Table 1 summarizes the calibration of the benchmark model.

Using equation (24), the method of moments estimator for the fixed model with $\beta = 0$ gives a $\tilde{\theta} = 1.49$. I will use this parameterization for the fixed cost model for means of comparison. The fit of both models is illustrated in Figures 7 and 8. In order to predict well the average sales in France of French firms selling to the most popular destinations versus those of all French firms the fixed cost model needs a lot of heterogeneity, which results to a lower estimate of $\tilde{\theta}$.[28]

To complete the calibration of the model, I will assign magnitudes to σ and θ. Broda and Weinstein (2006) estimate the elasticity of substitution for disaggregated categories. The average and median elasticity for SITC 5-digit goods is 7.5 and 2.8, respectively (see their table IV). A value of $\sigma = 6$ falls in the range of estimates of Broda and Weinstein (2006) and yields a markup of around 1.2, which is consistent with those values reported in the data (see Martins, Scarpetta, and Pilat (1996)).[29] In addition, $\tilde{\theta} = 1.65$ and $\sigma = 6$ imply that the marketing to GDP ratio, given by equation (16), is around 6.6%, which is within the range of marketing to GDP ratios reported in the data. Finally, this parameterization implies that $\theta = 8.25$ for the endogenous cost model, which is very close to the main estimate of Eaton and Kortum (2002) (8.28) and within the range of estimates of Romalis (2007) ($6.2 - 10.9$) and the ones reported in the review of Anderson and Van Wincoop (2004) ($5 - 10$). Since the model retains the aggregate predictions of the Melitz-Chaney framework if θ is the same I will calibrate the two models to have $\theta = 8.25$. For the fixed cost model, the estimated value of $\tilde{\theta} = 1.49$ implies $\sigma = 6.57$.

illustrate the robustness of model predictions to different parameterizations.

[28] In the French data, 77.5% of the total sales of French firms in France is coming from the exporting firms that constitute 14.8% of all firms. With the parameterization suggested the endogenous cost model predicts this number to be 67.2% while the fixed cost model 53.8%. In the model, a lower $\tilde{\theta}$ and a higher β imply higher share of exporters to sales in France.

[29] The value of $\sigma = 6$ is higher than the values used in the business cycles literature (around 2) or values previously estimated using models of trade with heterogeneous firms (e.g. Bernard, Eaton, Jensen, and Kortum (2003) report that $\sigma = 3.79$ is the value that allows their model to match the productivity and sales advantage of exporters in the US data).

4.2 Predictions on the Size Distribution of Firms

Calibrated to match the overall advantage of prolific exporters in terms of sales in France and their median exporting intensity, the model generates additional testable implications that can be confronted with the data.[30] Careful inspection of expression (25) reveals that the levels of normalized exporting intensity across percentiles, Pr_{ij}, differ only if $\beta > 0$. Allowing for adjustment in the consumers margin implies that exporting firms will invest systematically more in that margin in the domestic market rather than in the exporting markets. This effect is apparent for low percentiles in the foreign markets. In fact, for high percentiles in the exporting markets, the predicted exporting intensities converge to the ones predicted by the theory with $\beta = 0$. The variation of exporting intensity across percentiles is apparent in Figure 9. The model calibrated to match the median percentile does very well in predicting the 25th percentile, but it underpredicts the normalized exporting intensity of the 75th percentile.

Now I examine the quantitative predictions of the model for the distribution of exporting sales across markets. Figures 10 and 11 illustrate the predictions of the calibrated endogenous cost and fixed cost model, respectively. Owing to the identical parameterization of α and γ, both models capture the increase in sales for each percentile as a function of the size of the market. Moreover, the calibrated endogenous cost model delivers improved predictions regarding the sales of the 25th percentile.

To separate out the effects of increases in market size to the sales of firms, Figure 12 presents the distribution of sales normalized by mean sales. I categorize the markets in three groups depending on the total sales of French firms (Sma, Med, Lar) and present the average of the group for each percentile. The distribution of sales is notably similar across the three categories (except for the slight increase in the variance with the size of the group). In terms of predictions of the theory, both the endogenous and the fixed cost model imply a Pareto distribution of sales for the highest percentiles and thus can successfully predict

[30] These testable implications can be reinterpreted as additional (overidentifying) restrictions in a generalized method of moments estimation of the model's parameters. This approach is essentially followed (in a much larger scale) by EKK10, whereas I choose a calibration methodology to illustrate the predictive power of the new theory.

the distribution of sales for the larger firms in each market. In addition, the endogenous cost model predicts well the sales of the firms in the lower percentiles. The fixed cost model typically overpredicts the size of the smallest exporters (5^{th} percentile) by one or two orders of magnitude.

Finally, notice that lower values of $\tilde{\theta}$ could improve the predictions of the model for the size distribution of exporters within each destination whereas the fixed cost model is unable to capture the curvature in the distribution of smaller exporters. Nevertheless, low values of $\tilde{\theta}$ imply that the model grossly underperforms in terms of the predictions related to Figures 7-9. Therefore, the small discrepancy between the endogenous cost model and the data in terms of the distribution of sales within a market is symptomatic of un-modeled market-specific heterogeneity. Having successfully evaluated the ability of the model to predict the data, I will now use the model to perform counterfactual experiments of trade costs reductions.

5 Counterfactual Experiments: Trade Liberalization

I now quantitatively assess the ability of the model to match the patterns of trade flows after trade liberalization episodes. I choose the reduction in variable trade costs so that the two models match the share of Mexican goods in total US manufacturing expenditure, which has risen from 1% in 1991 to 2.6% in 2000. The additional calibration and data required for this experiment are described in Appendix A. All else equal, the corresponding decrease in trade costs is 8.9% for both models, which differs from the actual numbers in Figure 6 by 5% on average across categories. In Figure 13, I plot the predicted increase in growth for each category of previously traded goods along with the actual data. The endogenous cost model delivers a close match to the data, whereas the fixed cost model falls short of predicting the empirical pattern. Thus, the interaction between the extensive margin of consumers and the CES preferences allows the endogenous cost model to successfully replicate the increase in trade flows after the establishment of NAFTA, providing a solution to the puzzle reported by Kehoe (2005).

To evaluate the contribution of the new margin to the increase in total trade flows, I look at the predicted density of exports for firms with different productivities before and after the simulated trade liberalization episode. In Figure 14, I graph the predictions of the models for the contribution of intensive margin growth, the new firms margin, and the new consumers margin with respect to the change in aggregate trade flows for the calibrated US-Mexico trade liberalization episode. Consistent with what the theory predicts, relatively small trade cost changes imply that adjustments in the new consumers margin will be substantially larger for firms with small (but positive) numbers of consumers before the trade liberalization. I also use the model with $\beta > 0$ to decompose the percentage contribution of the three margins to new trade. The numbers for the intensive, new firms, and consumers margin are 51%, 16%, and 33%, respectively. In contrast, the model with $\beta = 0$ would predict that the percentage contribution of new firms is 49%.

The above calculations imply that up to 1/3 of new trade was not correctly accounted for by previous theory. Yet the results of subsection 3.2 imply that the model retains the desirable properties of the Melitz-Chaney framework at the aggregate level. Thus, the endogenous cost model gives improved predictions for the growth at the disaggregated level while confirming the robustness of previous estimates of the welfare gains from trade.

6 Conclusion

I propose a new formulation for the modeling of entry costs into individual markets. This formulation helps to reconcile a number of facts on the size and growth of sales of individual exporters and goods. The proposed framework is notably simple, amenable to a variety of exercises, and contributes to a better understanding of the data. This context nevertheless ignores a number of aspects of firm behavior, such as firm dynamics or possible variation of the market penetration costs across markets. Together with ideas developed here, these avenues are explored in new theories such as Eaton, Eslava, Krizan, Kugler, and Tybout (2008) and Arkolakis (2009). These theories promise to shed more light on individual exporter behavior and the growth of trade in trade liberalization episodes.

A Data Appendix

A.1 Evidence on Marketing Costs

Marketing Costs as a Fraction of GDP[31] US advertising expenditure, across the years 1919 to 2007, is publicly available in a dataset convenient for extensive analysis.[32] The data indicate that the advertising expenditure to GDP ratio is a balanced figure around 2-2.5% of GDP since 1982. These data include advertising on TV, newspapers, radio, magazines and other periodicals, in telephone directories (yellowbook), and on the Internet. They also quantify expenses on other media used for advertising, such as direct mail, billboard and outdoor advertising, and advertising in business papers (trade press). The main source of these data is universal McCann http://www.mccann.com.

The above data do not include forms of marketing such as brand sponsorship and public relations, sales promotion, and interactive marketing. Barwise and Styler (2003) estimate that the spending on these forms of marketing might be as high as the advertising expenditure for 2001-04. Using this expanded definition marketing spending is as much as 4-5% of GDP for 2001-04.

Finally, if the definition of marketing is extended to include marketing events (such as trade shows, telephone sales, supporting product materials, hiring of outside marketing personnel) the estimated marketing spending can raise up to 7.7% of GDP. To compute this figure I used the estimates of Butt and Howe (2006) for an actual $977 billion dollar spend on marketing in the United States of America (US) on 2005 and GDP data from the Bureau of Economic Analysis.

Marketing Costs and Market Size To investigate the relationship between the CPM and the size of the population in a market I collect data on CPM for TV, radio and newspapers. CPM stands for Cost Per Mille, where Mille is the Latin thousand. It is constructed as the cost of an advertisement divided by the exposure of the advertisement (audience for

[31] I am greatly indebted to Rachel Stampfli and Reach Caribean for kindly preparing CPM information for TV, newspapers, and Radio for the Caribbean markets and Jeffrey Campbell and Hugo Hopenhayn for sharing the information on advertising cost for US newspapers. I am also grateful to Joseph Butt and Carl Howe for providing me with the Butt and Howe (2006) report, Carly Litzenberger with AC Nielsen for providing CPM for TV across designated markets in the US and Jonathan Barnard with Zenith Optimedia for providing data CPM data for TV across Western Europe.

[32] http://purplemotes.net/2008/09/14/us-advertising-expenditure-data/

TV, circulation for newspapers) times a thousand. For the case of multiple media within a market I take weighted averages where the weights are the exposure for each media. In two cases where information for exposure is not available I simply divide the cost of the advertisement by population and take simple average for the case of more than one media. I run a regression of the logarithm of the CPM on the logarithm of population and income per capita of the market. The estimated coefficient on the logarithm of population is always negative and varies between -.107 to -.67. It is statistically significant at the 5% level at all but the case of TV data for Western Europe where the coefficient is negative but not significant. Interestingly, the estimated coefficients for newspapers is less negative than the one for TV (when I compare the estimated coefficients for the same set of markets). The newspapers example would be closer to the example of flyers where the returns to scale are not so strong.

The TV data include CPM for a) the US, across 210 designated market areas using ratings data provided by Nielsen, b) Western Europe, across 16 countries using data provided by Zenith Optimedia c) The Carribean area, across 16 markets using data provided by Rachel Stampfli and Reach Caribbean. The newspaper data include CPM for a) the US, across 236 metropolitan statistical areas using advertising rates provided by Campbell and Hopenhayn (2005), b) The Carribean area, across 13 markets. The radio data include CPM for the Carribean area, across 16 markets. All the rest of the details are described in the online Data Appendix.

A.2 Trade Data Description

French Firm-Level Data I use moments from the data of EKK10 that include France and 112 exporting destinations. The total number of French firms is 229,000 from which only a subset exports. The information includes the sales of manufacturing firms (with the occupation as declared in the mandatory reports of French firms to the fiscal administration) for their manufacturing products excluding only the firms in construction, mining and oil.

Population and Manufacturing Absorption Data Data on population are from the World Development Indicators (WDI) of the World Bank. In the case of missing values I use data from Penn World Tables. Data on manufacturing absorption and share of French firms' sales in 1986 in particular markets are taken from EKK04 (see their paper for details).

Educational Data Data for education for 1985 are obtained from Kyriacou (1991). There are 15 instances of missing data which are filled out using the Barro and Lee (2000) databases and 2 countries for which data are not available (Albania and Oman) which I treat as missing observations.

Trade by Commodity Data I use import data from the OECD International Trade by Commodity database (www.sourceoecd.org). In general, the reporting of trade flows from importing countries is more accurate. The results of my analysis remain the same if I instead use the data on Mexican exports. The data are recorded using the Harmonized System (HS) 1988 revision (rev. 1) at the 6-digit level of detail and the OECD database contains information on 5404 goods. Data on HS rev. 1 are available from 1990-2000. I report two inconsistencies in the US imports data. First, the imports of the US from Mexico reported by the US and the exports of Mexico to the US reported by Mexico, are not the same, particularly for 2000. But since the results do not depend on the choice of the year I choose to include the year 2000. Also note that trade flows at the 6-digit level add up to aggregate trade flows from 1990-1995. From 1996, there is an average of 1%-2% of trade flows that are not recorded in the 6-digit trade flows. The reason is that the HS was revised in 1996 (rev. 2), and the data on trade flows from 1996 onward were initially reported according to the rev. 2 and then translated to the HS 1988 (rev. 1). In this reclassification, goods that could not be categorized back in rev. 1 were discarded. Even though some of the trade flows are missing at the 6-digit level, there is no observable persistent inconsistency that could lead to a mistaken interpretation of the data.

Grouping the Goods The 10 categories that I define include goods in increasing order of total volume of trade during 1991-93. By considering only the goods that are traded throughout all the years of 1991-93, I avoid including goods that are randomly or very rarely traded. With this adjustment I also avoid –to some extent– including new goods that tend to grow for some years after their introduction before reaching steady state levels and could create a bias towards higher growth of least traded goods. By allowing for goods that stopped being traded after 1993 to be in the sample I adjust towards selection of only surviving goods that would create higher growth rates for the least traded goods categories.

Finally, I consider only the manufacturing goods. Thus, I drop all the HS codes below 100000. I also drop the categories that are not classified, categories 970000 and above. I construct figures related to aggregate trade data by aggregating commodities reported at the HS-6 digit classification to higher levels of aggregation. This aggregation creates a small downward bias due to reclassification issues described in the previous paragraph. The above procedures for grouping the goods are used both for the OECD but also for the Feenstra, Romalis, and Schott (2002) data for trade costs and trade flows.

Related to the definition of newly traded goods, the definition allows for goods that only appear one or two years throughout 1991-93 to be included. Thus, it is more favorable towards a higher importance of new goods in the event of a trade liberalization.

Domestic Absorption Data for the US The share of Mexican imports on US domestic manufacturing absorption is constructed as follows. I first construct manufacturing absorption for the US using OECD STAN data for total output, total imports and total exports from the same database (absorption=output-exports+imports) to avoid bias from using different data. I then divide the bilateral imports of US from Mexico using the aggregated OECD trade data with manufacturing absorption to construct the trade shares.

A.3 Brazilian Exporters

Evidence Using Firm Level Data: Brazilian Exporters

The Brazilian manufacturing data cover the universe of Brazilian exporting transactions at the exporter level. Following the Mercosur, Argentina has become the second most important exporting destination of Brazil (the top destination is the US which was not part of the Mercosur). As a result of the Mercosur free trade agreement that was signed on March, 1991 and fully implemented by the end of 1994 the share of Brazilian exports allocated to Argentina from 2.1% to 13.3% between the years 1990 to 1998.

I repeat the analysis at the firm-level by following the same methodology as I did with the product-level data. The reference years are now 1990-92 to 1996-98 and are chosen mainly because of data limitations: the firm-level data cover the period 1990-2001 and are denominated in US dollars for intertemporal comparisons. However, the Brazilian devaluation of 1999 seriously disrupted the figures of that year. An additional problem is that the start of the agreement coincides with the first set of years, 1990-92 so that trade started growing very early in my sample.

I first look at the "previously trading," firms in 1990-92 classified into deciles as in the product-level analysis. The results are summarized in Table 3, where, for each category, I compute the following numbers: (a) the number of firms selling throughout 1990-92, (b) how many of these firms sold during at least one of the years of 1996-98 (survivors), and (c) the growth of trade for each of the categories. Two are the main regularities that stand out from Table 3. Consistent with the fact O.1, the growth of the total trade in the least traded of these deciles is still higher. However, the number of surviving exporters is low, especially in the deciles with the lowest initial trade. If the survivor rate was as high as in the product-level data (almost 95% for the US data across all deciles) the growth rate would be even more amplified for the lowest deciles.

Regarding the robustness of fact O.2, the surge of new exporters and the attrition of previously trading exporters imply that the finding might not be robust to the analysis at the firm level. In particular, I find that only 18.9% of the firms that were trading in 1990 were also trading in 1998. Their contribution to total trade in 1996-1998 is large (54.3% of total trade). Notice that new firms have a large contribution in total trade after the liberalization (45.7%). The new firms that were sparsely trading (at least once) in 1990-92 account for 27.9% and the firms that were not trading any of the years 1990-92 account for 17.8%. A model with firm-level productivity dynamics can assign a clear role to the sparsely trading firms whereas attempting an interpretation within a static framework is likely to be misleading.

A.4 Calibration

Parameter Estimation: Robustness Regarding the constant of the OLS regression, that corresponds to the bracketed term in expression (22), its value is 20.14. Given the rest of the parameters estimated and the value of absorption per capita in France, this number translates to $\psi = 7.75$ for the model with $\beta = .915$. For the fixed cost model with $\tilde{\theta} = 1.49$, it implies a $\sigma = 6.57$, which in turns gives a higher $\psi = 13.7$.

Additionally to the OLS and 2SLS estimates I also perform the following robustness checks for the estimate of parameter α. I first take logs on expression (22) and then move the term $\gamma \ln y_j$ to the LHS. Assuming a wide range of γ (between 0 and 1) I run a regression and obtain a coefficient for α. This coefficient always lies between .41-.46 confirming that the estimate for α is robust. I also consider $\ln y_j$ as the dependent variable on the LHS moving all the rest of the terms in the RHS. The coefficients that I obtain imply that $\alpha = .43$ and $\gamma = .56$ (with an R^2 of .52).

Trade Liberalization In the model I am considering the empirical counterpart of the relationship I computed in the data and thus I map each one of the deciles of the goods to 10% of the model's previously trading firms in an increasing order of volume of trade and productivity correspondingly. In particular, I consider the total sales of firms selling the goods that corresponds to each decile. In fact, since I keep track of the same number of goods throughout time, I only have to compute the average sales of goods for each decile. For the period before liberalization, average sales of each category in the model are given by

$$L_j^{\alpha} (y_j)^{\gamma} (y_i)^{1-\gamma} \frac{1}{\tilde{\psi}} \int_{\phi_k}^{\phi_{k+1}} \left[\left(\frac{\phi}{\phi_{ij}^*} \right)^{\sigma-1} - \left(\frac{\phi}{\phi_{ij}^*} \right)^{(\sigma-1)/\tilde{\beta}} \right] \frac{\theta \phi_k^{\theta}}{\phi^{\theta+1}} d\phi =$$

$$L_j^{\alpha} (y_j)^{\gamma} (y_i)^{1-\gamma} \frac{1}{\tilde{\psi}} \left[\begin{array}{c} \left(\frac{\phi_{k+1}}{\phi_{ij}^*} \right)^{\sigma-1} \frac{1}{1/\tilde{\theta}-1} \frac{\phi_k^{\theta}}{\phi_{k+1}^{\theta}} - \left(\frac{\phi_{k+1}}{\phi_{ij}^*} \right)^{(\sigma-1)/\tilde{\beta}} \frac{1}{1/\left(\tilde{\theta}\tilde{\beta}\right)-1} \frac{\phi_k^{\theta}}{\phi_{k+1}^{\theta}} \\ - \left(\frac{\phi_k}{\phi_{ij}^*} \right)^{\sigma-1} \frac{1}{1/\tilde{\theta}-1} + \left(\frac{\phi_k}{\phi_{ij}^*} \right)^{(\sigma-1)/\tilde{\beta}} \frac{1}{1/\left(\tilde{\theta}\tilde{\beta}\right)-1} \end{array} \right],$$

where ϕ_k, ϕ_{k+1} is the threshold productivity corresponding to each percentile of firms and this is determined through the expression (31). Similarly, for the period after the liberalization (abusing notation for the rest of this Appendix, I denote with a prime the ex-post variables),

$$\left(L_j'\right)^{\alpha} \left(y_j'\right)^{\gamma} \left(y_i'\right)^{1-\gamma} \frac{1}{\tilde{\psi}} \left[\begin{array}{c} \left(\frac{\phi_{ij}^*}{\phi_{ij}^{*\prime}} \frac{\phi_{k+1}}{\phi_{ij}^*} \right)^{\sigma-1} \frac{1}{1/\tilde{\theta}-1} \frac{\phi_k^{\theta}}{\phi_{k+1}^{\theta}} - \left(\frac{\phi_{ij}^*}{\phi_{ij}^{*\prime}} \frac{\phi_{k+1}}{\phi_{ij}^*} \right)^{(\sigma-1)/\tilde{\beta}} \frac{1}{1/\left(\tilde{\theta}\tilde{\beta}\right)-1} \frac{\phi_k^{\theta}}{\phi_{k+1}^{\theta}} \\ - \left(\frac{\phi_{ij}^*}{\phi_{ij}^{*\prime}} \frac{\phi_k}{\phi_{ij}^*} \right)^{\sigma-1} \frac{1}{1/\tilde{\theta}-1} + \left(\frac{\phi_{ij}^*}{\phi_{ij}^{*\prime}} \frac{\phi_k}{\phi_{ij}^*} \right)^{(\sigma-1)/\tilde{\beta}} \frac{1}{1/\left(\tilde{\theta}\tilde{\beta}\right)-1} \end{array} \right].$$

In order to determine the ratio of average sales between the two periods I have to compute the ratios $\frac{\phi_{ij}^*}{\phi_{ij}^{*\prime}}$, $\left(\frac{L_j'}{L_j}\right)^{\alpha} \left(\frac{y_j'}{y_j}\right)^{\gamma} \left(\frac{y_i'}{y_i}\right)^{1-\gamma}$. For the ratio $\frac{\phi_{ij}^*}{\phi_{ij}^{*\prime}}$ I use the following expression of ϕ_{ij}^* in terms of $y_i,\ y_j,\ L_j$,

$$\left(\phi_{ij}^{*\prime}\right)^{\theta} = \frac{J_i b_i^{\theta} y_i^{1-\gamma}}{\lambda_{ij}} \frac{\left(\frac{1}{1-1/\tilde{\theta}} - \frac{1}{1-1/\left(\tilde{\theta}\tilde{\beta}\right)}\right)}{L_j^{1-\alpha} y_j^{1-\gamma} \tilde{\psi}} .$$

Using the assumption that there is no change in J_i, b_i ,[33]

$$\frac{\phi_{ij}^{*}}{\phi_{ij}^{*\prime}} = \left(\frac{\lambda_{ij}^{\prime}}{\lambda_{ij}} \frac{\left(y_i\right)^{1-\gamma}}{\left(y_i^{\prime}\right)^{1-\gamma}} \frac{\left(L_j^{\prime}\right)^{1-\alpha} \left(y_j^{\prime}\right)^{1-\gamma}}{L_j^{1-\alpha} \left(y_j\right)^{1-\gamma}}\right)^{1/\theta} .$$

Therefore, the required information to determine the yet undetermined ratios $\frac{\phi_{ij}^{*}}{\phi_{ij}^{*\prime}}, \left(\frac{L_j^{\prime}}{L_j}\right)^{\alpha} \left(\frac{y_j^{\prime}}{y_j}\right)^{\gamma} \left(\frac{y_i^{\prime}}{y_i}\right)^{1-\gamma}$ is the values of $\lambda_{ij},\ L_j,\ y_j$. I describe how I construct these ratios in the next paragraph. Using the data I describe below, I calculate each of the ratios I need for the years 2000 to 1993, 1999 to 1992, 1998 to 1991 and take the mean of the three ratios.

For the particular calibration exercise that I perform, i corresponds to Mexico (M) and j to the US (U). I use data on population for $L_M,\ L_U$ and data on manufacturing absorption for $y_M,\ y_U$, as described above. I finally pick the ratio $\lambda_{MU}^{\prime}/\lambda_{MU}$ so that I generate the average increase in manufacturing trade to output for the reference years (2.17 times, which all else equal and with $\theta = 8.25$, requires an 8.9% drop in trade costs). Not surprisingly this calibration implies changes in overall trade that are very close to the one observed in the data. Finally notice that for the decomposition of the margins I apply an 8.9% change in trade costs across all goods and compute the contribution of each margin to the increase in total trade separately.

B Theory Appendix

B.1 The Maximization Problem of the Firm

First, notice that for the case where $\beta > 0$ the market penetration cost function inherits an interiority condition when $n \rightarrow 1$ since $\lim\limits_{n \rightarrow 1} \frac{1-(1-n)^{1-\beta}}{1-\beta} = +\infty$. Therefore, when solving for the maximization problem of the firm I need only to consider the restriction $n \geq 0$.

Rewriting the problem of a type ϕ firm in a Langrangian formulation with the additional

[33]Extending to the case where J_i, b_i change would deliver the same results (but complicate notation).

constraint that $n \geq 0$ (I supress country notation for simplicity):

$$\mathcal{L}(\phi) = nLy\frac{p^{1-\sigma}}{P^{1-\sigma}} - nLy\frac{p^{-\sigma}w}{P^{1-\sigma}\phi} - w\frac{L^{\alpha}}{\psi}\frac{1-(1-n)^{1-\beta}}{1-\beta} + \Lambda n,$$

where Λ is the Lagrange multiplier.

FOC with respect to p:

$$p(\phi) = \tilde{\sigma}\frac{w}{\phi}, \tag{28}$$

FOC with respect to n :

$$Ly\frac{p(\phi)^{1-\sigma}}{P^{1-\sigma}} - Ly\frac{p(\phi)^{-\sigma}w}{P^{1-\sigma}\phi} - w\frac{L^{\alpha}}{\psi}[1-n(\phi)]^{-\beta} + \Lambda = 0 \tag{29}$$

and the complementary slackness condition $\Lambda n(\phi) = 0,\ \Lambda \geq 0$.

Using equation (28), (29) becomes

$$\frac{y}{\sigma}\frac{\left(\tilde{\sigma}\frac{w}{\phi}\right)^{1-\sigma}}{P^{1-\sigma}} - w\frac{L^{\alpha}}{\psi}[1-n(\phi)]^{-\beta} + \Lambda = 0\ .$$

Using the definition of ϕ^*, equation (9), then $\forall\ \phi \leq \phi^*$ the above equation holds only for some $\Lambda > 0 \implies n(\phi) = 0$ (the constraint $n(\phi) \geq 0$ is binding). However, $\forall\ \phi > \phi^*$ $n(\phi) \in (0,1) \implies \Lambda = 0$. In that case the optimal $n(\phi)$ is given by the solving equation (8).

I also check the second order conditions in order to derive sufficient conditions for this problem to have a unique solution for $n(\phi) \in (0,1)$. The Hessian matrix is

$$A = \begin{bmatrix} \frac{\partial^2\pi}{\partial p^2} & \frac{\partial^2\pi}{\partial p\partial n} \\ \frac{\partial^2\pi}{\partial n\partial p} & \frac{\partial^2\pi}{\partial n^2} \end{bmatrix},$$

where,

$\frac{\partial^2\pi}{\partial p^2} = -\sigma(1-\sigma)\,n(\phi)\,Ly\frac{p(\phi)^{-\sigma-1}}{P^{1-\sigma}} + (-\sigma-1)\,\sigma n(\phi)\,Ly\frac{p(\phi)^{-\sigma-2}}{P^{1-\sigma}\phi} < 0$,

$\frac{\partial^2\pi}{\partial n^2} = (-\beta-1)\,w\frac{L^{\alpha}}{\psi}\frac{1}{[1-n(\phi)]^{\beta+1}} < 0$ only if $\beta > 0$,

$\frac{\partial^2\pi}{\partial n\partial p} = \frac{\partial^2\pi}{\partial p\partial n} = (1-\sigma)\,Ly\frac{p(\phi)^{-\sigma}}{P^{1-\sigma}} + \sigma Ly\frac{p(\phi)^{-\sigma-1}}{P^{1-\sigma}\phi} = 0$.

Therefore, the principle submatrices satisfy $|A_1| < 0$, $|A_2| > 0$. Since the second order conditions are satisfied, the unique pair $(n(\phi), p(\phi))$ that solves the equations (28) and (29), for a given $\phi > \phi^*$, is the unique maximum solving the firm's optimization problem (given the price index P). Therefore, the above formulation gives $n(\phi)$ as the solution of equation

(29) $\forall\phi > \phi^*$. In addition, for $\phi \leq \phi^*$, $n(\phi) = 0$.

B.2 The Share of Profits

In this Appendix, I will show that the share of profits out of total income is constant and equal to $\eta = (\sigma - 1)/(\theta\sigma)$.[34] The total variable profits of firms from i in j are simply X_{ij}/σ and thus labor income from production is $X_{ij}(\sigma - 1)/\sigma$. Using the definition of total exports, equation (15), total market penetration costs paid by firms of i selling to j are

$$M_{ij} \int_{\phi_{ij}^*}^{\infty} L_j^{\alpha} w_j^{\gamma} w_i^{1-\gamma} \frac{1}{\psi} \frac{1 - [1 - n_{ij}(\phi)]^{1-\beta}}{1-\beta} \frac{\theta \left(\phi_{ij}^*\right)^{\theta}}{\phi^{\theta+1}} d\phi = X_{ij} \frac{\theta - (\sigma - 1)}{\theta\sigma} = X_{ij} m \ . \tag{30}$$

Thus, total profits accrued to country i are

$$\begin{aligned} \pi_i L_i &= \frac{1}{\sigma} \sum_v X_{iv} - \frac{\theta - (\sigma - 1)}{\theta\sigma} \sum_v X_{iv} \\ &= \frac{\sigma - 1}{\theta\sigma} \sum_v X_{iv} \ . \end{aligned}$$

To conclude the proof I need to show that country output, $\sum_v X_{iv}$, equals spending, $\sum_v X_{vi} = y_i L_i$. Trade balance implies that the total income of i must be equal to its total spending. Total income is composed of i) income other than fixed costs, ii) income from fixed costs from exporting activities, iii) income from exporting activities of foreign countries in country i, and equals total spending,

$$\begin{gathered} (1 - m) \sum_v X_{iv} + \gamma m \sum_v X_{iv} + (1 - \gamma) m \sum_v X_{vi} = \sum_v X_{vi} \implies \\ \sum_v X_{iv} = \sum_v X_{vi} \ , \end{gathered}$$

proving the result. Notice that the RHS of the last expression is by definition equal to $y_i L_i$. Therefore, profits can be written as

$$\pi_i = \eta y_i \ , \ \eta = \frac{\sigma - 1}{\theta\sigma} \ ,$$

[34] For an in-depth analysis of the derivation of the labor market equilibrium in models with heterogeneous firms, see Eaton and Kortum (2005).

and the labor market equilibrium can be written as a function of country sales

$$w_i L_i = (1-\eta)\, y_i L_i = (1-\eta) \sum_v X_{vi} = (1-\eta) \sum_v X_{iv} \ ,$$

which gives equation (18) in the text.

B.3 Appendix Sales' Distribution

I consider the case of sales of firms from country i in market j. I proceed to represent the results as in EKK10 in order to compare the predictions of the model with the data they report.

Define by $r_{ij}^{\min}$ the sales for the firm with threshold productivity ϕ_{ij}^*. The objective is to derive the distribution of sales as a function of the relative firm percentile in that market, $\Pr_{ij}$. Sales r_{ij}, for firms with $\phi \geq \phi_{ij}^*$, are given by expression (14). Notice the following:

$$\Pr\left[R \geq r | R \geq r_{ij}^{\min}\right] = \frac{\Pr\left[\Phi \geq \phi\right]}{\Pr\left[\Phi \geq \phi_{ij}^*\right]} = \frac{\left(\phi_{ij}^*\right)^\theta}{\left(\phi\right)^\theta} \ .$$

However, this can also be written as

$$\Pr\left[R \geq r | R \geq r_{ij}^{\min}\right] = 1 - \Pr\left[R < r | R \geq r_{ij}^{\min}\right] = 1 - \Pr_{ij} \ ,$$

which implies that

$$1 - \Pr_{ij} = \frac{\left(\phi_{ij}^*\right)^\theta}{\left(\phi\right)^\theta} \ . \tag{31}$$

Replacing (31) into (14) obtains that sales for firms are given by equation (23) in the text.

B.4 Proof of Proposition 3

For part (a), note that

$$\frac{d \ln X_{ij}}{d \ln \tau_{ij}} = \frac{\tau_{ij}}{X_{ij}} \frac{dX_{ij}}{d\tau_{ij}} \tag{32}$$

Thus, I compute the terms of the decomposition of $d \ln X_{ij} / d \ln \tau_{ij}$ by computing each of the terms of equation (26) and multiplying them by τ_{ij}/X_{ij}.

The first term of the decomposition is given by

$$\begin{aligned}
\frac{\tau_{ij}}{X_{ij}} J_i \int_{\phi_{ij}^*}^{+\infty} n_{ij}(\phi) \frac{d\left(\frac{p_{ij}(\phi)^{1-\sigma}}{P_j^{1-\sigma}} y_j\right)}{d\tau_{ij}} g_i(\phi)\, d\phi &= \frac{\tau_{ij} J_i}{X_{ij}} \int_{\phi_{ij}^*}^{+\infty} n_{ij}(\phi) \frac{d\left(\frac{\phi^{\sigma-1}}{\left(\phi_{ij}^*\right)^{\sigma-1}} \frac{\sigma}{\psi} w_j^{\gamma} w_i^{1-\gamma} L_j^{\alpha-1}\right)}{d\tau_{ij}} g_i(\phi)\, d\phi \\
&= (1-\sigma) \frac{d \ln \phi_{ij}^*}{d \ln \tau_{ij}} + \gamma \frac{d \ln w_j}{d \ln \tau_{ij}} + (1-\gamma) \frac{d \ln w_i}{d \ln \tau_{ij}} ,
\end{aligned}$$

where the definition of ϕ_{ij}^*, equation (9), is used in the second equality and by setting $w_j = 1$ as the numeraire I obtain the expression for the intensive margin.

Computing the second term requires more cumbersome calculations. Using the equilibrium choice of $n_{ij}(\phi)$, equation (10), and the definition of ϕ_{ij}^*, equation (9),

$$\begin{aligned}
\frac{d n_{ij}(\phi)}{d \ln \tau_{ij}} &= \frac{d\left(1 - \left(\phi_{ij}^*/\phi\right)^{\frac{\sigma-1}{\beta}}\right)}{d \ln \tau_{ij}} \\
&= -\frac{(\sigma-1)}{\beta} \left(\frac{\phi_{ij}^*}{\phi}\right)^{\frac{\sigma-1}{\beta}} \frac{d \ln \phi_{ij}^*}{d \ln \tau_{ij}} ,
\end{aligned}$$

so that

$$\begin{aligned}
&\frac{\tau_{ij}}{X_{ij}} J_i \int_{\phi_{ij}^*}^{+\infty} \frac{d n_{ij}(\phi)}{d\tau_{ij}} p_{ij}(\phi)\, x_{ij}(\phi)\, g_i(\phi)\, d\phi \\
&= -\frac{J_i}{X_{ij}} \frac{\sigma-1}{\beta} \left[\int_{\phi_{ij}^*}^{+\infty} \left(\frac{\phi_{ij}^*}{\phi}\right)^{\frac{\sigma-1}{\beta}} \frac{\left(\tilde{\sigma} \frac{w_i}{\phi} \tau_{ij}\right)^{1-\sigma}}{P_j^{1-\sigma}} y_j \frac{\theta b_i^{\theta}}{\phi^{\theta+1}} d\phi \right] \frac{d \ln \phi_{ij}^*}{d \ln \tau_{ij}} .
\end{aligned}$$

By performing the integration and using the definition of ϕ_{ij}^*, equation (9), this equation equals to

$$-\frac{J_i}{X_{ij}} \frac{b_i^{\theta}}{\left(\phi_{ij}^*\right)^{\theta}} \frac{(\sigma-1)}{\beta} \frac{\theta\sigma}{\theta - (\sigma-1) + (\sigma-1)/\beta} \frac{w_j^{\gamma} w_i^{1-\gamma} L_j^{\alpha-1}}{\psi} \frac{d \ln \phi_{ij}^*}{d \ln \tau_{ij}} .$$

Using the expression for average sales, equation (22), together with (17), the above equation can be written as

$$-\frac{M_{ij} \bar{X}_{ij}}{X_{ij}} \frac{(\sigma-1)}{\beta} \frac{\frac{\theta}{\theta-(\sigma-1)+(\sigma-1)/\beta}}{\theta \frac{(\sigma-1)/\beta}{[\theta-(\sigma-1)]\left[\theta-(\sigma-1)/\tilde{\beta}\right]}} \frac{d \ln \phi_{ij}^*}{d \ln \tau_{ij}} = (-\theta + \sigma - 1) \frac{d \ln \phi_{ij}^*}{d \ln \tau_{ij}} ,$$

obtaining the second term of the decomposition.

Finally, for the third term, notice that it involves $n\left(\phi_{ij}^*\right)$ which from equation (10) equals to 0 for firms with $\phi = \phi^*_{ij}$. Thus, this term equals to 0. Adding the three terms gives us the decomposition of (32) that appears in equation (27).

For part (b) simply notice that I consider a partial elasticity so that $\frac{\partial \ln w_i}{\partial \ln \tau_{ij}} = 0$, which by the definition of ϕ^*_{ij}, equation (9), it implies that $\frac{\partial \ln \phi^*_{ij}}{\partial \ln \tau_{ij}} - \frac{\partial \ln \phi^*_{jj}}{\partial \ln \tau_{ij}} = 1$. This last relationship combined with the expression for the decomposition obtained in part (a) can be directly used to compute $\partial \ln (X_{ij}/X_{jj}) / \partial \ln \tau_{ij} = -\theta$ concluding the proof of part (b).

In general, notice that by following Chaney (2008) in assuming that the trading relationship of i and j is remote enough to j so that changes in τ_{ij} have only a minor effect in the relative wages of i to j, $\frac{\partial \ln w_i}{\partial \ln \tau_{ij}} \simeq 0 \ \forall i$ (given the choice of the numeraire), and also a minor effect in the price index of j $\frac{\partial \ln P_j}{\partial \ln \tau_{ij}} \simeq 0$, then using equation (9), it is $\frac{\partial \ln \phi^*_{ij}}{\partial \ln \tau_{ij}} \simeq 1$. These approximations imply that the decomposition becomes

$$\frac{d \ln X_{ij}}{d \ln \tau_{ij}} \simeq - \underbrace{(\sigma - 1)}_{\substack{\text{Intensive margin} \\ \text{growth elasticity}}} - \underbrace{(\theta - \sigma + 1)}_{\substack{\text{New consumers} \\ \text{margin elasticity}}} + \underbrace{0}_{\substack{\text{New firms} \\ \text{margin elasticity}}} ,$$

and it is also true that $\frac{d \ln X_{ij}}{d \ln \tau_{ij}} \simeq -\theta$ which is the result of Chaney (2008).

B.5 Welfare

To compute welfare consider the ideal price index, equation (4),

$$\log P_j = \frac{1}{1-\sigma} \log \left[\sum_v J_v \left(\frac{\sigma}{\sigma - 1} w_v \tau_{vj} \right)^{1-\sigma} \int_{\phi^*_{vj}}^{+\infty} \phi^{\sigma-1} \left(1 - \left(\frac{\phi^*_{vj}}{\phi} \right)^{\frac{\sigma-1}{\beta}} \right) g_v(\phi)\, d\phi \right] .$$

Taking the derivative of this expression with respect to changes in $\log \tau_{ij}$ I can write

$$\frac{d \log P_j}{d \log \tau_{ij}} = \sum_v \lambda_{vj} \left[\left(\frac{d \log w_v}{d \log \tau_{ij}} + 1 \right) - \frac{1}{1-\sigma} \tilde{c}_{vj} \frac{d \log \phi^*_{vj}}{d \log \tau_{ij}} + 0 \right] , \tag{33}$$

where the derivative of the integral is taken using Leibnitz's rule, I have used $1 - \left(\phi^*_{ij} / \phi^*_{ij} \right)^{\frac{\sigma-1}{\beta}} = 0$, and I also define

$$\tilde{c}_{ij} = \frac{(\sigma-1)}{\beta} \left(\int_{\phi^*_{ij}}^{+\infty} \phi^{\sigma-1} \left(\frac{\phi^*_{ij}}{\phi} \right)^{\frac{\sigma-1}{\beta}} g_i(\phi)\, d\phi \right) / \left[\int_{\phi^*_{ij}}^{+\infty} \phi^{\sigma-1} \left(1 - \left(\frac{\phi^*_{ij}}{\phi} \right)^{\frac{\sigma-1}{\beta}} \right) g_i(\phi)\, d\phi \right] .$$

With the Pareto distribution assumption for the productivities $\tilde{c}_{ij} = \theta - \sigma + 1$ which completes the derivation.

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Table 1: Calibration of the Benchmark model

Parameters	Value	Benchmark Calibration
α	.43	Average sales of French firms as a function of population
γ	.29	size and manufacturing income per capita of the market
$\tilde{\theta}$	1.65	Sales in France and exporting intensity of French exporters
β	.915	(equations 22 and 25)
σ	6	Broda and Weinstein (2006) and calibrated value of $\tilde{\theta}$
θ	8.25	

Table 2: Percentage trade shares of newly traded, and previously traded goods

	"Newly traded"	"Previously Traded" by decile									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Share of '91-'93 trade	.42	.01	.04	.10	.21	.43	.84	1.71	3.47	7.63	85.15
Share of '98-'00 trade	3.21	.16	.47	.73	.51	1.45	1.36	2.61	7.51	7.34	74.65
Share of new trade	4.50	.23	.67	1.03	.65	1.92	1.60	3.04	9.35	7.21	69.82

Table 3: Number of exporters and trade growth for Brazilian firms previously trading to Argentina

	"Previously Trading" by decile									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Exporters '90-'92	98	98	97	98	97	98	98	97	98	97
Surviving exporters '96-'98	57	70	69	81	77	81	79	76	81	83
Imports '96-'98 vs '90-'92	12.5	4.4	7.1	4.0	4.9	3.3	5.4	4.3	2.8	3.0

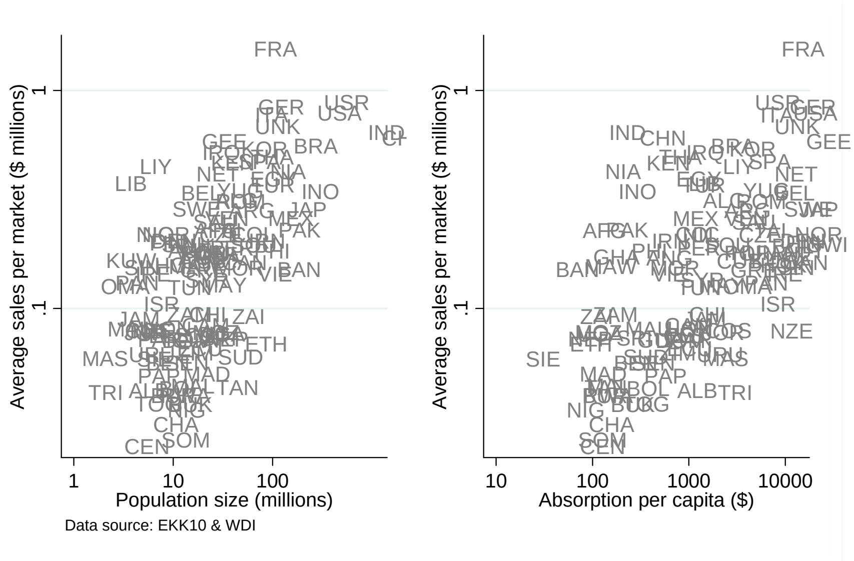

Figure 1: Average sales in a market and market size.

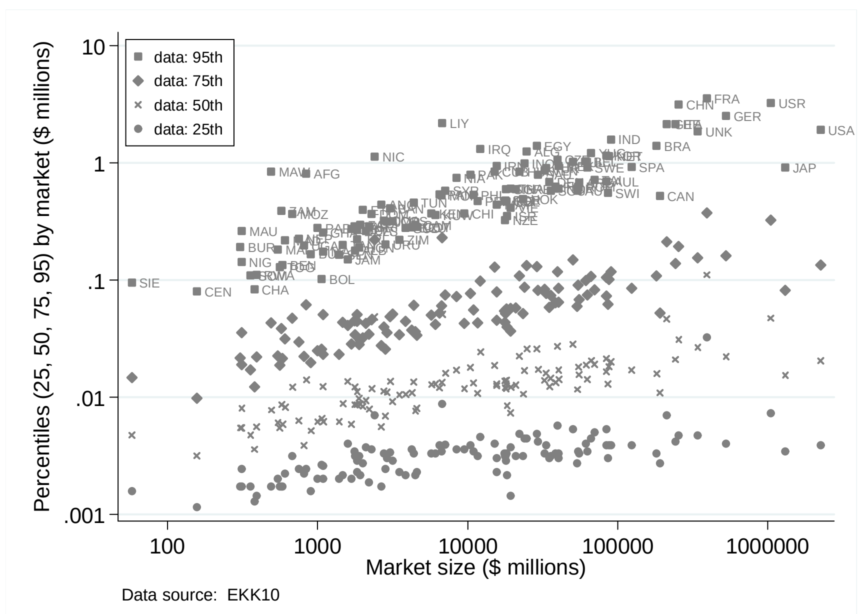

Figure 2: Sales distribution by market.

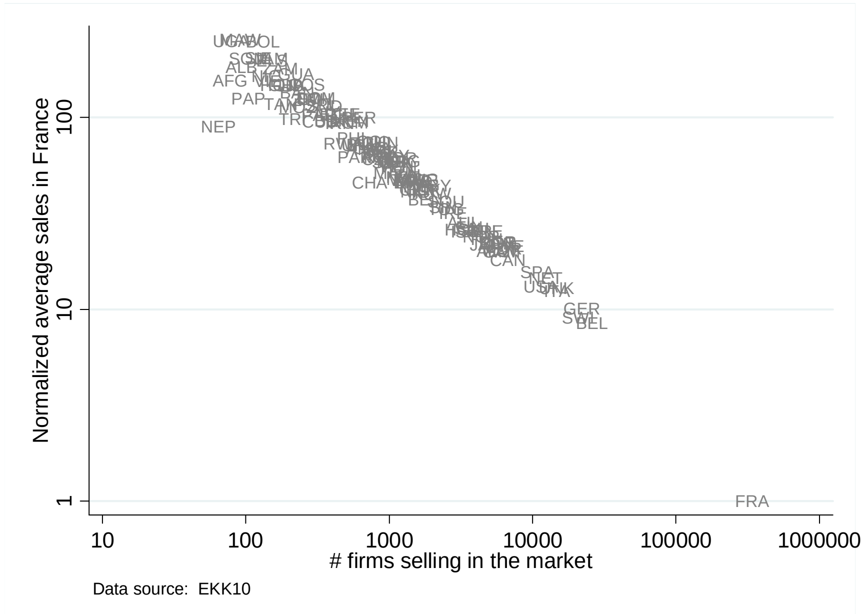

Figure 3: Normalized average sales.

Figure 4: Normalized exporting intensity by market.

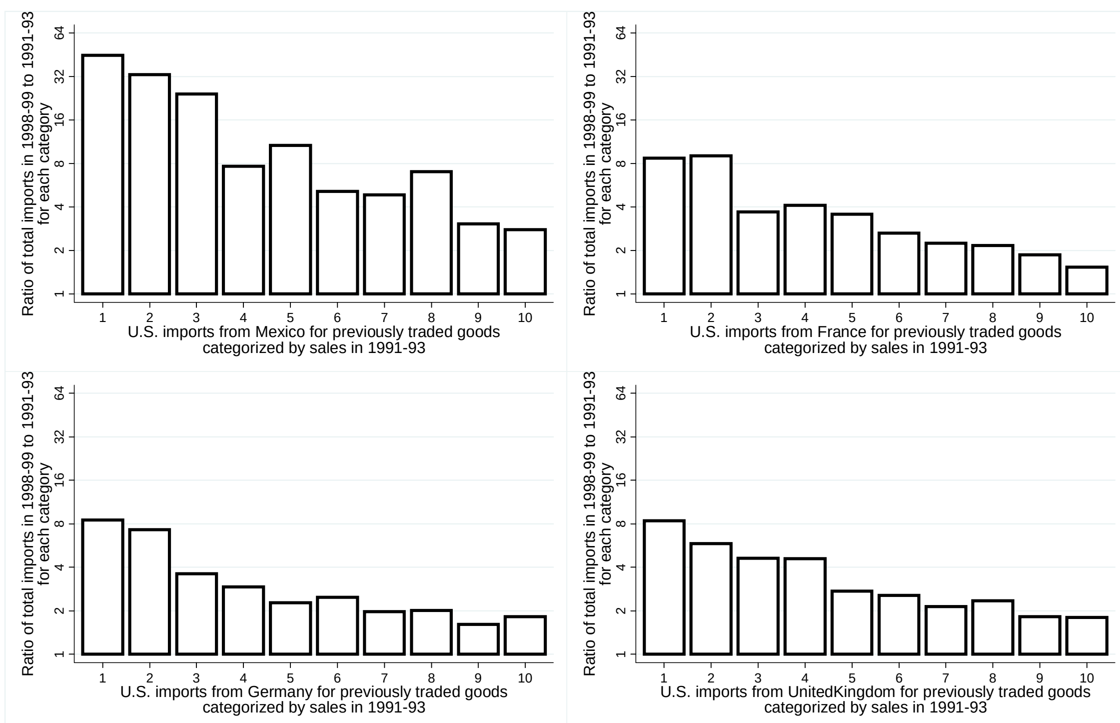

Figure 5: Ratio of US imports from four partner countries for goods categorized by initial volume of sales.

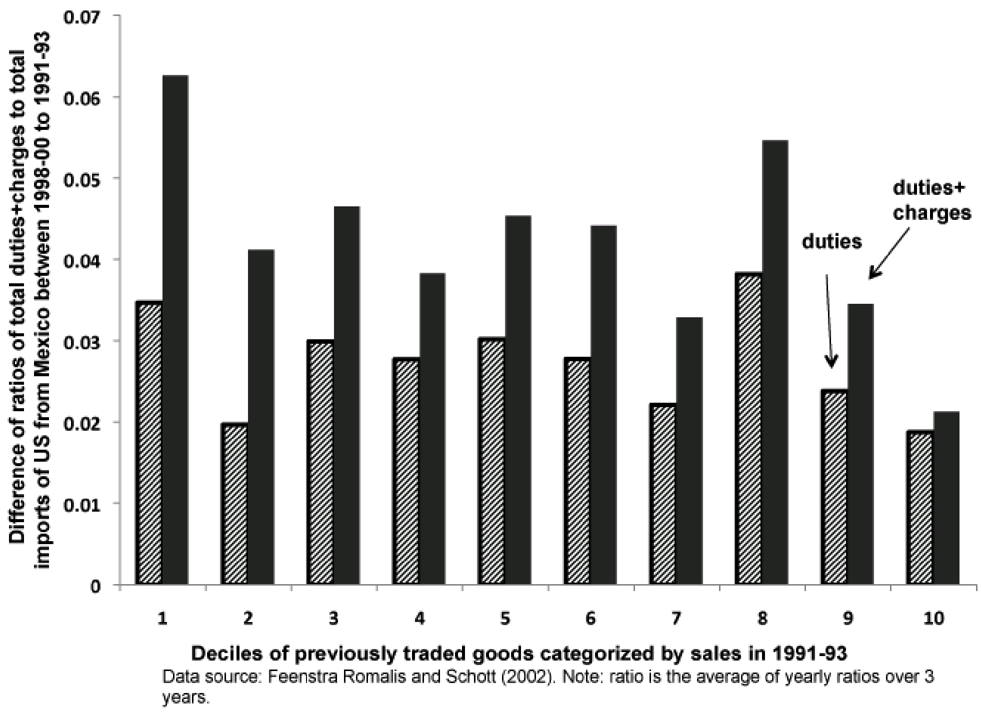

Figure 6: Trade costs changes in the US-Mexico NAFTA liberalization for previously traded goods categorized by initial volume of sales.

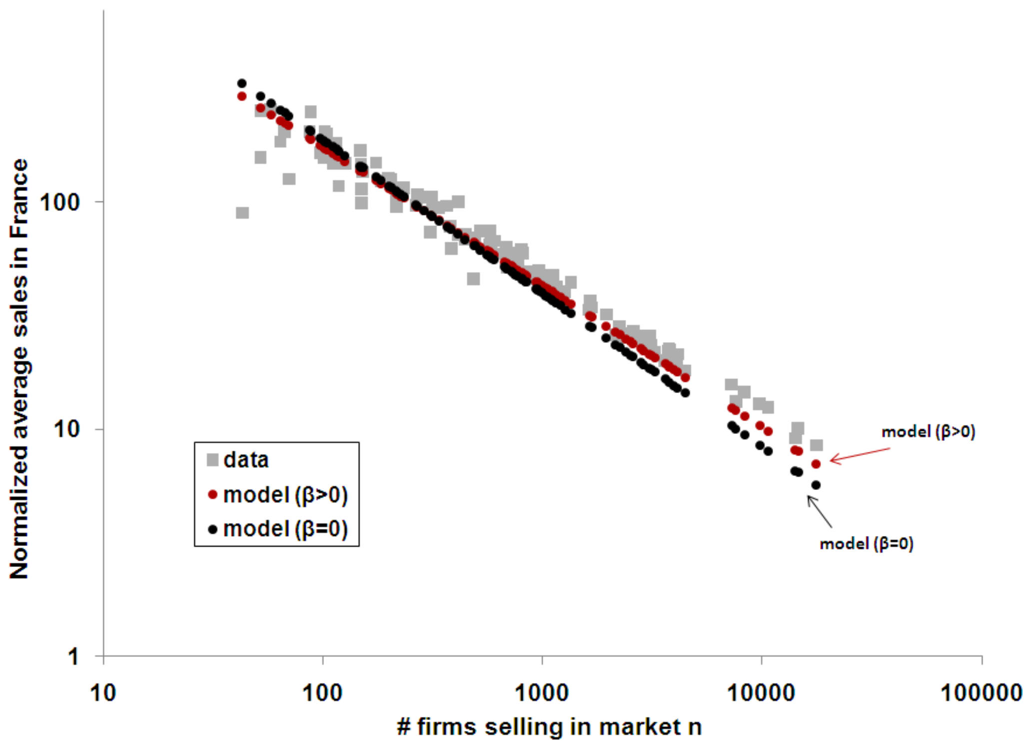

Figure 7: Normalized average sales in the French data and the model.

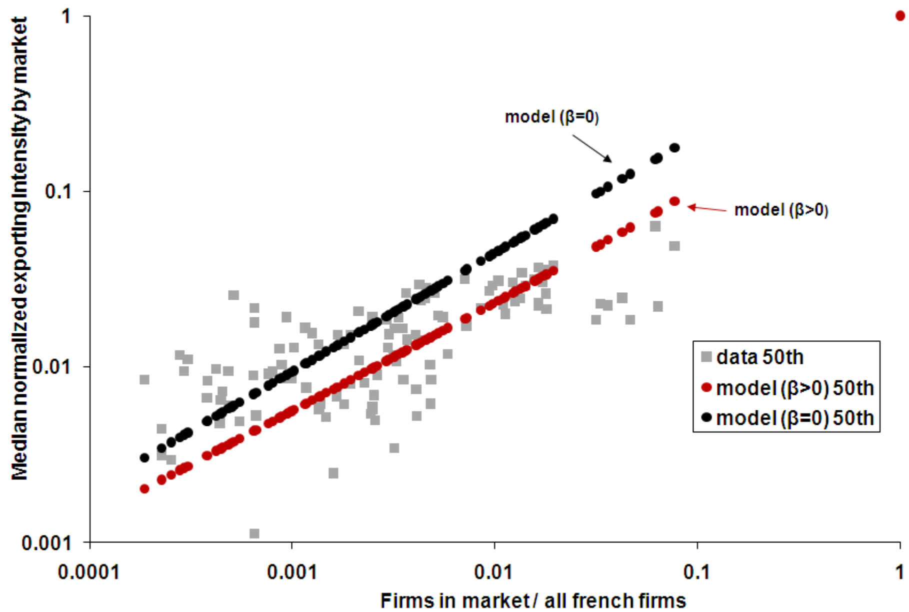

Figure 8: Normalized exporting intensity and model predictions.

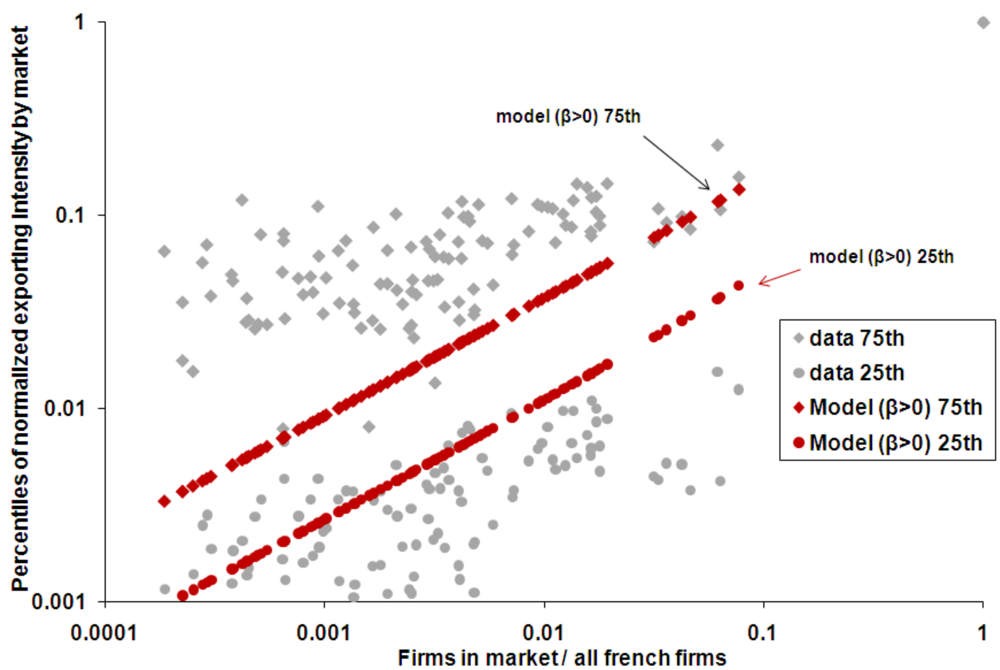

Figure 9: Percentiles of normalized exporting intensity and model predictions.

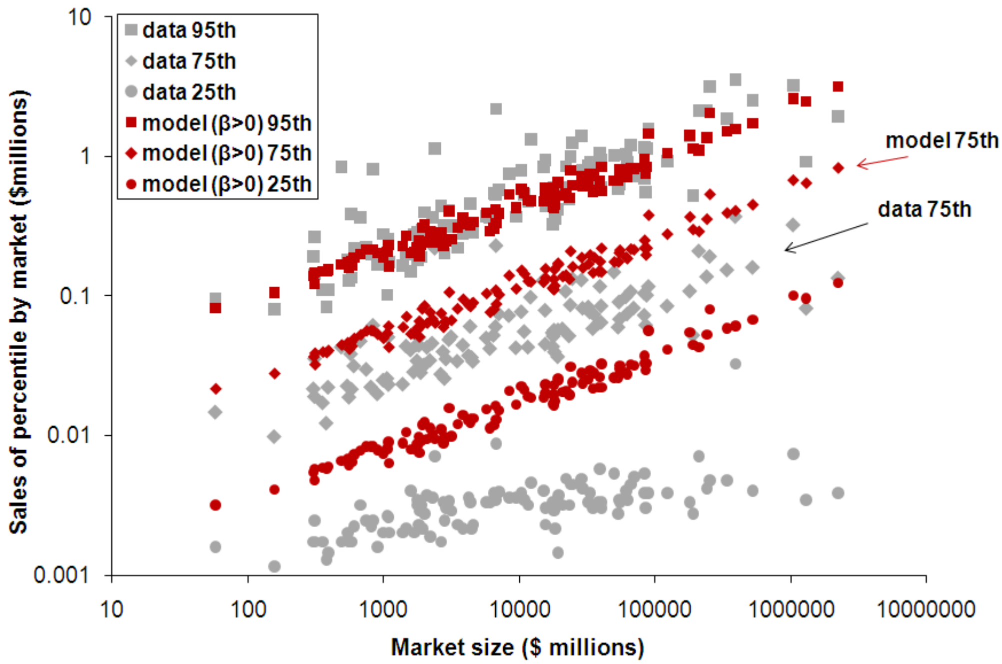

Figure 10: Sales distribution by market and the endogenous cost model.

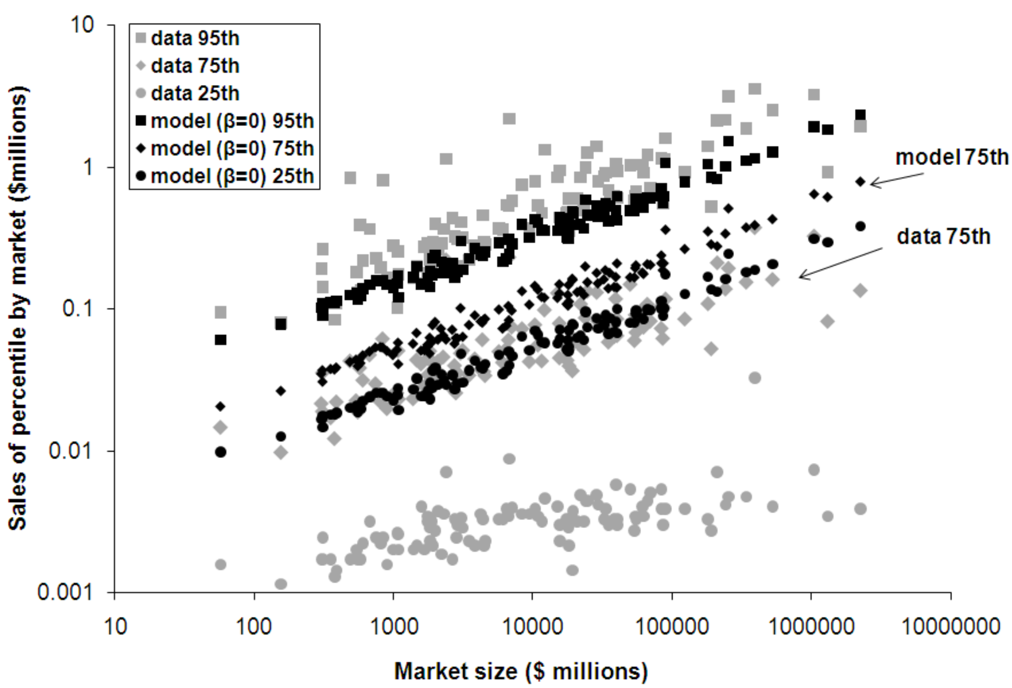

Figure 11: Sales distribution by market and the fixed cost model.

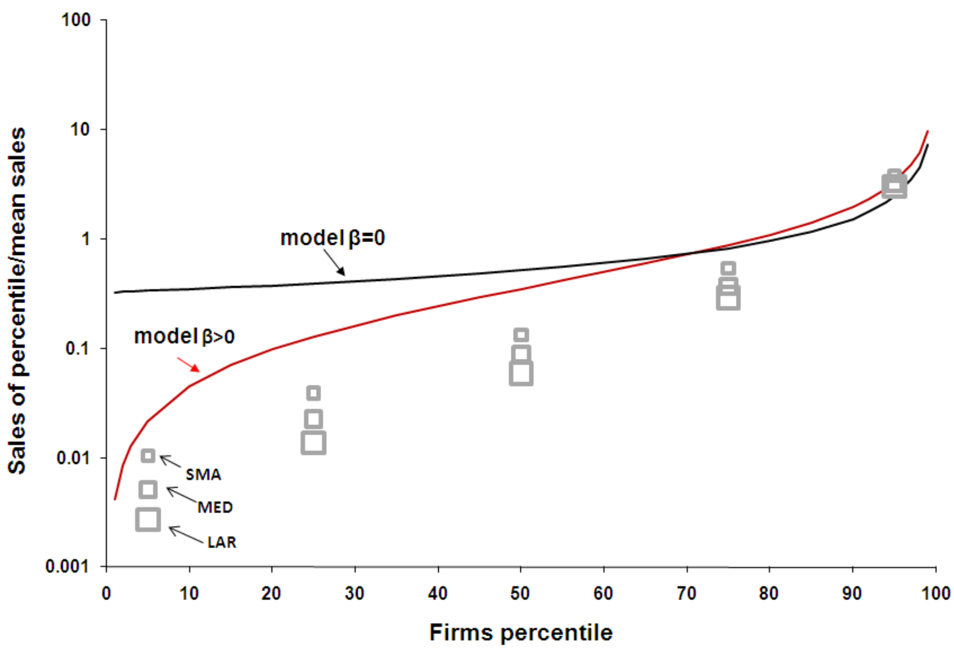

Figure 12: Distribution of sales relative to mean sales in calibrated model and in the French data (for small, medium, and larger exporting destinations).

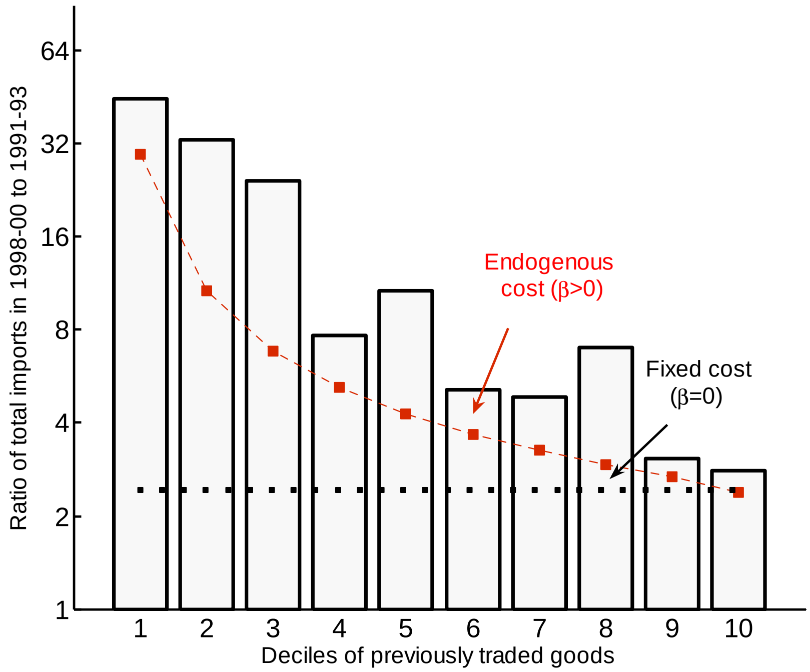

Figure 13: Predicted and actual ratio of US imports from Mexico in 1998-2000 to 1991-1993 for each decile of previously traded goods.

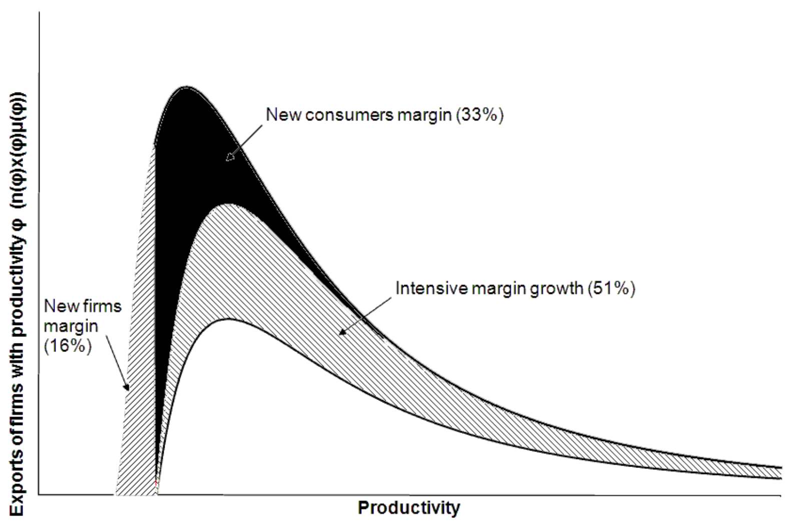

Figure 14: Trade liberalization and the margins of trade.