# Sequential Exporting*

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**Abstract**

Firms need to incur substantial sunk costs to break in foreign markets, yet many give up exporting shortly after their first experience, which often involves very small sales. Conversely, other new exporters shoot up their foreign sales and expand to new destinations. We investigate a simple theoretical mechanism that can rationalize these patterns. A firm discovers its profitability as exporter only after actually engaging in exporting. The profitability is positively correlated over time and across destinations. Accordingly, once the firm learns how good it is as an exporter, it adjusts quantities and decides whether to exit and whether to serve new destinations. Thus, it is the possibility of profitable expansion at both the intensive and extensive margins what makes incurring the sunk costs to enter a single foreign market worthwhile despite the high failure rates. Using a census of Argentinean firm-level manufacturing exports from 2002 to 2007, we find empirical support for several implications of our proposed mechanism, indicating that the practice of "sequential exporting" is pervasive. Sequential exporting has broad and subtle implications for trade policy. For example, a reduction in trade barriers in a country has delayed entry effects in its own market, while also promoting entry in *other* markets. This trade policy externality poses challenges for the quantification of the effects of trade liberalization programs, while suggesting an entirely novel rationale for the negotiation of international trade agreements.

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# 1 Introduction

How do firms break in foreign markets? To understand patterns of international trade and the aggregate impact of trade liberalization, answering this question convincingly is of central importance. Recent trade theories (e.g. Melitz 2003) put great emphasis on the sunk costs firms have to incur to start exporting, and existing estimates indicate that those costs are indeed very high.[1] The importance of sunk costs is however difficult to reconcile with the patterns of entry in foreign markets that recent empirical research has uncovered. For example, Eaton et al. (2008) show evidence suggesting that Colombian firms often start exporting small quantities to a single neighbor country, but almost half of them cease all exporting activities in less than a year. Those who survive, on the other hand, tend to expand their presence in their current destinations, and a sizeable fraction also expands to other markets. Similar patterns have been observed in other countries,[2] including in our data set of Argentinean exporters.

On face of significant sunk costs to export and steeply high failure rates, how can we explain so much entry activity and with so little initial sales? And what could explain the seemingly sequential entry pattern of the surviving exporters? A possibility is that firms are uncertain about their success as exporters. If a firm's export profit in a market is correlated over time, then firms could enter in a foreign market, even at a really small scale, to learn about their profit potential there today and in the future. Furthermore, since breaking in new markets entails significant and unrecoverable costs, firms could enter a relatively "easy" market (e.g. a small neighbor) as a "testing ground" for future bolder steps, such as serving the American or the European markets. This "experimentation" can explain the sequential nature of entry across markets provided that there is a positive correlation between the profitability of exporting to different markets. Such a correlation could be due to demand similarities or to firms' characteristics that are associated with success in exporting, but which the firms themselves learn only after actually engaging in exporting.

In this paper, we develop the simplest model that can formalize these ideas. The driving assumption is that a firm's success in foreign markets is uncertain, but that the uncertainty is highly persistent over time and correlated across destinations. Despite its parsimony, our model rationalizes several of the recently uncovered empirical findings in the literature on export dynamics, such as the small size and the high exit rates of new exporters, as well as the rapid expansion of those who survive, at both the intensive and the extensive margins. Our model also has a number of specific empirical implications.

First, if indeed firms fully learn about their export profitability only once they have exported, then those that survive should experience on average higher growth in their early exporting years than in subsequent years. Moreover, if export profitabilities are positively correlated across destinations, this high initial growth should be most pronounced in the first market the firm exports

[1] Das et al. (2007) structurally estimate sunk entry costs for Colombian manufacturers of leather products, knitted fabrics, and basic chemicals to be at least $344,000 in 1986 U.S. dollars.

[2] Buono et al. (2008) confirm the findings of Eaton et al. (2008) in a detailed study of the intensive and extensive margins of French exports. Lawless (2009a) carries out a similar exercise for a survey of Irish firms.

to, since there is where the firm has most to learn. Second, the likelihood of breaking into new markets should be higher for first-time exporters than for experienced ones, since the latter have already learned about their export potential, and therefore will enter new markets only if market conditions change or if they experience positive productivity shocks—unlike the fledgling exporters. Third, exit from new markets should be more likely for first-time exporters than for experienced ones, exactly as with entry.

We test these predictions using Argentinean customs data comprising the universe of the country's manufacturing exports from 2002 to 2007, disaggregated by firm and destination country. We find strong support for each of our predictions, even after controlling for firms' heterogeneity and for year-destination fixed effects. We also carry a series of robustness checks to isolate other factors that could be driving some of our predictions; results remain qualitatively unchanged. Hence, while uncertainty correlated across time and markets is surely only one of several possible forces shaping firms' export strategies, our evidence indicates that it plays an unequivocal role. For brevity, we refer to the implications of this uncertainty for exporting firms simply as "sequential exporting."

The policy implications of sequential exporting are far-reaching. Consider the impact of trade liberalization in different countries for the firms of a "Home" country. When a nearby country lowers its trade barriers, it attracts new exporting firms from Home. As these new exporters learn about their ability to serve foreign markets, some endure unsuccessful experiences while others realize that they are capable of serving foreign markets very profitably. The former group gives up exporting, whereas the latter expands to other foreign destinations. As a result, trade liberalization in the nearby country not only promotes entry in that market; it also induces entry in *third* markets, albeit with a lag. Similarly, the reduction of trade barriers in a distant country initially induces entry of some Home firms in the markets of Home's *neighbors*. Put simply, lower trade barriers in the distant country raise the value of an eventual entry there; this enhances the value of "export experimentation," thereby fostering entry in third markets in the short run. Once some of the entrants realize a high export potential from their experience in the neighbors' markets, they move on to the market of the liberalizing country.

Thus, our findings suggest the existence of a *trade policy externality*: trade barriers in a country induce entry of foreign firms in other markets. This provides a new role for international coordination of trade policies, and one of a very different nature from those often emphasized by trade economists.[3] As such, our proposed mechanism offers the basis for an entirely novel rationale for global trade institutions such as the World Trade Organization (WTO). If this externality is stronger at the regional level, it could also help to explain the pattern of free trade agreements throughout the world.

If fact, our model suggests that the impact of trade agreements could be very distinct from what existing studies indicate. For example, a regional trade agreement would boost "export experimentation" by lowering the costs of exporting to bloc partners. As a result of more experimentation,

[3] See Bagwell and Staiger (2002) for a general discussion of the motivations for international trade policy coordination.

a greater number of domestic firms would eventually find it profitable to export also to bloc outsiders. In that sense, regional integration generates a type of "trade creation" that is very different from the concept economists often emphasize: in addition to promoting intra-bloc trade, a regional trading bloc should also stimulate *exports* to *non*-member countries. If the agreement is of the multilateral type, tracking down its effects becomes even trickier.

Third-country and lagged effects of trade liberalization can be useful to explain an enduring puzzle in the trade literature: while world trade has almost quadrupled in the last fifty years, tariffs on manufactured goods in developed countries have fallen during the same period by little more than ten percentage points. Attempts to explaining this phenomenon, such as the rise of vertical specialization (Yi 2003) or the role of offshoring under contract incompleteness (Ornelas and Turner 2008), are quantitatively unsatisfactory.[4] But if correlated export profitability explains observed sequential export entry, tariff reductions could have much larger impacts on global trade flows than existing models suggest. Third-country and delayed effects could also help to explain the difficulty in identifying significant trade effects of multilateral liberalization undertaken under the General Agreement on Tariffs and Trade and the WTO (Rose 2004), which contrasts with the entrenched beliefs that the GATT/WTO system has been crucial in promoting international trade.

The growing documentation of the pattern of firm's foreign sales has been fostering increasing research interest on the dynamics of firms' exporting strategies.[5] The current work of Eaton et al. (2009) and Freund and Pierola (2008), who emphasize learning mechanisms, are closely related to ours. Eaton et al. develop a model where producers learn about the appeal of their products in a market by devoting resources to finding consumers and by observing the experiences of competitors. Freund and Pierola also consider a single export market, but with product-specific uncertainty, as their focus is on the incentives of firms to develop new products for exporting. Using data on exports of non-traditional agricultural products in Peru, Freund and Pierola uncover interesting patterns of trial and error based on the frequency of entry and exit from foreign markets. Unlike here, in such models where uncertainty is destination-specific, the focus is on the export dynamics within a market, without distinction between first and subsequent markets.

Our work is also related to other recent empirical findings at the product and country levels. Evenett and Venables (2002) document a "geographic spread of exports" for 23 developing countries between 1970 and 1997, in the sense that importing a product from a certain country is more likely if the origin country is supplying the same product to nearby markets. Besedes and Prusa (2006)

[4] For instance, Yi (2003) concludes that vertical specialization can resolve at most fifty percent of the excessive responsiveness of trade flows to trade barriers.

[5] Segura-Cayuela and Vilarrubia (2008) develop a model where potential exporters are uncertain about country-specific fixed export costs, but learn about them from other firms in the industry that start exporting to the same market. This idea is related to Hausmann and Rodrik's (2003) earlier insight that ex ante unknown export opportunities can be gauged from the experience of export pioneers, who effectively provide a public good to the rest of the industry. While those authors focus on learning from rivals, we are interested in individual self-discovery. Das et al. (2007) develop a structural model of firm heterogeneity and export dynamics to quantify the value of the sunk costs of exporting. Arkolakis (2008) proposes a model with increasing market penetration costs, where a firm's productivity evolves over time according to an exogenous stochastic process. This process determines the firm's entry, exit and production decisions in foreign markets.

find that the median duration of exporting a product to the United States is very short, with a hazard rate that decreases sharply over time. Alvarez et al. (2008) find evidence from Chilean firms that exporting a product to a country increases the likelihood of selling the same product to another foreign market. Bernard et al. (2009) study U.S. firms and show that the extensive margins of trade are key to explain variation in trade at long intervals, but that the intensive margin is responsible for most short-run (i.e. year-to-year) variation. These varying contributions of extensive and intensive margins at different intervals reflect the fact that new exporters start small but grow fast and rapidly expand if they survive. Our model helps to rationalize these findings.

The remainder of the paper is organized as follows. Section 2 presents our model. In Section 3 we use Argentinean customs data to test the distinguishing features of our theoretical mechanism. In Section 4 we develop the impact of trade liberalization under our mechanism and the resulting policy implications. Section 5 concludes.

# 2 Model

## 2.1 Basic structure

We consider the decision of a risk-neutral producer to serve two segmented foreign markets, $A$ and $B$. Countries $A$ and $B$ are symmetric except for the unit trade costs that the home firm must pay to export there, denoted by $\tau^A$ and $\tau^B$, $\tau^A \leq \tau^B$. To sell in each foreign market, the firm needs to incur in a one-time fixed cost, $F$. This corresponds to the costs of establishing distribution channels, of designing a marketing strategy, of learning about exporting procedures, of familiarization with the institutional and policy characteristics of the foreign country etc.

Variable costs comprise two elements: an unknown export unit cost, $c^j$, and a unit production cost that is known to the firm and which we normalize to zero. In subsection 2.3 we show that allowing for varying production costs has no qualitatively important impact on our results beyond implying that more productive firms are more likely to export and to do so by entering markets $A$ and $B$ simultaneously, rather than sequentially. The producer faces the following demand in each market $j = A, B$:

$$q^j(p^j) = d^j - p^j, \tag{1}$$

where $q^j$ denotes the output sold in destination $j$, $p^j$ denotes the corresponding price, and $d^j$ is an (unknown) parameter.

We allow for uncertainty in both demand and supply parameters. Let

$$\mu^j \equiv d^j - c^j$$

be a random variable with a continuous cumulative distribution function $G(\cdot)$ on the support $[\underline{\mu}, \overline{\mu}]$. We refer to $\mu^j$ as the firm's "export profitability" in market $j$. $\overline{\mu}$ obtains when the highest possible demand intercept and the lowest possible export unit cost are realized; $\underline{\mu}$ obtains under the opposite extreme scenario. The analysis becomes interesting when trade costs are such that, upon the resolution of uncertainty, it may become optimal to serve both, only one, or none of the markets. Accordingly, we assume $\underline{\mu} < \tau^A$—so that exporting may not be worthwhile even if $F = 0$—and $2F^{1/2} + \tau^B < \overline{\mu}$. This last condition implies that exporting may be profitable even in the distant market. To ensure that prices are always strictly positive, we need that $E\mu < 2d^j$, which we assume throughout the paper.[6]

Our central assumption is that export profitability is correlated over time and across markets. Correlation of export profitability over time reflects the fact that the structure of demand a firm faces in a market, while likely unknown ex ante, tends to be persistent.[7] The same is true for the idiosyncratic component of some export costs, which a firm learns only after actually engaging in exports but that do not change much over time. For example, shipping and other port activities, maintenance of an international division within the firm, distribution of goods in foreign markets, compliance with requirements of financial services, as well as the handling and processing of the documents necessary for exporting—all these activities involve relatively stable idiosyncratic costs that are often unknown to the firm until it actually starts exporting.[8] Similarly, cross-country correlations in export profitability can come from similarities across countries either in demand or supply conditions. The patterns uncovered by gravity equations—which show that bilateral trade correlates strongly with indicators for language, religion, colonial origin etc.—suggest that demand similarities across countries can be significant.[9] Likewise, part of the initially unknown export costs mentioned above involve the business of exporting in general, implying a correlation across markets.

To make the analysis as clear and simple as possible, we focus on the limiting cases. First, as the definition of $\mu^j$ without time subscripts indicates, we consider that the $\mu^j$'s are constant over time. Second, we look at the case where the draws of $\mu^j$ are perfectly correlated across markets: $\mu^A = \mu^B = \mu$. Each of these assumptions can be relaxed. All of our qualitative results generalize to any strictly positive correlation of export profitabilities across markets and time. In Appendix B we show this for the case where $\mu^j$'s are positively but imperfectly correlated.

Since our main goal is to understand entry into foreign markets, we evaluate all profits from an *ex ante* perspective, i.e. at their $t = 0$ expected value. For simplicity we do not consider a discount

[6] In a technical addendum available upon request, we analytically show that adopting instead a demand function of the form $q^j(p^j) = \max\{d^j - p^j, 0\}$ leaves our results and empirical predictions unaffected.

[7] Trade facilitation agencies do indeed place a heavy emphasis on the importance of uncovering foreign demand for would-be exporters, and their advices indicate that the key uncertainty is about persistent demand components (see for example the discussion of SITPRO, the British trade facilitation agency, at http://www.sitpro.org.uk).

[8] Even important but relatively straightforward tasks related to exporting are often performed very poorly—implying high costs—by some firms. For example, SITPRO points out that "well in excess of 50% of documents presented by exporters to banks for payment under letters of credit are rejected on first presentation" (http://www.sitpro.org.uk). This figure includes new as well as old exporters. And such mistakes can be quite costly, since "slight discrepancies or omissions may prevent merchandise from being exported, result in nonpayment, or even in the seizure of the exporter's goods by [...] customs" (U.S. International Trade Administration, "A Basic Guide to Exporting," http://www.unzco.com/basicguide). Arguably, firms learn how well they can perform such export-specific activities only after they actually engage in them.

[9] Buono et al. (2008) show evidence consistent with persistent market characteristics driving firms' choices of export destinations. Kee and Krishna (2008) argue that market, but also firm-specific demand shocks can help reconcile the predictions of heterogeneous firms models with detailed micro evidence. Demidova et al. (2009) confirm this when studying how variations in American and European trade policies vis-à-vis Bangladeshi apparel products affect firms' choices of export destinations.

factor, but this has no bearing on our results. We denote by $e_t^j$ the firm's decision to enter market $j$ at time $t$, $j = A, B$, $t = 1, 2$. Thus, $e_t^j = 1$ if the firm enters market $j$ (i.e. pays the sunk cost) at $t$, $e_t^j = 0$ otherwise. Output $q_t^j$ can be strictly positive only if either $e_t^j = 1$ or $e_{t-1}^j = 1$.

The timing is as follows:

$t = 1$: At period 1, the firm decides whether to enter each market. If the firm decides to enter market $j$, it pays the per-destination fixed entry cost $F$ and chooses how much to sell there in that period, $q_1^j$. At the end of period 1, export profits in destination $j$ are realized. If the firm has entered and produced $q_1^j \geq \varepsilon$, where $\varepsilon > 0$ is arbitrarily small, it infers $\mu$ from its profit.

$t = 2$: At period 2, if the firm has entered market $j$ at $t = 1$, it chooses how much to sell in that market, $q_2^j$. If the firm has not entered destination $j$ at $t = 1$, it decides whether to enter that market. If the firm enters, it pays $F$ and chooses $q_2^j$. At the end of period 2, export profits are realized.

Notice that the firm's export profitability parameter $\mu$ is not directly observed but inferred by the firm from its profits. To learn $\mu$ the firm must pay the fixed entry cost $F$ and export a strictly positive quantity to one of the markets. This is reminiscent of Jovanovic's (1982) model, although a central difference is that we consider entry into several destinations.

Uncovering $\mu$ must be costly, or else all firms would, counterfactually, export at least a tiny quantity to gather their export potential. We rely on previous findings in the literature and model this as a sunk cost, but this is not necessary for our results. Alternatively, one could specify that a firm needs a minimum scale of experimentation to reliably uncover its true export profitability. We allow this minimum scale to be an arbitrarily small number ($\varepsilon$) because we require the firm to spend $F$ to sell in a foreign market, but one could also assume the opposite (i.e. set $F = 0$ and require a larger minimum scale).[10]

In reality, entry may also be "passive," where a foreign buyer posts an order and the exporting firm simply delivers it. Trade in intermediate goods, for example, is indeed often importer-driven, rather than exporter-driven. Thus, in general firms may either choose to enter a market, as in our model, or simply wait until they are chosen by a foreign buyer. Importantly, both ways of exporting help to resolve uncertainty. Initially passive exporters may therefore become active, and pay entry costs, if upon delivery of their first foreign order they learn about their future export profitability. Since our predictions apply to export activity after a first experience, they would remain qualitatively valid even when that first experience is "passive."

## 2.2 A Firm's Export Decision

Export profitability correlated across time and markets implies that exporting to country $A$ reveals information about the firm's export performance in country $B$. As a result, there are three undom-

[10] The specific type of experimentation chosen by the exporter is not the focus of this paper. For a more general analysis of experimentation, see for example the model of Aghion et al. (1991), where a Bayesian decision maker with an unknown objective function engages into costly experimentation, provided that it is informative enough.

inated entry strategies. The firm may enter both markets simultaneously at $t = 1$ ("simultaneous entry"); enter only market $A$ at $t = 1$, deciding at $t = 2$ whether to enter market $B$ ("sequential entry"); or enter neither market. The other two possibilities, of entering both markets only at $t = 2$ and of entering market $B$ before market $A$, need not be considered. The latter is dominated by entering market $A$ before market $B$, since $\tau^A \leq \tau^B$. The former is dominated by simultaneous entry at $t = 1$, since by postponing entry the producer is faced with the same problem as in $t = 1$, but is left with a shorter horizon to recoup identical fixed entry and production costs.

We solve for the firm's decision variables $\{e_1^j, e_2^j, q_1^j, q_2^j\}$ using backward induction. We denote optimal quantities in period $t$ under simultaneous entry by $\widehat{q}_t^j$, and under sequential entry by $\widetilde{q}_t^j$.

### 2.2.1 Period $t = 2$

i) *No entry.* The firm does not export, earning zero profit.

ii) *Simultaneous entry.* When the firm exports to both destinations at $t = 1$, at $t = 2$ it will have inferred its export profitability $\mu$ and will choose its export volumes by solving

$$\max_{q_2^j \geq 0} \left\{ (\mu - \tau - q_2^j) q_2^j \right\}, \; j = A, B.$$

This yields

$$\widehat{q}_2^j(\tau^j) = \mathbf{1}_{\{\mu > \tau^j\}} \left( \frac{\mu - \tau^j}{2} \right), \tag{2}$$

where $\mathbf{1}_{\{.\}}$ represents the indicator function, here denoting whether $\mu > \tau^j$. Second-period output is zero for low $\mu$. Profits at $t = 2$, expressed in $t = 0$ expected terms, can then be written as

$$V(\tau^j) = \int_{\tau^j}^{\overline{\mu}} \left( \frac{\mu - \tau^j}{2} \right)^2 dG(\mu), \; j = A, B.$$

Function $V(\tau^j)$ represents the firm's option value of keeping exporting to market $j$ after learning its profitability in foreign markets. If the firm cannot deliver positive profits in a market, it exits to avoid further losses. Otherwise, the firm tunes up its output choice to that market.

iii) *Sequential entry.* When the firm only exports to country $A$ in $t = 1$, at $t = 2$ it will have inferred its export profitability $\mu$. Thus, $q_2^A$ is again given by (2): $\widetilde{q}_2^A(\tau^A) = \widehat{q}_2^A(\tau^A) = \mathbf{1}_{\{\mu > \tau^A\}} \left( \frac{\mu - \tau^A}{2} \right)$, generating second-period profit $V(\tau^A)$.

The firm chooses to enter market $B$ at $t = 2$ if the operational profit is greater than the sunk cost to enter that market. This will be the case when the firm realizes its export profitability is large relative to the sunk cost:

$$\left( \frac{\mu - \tau^B}{2} \right)^2 \geq F. \tag{3}$$

Hence, the firm's entry decision in market $B$ at $t = 2$ is

$$e_2^B(\tau^B) = 1 \Leftrightarrow \mu \geq 2F^{1/2} + \tau^B. \tag{4}$$

Thus, defining $F_2^B(\tau^B)$ as the $F$ that solves (3) with equality, the firm enters market $B$ at $t = 2$ if $F \leq F_2^B(\tau^B)$. It is straightforward to see that $F_2^B(\tau^B)$ is strictly decreasing in $\tau^B$.

If the firm enters market $B$, it will choose $q_2^B$ much like it chooses $q_2^A$, adjusted for market $B$'s specific trade cost, $\tau^B$. However, conditional on $e_2^B = 1$, we know that $\mu > \tau^B$. Therefore, the firm sets $\tilde{q}_2^B(\tau^B) = \frac{\mu - \tau^B}{2}$.

Expressed in $t = 0$ expected terms, the firm's profit from (possibly) entering market $B$ at $t = 2$ corresponds to

$$W(\tau^B; F) \equiv \int_{2F^{1/2}+\tau^B}^{\overline{\mu}} \left[ \left( \frac{\mu - \tau^B}{2} \right)^2 - F \right] dG(\mu) \tag{5}$$

$$= \left\{ V(\tau^B) - \int_{\tau^B}^{2F^{1/2}+\tau^B} \left( \frac{\mu - \tau^B}{2} \right)^2 dG(\mu) \right\} - F \left[ 1 - G(2F^{1/2} + \tau^B) \right]. \tag{6}$$

Function $W(\tau^B; F)$ represents the firm's option value of exporting to market $B$ after learning its profitability in foreign markets by entering market $A$ first. The expression in curly brackets represents the (ex ante) expected operational profit from entering market $B$ only at $t = 2$. The other term represents the sunk cost from entering $B$ times the probability that this happens.

Thus, the return from first entering destination $A$ includes the option value of subsequently becoming an exporter to destination $B$ without incurring the costs from directly "testing" that market. Naturally, this option has value because export profitabilities are correlated across destinations. In Appendix B we show that if the correlation is positive but less than perfect, the value of the option falls but remains strictly positive. In the extreme case where export profitabilities are independent, $W(\tau^B; F) = 0$ and there is no gain from entering export markets sequentially.

### 2.2.2 Period $t = 1$

i) *No entry.* The firm does not export, earning zero profit.

ii) *Simultaneous entry.* A firm exporting to both destinations at $t = 1$ chooses $q_1^A$ and $q_1^B$ to maximize gross profits:

$$\Psi^{Sm}(q_1^A, q_1^B; \tau^A, \tau^B) \equiv \int_{\underline{\mu}}^{\overline{\mu}} (\mu - \tau^A - q_1^A) q_1^A dG(\mu) + \int_{\underline{\mu}}^{\overline{\mu}} (\mu - \tau^B - q_1^B) q_1^B dG(\mu)$$
$$+ \max \left\{ \mathbf{1}_{\{q_1^A > 0\}}, \mathbf{1}_{\{q_1^B > 0\}} \right\} \left[ V(\tau^A) + V(\tau^B) \right], \tag{7}$$

where superscript $Sm$ stands for "simultaneous" entry. The first two terms correspond to the firm's period 1 per-destination operational profits. The third term denotes how much the firm expects to earn in period 2, depending on whether *either* $q_1^A > 0$ *or* $q_1^B > 0$. Since exporting to one market provides the firm with information on its export profitability in both markets, it is enough to have exported a positive amount in period 1 to either destination.

Maximization of (7) yields outputs

$$\widehat{q}_1^A(\tau^A) = \mathbf{1}_{\{E\mu>\tau^A\}}\left(\frac{E\mu-\tau^A}{2}\right)+\mathbf{1}_{\{E\mu\leq\tau^A\}}\varepsilon, \tag{8}$$

$$\widehat{q}_1^B(\tau^B) = \mathbf{1}_{\{E\mu>\tau^B\}}\left(\frac{E\mu-\tau^B}{2}\right), \tag{9}$$

where $\varepsilon>0$ is an arbitrarily small number. To understand these expressions, notice that there are three possibilities. If $E\mu>\tau^B$, $q_1^j=\frac{E\mu-\tau^j}{2}$ for $j=A,B$ is clearly optimal. If $\tau^B\geq E\mu>\tau^A$, $q_1^A=\frac{E\mu-\tau^A}{2}$ and $q_1^B=0$ is the obvious choice. If $E\mu\leq\tau^A$, setting $q_1^A=q_1^B=0$ may appear optimal. However, inspection of (7) makes clear that a small but strictly positive $q_1^A=\varepsilon>0$ dominates that option, since $\Psi^{Sm}(\varepsilon,0;\tau^A,\tau^B)=\left(E\mu-\tau^A-\varepsilon\right)\varepsilon+V(\tau^A)+W(\tau^B;F)>0$.[11] Clearly, setting $q_1^A=q_1^B=0$ forgoes the main benefit from cross-market learning—the savings of fixed costs in foreign markets that prove not to be profitable.

Define $\Psi(\tau^j)\equiv\mathbf{1}_{\{E\mu>\tau^j\}}\left(\frac{E\mu-\tau^j}{2}\right)^2+V(\tau^j)$. Evaluating (7) at the optimal output choices (8), (9) and (2), we obtain the firm's expected gross profit from simultaneous entry:

$$\Psi^{Sm}(\tau^A,\tau^B)\equiv\lim_{\varepsilon\to 0}\Psi^{Sm}(\widehat{q}_1^A(\tau^A),\widehat{q}_1^B(\tau^B);\tau^A,\tau^B)=\Psi(\tau^A)+\Psi(\tau^B). \tag{10}$$

iii) *Sequential entry.* At $t=1$, a firm that enters market $A$ but not market $B$ chooses $q_1^A$ to maximize

$$\Psi^{Sq}(q_1^A;\tau^A,\tau^B)\equiv\int_{\underline{\mu}}^{\overline{\mu}}(\mu-\tau^A-q_1^A)q_1^A dG(\mu)+\mathbf{1}_{\{q_1^A>0\}}\left[V(\tau^A)+W(\tau^B;F)\right], \tag{11}$$

where $Sq$ stands for "sequential" entry. The firm only learns its export profitability if $q_1^A>0$. This allows the firm to make a more informed entry decision in market $B$ at $t=2$, according to (4). Clearly, the solution to this program is also $\widetilde{q}_1^A(\tau^A)=\widehat{q}_1^A(\tau^A)$, as in (8).

Our model therefore suggests that some firms will "test" foreign markets before fully exploring them (or exiting them altogether), a feature consistent with the empirical findings discussed in the onset. Interestingly, experimentation can arise even when the trade cost is large enough to make expected operational profits at $t=1$ negative, and despite the existence of sunk costs to export. Intuitively, the firm can choose to incur the sunk cost and a small initial operational loss because it knows that it *may* be competitive in that foreign market as well as in others; the return from the initial sale allows the firm to find out whether it actually is.

Figure 1 illustrates this point by showing a situation where export experimentation is worthwhile even though $E\mu<\tau^A$. The lowest curve represents the profit of entering market $A$ when experi-

[11] Strictly speaking, $\varepsilon$ is allowed to be arbitrarily small for simplicity (quantities are defined on $\mathbb{R}_+$ as usual). It obtains because the profit function has a built-in discontinuity at $q=0$, which captures the simplest notion of learning-by-doing we could think of (see figure 1 below). Alternatively, one could impose either a minimum quantity that can be exported, or a more general relationship between the amount shipped and the amount of information gathered (as for example in Aghion et al. 1991). Both would add an extra term in the equilibrium profit function defined below, but otherwise would make no qualitatively difference in our results.

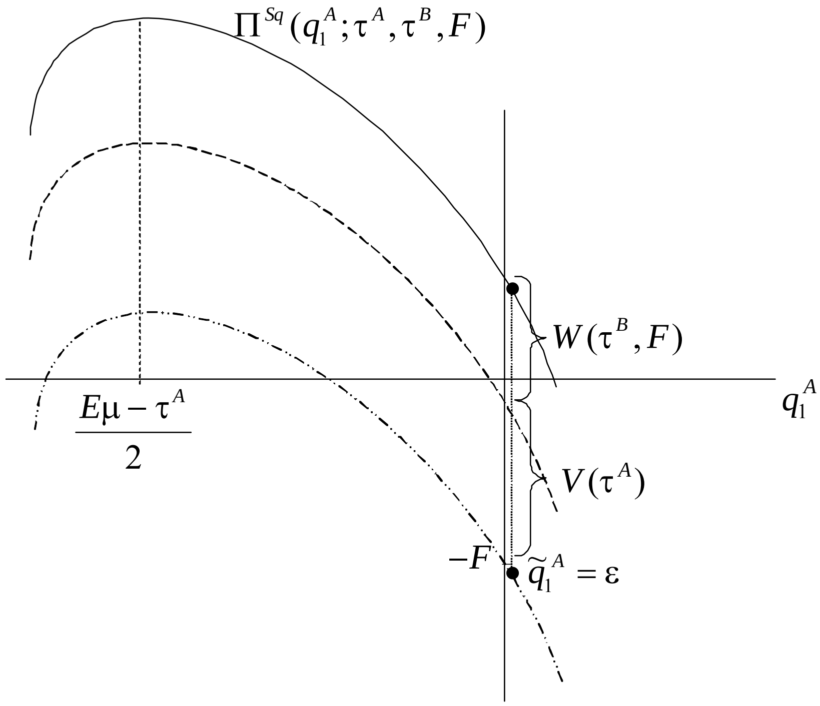


Figure 1: The Profit Function from Sequential Exporting when $E\mu < \tau^A$

mentation is useless. The middle curve adds the value of experimentation in the entry market; the highest curve includes also the value of experimentation across markets. In the figure, experimentation is worthwhile only because it has value in the other market; otherwise the value of information would not be high enough to compensate for the sunk costs [i.e., $V(\tau^A)+W(\tau^B;F) > F > V(\tau^A)$].

Evaluating (11) at the optimal output choice $\widetilde{q}_1^A(\tau^A)$, we obtain the firm's expected profit from sequential entry:

$$\Psi^{Sq}(\tau^A,\tau^B) \equiv \lim_{\varepsilon\to 0^+} \Psi^{Sq}(\widetilde{q}_1^A(\tau^A);\tau^A,\tau^B) = \Psi(\tau^A) + W(\tau^B;F). \tag{12}$$

### 2.2.3 Entry strategy

We can now fully characterize the firm's entry strategy. Using (10), the firm's net profit from simultaneous entry, $\Pi^{Sm}$, is

$$\Pi^{Sm} = \Psi(\tau^A) + \Psi(\tau^B) - 2F. \tag{13}$$

In turn, we have from (12) that the firm's net profit from sequential entry, $\Pi^{Sq}$, is

$$\Pi^{Sq} = \Psi(\tau^A) + W(\tau^B;F) - F. \tag{14}$$

Simultaneous entry is optimal if $\Pi^{Sm} > \Pi^{Sq}$ and $\Pi^{Sm} \geq 0$. Conversely, sequential entry is optimal if $\Pi^{Sq} \geq \Pi^{Sm}$ and $\Pi^{Sq} \geq 0$. If neither set of conditions is satisfied, the firm does not enter any market. Using (13) and (14), we can rewrite these conditions as follows. Simultaneous entry is optimal if

$$\begin{cases} F < \Psi(\tau^B) - W(\tau^B; F) \quad \text{and} \\ F \leq \left[\Psi(\tau^A) + \Psi(\tau^B)\right]/2. \end{cases}$$

Notice that the right-hand side of the first inequality above is strictly less than the right-hand side of the second inequality, since $W(\tau^B; F) > 0$ and $\tau^A \leq \tau^B$. Intuitively, if $F$ is small enough to make simultaneous entry preferred to sequential entry, it also makes simultaneous entry preferred to no entry at all. Thus, simultaneous entry is optimal if

$$F < \Psi(\tau^B) - W(\tau^B; F). \tag{15}$$

In turn, sequential entry is optimal if

$$\Psi(\tau^B) - W(\tau^B; F) \leq F \leq \Psi(\tau^A) + W(\tau^B; F). \tag{16}$$

Inequalities (15) and (16) define the firm's entry strategy at $t = 1$. The firm enters market $A$ at $t = 1$ if either (15) or (16) are satisfied; it enters market $B$ at $t = 1$ if (15) is satisfied but (16) is not:

$$e_1^A(\tau^A, \tau^B) = 1 \Leftrightarrow F \leq \Psi(\tau^A) + W(\tau^B; F), \tag{17}$$

$$e_1^B(\tau^B) = 1 \Leftrightarrow F < \Psi(\tau^B) - W(\tau^B; F). \tag{18}$$

Naturally, the condition for $e_1^B = 1$ is stricter than the condition for $e_1^A = 1$. Condition (18) implies that $e_1^B = 1$ (in which case simultaneous entry occurs) only if the sunk cost to export is sufficiently small. As the following proposition shows, this is the case even though $W(\tau^B; F)$ decreases with $F$.

**Proposition 1** *There are numbers $F^{Sq}$ and $F^{Sm}$, with $F^{Sq} > F^{Sm} \geq 0$, such that at $t = 1$ the firm enters both markets A and B if $F < F^{Sm}$, enters only market A if $F \in [F^{Sm}, F^{Sq}]$, and enters neither market if $F > F^{Sq}$. Moreover, $F^{Sm} > 0$ iff $E\mu > \tau^B$. When $F \in [F^{Sm}, F^{Sq}]$, at $t = 2$ the firm enters market B if it learns that condition (4) is satisfied.*

**Proof.** Rewrite condition (18) for $e_1^B = 1$ as

$$F + W(\tau^B; F) < \Psi(\tau^B). \tag{19}$$

The right-hand side of (19) is independent of $F$, whereas the left-hand side is strictly increasing in $F$. To see that, use Leibniz's rule to find that

$$\begin{aligned} \frac{\partial\left[F + W(\tau^B; F)\right]}{\partial F} &= 1 - \int_{2F^{1/2}+\tau^B}^{\overline{\mu}} dG(\mu) \\ &= G(2F^{1/2} + \tau^B) > 0. \end{aligned} \tag{20}$$

Defining $F^{Sm}$ as the $F$ that would turn (19) into an equality, $e_1^B = 1$ if $F < F^{Sm}$. However, $F^{Sm} = 0$ if $E\mu \leq \tau^B$, since in that case (19) becomes

$$F + \int_{2F^{1/2}+\tau^B}^{\overline{\mu}} \left[ \left( \frac{\mu - \tau^B}{2} \right)^2 - F \right] dG(\mu) < \int_{\tau^B}^{\overline{\mu}} \left( \frac{\mu - \tau^B}{2} \right)^2 dG(\mu).$$

This expression becomes an equality when $F = 0$. Given (20), it follows that it does not hold for any $F > 0$.

Next rewrite condition (17) for $e_1^A = 1$ as

$$F - W(\tau^B; F) \leq \Psi(\tau^A). \tag{21}$$

The right-hand side of (21) is independent of $F$, whereas it is straightforward to see that the left-hand side is strictly increasing in $F$. Thus, defining $F^{Sq}$ as the $F$ that solves (21) with equality, $e_1^A = 1$ if $F \leq F^{Sq}$. Since $F^{Sm}$ is the value of $F$ that leaves the firm indifferent between a sequential and a simultaneous entry strategy [i.e. $\Pi^{Sq}(F^{Sm}) = \Pi^{Sm}(F^{Sm}) > 0$], while $F^{Sq}$ is the value of $F$ that leaves the firm indifferent between sequential entry and no entry [i.e. $\Pi^{Sq}(F^{Sq}) = 0$], because profits are decreasing in the value of the sunk entry cost, $\partial \Pi^{Sq}(F)/\partial F = G(2F^{1/2} + \tau^B) - 2 < 0$, it follows that $F^{Sq} > F^{Sm}$.

Finally, since the firm learns $\mu$ at $t = 1$ when $F \in [F^{Sm}, F^{Sq}]$, it enters market $B$ at $t = 2$ according to (4). ■

The intuition for this result is simple. By construction $\tau^A \leq \tau^B$, so if the firm ever enters any foreign market, it will enter market $A$. Since there are gains from resolving the uncertainty about export profitability, the entry in market $A$, if it happens, will take place in the first period. Provided that the firm enters country $A$, it can also enter country $B$ in the first period or wait to learn its export profitability before going to market $B$. If the firm enters market $B$ at $t = 1$, it earns the expected operational profit in that market in the first period. Naturally, this can make sense only when the operational profit in $B$ is expected to be positive ($E\mu > \tau^B$). By postponing entry the firm forgoes that profit but saves the entry sunk cost if it realizes its profitability is not sufficiently high. The size of the sunk cost has no bearing on the former, but increases the latter. Hence, the higher the sunk cost to export, the more beneficial is waiting before sinking $F$ in the less profitable market, $B$.

Figure 2 illustrates this result when $E\mu > \tau^B$, in which case simultaneous entry is optimal for small enough $F$. Notice that trade cost $\tau^B$ affects both thresholds, while trade cost $\tau^A$ only affects $F^{Sq}$. Thus, we can denote the thresholds as $F^{Sq}(\tau^A, \tau^B)$ and $F^{Sm}(\tau^B)$. We characterize how trade costs affect each of the thresholds in Section 4.

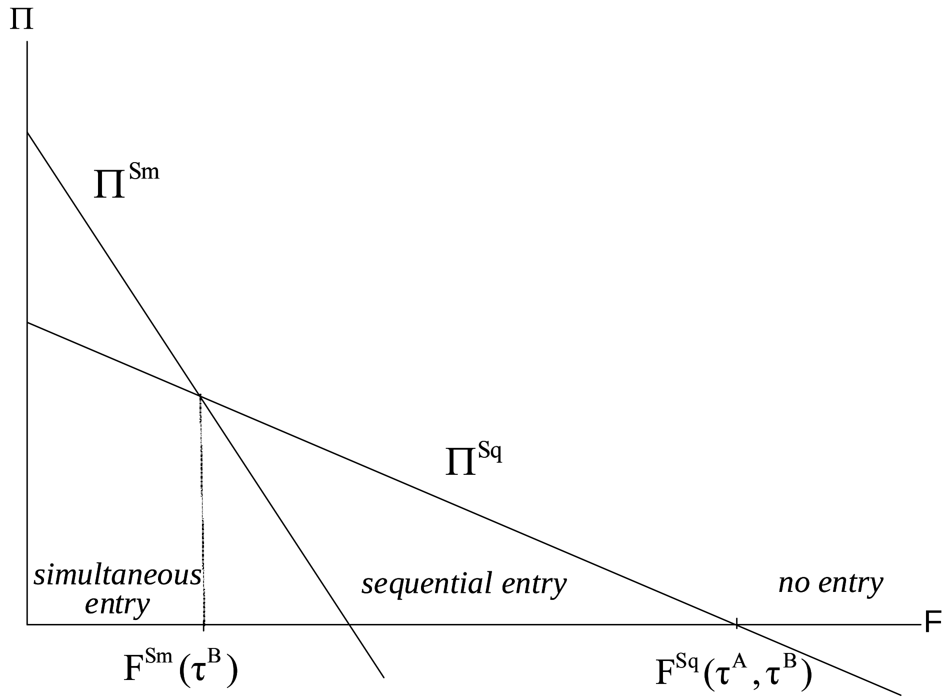


Figure 2: Optimal Entry Strategy ($E\mu > \tau^B$)

### 2.3 Differences in productivity

We have developed the analysis so far without mentioning how differences in productivity would affect our results. Yet the large and growing literature spurred by Melitz (2003) emphasizes that productivity differences are key to explain firms' export behavior. As we now show, they matter in our analysis too, but in a rather straightforward way.

To allow for differences in productivity, we denote a firm's unit costs as $\frac{1}{\varphi}+c$, where $\varphi \in [0, +\infty)$ denotes the firm's efficiency in production (i.e. its measure of productivity) and $c$ again reflects its (unknown) unit export cost. It is easy to see, for example, that more productive firms will sell larger quantities (and expect higher profits) in the destinations they serve. More important for our purposes is how differences in productivity affect entry patterns in foreign markets. The following proposition shows that the more productive a firm is, the less stringent the start-up fixed entry thresholds $F^{Sq}$ and $F^{Sm}$ become.

**Proposition 2** *$F^{Sq}$ and $F^{Sm}$ are increasing in productivity $\varphi$.*

**Proof.** Rewrite condition (18) for $e_1^B = 1$ as

$$F < \Psi(\tau^B + \frac{1}{\varphi}) - W(\tau^B + \frac{1}{\varphi}; F). \tag{22}$$

Analogously to Proposition 1, $F^{Sm} = 0$ if $E\mu \leq \tau^B + \frac{1}{\varphi}$, in which case $\frac{dF^{Sm}}{d\varphi} = 0$. Otherwise, the expression above rewritten as an equality defines $F^{Sm}$ implicitly:

$$F^{Sm} = \left[\Psi(\tau^B + \frac{1}{\varphi}) - W(\tau^B + \frac{1}{\varphi}; F^{Sm})\right],$$

or equivalently,

$$\begin{aligned} F^{Sm} &= \left(\frac{E\mu - \tau^B - \frac{1}{\varphi}}{2}\right)^2 + \int_{\tau^B + \frac{1}{\varphi}}^{\overline{\mu}} \left(\frac{\mu - \tau^B - \frac{1}{\varphi}}{2}\right)^2 dG(\mu) \\ &\quad - \int_{2(F^{Sm})^{1/2} + \tau^B + \frac{1}{\varphi}}^{\overline{\mu}} \left[\left(\frac{\mu - \tau^B - \frac{1}{\varphi}}{2}\right)^2 - F^{Sm}\right] dG(\mu). \end{aligned}$$

Totally differentiating this expression and manipulating it, we find

$$\begin{aligned} \frac{dF^{Sm}}{d\varphi} &= \frac{\partial\Psi(\tau^B + \frac{1}{\varphi})/\partial\varphi - \partial W(\tau^B + \frac{1}{\varphi}; F^{Sm})/\partial\varphi}{1 + \partial W(\tau^B + \frac{1}{\varphi}; F^{Sm})/\partial F} \\ &= \frac{(E\mu - \tau^B - \frac{1}{\varphi}) + \int_{\tau^B + \frac{1}{\varphi}}^{2\left[F^{Sm}\right]^{1/2} + \tau^B + \frac{1}{\varphi}} (\mu - \tau^B - \frac{1}{\varphi}) dG(\mu)}{2\varphi^2 G(2\left[F^{Sm}\right]^{1/2} + \tau^B + \frac{1}{\varphi})} > 0. \end{aligned}$$

Next rewrite condition (17) for $e_1^A = 1$ as

$$F \leq \Psi(\tau^A + \frac{1}{\varphi}) + W(\tau^B + \frac{1}{\varphi}; F). \tag{23}$$

This expression defines $F^{Sq}$ implicitly when it holds with equality:

$$F^{Sq} = \Psi(\tau^A + \frac{1}{\varphi}) + W(\tau^B + \frac{1}{\varphi}; F^{Sq}),$$

or equivalently,

$$\begin{aligned} F^{Sq} &= \mathbf{1}_{\{E\mu > \tau^A + \frac{1}{\varphi}\}} \left(\frac{E\mu - \tau^A - \frac{1}{\varphi}}{2}\right)^2 + \int_{\tau^A + \frac{1}{\varphi}}^{\overline{\mu}} \left(\frac{\mu - \tau^A - \frac{1}{\varphi}}{2}\right)^2 dG(\mu) \\ &\quad + \int_{2(F^{Sq})^{1/2} + \tau^B + \frac{1}{\varphi}}^{\overline{\mu}} \left[\left(\frac{\mu - \tau^B - \frac{1}{\varphi}}{2}\right)^2 - F^{Sq}\right] dG(\mu). \end{aligned}$$

Totally differentiating this expression and manipulating it, we find

$$\frac{dF^{Sq}}{d\varphi} = \frac{\partial\Psi(\tau^A + \frac{1}{\varphi})/\partial\varphi + \partial W(\tau^B + \frac{1}{\varphi}; F^{Sq})/\partial\varphi}{1 - \partial W(\tau^B + \frac{1}{\varphi}; F^{Sq})/\partial F}$$

$$= \frac{1}{2\varphi^2\left[2 - G(2\left[F^{Sq}\right]^{1/2} + \tau^B + \frac{1}{\varphi})\right]} \times \left[\mathbf{1}_{\{E\mu > \tau^A + \frac{1}{\varphi}\}}\left(E\mu - \tau^A - \frac{1}{\varphi}\right) + \right.$$

$$\left. + \int_{\tau^A+\frac{1}{\varphi}}^{\overline{\mu}} (\mu - \tau^A - \frac{1}{\varphi})dG(\mu) + \int_{2[F^{Sq}]^{1/2}+\tau^B+\frac{1}{\varphi}}^{\overline{\mu}} (\mu - \tau^B - \frac{1}{\varphi})dG(\mu)\right] > 0,$$

completing the proof. ■

Thus, varying productivity levels shift the thresholds defining sequential and simultaneous entry in foreign markets in an unambiguous way. Higher productivity increases the expected profits from entering foreign markets simultaneously, as well as the expected profits from exporting at all. The entry strategies can nevertheless still be characterized by the sunk cost thresholds. Thus, in the remaining of the paper we keep the specification where we normalize unit production costs to zero (equivalent to having $\varphi \to \infty$), while bearing in mind that they are affected by productivity levels.

## 2.4 Testable implications

Our model is parsimonious in many dimensions. But it is straightforward to extend it to $T > 2$ periods and $N > 2$ foreign countries, so we can derive testable predictions for the intensive and the extensive (both entry and exit) margins of exporting. We assume throughout that $F$ is 'moderate,' so sequential exporting is optimal.[12] We maintain the convention that $\tau^A = \min\{\tau^j\}$, $j = A, ..., N$, so that market $A$ is the first the firm enters at $t = 1$.

In the basic formulation of our model, firms learn fully about their profitability in exporting to market $j$ by selling at market $i$, $i \neq j$. In truth, the correlation of export profitabilities across markets is surely less than perfect. However, if it is not negligible, our main messages remain intact (Appendix B). The same is true about correlation of export profitabilities in a given market over time. Effectively, our running hypothesis is that the highest informational content is extracted from the first export experience. Our predictions should be interpreted accordingly.

Our model predicts, first, that conditional on survival we should expect faster intensive margin export growth when firms are learning their export profitabilities—i.e. right after they enter their first foreign market.

**Prediction 1 (Intensive margin)** *Conditional on survival, the growth of a firm's exports to a market is on average highest between the first and second periods in the first foreign market served by the firm.*

[12] In practice, entry in foreign markets is indeed always "sequential" to some extent, as no firm in our sample enters all possible markets within a single year.

**Proof.** Consider the first market, $A$. Conditional on entry, export volume at $t = 1$ is given by (8). At $t = 2$, the firm decides to stay active there if $\mu > \tau^A$, and in that case produces $q_2^A = \frac{\mu - \tau^A}{2}$. Ex post quantities conditional on survival are distributed according to $G(\cdot|\mu > \tau^A)$. It follows that the average surviving firm will produce the ex ante expected quantity $E_0(q_2^A\big|\, \mu > \tau^A) = \frac{E_0(\mu|\mu > \tau^A) - \tau^A}{2}$. There are two cases. If $E\mu \leq \tau^A$, export growth from first to second year is $\sigma^A \equiv \frac{E_0(\mu|\mu > \tau^A) - \tau^A}{2} - \varepsilon > 0$. Otherwise, $\sigma^A = \frac{E_0(\mu|\mu > \tau^A) - \tau^A}{2} - \frac{E\mu - \tau^A}{2} = \frac{1}{2}[E_0(\mu|\, \mu > \tau^A) - E\mu]$. Lemma 2 in Appendix A shows that this inequality is strictly positive. Hence, conditional on survival, the firm expects to increase its export volume to market $A$ in the second period. In all subsequent periods expected growth in market $A$ conditional on survival is nil, since $E_0(q_t^A\big|\, \mu > \tau^A) = \frac{E_0(\mu|\mu > \tau^A) - \tau^A}{2}$ for all $t > 1$.

Consider now foreign market $j$, $j \neq A$. Since the firm enters market $j$ only if $\mu > 2F^{1/2} + \tau^j$, $E_0(q_{t+1}^j\big|\, \mu > 2F^{1/2} + \tau^j) = E_0(q_t^j\big|\, \mu > 2F^{1/2} + \tau^j) = \frac{E_0(\mu|\mu > 2F^{1/2} + \tau^j) - \tau^j}{2}$ for all $t \geq 1$. Thus, export growth in market $j$ is nil in all periods. Hence, export growth is on average highest in market $A$ between the first and second years of exporting. ■

The intuition for this result is simple. Since export profitability is uncertain for a firm before it starts exporting, first-year exports are relatively low. If the firm anticipates positive variable profit in its first market, it produces according to this expectation. If the firm stays there in the second period, it must be because its uncovered export potential is relatively high ($\mu > \tau^A$). Therefore, conditional on survival, on average the firm expands sales in its first market, as the relevant distribution of $\mu$ is a truncation of the original one. If the firm had entered that market just to learn about its export potential (and to potentially benefit from expanding to other destinations in the future), the firm initially produces just the minimum necessary for effective learning and the same argument applies even more strongly. On the other hand, once the uncertainty about export profitability has been resolved, there is no reason for further changes in sales, and there should be no growth in export volumes in the years following this discovery period. Similarly, since the profitability of the firm in its first export destination conveys all information about export profitability in other destinations, there is no reason for export growth in markets other than the firm's first either.

Obviously, our basic model delivers these results too bluntly. It abstracts from a range of shocks that are likely to affect the firm's output choices and growth; we will control for those in our empirical analysis. There are also other reasons to expect export growth in new foreign markets, as we discuss later. Moreover, while in the basic model we assume that export profitability is perfectly correlated across markets and time, this is clearly too strong. In particular, imperfectly correlated export profitability across markets implies strictly positive first-to-second year export growth in every market the firm expands to and survives. We will control for that as well.

Our second prediction relates to entry patterns. Once a firm starts exporting, it will uncover its export profitability. If it turns out to be sufficiently high, the firm expands in the next period to other markets where the firm anticipates positive profits.

**Prediction 2 (Entry)** *Conditional on survival, new exporters are more likely to enter other foreign markets than experienced ones.*

**Proof.** Denote the probability that a firm that has just started to export will enter a new foreign market $j$ in the next period by $pr(e_2^j = 1|e_1^A = 1 \ \& \ e_1^j = 0)$, and the probability that a firm that has been an exporter for a longer period will enter market $j$ by $pr(e_t^j = 1|\prod_{i=1}^{t-1} e_{t-i}^A = 1 \ \& \ e_{t-1}^j = 0)$, $t \geq 2$. The model implies that $pr(e_2^B = 1|e_1^A = 1 \ \& \ e_1^j = 0) = 1 - G(2F^{1/2} + \tau^j) > 0 = pr(e_t^j = 1|\prod_{i=1}^{t-1} e_{t-i}^A = 1 \ \& \ e_{t-1}^j = 0)$, concluding the proof. ∎

Experienced exporters have already learnt enough about their export profitability, and therefore have already made their entry decisions in the past. In contrast, new exporters are learning now how profitable they can be as exporters, and some will realize it pays to expand to other destinations.

Again, the message from our basic model is extreme, as it abstracts from all other motives for expansion to different foreign markets—which we seek to control for in our empirical analysis. But it helps to highlight our central point, that (surviving) new exporters have an *extra* motivation for expansion.

Our last prediction refers to the exit patterns of exporting firms.

**Prediction 3 (Exit)** *A firm is more likely to exit a foreign market if it is a new exporter.*

**Proof.** Let the probability of exiting a foreign market right after entering there be $pr(e_2^A = 0|e_1^A = 1)$ if the foreign market is the firm's first, and $pr(e_{t+1}^j = 0|e_t^j = 1 \ \& \ e_{t-1}^j = 1)$, $t \geq 2$, $j \neq A$, otherwise. The latter is also equal to the probability of exiting a market after being there for more than one period. The model implies that

$$pr(e_2^A = 0|e_1^A = 1) = G(\tau^A) > 0 = pr(e_{t+1}^j = 0|e_t^j = 1 \ \& \ e_{t-1}^j = 1),$$

completing the proof. ∎

An experienced exporter is better informed about export profitability in a new foreign destination than it would have been, were that foreign market the firm's first. Accordingly, finding out that it is not worthwhile to keep serving that market is more likely in the latter than in the former case. While many reasons can cause a firm to abandon a foreign destination, we argue that being a new exporter creates an additional motivation to do so, in expected terms.

# 3 Evidence

We can now test the main predictions of our model. We start by describing the data.

## 3.1 Data

Our data set includes the universe of Argentinean manufacturing export transactions, as collected by the Argentinean Customs Office, between 2002 and 2007. It records the value (in US dollars), the exporter's tax code and the country of destination for each export transaction. Over our sample period, Argentinean manufacturing exports involved 15,301 exporters and 130 export destinations.

Appendix C presents the trends of aggregate exports in Argentina during 2002-2007, as well as annual exports by sector and by destination. Figure 3 shows that Argentina experienced high export growth during this period, mainly a consequence of the steep depreciation of its currency in early 2002. As of 2007, Argentina's main export manufacturing sectors (Table 9) are petroleum (30%); food, tobacco and beverages (23%); and automotive and transport equipment (13%), while Argentina's main export destinations (Table 10) are its Mercosur partners Brazil, Paraguay and Uruguay (35%), followed by North America (13%) and by Argentina's other neighbors Chile and Bolivia (10%).

All new exporters in our data set are "sequential exporters," in the sense that none of them enter all 130 destinations at once. In fact, 79% of new exporters start in a single market, 15% enter initially in two or three destinations, and just 6% start with more than three destinations. On average, exporting firms serve three distinct foreign markets; around 40% of the exporting firms serve only one destination.

Table 1 reveals some interesting features of different types of exporters. First, new exporters—which correspond to the sum of "entrants" (firms that not do not export in $t-1$ but do so in both $t$ and $t+1$) and "single-year" exporters (i.e. firms that export in $t$ but not in either $t-1$ or $t+1$)—are common in our sample, representing on average 24% of all exporters in a year. Second, the share of the new exporters that are single-year is large: 38% on average, and their absolute and relative participation increases over time, reaching 47% of all new exporters in 2007. Third, "continuers" (those that export in $t-1$, $t$ and $t+1$) account for the bulk of exports in Argentina, while entrants and "exiters" (firms that export in $t-1$ and in $t$ but not in $t+1$) are much smaller, and single-year exporters even more so.[13]

New exporters that remain active, on the other hand, grow fast. This can be observed in Table 2, where we report the foreign sales of firms that break into a new market in 2003 and keep exporting there in the subsequent years of our data set. We distinguish those exporting in 2003 for the first time ("First Market 2003") from those already in the exporting business ("New Market 2003").[14] The table displays each group's average export value by year of experience. Observe that the average firm of both groups increases its exports by more than 100% during the first year. Export growth is considerably lower in subsequent years. Moreover, in all years export growth is significantly higher in the first market than in subsequent destinations, whereas average values shipped by experienced exporters are much larger than those shipped by fledgling ones.

These regularities are not specific to Argentina. In fact, most of them echo those observed by other authors in other countries (e.g. Eaton et al. 2008 in Colombia, Buono et al. 2008 in France,

[13] Single-year exporters sell on average less than 20% of what other new exporters sell abroad in their first year. In terms of our model, this suggests that the share of "pure experimenters" (i.e. those that start exporting even though $E\mu \leq \tau^A$) is higher among the single-year exporters than among the other entrants. Naturally, the pure experimenters are indeed the least likely to succeed as exporters.

[14] We focus on 2003 to obtain the longest possible time span after entry.

Table 1: Exports by Type of Exporter

| Year | Total | Entrant | Exiter | Continuer | Single Year |
|---|---|---|---|---|---|
| **Number of firms** | | | | | |
| Year | Total | Entrant | Exiter | Continuer | Single Year |
| 2002 | 7205 | | | | |
| 2003 | 8251 | 1484 | 499 | 5520 | 748 |
| 2004 | 9055 | 1569 | 487 | 6517 | 482 |
| 2005 | 10884 | 1568 | 1053 | 7033 | 1230 |
| 2006 | 10944 | 1244 | 1230 | 7371 | 1099 |
| 2007 | 10062 | | | | |
| **Total Value of exports (US$ Millions)** | | | | | |
| Year | Total | Entrant | Exiter | Continuer | Single Year |
| 2002 | 17890 | | | | |
| 2003 | 18554 | 80 | 299 | 18183 | 26 |
| 2004 | 23544 | 133 | 34 | 23369 | 16 |
| 2005 | 29060 | 204 | 161 | 28603 | 102 |
| 2006 | 30872 | 362 | 127 | 30405 | 41 |
| 2007 | 41395 | | | | |
| **Exports per firm (US$ Thousands)** | | | | | |
| Year | Total | Entrant | Exiter | Continuer | Single Year |
| 2002 | 2483 | | | | |
| 2003 | 2249 | 54 | 598 | 3294 | 34 |
| 2004 | 2600 | 85 | 70 | 3586 | 32 |
| 2005 | 2670 | 130 | 153 | 4067 | 83 |
| 2006 | 2821 | 291 | 103 | 4125 | 37 |
| 2007 | 4114 | | | | |

Note: "Entrants" in year $t$ are firms that not did not export in t-1 and exported in t, *and will export* in t + 1 as well. "Exiters" exported in t-1 and in t but are not exporters in t + 1. "Continuers" export in t-1, t and in t + 1. "Single Year" exporters are firms that exported in t but neither in t-1, nor in t + 1.

Table 2: Firm-level export growth, First Market versus New Market

| Year | First Market 2003 | | New Market 2003 | |
|---|---|---|---|---|
| | USD | Growth (%) | USD | Growth (%) |
| 2003 | 34023 | | 96541 | |
| 2004 | 88262 | 159 | 200799 | 108 |
| 2005 | 149602 | 69 | 304295 | 52 |
| 2006 | 197447 | 32 | 340015 | 12 |
| 2007 | 303041 | 53 | 449147 | 32 |

Lawless 2009 in Ireland), although previous authors do not distinguish between the behavior of exporters in their first and their subsequent foreign markets. These regularities provide a good illustration of our discussion in the Introduction. New exporters are very small in foreign markets relative to old exporters, and almost 40% of them drop out of foreign markets in less than a year. Given the need to incur sunk costs to start exporting, those going through such short export spells ought to be realizing substantially negative profits from their export experience. They must then have expected very high profits in case of success in the export business. Indeed, the new exporters that survive expand quite fast.

Naturally, while these regularities are all consistent with export profitability being positively correlated over time and across destinations, many other factors may also play a role in shaping these aggregate figures. We therefore turn now to investigating our predictions in more detail.

## 3.2 Empirical results

### 3.2.1 Intensive margin

Our model predicts that, conditional on survival, the growth of a firm's exports is on average highest between the first and second periods in the first foreign market served by the firm (Prediction 1). We test this prediction by estimating the following equation:

$$\Delta \log X_{ijt} = \alpha_1 \left( FY_{ij,t-1} \times FM_{ij} \right) + \alpha_2 FM_{ij} + \alpha_3 FY_{ij,t-1} + \{FE\} + u_{ijt},$$

where $\Delta \log X_{ijt}$ is the growth rate of the value of exports between $t$ and $t-1$ by firm $i$ in market $j$, $FY_{ij,t-1}$ is a dummy indicating whether firm $i$ exported to destination $j$ in $t-1$ for the first time, and $FM_{ij}$ indicates whether $j$ was the firm's first export market. Proposition 1 indicates that $\alpha_1 > 0$, but we also include $FY$ and $FM$ by themselves because there could be reasons that make growth distinct in the first export market of a firm or in the firm's first periods of activity in a foreign market.

Of course, a number of other factors affect a firm's export growth in a market as well, such as the general characteristics of the destination, the economic conditions in the year, and the firm's own distinguishing characteristics. To account for these factors, we take advantage of the richness of our data set and include a wide range of fixed effects, $\{FE\}$, including firm, year and destination—or alternatively, year-destination—fixed effects. Firm fixed effects control for all systematic differences across firms that do not change over time. Year-destination fixed effects control for all aggregate shocks that affect the attractiveness of a market—aggregate demand growth, exchange rates variations, political changes etc.

Importantly, the sample used in the intensive margin regressions consists of firms that exported for at least two consecutive years to a destination—i.e. firms that survive more than a year in a foreign market. Thus, selection is not an issue here. Notice also that, while the prediction is stated in terms of export quantities, the data report export values. Nonetheless, Prediction 1 can be equivalently stated in terms of sales values as long as demand ($d$) and supply shocks ($c$) are independently distributed (see Lemma 3 in Appendix A for the proof).

Table 3 displays the results. They show that growth is not in general higher in firms' first market, but it is so in their early periods of activity in a market. This could reflect the dynamics of trust in interpersonal relationships[15] or market-specific uncertainty (as in Eaton et al. 2009 and Freund and Pierola 2008). It reflects also a simple accounting phenomenon: since firms enter markets over the year, initial exports appear artificially low in the first year whenever the data are on an annual basis, as here.

Table 3: Intensive Margin Growth (Dependent Variable: $\Delta \log X_{ijt}$)

| OLS | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| $FY_{ij,t-1} \times FM_{ij}$ | -.032 | .141** | .098** | .095** | .308** |
| | (.028) | (.036) | (.036) | (.036) | (.029) |
| $FM_{ij}$ | .024 | -.013 | -.009 | -.008 | -.043 |
| | (.018) | (.038) | (.039) | (.038) | (.034) |
| $FY_{ij,t-1}$ | .263** | .238** | .233** | .232** | -.137** |
| | (.013) | (.016) | (.016) | (.016) | (.014) |
| $\log X_{ij,t-1}$ | | | | | -.427** |
| | | | | | (.007) |
| Firm FE | | yes | yes | yes | yes |
| Year FE | | | yes | | |
| Destination FE | | | yes | | |
| Year-Destination FE | | | | yes | yes |
| Number of obs | 107390 | 107390 | 107390 | 107390 | 107390 |
| R-squared | .01 | .09 | .10 | .10 | .30 |

**: significant at 1%; *: significant at 5%

Robust standard errors adjusted for clusters in firms.

The distinguishing feature of our proposed mechanism with respect to the intensive margin regards, however, the interaction term: firms' export growth should be higher in their early periods of activity in their first export market. That is, we compare firms' early growth in their first market relative to their early growth in subsequent markets. We find that, indeed, the coefficient associated with $FY_{ij,t-1} \times FM_{ij}$ is positive and significant in all specifications that include firm fixed effects. The insignificant coefficient in the regression without firm fixed effects simply reveals the degree of firm heterogeneity in our sample. It indicates that firms that have high initial growth in general tend to enter more markets, washing out the differential first-market effect in the sample when the firms' average export growth is not accounted for.

The effect of being a new exporter on intensive margin growth is economically sizeable, too. Unconditional intensive margin growth in our sample is 20%. However, average growth is about 23 percentage points higher in a firm's initial period of activity in a market, and this additional effect jumps to almost 33 percentage points if the market is the firm's first.

A prominent view in the literature is that firms start exporting after experiencing positive

[15] Rauch and Watson (2003) argue that exporters "start small" and are only able to expand once their foreign partners are convinced of their reliability. Araujo and Ornelas (2007) point out that evolving trust levels within partnerships substitute for weak cross-border contract enforcement, implying that trade volumes increase over time, conditional on survival.

persistent idiosyncratic productivity shocks (e.g. Arkolakis 2008, Irrarazabal and Opromolla 2008). Due to serial correlation, growth in exports fades over time as shocks die out. This could explain why early export growth is highest in the first market. A way to partially control for this effect is by including the firm's lagged export level. Column 5 of Table 3 shows that, when doing so, the effect of $FY_{ij,t-1} \times FM_{ij}$ on export growth remains positive and significant. In fact, the coefficient is much higher in that case.[16]

### 3.2.2 Entry

Our model predicts also that new exporters are more likely to enter new foreign destinations (Prediction 2). To test this prediction, we create for every firm $i$ exporting to some destination $s$ other than $r$ at period $t-1$, a binary variable $Entry_{irt}$ that takes the value of one if firm $i$ *enters* destination $r$ at time $t$, and zero otherwise. Therefore non-entry corresponds to the choice by an exporting firm $i$ *to not enter* destination $r$ at time $t$, although it might do so in the future. The sample consists of all firms that export for at least 2 years.

For computational reasons, we must place a limit on the number of destinations. We define nine regions ($r$) grouping different countries: Mercosur, Chile-Bolivia (Argentina's neighbors that are not full Mercosur members), Other South America, Central America-Mexico, North America, Spain-Italy (Argentina's main migration sources), EU-27 except Spain-Italy, China, and Rest of the World. Each of these geographic areas is relatively homogenous and account for a sizeable share of Argentine exports (see Table 10 in Appendix C).[17] The region that is responsible for the smallest share is Spain-Italy, receiving 2% of Argentina's exports in 2007. However, it attracts 5% of all Argentine exporters, and 8% of all new exporters. Table 11 in Appendix C shows, for each of our nine regions, their share of Argentine exporters, in general and among new exporters. If the latter is larger than the former, it suggests the regions is particularly attractive as a "testing ground." The table shows that this is the case for Spain-Italy, Mercosur, North America, Chile-Bolivia and, recently, China. Notice that our grouping of countries in regions implies that when a firm enters a new country in a region $r$ where it already exports, this is not coded as entry.[18]

We thus run the following basic regression on the probability of starting to export to a new market:

$$Prob[Entry_{irt} = 1] = \beta_1 FY_{i,t-1} + \{FE\} + v_{irt},$$

where $FY_{i,t-1}$ indicates whether the firm's export experience started at $t-1$ (i.e., whether $t$ is firm $i$'s second year as an exporter). We include a wide range of fixed effects here as well. Prediction 2 indicates that $\beta_1 > 0$: fledgling exporters should be more likely to enter new destinations than experienced exporters.

[16] Notice that, once we include firms' lagged exports in the regression, the coefficient of $FY_{ij,t-1}$ turns to negative, indicating that an old exporter in a new market does not grow faster than an old exporter already in that market. Without the control this appears to be the case, but reflects instead the facts that firms start small in new markets and that small exporters grow faster than large exporters.

[17] We experienced with alternative divisions of destinations; they yield qualitatively similar results.

[18] Considering entry/non-entry within the region makes no meaningful difference to the results.

Results from this basic specification are presented in columns 1-4 of Table 4. $FY_{i,t-1}$ has a positive and highly significant coefficient in all four specifications. The magnitudes may look small at first, but recall that they reflect entry in a given region in a given year, so the entry we consider is a rather specific event. We find that the probability of entering an "average" destination in an "average" year is around one percentage point higher if the firm is a new exporter. This compares with an overall average probability of 7% of entering a new foreign region.

Table 4: Probability of Exporting to a New Market

| Dependent Variable: | $Entry_{irt}$ | $Entry_{irt}$ | $Entry_{irt}$ | $Entry_{irt}$ | $Entry_{irt}$ | $D(ND)_{it}$ | $D(ND)_{it}$ |
|---|---|---|---|---|---|---|---|
| LPM | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| $FY_{i,t-1}$ | .008** | .015** | .009** | .009** | .006** | .033** | .048** |
| | (.001) | (.002) | (.002) | (.002) | (.002) | (.002) | (.010) |
| $\Delta logX_{i,-r,t}$ | | | | | .006** | | .052** |
| | | | | | (.002) | | (.003) |
| $\Delta logX_{i,-r,t} \times FY_{i,t-1}$ | | | | | -.005** | | -.043** |
| | | | | | (.002) | | (.008) |
| Tests: | | | | | | | |
| $FY_{i,t-1} + (\Delta logX_{i,-r,t} \times FY_{i,t-1}) \times .10 = 0$ | | | | | 5.25 | | |
| | | | | | [.002] | | |
| $FY_{i,t-1} + (\Delta logX_{i,-r,t} \times FY_{i,t-1}) \times .08 = 0$ | | | | | | | 19.80 |
| | | | | | | | [.0001] |
| Firm FE | | yes | yes | yes | yes | yes | yes |
| Destination FE | | | yes | | | | |
| Year FE | | | yes | | | yes | yes |
| Year-Destination FE | | | | yes | yes | | |
| Number of obs | 235693 | 235693 | 235693 | 235693 | 220335 | 32135 | 29760 |
| R-squared | .0002 | .08 | .09 | .09 | .10 | .32 | .32 |

**: significant at 1%; *: significant at 5%

Robust standard errors adjusted for clusters in firms. P-values in square brackets.

While we control for time-invariant unobserved heterogeneity by using firm fixed effects, those regressions do not rule out the positive that positive idiosyncratic productivity shocks are the factors actually leading firms to expand in their early years as exporters. But since such shocks would induce expansion at both intensive and extensive margins, we can control for them by introducing intensive margin export growth (in the current destinations) by itself and interacted with our indicator for new exporters, $FY_{i,t-1}$:

$$Prob[Entry_{irt} = 1] = \beta_1 FY_{i,t-1} + \beta_2 \Delta logX_{i,-r,t} + \beta_3 \left[\Delta logX_{i,-r,t} \times FY_{i,t-1}\right] + \eta_{irt}.$$

The results are displayed in column 5 of Table 4. The coefficient of $FY_{i,t-1}$ remains positive and significant. But we want to check whether being a new exporter matters also among the firms expanding at the intensive margin. The relevant comparison is between new and old exporters growing at the same rate $g$. A fledgling exporter growing at rate $g$ is more likely to enter a new destination than an experienced exporter growing at same rate if $\beta_1 + \beta_3 g > 0$. At the point estimates, this condition is equivalent to $g < 1.2$. Close to 97% of the observations satisfy this condition. At the sample median, $g = .10$, this sum is positive and highly statistically significant, as the F-test shows.

In columns 6 and 7, we run a different regression, where we simply look at whether a surviving exporter increased its number of foreign destinations (in which case $D(ND)_{it} = 1$). This regression has the disadvantage of bundling all destinations, so for example entry in a very large market and entry in a very small market are treated equally. On the other hand, it makes possible to consider entry in each of the 130 markets in the sample. We find that new exporters are 3.3 percentage points more likely to expand the number of markets they serve than experienced ones. This is slightly more than a seventh of the overall (unconstrained) probability that a surviving exporter will expand the number of destinations it serves, 22%. When we include intensive margin growth in the regression (column 7), the point estimates indicate that a new exporter growing at rate $g$ is always more likely to add a new destination than an experienced exporter growing at the same rate if $g < 1.12$. At the sample median of $g = .08$, the F-test shows that this condition is clearly satisfied.

#### 3.2.3 Exit

We turn now to the exit patterns of Argentina's exporting firms. Our model predicts that the probability that firm $i$ will exit a particular export market $j$ in period $t$ ($Exit_{ijt} = 1$) is higher if the firm exported for the first time in $t - 1$ (Prediction 3). To test this, we estimate the following equation:

$$Prob[Exit_{ijt} = 1] = \gamma_1 (FY_{ij,t-1} \times FM_{ij}) + \gamma_2 FM_{ij} + \gamma_3 FY_{ij,t-1} + \{FE\} + \zeta_{ijt}.$$

The sample consists of all exporting firms. Again, we introduce fixed effects to account for country and year specific factors that affect exit. Firm fixed effects, on the other hand, are *not* appropriate for the exit regressions, since Prediction 3 is about the behavior of single-year exporters. As most single-year exporters represent only one observation in our data set, they are excluded when we focus on within-firm variation. The only cases of single-year exporters that remain after controlling for firm fixed effects are re-entrant single-year exporters (firms that exported prior but not at $t - 2$, and exited after exporting again at $t - 1$) or simultaneous single-year exporters (those that broke simultaneously into more than one market in $t - 1$ and exited in $t$). Since simultaneous exporters are relatively more confident about their export success at time of entry (recall that simultaneous entry requires $E\mu$ to be greater than $\tau^B$ and large relative to $F$), they are less likely to exit right after entry than pure sequential exporters. A related rationale applies for re-entrants.[19] Thus, we expect $\gamma_1$ to be positive in all specifications that do not include firm fixed effects. In that case, we also include sector fixed effects to control, to some extent, for unobserved heterogeneity. When firm fixed effects are included, our model is silent about the sign of $\gamma_1$.

Table 5 shows the results. Observe first that, in all estimations without firm fixed effects

[19] In the next subsection we study more closely both simultaneous exporters and re-entrants.

(first four columns), the coefficients associated with $FY_{ij,t-1}$ and $FM_{ij}$ are positive and significant, indicating that in general exit from a market is more likely in firms' first market and in their early periods of operation in a market. More importantly, the coefficient of the interaction $FY_{ij,t-1} \times FM_{ij}$ is positive and significant in those regressions, confirming that exit rates from a market are highest for fledgling exporters. Magnitudes are also economically significant. Being a fledgling exporter increases the probability of exiting a market by almost 30 percentage points relative to an exporter with experience in a market other than its first, or by 15 percentage points relative to an exporter with experience in its first market, or by over 26 percentage points relative to an experienced exporter that has just entered an additional market. These figures compare with an overall average probability of just 5% of exiting a market in a certain year.

Table 5: Probability of Exit after Exporting to a New Market (Dependent Variable: $Exit_{ijt}$)

| LPM | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| $FY_{ij,t-1} \times FM_{ij}$ | .122** | .123** | .125** | .125** | -199** | -.197** | .133** |
| | (.004) | (.006) | (.006) | (.006) | (.003) | (.003) | (.006) |
| $FM_{ij}$ | .153** | .149** | .139** | .138** | -.015** | -.017** | .129** |
| | (.003) | (.004) | (.004) | (.004) | (.003) | (.003) | (.004) |
| $FY_{ij,t-1}$ | .017** | .015** | .026** | .025** | -.010** | -.013** | .009** |
| | (.001) | (.001) | (.001) | (.001) | (.001) | (.001) | (.002) |
| $\log X_{ij,t-1}$ | | | | | | | -.009** |
| | | | | | | | (.001) |
| Firm FE | | | | | yes | yes | |
| Sector FE | | yes | yes | yes | | | yes |
| Destination FE | | | yes | | | | |
| Year FE | | | yes | | | | |
| Year-Destination FE | | | | yes | | yes | yes |
| Number of obs | 119610 | 119610 | 119610 | 119610 | 119610 | 119610 | 119610 |
| R-squared | .13 | .14 | .15 | .15 | .69 | .70 | .10 |

**: significant at 1%; *: significant at 5%

Robust standard errors adjusted for clusters in firms.

Now, once firm fixed effects are introduced (columns 5 and 6), the sign of the interaction (and of $FY_{ij,t-1}$) shifts to negative. Clearly, the exit patterns of firms that re-start to export or start exporting in more than one market simultaneously are very different from those of the firms that start with a single market. Specifically, new simultaneous exporters and re-entrants are, jointly, less likely to exit than continuing exporters.

Finally, in column 7 we control for firms' lagged export levels (in addition to sector and year-destination fixed effects), since low sales in a year may suggest a low expectation of survival. This is indeed what we find. The coefficient of $FY_{ij,t-1} \times FM_{ij}$ remains nevertheless virtually unaltered.

## 3.3 Robustness *[to be completed & adjusted]*

The key predictions from our model are strongly supported by the Argentine data, but they may be driven by alternative explanations that are correlated with ours. We have discussed in particular the possibility that our regressions may be simply picking up behavior driven by idiosyncratic firm productivity shocks. Our controls in the growth and entry regressions indicate that this is not the case. Moreover, the productivity shocks rationale is at odds with our results on exit. As pointed out by Ruhl and Willis (2009), if productivity shocks alone are driving the behavior of exporting firms, the hazard rate out of exporting must increase with export tenure as shocks die out over time. Our results on exit indicate that the opposite is true,[20] further confirming that there is more to the dynamics of new exporters than productivity shocks.[21] But there are other possibilities. Thus, we now run further tests to better distinguish our mechanism from others.

First, we focus on *re-entrant* exporters. These are the firms that did not export at $t-1$ but did so before $t-1$ and export again at $t$. Of the 15,301 exporting firms in our sample, we can identify 17% as re-entrants. Observations associated with the activities of these re-entrants correspond to 6%, 3% and 2% of the observations in the samples used in the intensive margin, entry and exit regressions, respectively. Since we cannot spot all re-entrants (i.e. some firms that we identify as new exporters may have exported before 2002, the fist year in our sample), in the main regressions we treat all firms that export at $t$ but not at $t-1$ as new exporters. However, according to our model (barring problems with "short memory"), if firm $i$ had exported prior to $t-1$, when re-starting to export in period $t$ the firm should already have a reliable (in the strictest version of the model, a perfect) signal of its export profitability, so the change in the value of its shipment to a market between $t$ and $t-1$ should not be as large as it would for a first-time exporter. By the same token, re-entrants in $t$ should be less likely to exit and to expand to new destinations at $t+1$ than first-time exporters. Thus, if our model is right, the inclusion of re-entrants as new exporters should only weaken our results.

But we can also test explicitly for differential effects between "regular" new exporters and re-entrants, which no alternative theories that we are aware of would predict. To do so, we re-run our three main regressions (intensive margin, entry and exit) with our key variables by themselves and interacted with an indicator of whether the firm is a re-entrant ($RE_i$), plus the indicator by itself. We add year-destination fixed effects in all regressions, sector fixed effects in the exit regression, and firm fixed effects in the intensive margin and entry regressions. We run the intensive margin and exit regressions with and without lagged export levels.

Table 6 displays the results. In general, they lend support to our theory. For example, for firms that are in their first market ($FM_{ij} = 1$), we can ask whether the extra effect from being in their first year of activity there (in the current spell) is different for re-entrants. The differential effect is given by the sum of the coefficients on $FY * FM * RE$ and $FY * RE$. As the F-tests

[20] In line with the findings of previous studies focusing on the hazard rates out of exporting, such as Besedes and Prusa (2006).

[21] Other forces that might be consistent with high early intensive and extensive margin growth but not with early exit are learning by exporting and capacity constraints. Under the former, the idea is that a firm's productivity increases through contact with foreign customers or competitors. As long as learning is more intense in the early periods of exporting, it would be consistent with our Predictions 1 and 2. The same is true for capacity constraints that bind initially but are relaxed after the first year of exporting. However, both mechanisms would generate the opposite of our results on exit. The idea of capacity constraints forcing firms to enter foreign markets "small" also conflicts with studies that show that firms often undertake significant investment *before* entering foreign markets, as a preparation for exporting (e.g. Iacovone and Javorcik 2009).

show, this sum is negative and statistically significant for both exit specifications and for the intensive margin specification that does not include lagged exports (when they are included, the sum is statistically indistinguishable from zero). These results indicate that, for firms in their first market, the extra effect on intensive margin growth and the likelihood of exit from being a new exporter there is lower if the firm is a re-entrant. The F-tests on the sum of the coefficients on $(FY * FM) + (FY * FM * RE) + FY + (FY + RE)$ indicate that the overall extra effect due to $FY$ for firms in their first market is nevertheless positive for intensive margin growth, but *negative* for the probability of exit.

Similarly, for firms starting to export to a market ($FY_{ij,t-1} = 1$), we can test whether the extra effect due to being in their first market is different for re-entrants. Results are very similar, as shown by the F-tests on the sum of the coefficients on $(FY * FM * RE) + (FM * RE)$ and of $(FY * FM * RE) + (FM * RE) + (FY + (FM * RE)$.

Finally, we can ask whether the pattern of entry in different regions is the same for first-time exporters and those re-entering export activities. The results indicate that the latter are indeed less likely to expand to new regions. The sum of the coefficients on $FY + FY * RE + RE$ indicate that the entry pattern of those returning to foreign markets is hardly different from the pattern of continuing exporters.

Overall, then, we find that re-entrants are less likely to grow in their first market and to exit right after re-entering their first market than ordinary entrants. Moreover, they are less likely to expand to different regions after re-starting foreign sales than first-time exporters. One interpretation is that re-entrants are firms that respond to customers' orders but do not establish permanent export presence in foreign markets, perhaps because of the type of product they produce or industry they operate in, perhaps because their uncovered $\mu$ is not large enough to justify paying the sunk costs necessary to have a permanent foreign presence.

Second, we investigate whether the behavior of firms that start exporting to more than one destination (which we code as $SIM_i = 1$) is distinct from the behavior of those pure sequential exporters.[22] Again, for firms that are in their first market ($FM_{ij} = 1$), we can ask whether the extra effect from being in their first year of activity there is different fro the simultaneous entrants. The differential effect is given by the sum of the coefficients on $FY * FM * RE$ and on $FY * SIM$. Table 7 shows the results. As the F-tests show, this sum is indistinguishable from zero in the intensive margin regressions. However, it is clearly negative in the exit regressions. The F-tests on the sum of the coefficients on $(FY * FM) + (FY * FM * SIM) + FY + (FY + SIM)$ indicate that the overall extra effect due to $FY$ for firms in their first market is nevertheless positive for both intensive margin growth and the probability of exit. Similarly, for firms starting to export to a market ($FY_{ij,t-1} = 1$), we can test whether the extra effect due to being in their first market is different for simultaneous exporters. We cannot distinguish the extra effect form being in one's first market is similar for simultaneous and pure sequential exporters with respect to intensive margin growth. However, there is no such an effect for the probability of exit: new simultaneous exporters

[22] Notice that, whenever we use firm fixed effects, the variable $SIM_i$ is dropped from the regression.

Table 6: Differential Effects: Re-entrant Exporters ($RE$)

| | $\Delta \log X_{ijt}$ | $\Delta \log X_{ijt}$ | $Entry_{irt}$ | $Exit_{ijt}$ | $Exit_{ijt}$ |
|---|---|---|---|---|---|
| $FY_{ij,t-1} \times FM_{ij}$ | .160** | .294** | | .158** | .164** |
| | (.040) | (.033) | | (.006) | (.006) |
| $FM_{ij}$ | -.049 | -.047 | | .093** | .086** |
| | (.039) | (.037) | | (.004) | (.004) |
| $FY_{ij,t-1}$ | .256** | -.119** | | .012** | -.002 |
| | (.018) | (.016) | | (.001) | (.001) |
| $FY_{ij,t-1} \times FM_{ij} \times RE_{it}$ | -.178* | .079 | | -.364** | -.363** |
| | (.081) | (.064) | | (.013) | (.014) |
| $FM_{ij} \times RE_{it}$ | -.089 | -.109 | | -.049** | -.047** |
| | (.131) | (.112) | | (.013) | (.013) |
| $FY_{ij,t-1} \times RE_{it}$ | -.098** | -.072** | | .087** | .089** |
| | (.032) | (.028) | | (.014) | (.014) |
| $RE_{it}$ | .536* | .331† | | .320** | .314** |
| | (.231) | (.204) | | (.014) | (.014) |
| $\log X_{ij,t-1}$ | | -.428** | | | -.008** |
| | | (.007) | | | (.001) |
| $FY_{i,t-1}$ | | | .009** | | |
| | | | (.002) | | |
| $FY_{i,t-1} \times RE_{it}$ | | | -.003 | | |
| | | | (.011) | | |
| $RE_{it}$ | | | -.043† | | |
| | | | (.024) | | |
| Tests: | | | | | |
| $(FY_{ij,t-1} \times FM_{ij} \times RE_{it}) + (FY_{ij,t-1} \times RE_{it}) = 0$ | 3.91 | 0.01 | | 352.08 | 345.88 |
| | [.048] | [.918] | | [.0001] | [.0001] |
| $(FY_{ij,t-1} \times FM_{ij} \times RE_{it}) + (FM_{ij} \times RE_{it}) = 0$ | 11.69 | 0.07 | | | |
| | [.001] | [.793] | | | |
| $(FY_{ij,t-1} \times FM_{ij}) + (FY_{ij,t-1} \times FM_{ij} \times RE_{it}) +$ $FY_{ij,t-1} + (FY_{ij,t-1} \times RE_{it}) = 0$ | 3.88 | 4.49 | | 60.01 | 64.53 |
| | [.049] | [.034] | | [.0001] | [.0001] |
| $(FY_{ij,t-1} \times FM_{ij}) + (FY_{ij,t-1} \times FM_{ij} \times RE_{it}) +$ $FM_{ij} + (FM_{ij} \times RE_{it}) = 0$ | 1.63 | 10.65 | | 157.24 | 153.77 |
| | [.202] | [.001] | | [.0001] | [.0001] |
| $FY_{i,t-1} + (FY_{i,t-1} \times RE_{it}) + RE_{it}$ | | | 2.80 | | |
| | | | [.101] | | |
| Firm FE | yes | yes | yes | | |
| Sector FE | | | | yes | yes |
| Year-Destination FE | yes | yes | yes | yes | yes |
| Number of obs | 107390 | 107390 | 235693 | 119610 | 119610 |
| R-squared | .10 | .30 | .06 | .23 | .24 |

**: significant at 1%; *: significant at 5%; †: significant at 10%

Robust standard errors adjusted for clusters in firms. P-values in square brackets.

are as likely to exit one of their first markets as old exporters are to exit their subsequent markets upon entry there. Finally, the entry regression shows that new simultaneous exporters are no more likely to expand to new regions than old exporters.

Overall, we find that, upon entry, simultaneous exporters behave similarly to pure sequential exporters in terms of their intensive margin growth, conditional on survival. On the other hand, new simultaneous exporters are much less likely to exit and to expand to other destinations than other new exporters. In our model, simultaneous entry requires $E\mu$ to be greater than $\tau^B$ and large relative to $F$. This suggests that on average simultaneous firms should be less likely to exit right after entry than pure sequential exporters. The same is true for subsequent entry, since they are more likely to enter at once in the markets they expect to be profitable.

Third, some of our findings are consistent with *within-industry learning*, as in Hausmann and Rodrik (2003), Alvarez et al. (2007), Krautheim (2008) and Segura-Cayuela and Vilarrubia (2008). That is, firms may use the entry of domestic rivals in foreign markets as a signal of their own odds of success as exporters.[23] To consider this possibility, we estimate the following expanded specification (with firm and year-destination fixed effects) of our entry regression:

$$Prob[Entry_{ijt} = 1] = \beta_1 FY_{i,t-1} + \beta_2 NArgExp_{kr,t-1} + \beta_3 \Delta logX(ArgExp_{krt}) + \xi_{ijt},$$

where $NArgExp_{kr,t-1}$ is the number of Argentine exporters in industry $k$ selling to region $r$ at $t-1$ and $\Delta logX(ArgExp_{krt})$ is the export growth to $r$ of these same competitors between $t$ and $t-1$. These variables control, respectively, for static and dynamic characteristics of export profitability that a firm may infer from observing its rivals.

The first two columns of Table 8 display the results controlling for within-industry learning. Consistently with within-industry learning effects, the number and the growth rates of domestic competitors in a given destination help to explain entry there. Nevertheless, a new exporter remains significantly more likely to enter a new destination than an experienced exporter. Thus, our finding of the role of experimentation in fostering entry in new destinations is not a mere artifact of domestic rivals' informational externality.

Some of our results may also be driven by the presence of *credit constraints*. For example, if firms face liquidity constraints at entry, then the inability of either financing sunk entry costs internally or of obtaining the necessary external credit could force some firms to enter foreign markets sequentially when they would prefer to enter them simultaneously. Similarly, as more experienced exporters become less constrained due to retained earnings, credit constraints may also help to explain the high intensive margin growth of surviving new exporters. Employing a panel of bilateral exports at the industry level, Manova (2008) finds that credit constraints are indeed important determinants of export participation and of export volumes. Muuls (2009) finds that credit constraints make Belgian exporters less likely to expand to other foreign destinations. Since credit constraints may be correlated with being a new exporter, we need to check whether

[23] The idea that firms can learn from the experience of others before entering a foreign market extends to decisions beyond exporting, such as foreign direct investments (Lin and Saggi 1999).

Table 7: Differential Effects: Simultaneous Exporters ($SIM$)

| | $\Delta \log X_{ijt}$ | $\Delta \log X_{ijt}$ | $Entry_{irt}$ | $Exit_{ijt}$ | $Exit_{ijt}$ |
|---|---|---|---|---|---|
| $FY_{ij,t-1} \times FM_{ij}$ | .106* | .306** | | .243** | .250** |
| | (.046) | (.007) | | (.005) | (.007) |
| $FM_{ij}$ | .007 | -.061 | | .140** | .132** |
| | (.051) | (.048) | | (.005) | (.005) |
| $FY_{ij,t-1}$ | .234** | -.146** | | .023** | .007** |
| | (.016) | (.015) | | (.001) | (.001) |
| $FY_{ij,t-1} \times FM_{ij} \times SIM_i$ | -.003 | -.165* | | -.063** | -.050** |
| | (.046) | (.076) | | (.015) | (.023) |
| $FM_{ij} \times SIM_i$ | -.042 | .116 | | -.291** | -.301** |
| | (.081) | (.073) | | (.021) | (.027) |
| $FY_{ij,t-1} \times SIM_i$ | -.028 | .183** | | -.196** | -.205* |
| | (.072) | (.057) | | (.017) | (.024) |
| $SIM_i$ | | | | .285** | .292** |
| | | | | (.024) | (.029) |
| $\log X_{ij,t-1}$ | | -.428** | | | -009** |
| | | (.007) | | | (.029) |
| $FY_{i,t-1}$ | | | .011** | | |
| | | | (.002) | | |
| $FY_{i,t-1} \times SIM_i$ | | | -.007† | | |
| | | | (.004) | | |
| Tests: | | | | | |
| $(FY_{ij,t-1} \times FM_{ij} \times SIM_i) + (FY_{ij,t-1} \times SIM_i) = 0$ | 0.09 | 0.32 | | | |
| | [.768] | [.570] | | | |
| $(FY_{ij,t-1} \times FM_{ij} \times SIM_i) + (FM_{ij} \times SIM_i) = 0$ | 0.21 | 0.35 | | | |
| | [.650] | [.555] | | | |
| $(FY_{ij,t-1} \times FM_{ij}) + (FY_{ij,t-1} \times FM_{ij} \times SIM_i) + FY_{ij,t-1} + (FY_{ij,t-1} \times SIM_i) = 0$ | 43.57 | 23.48 | | 2.98 | 3.42 |
| | [.0001] | [.0001] | | [.084] | [0.06] |
| $(FY_{ij,t-1} \times FM_{ij}) + (FY_{ij,t-1} \times FM_{ij} \times SIM_i) + FM_{ij} + (FM_{ij} \times SIM_i) = 0$ | 1.28 | 12.36 | | 0.25 | 0.01 |
| | [.259] | [.0004] | | [.620] | [.903] |
| $FY_{i,t-1} + (FY_{i,t-1} \times SIM_i) + SIM_i$ | | | 0.62 | | |
| | | | [.430] | | |
| Firm FE | yes | yes | yes | | |
| Sector FE | | | | yes | yes |
| Year-Destination FE | yes | yes | yes | yes | yes |
| Number of obs | 107390 | 107390 | 235693 | 119610 | 119610 |
| R-squared | .10 | .30 | .09 | .18 | .19 |

**: significant at 1%; *: significant at 5%; †: significant at 10%
Robust standard errors adjusted for clusters in firms. P-values in square brackets.

Table 8: Controlling for Within-Industry Learning and Credit Constraints

| | $Entry_{irt}$ | $Entry_{irt}$ | $\Delta \log X_{ijt}$ | $Entry_{irt}$ | $Exit_{ijt}$ |
|---|---|---|---|---|---|
| *Controlling for Within-Industry Learning* | | | | | |
| $FY_{i,t-1}$ | .009** | .009** | | | |
| | (.002) | (.002) | | | |
| $NArgExp_{kr,t-1}$ | .0001** | .0001** | | | |
| | (.0001) | (.0001) | | | |
| $\Delta logXArgExp_{krt}$ | | .004** | | | |
| | | (.001) | | | |
| *Excluding Credit-Constrained Sectors* | | | | | |
| $FY_{ij,t-1} \times FM_{ij}$ | | | .165** | | .123** |
| | | | (.057) | | (.008) |
| $FM_{ij}$ | | | -.034 | | .133** |
| | | | (.059) | | (.006) |
| $FY_{ij,t-1}$ | | | .242** | | .021** |
| | | | (.024) | | (.002) |
| $FY_{i,t-1}$ | | | | .009** | |
| | | | | (.004) | |
| Firm FE | yes | yes | yes | yes | |
| Sector FE | | | | | yes |
| Year-Destination FE | yes | yes | yes | yes | yes |
| Number of obs | 235693 | 227769 | 43258 | 87892 | 71349 |
| R-squared | .09 | .10 | .10 | .09 | .15 |

**: significant at 1%; *: significant at 5%
Robust standard errors adjusted for clusters in firms.

they may be driving our results.

To account for the role of credit constraints in shaping exporting behavior, we borrow Manova's (2008) measure of 'asset tangibility' to identify the industries that are least credit constrained, i.e. those that have the highest proportion of collateralizable assets. We then define an industry to be relatively credit unconstrained if the value of asset tangibility for the industry is above the median for the whole manufacturing sector (i.e. 30%), and examine whether our predictions hold for the subsample of credit unconstrained firms (we include firm fixed effects in the intensive margin and entry regressions, sector fixed effects in the exit regressions, and year-destination fixed effects in all of them). The last three columns of Table 8 show the results. They are very similar to our previous results, indicating that the effects from experimentation that we uncover are not driven by firms being in sectors that are more likely to be liquidity constrained.

We also carry a few other robustness checks, which we do not report to save space but are available upon request. Specifically, ...

# 4 Trade Liberalization and Policy Implications *(to be adjusted)*

Correlation of firms' export profitabilities over time and across destinations renders the impact of trade liberalization on trade flows subtler, more complex, and potentially much larger than standard trade theories suggest. This opens new perspectives for trade policy, in particular the coordination of trade policies across countries, as in regional and multilateral trade agreements. To show this, we examine trade liberalization in a very simple extension of the model with many firms and sectors.

Consider a continuum of different sectors with heterogeneous sunk costs of exporting $F$. Let $F$ follow a continuous c.d.f. $H(F)$ on the support $[0, +\infty)$. As before, in each sector ex ante profitability follows $G(\mu)$. We assume that $F$ and $\mu$ are independently distributed. Assuming independence is analytically very convenient. It also clarifies that the third-country effects of trade liberalization identified below do not depend on assuming (perhaps more realistically) that more profitable sectors have higher fixed entry costs. The independence assumption implies an equivalence between having a single firm in each sector (as in the basic model) and a continuum of monopolists in each sector.[24]

The number of potential firms in each sector and the number of potential sectors are exogenous and normalized to one. The total number of exporters to market $j$ in period $t$, $EM_t^j$, follows from Proposition 1 ($EM$ stands for extensive margin):

- $EM_1^A = H\left[F^{Sq}(\tau^A, \tau^B)\right]$ firms export to market $A$ at $t = 1$;
- $EM_1^B = H\left[F^{Sm}(\tau^B)\right]$ of firms export to market $B$ at $t = 1$;
- $EM_2^A = H\left[F^{Sq}(\tau^A, \tau^B)\right]\left[1 - G(\tau^A)\right]$ of firms export to market $A$ at $t = 2$, all of which already exported to $A$ at $t = 1$;
- $EM_2^B = H\left[F^{Sm}(\tau^B)\right]\left[1 - G(\tau^B)\right] + \int_{F^{Sm}}^{F^{Sq}}\left[1 - G(2F^{\frac{1}{2}} + \tau^B)\right] dH(F)$ firms exports to market $B$ at $t = 2$. The first term corresponds to existing exporters ($\widehat{EM}_2^B$), the second to new entrants ($\widetilde{EM}_2^B$);
- $1 - H\left[F^{Sq}(\tau^A, \tau^B)\right]$ firms do not export.

Denoting by $X_t^j$ the aggregate volume of exports to country $j$ at period $t$, we can decompose aggregate exports into its extensive and intensive margin components as:

[24] In both cases, it is the assumption of identical and correct expectations that guarantees the coincidence of the ex-ante distribution of profitabilities with the ex-post cross-sectoral one. But in the many-firm case the continuum assumption is also necessary.

$$X_1^A = \int_0^{F^{Sq}} \int_{\underline{\mu}}^{\overline{\mu}} \widehat{q}_1^A dG(\mu) dH(F) \tag{24}$$
$$= \underbrace{H\left[F^{Sq}(\tau^A, \tau^B)\right]}_{EM_1^A} \left[\mathbf{1}_{\{E\mu > \tau^A\}} \left(\frac{E\mu - \tau^A}{2}\right) + \mathbf{1}_{\{E\mu \leq \tau^A\}} \varepsilon\right];$$

$$X_1^B = \int_0^{F^{Sm}} \int_{\underline{\mu}}^{\overline{\mu}} \widehat{q}_1^B dG(\mu) dH(F) \tag{25}$$
$$= \underbrace{H(F^{Sm}(\tau^B))}_{EM_1^B} \left(\frac{E\mu - \tau^B}{2}\right);$$

$$X_2^A = \int_0^{F^{Sq}} \int_{\tau^A}^{\overline{\mu}} \widehat{q}_2^A dG(\mu) dH(F) \tag{26}$$
$$= \underbrace{H\left[F^{Sq}(\tau^A, \tau^B)\right]\left[1 - G(\tau^A)\right]}_{EM_2^A} \int_{\tau^A}^{\overline{\mu}} \left(\frac{\mu - \tau^A}{2}\right) dG(\mu | \, \mu > \tau^A);$$

$$X_2^B = \int_0^{F^{Sm}} \int_{\tau^B}^{\overline{\mu}} \widehat{q}_2^B dG(\mu) dH(F) + \int_{F^{Sm}}^{F^{Sq}} \int_{2F^{\frac{1}{2}} + \tau^B}^{\overline{\mu}} \widetilde{q}_2^B dG(\mu) dH(F) \tag{27}$$
$$= \underbrace{H(F^{Sm}(\tau^B))\left[1 - G(\tau^B)\right]}_{\widehat{EM}_2^B} \int_{\tau^B}^{\overline{\mu}} \left(\frac{\mu - \tau^B}{2}\right) dG(\mu | \, \mu > \tau^B)$$
$$+ \underbrace{\int_{F^{Sm}}^{F^{Sq}} \left[1 - G(2F^{\frac{1}{2}} + \tau^B)\right] dH(F)}_{\widetilde{EM}_2^B} \int_{F^{Sm}}^{F^{Sq}} \int_{2F^{\frac{1}{2}} + \tau^B}^{\overline{\mu}} \frac{\left(\frac{\mu - \tau^B}{2}\right) dG(\mu) dH(F)}{\int_{F^{Sm}}^{F^{Sq}} \left[1 - G(2F^{\frac{1}{2}} + \tau^B)\right] dH(F)}.$$

We now look at the effects of a $t = 1$ permanent decrease in trade costs $\tau^A$ and $\tau^B$ on the intensive and extensive margins of exports.

Consider first the intensive margin. As expected, a fall in $\tau^A$ increases average exports to $A$ at $t = 1$ without affecting average exports to $B$, while a fall in $\tau^B$ has symmetric immediate effects. At $t = 2$ individual exports increase for older exporters. This is counterbalanced by a negative composition effect: the new survivors benefiting from lower trade costs operate at a lower-than-average scale. The overall intensive margin effect is therefore generally ambiguous.[25]

The most interesting and novel features of the model regard the extensive margin effects of trade liberalization. As a first step, we determine how variable trade costs affect the entry thresholds $F^{Sm}(\tau^B)$ and $F^{Sq}(\tau^A, \tau^B)$.

**Lemma 1** *Variable trade costs in markets A and B affect the sunk cost thresholds as follows:*

[25] Lawless (2009b) shows that both effects exactly offset each other in a heterogeneous firms' model *a la* Melitz (2003) where export sales follow a Pareto distribution. However, she finds ambiguous intensive margin effects of trade cost reductions in empirical work on US firms' exports.

- $\frac{dF^{Sm}}{d\tau^A} = 0$;

- $\frac{dF^{Sm}}{d\tau^B} = -\mathbf{1}_{\{E\mu>\tau^B\}} \frac{\left(\frac{E\mu-\tau^B}{2}\right)+\int_{\tau^B}^{2\left[F^{Sm}\right]^{\frac{1}{2}}+\tau^B}\left(\frac{\mu-\tau^B}{2}\right)dG(\mu)}{G(2[F^{Sm}]^{\frac{1}{2}}+\tau^B)} \leq 0$;

- $\frac{dF^{Sq}}{d\tau^A} = -\frac{\left[\mathbf{1}_{\{E\mu>\tau^A\}}\left(\frac{E\mu-\tau^A}{2}\right)+\int_{\tau^A}^{\overline{\mu}}\left(\frac{\mu-\tau^A}{2}\right)dG(\mu)\right]}{2-G\left(2[F^{Sq}]^{\frac{1}{2}}+\tau^B\right)} < 0$;

- $\frac{dF^{Sq}}{d\tau^B} = -\frac{\left[\int_{2[F^{Sq}]^{\frac{1}{2}}+\tau^B}^{\overline{\mu}}\left(\frac{\mu-\tau^B}{2}\right)dG(\mu)\right]}{2-G\left(2[F^{Sq}]^{\frac{1}{2}}+\tau^B\right)} < 0$.

**Proof.** Condition (18) for $e_1^B = 1$ defines $F^{Sm}$ implicitly when it holds with equality: $F^{Sm} = \mathbf{1}_{\{E\mu>\tau^B\}}\left[\Psi(\tau^B) - W(\tau^B; F^{Sm})\right]$.

It is straightforward to see that $\frac{dF^{Sm}}{d\tau^A} = 0$. From Proposition 1, we know that $F^{Sm} = 0$ if $E\mu \leq \tau^B$, so in that case $\frac{dF^{Sm}}{d\tau^B} = 0$ too. If instead $E\mu > \tau^B$, then $F^{Sm} > 0$ and we can find $dF^{Sm}/d\tau^B$ by applying the implicit function theorem. Therefore:

$$\begin{aligned}\frac{dF^{Sm}}{d\tau^B} &= \mathbf{1}_{\{E\mu>\tau^B\}}\left[\frac{\partial\Psi(\tau^B)/\partial\tau^B - \partial W(\tau^B;F^{Sm})/\partial\tau^B}{1+\partial W(\tau^B;F^{Sm})/\partial F}\right] \\ &= -\mathbf{1}_{\{E\mu>\tau^B\}}\left[\frac{\left(\frac{E\mu-\tau^B}{2}\right)+\int_{\tau^B}^{2\left[F^{Sm}\right]^{\frac{1}{2}}+\tau^B}\left(\frac{\mu-\tau^B}{2}\right)dG(\mu)}{G(2\left[F^{Sm}\right]^{\frac{1}{2}}+\tau^B)}\right].\end{aligned}$$

Condition (17) for $e_1^A = 1$ defines $F^{Sq}$ implicitly when it holds with equality: $F^{Sq} = \Psi(\tau^A) + W(\tau^B; F^{Sq})$. Applying the implicit function theorem to this identity, we obtain

$$\frac{dF^{Sq}}{d\tau^A} = \frac{\partial\Psi(\tau^A)/\partial\tau^A}{1-\partial W(\tau^B;F^{Sq})/\partial F} = -\frac{\left[\mathbf{1}_{\{E\mu>\tau^A\}}\left(\frac{E\mu-\tau^A}{2}\right)+\int_{\tau^A}^{\overline{\mu}}\left(\frac{\mu-\tau^A}{2}\right)dG(\mu)\right]}{2-G\left(2\left[F^{Sq}\right]^{\frac{1}{2}}+\tau^B\right)} \text{ and}$$

$$\frac{dF^{Sq}}{d\tau^B} = \frac{\partial W(\tau^B;F)/\partial\tau^B}{1-\partial W(\tau^B;F^{Sq})/\partial F} = -\frac{\left[\int_{2[F^{Sq}]^{\frac{1}{2}}+\tau^B}^{\overline{\mu}}\left(\frac{\mu-\tau^B}{2}\right)dG(\mu)\right]}{2-G\left(2\left[F^{Sq}\right]^{\frac{1}{2}}+\tau^B\right)},$$

completing the proof. ■

We can now establish the extensive margin effects of trade liberalization in countries $A$ and $B$ in both the short and the long runs.[26]

**Proposition 3** *Bilateral trade liberalization has qualitatively different effects on entry in the short and long runs, and encourages entry in third countries. Specifically:*

[26] It can be easily shown that reductions in trade costs have qualitatively similar effects on aggregate trade flows in both the short and long runs, despite the ambiguous intensive margin effect in the long run.

*a) A decrease in $\tau^A$ at $t = 1$, holding $\tau^B$ fixed:*

1. *increases the number of exporters to A at $t = 1$ and at $t = 2$;*

2. *has no effect on exports to B at $t = 1$, but increases the number of exporters to B at $t = 2$.*

*b) A decrease in $\tau^B$ at $t = 1$, holding $\tau^A$ fixed:*

1. *increases the number of exporters to A at $t = 1$ and $t = 2$;*

2. *increases the number of exporters to B at $t = 1$ and $t = 2$.*

**Proof.** The proof follows from the definition of $EM_t^j$, Lemma 1, and the facts that $H(\cdot)$ is a non-decreasing function and that both $1 - G(\tau_B + 2F^{\frac{1}{2}})$ and $1 - G(\tau_B)$ are decreasing in $\tau_B$. Differentiating the $EM_t^j$'s with respect to both variable trade costs, we obtain:

- $\frac{dEM_1^A}{d\tau^j} = h(F^{Sq})\frac{dF^{Sq}}{d\tau^j} < 0$, $j = A, B$;
- $\frac{dEM_1^B}{d\tau^A} = h(F^{Sm})\frac{dF^{Sm}}{d\tau^A} = 0$;
- $\frac{dEM_2^A}{d\tau^A} = h(F^{Sq})\frac{dF^{Sq}}{d\tau^A}\left[1 - G(\tau^A)\right] - H(F^{Sq})g(\tau^A) < 0$;
- $\frac{dEM_2^B}{d\tau^A} = h(F^{Sq})\frac{dF^{Sq}}{d\tau^A}\left[1 - G(2\left[F^{Sq}\right]^{\frac{1}{2}} + \tau^B)\right] < 0$;
- $\frac{dEM_1^B}{d\tau^B} = h(F^{Sq})\frac{dF^{Sm}}{d\tau^B} < 0$;
- $\frac{dEM_2^A}{d\tau^B} = h(F^{Sq})\frac{dF^{Sq}}{d\tau^B}\left[1 - G(\tau^A)\right] < 0$,

where $h(\cdot)$ and $g(\cdot)$ denote the p.d.f.s of $H(\cdot)$ and $G(\cdot)$, respectively.

To find $\frac{dEM_2^B}{d\tau^B}$, notice that

$$\begin{aligned}\frac{dEM_2^B}{d\tau^B} =& h(F^{Sm})\frac{dF^{Sm}}{d\tau^B}\left[1 - G(\tau^B)\right] - H(F^{Sm})g(\tau^B) \\ &+ h(F^{Sq})\frac{dF^{Sq}}{d\tau^B}\left[1 - G(2\left[F^{Sq}\right]^{\frac{1}{2}} + \tau^B)\right] - \int_{F^{Sm}}^{F^{Sq}} g(2F^{\frac{1}{2}} + \tau^B)dH(F) \\ &- h(F^{Sm})\frac{dF^{Sm}}{d\tau^B}\left[1 - G(2\left[F^{Sm}\right]^{\frac{1}{2}} + \tau^B)\right] \\ =& h(F^{Sq})\frac{dF^{Sq}}{d\tau^B}\left[1 - G(2\left[F^{Sq}\right]^{\frac{1}{2}} + \tau^B)\right] - \int_{F^{Sm}}^{F^{Sq}} g(2F^{\frac{1}{2}} + \tau^B)dH(F) + \\ &+ h(F^{Sm})\frac{dF^{Sm}}{d\tau^B}\left[G(2\left[F^{Sm}\right]^{\frac{1}{2}} + \tau^B) - G(\tau^B)\right] - H(F^{Sm})g(\tau^B),\end{aligned}$$

which is negative since each of its terms are negative. ∎

The startling element of Proposition 3 regards the effect of bilateral trade liberalization on entry into third-countries. In the short run, these effects are asymmetric. A lower $\tau^A$ makes early entry in market $A$ more appealing, as expected, and so does a lower $\tau^B$, because it increases the profits from potentially entering market $B$ at $t = 2$. By contrast, while $\tau^B$ directly affects the decision to enter market $B$ at $t = 1$, $\tau^A$ plays no direct role in that decision, since the choice between entering markets sequentially or simultaneously is unaffected by $\tau^B$, whereas the choice between entering markets sequentially or not at all does not involve early entry in $B$. Conversely, in the long run there is no asymmetry and cross-market effects are always present. As variable trade costs fall, firms' potential future gains from learning their export profitabilities increase. As a result, more firms choose to engage in exporting. Among those new exporters, a fraction will find it profitable to enter other destinations in the future.

Hence, Proposition 3 implies that trade liberalization in a country creates *externalities* to other countries. From the perspective of Argentine firms, for example, this means that events such as the opening of the Chinese market since the late 1990s may have induced some firms to start exporting to Argentina's *neighbors*: even though trade policy in those countries have hardly changed in the last ten years, the better prospect of serving the Chinese market increases the attractiveness of experimenting as exporters, and nearby markets could serve that role. Similarly, the formation of Mercosur in the early 1990s may have been responsible for the entry of some Argentine firms in North American or European markets, as they realized their export potential by serving the Mercosur partners.

The Mercosur example highlights another implication of the mechanism we uncover, namely that the consequences of regional trade agreements could be very different from what existing studies suggest. In particular, an RTA will tend to involve a new form of trade creation: *export creation with third countries*. That is, even from a purely partial equilibrium perspective, regional integration can create trade with non-partner countries for entirely different reasons than those emphasized in the existing literature, and involving not greater imports, but enhanced *exports* to non-members.

Clearly, empirical research focused on this effect is necessary to gather its practical relevance. Our data set does not permit a proper evaluation of these implications, as it starts in 2002. However Borchert (2009), who develops the single empirical study of how an RTA affects members' exports to non-members that we are aware of, suggests the effect is meaningful. Borchert finds, in particular, that the growth of Mexican exports *to Latin America* from 1993—right before NAFTA entered into force—to 1997 is higher, the greater the reduction in the preferential U.S. tariff under NAFTA for that product. Moreover, and critically, this effect comes entirely from changes in the *extensive* margin. While most existing trade models would find it difficult to explain this finding, it fits squarely the predictions of our model.[27]

The trade policy externality we uncover provides also a strong reason for broader coordination of trade policies across countries. In this sense they generate an entirely novel rationale for multilateral

[27] In the same spirit, the literature on the euro's trade effect finds a positive effect of the euro on the eurozone's external trade, and in particular a one-sided effect on eurozone exports, not imports (see for example Micco et al. 2003, and Flam and Nordström 2007). Our theory offers one possible rationalization of this external and one-sided effect of the euro.

trade institutions such as the WTO. This rationale is independent of terms of trade effects (Bagwell and Staiger 1999), strategic uncertainty (Calvo-Pardo, 2009), commitment motives (Maggi and Rodriguez-Clare 2007), production relocation externalities (Ossa 2009), and profit-shifting motives (Mrazova 2009)—the existing explanations for multilateral trade cooperation. Instead, it relies on the sequentiality of firms' export strategies due to their profitabilities as exporters being uncertain but correlated across markets.

Now, what the resulting trade policy externality does not warrant is export promotion policies. One may be led to think that, because entry in one foreign market can lead to future entry in other destinations, governments may play a positive role in this process by enacting policies that induce domestic firms to start exporting. This would be misleading, because individual firms take all the benefits related to their future export performance into account when deciding whether to become an exporter in the first place. Naturally, if there were market inefficiencies—e.g. credit constraints that prevent willing domestic firms from entering foreign markets—then their interaction with our proposed mechanism may suggest a role for export promotion policies. But such market inefficiencies alone may already justify active trade policies at the national (i.e. absent international coordination) level even in the absence of sequential exporting, so the mechanism we develop here does not create new reasons for national export promotion policies.

# 5 Conclusion

Firms typically start exporting small volumes to a single country. Despite the high entry sunk costs these firms have to incur, many drop out of the export business very shortly. By contrast, the successful ones grow at both the intensive and the extensive margins. Most existing trade models, including 'new new trade theory' ones based on selection due to heterogeneity in productivity and export sunk costs, are not well equipped to address these dynamic patterns. In this paper, we argue that firms' uncertainty about their success in foreign markets is central to understanding their export patterns, provided that this uncertainty is correlated over time and across markets.

We develop the minimal model to address the implications of this mechanism. A firm discovers its profitability as an exporter only after exporting takes place. After learning it, the firm can condition the decision to serve other destinations on this information. Since breaking into new markets entails significant and unrecoverable costs, the correlation of export profitability across markets gives the firm an incentive to enter foreign destinations sequentially. For example, neighboring markets could serve as natural "testing grounds" for future expansions to larger or distant markets. We derive specific predictions from our model and test them using Argentinean firm-level data. We cannot reject any of the predictions. We are equally unable to come up with alternative mechanisms that would lead to a similar set of predictions. This leads us to conclude that uncertainty correlated over time and across markets is a central determinant of firms' export strategies.

This mechanism has subtle but broad policy implications. First, it implies a *trade policy externality*: exports to a country could increase because *other* countries have liberalized trade, thereby making experimentation in foreign markets more profitable. This externality provides an entirely novel rationale for multilateral trade negotiations, as those under the auspices of the World Trade Organization. In fact, our findings imply that existing studies of major proposals for multilateral liberalization, like those discussed under the current Doha Round of negotiations in the WTO, could greatly understate their impact on trade flows, since those studies do not account for the lagged and third-country effects on firms' export decisions that we uncover. The same is true for studies seeking to evaluate the effectiveness of the GATT/WTO system in promoting trade (e.g. Rose 2004).

Similar implications apply to the more limited—but much more widespread—arrangements of liberalization at the regional level. Regional liberalization raises the number of firms willing to experiment with intra-regional exports. Eventually, some of those firms will choose to break into extra-regional markets as well. This lagged trade-creation effect toward *non-members* corresponds to an entirely novel implication of regional trade agreements, which the literature has so far entirely neglected.

Sequential exporting strategies could also help to rationalize some empirical findings from the trade literature, such as the apparent excess sensitivity of trade flows to changes in trade barriers (Yi 2003), and the greater sensitivity of trade flows to trade costs at the extensive relative to the intensive margin (Bernard et al. 2007, Mayer and Ottaviano 2008). However, for a thorough evaluation of the implications of sequential exporting for these issues, a much more general theoretical structure would be necessary.

A distinct but equally promising avenue for future research is in exploring the mechanism we lay out in this paper at a disaggregated level, seeking to identify the types of products, or the sectors, as well as the characteristics of foreign markets, for which correlation of export profitabilities is likely to be stronger. Here our purpose is to identify only whether there is such a mechanism or not, and to do so we take the simplistic view that the correlation of export profitabilities across destinations is the same for all sectors and for all pairs of countries. In reality, there should be instead a matrix of correlations among countries for each sector. Exploring the structure of those matrixes is well beyond the scope of this paper, but it could prove very useful, making it possible to fine tune the analysis of firms' export strategies and the analysis of the impact of trade policies.[28] We look forward to advances in those areas.

# 6 Appendices

## Appendix A: Proofs

**Lemma 2** $E_0(\mu | \mu > \tau) \geq E_0(\mu)$.

[28] Elliott and Tian (2009) provide a first step in this direction. Using our data set and empirical methodology, they evaluate the patterns of sequential exporting of Argentine firms in Asia. They find that China serves as the main stepping stone for entry in the ten members of the ASEAN free trade bloc. Japan also plays such a role, but the effect is smaller. Entry in Europe and in the U.S., on the other hand, does not seem to help subsequent entry in ASEAN.

**Proof.** Integrating both expressions by parts, we find

$$E_0(\mu) = \overline{\mu} - \int_{\underline{\mu}}^{\tau} G(\mu)d\mu - \int_{\tau}^{\overline{\mu}} G(\mu)d\mu,$$

$$E_0(\mu|\,\mu > \tau) = \overline{\mu} - \int_{\tau}^{\overline{\mu}} G(\mu|\,\mu > \tau)d\mu.$$

Thus,

$$\begin{aligned} E_0(\mu|\,\mu > \tau) - E_0(\mu) &= \int_{\underline{\mu}}^{\tau} G(\mu)d\mu + \int_{\tau}^{\overline{\mu}} [G(\mu) - G(\mu|\,\mu > \tau)]\, d\mu \\ &= \int_{\underline{\mu}}^{\tau} G(\mu)d\mu + \frac{G(\tau)}{1-G(\tau)} \int_{\tau}^{\overline{\mu}} [1 - G(\mu)]\, d\mu \geq 0, \end{aligned}$$

where the second equality follows from $G(u|\,\mu > \tau) = \int_{\tau}^{u} \frac{dG(s)}{1-G(\tau)} = \frac{1}{1-G(\tau)} \left[\int_{\underline{\mu}}^{u} dG(s) - \int_{\underline{\mu}}^{\tau} dG(s)\right] = \frac{1}{1-G(\tau)} [G(u) - G(\tau)]$. Since $\tau \in \left(\underline{\mu}, \overline{\mu}\right)$ implies $G(\tau) \geq 0$, the inequality follows. ■

**Lemma 3** *$E_0(pq|\,\mu > \tau) \geq E_0(pq)$.*

**Proof.** The left-hand side of the inequality describes the exporter's expected optimal sales conditional on survival. Recalling that $\mu \equiv d - c$, we can rewrite it in terms of demand ($d$) and supply ($c$) shocks as

$$\begin{aligned} E_0(pq|\,\mu > \tau) &= E_0((d-q)q|\,\mu > \tau) \\ &= E_0\left[\left(d - \frac{E_0(\mu|\,\mu > \tau) - \tau}{2}\right)\left(\frac{E_0(\mu|\,\mu > \tau) - \tau}{2}\right)\middle|\,\mu > \tau\right] \\ &= E_0\left[\left(d - \frac{E_0(d-c|\,d-c > \tau) - \tau}{2}\right)\left(\frac{E_0(d-c|\,d-c > \tau) - \tau}{2}\right)\middle|\,d-c > \tau\right] \\ &= \frac{[E_0(d|\,d > \tau + c)]^2 - [E_0(c|\,c < d - \tau) + \tau]^2}{4} \end{aligned}$$

under the condition that demand and supply shocks are independently distributed. Similarly, we can express the exporter's unrestricted expected optimal sales as

$$\begin{aligned} E_0(pq) &= E_0\left[(d-q)q\right] \\ &= E_0\left[\left(d - \frac{E_0(\mu) - \tau}{2}\right)\left(\frac{E_0(\mu) - \tau}{2}\right)\right] \\ &= E_0\left[\left(d - \frac{E_0(d-c) - \tau}{2}\right)\left(\frac{E_0(d-c) - \tau}{2}\right)\right] \\ &= \frac{[E_0(d)]^2 - [E_0(c) + \tau]^2}{4}. \end{aligned}$$

Now, by Lemma 2 we have that

$$E_0(d|\,d > \tau + c) \geq E_0(d),$$

since the left-hand side is an expectation truncated at the left of the distribution (given that assumption $\underline{\mu} < \tau$ implies $\underline{d} < \tau + \overline{c}$). Proceeding analogously, we also have that

$$E_0(c|\, c < d - \tau) \leq E_0(c).$$

Therefore,

$$\begin{aligned} E_0(pq) &= \frac{[E_0(d)]^2 - [E_0(c) + \tau]^2}{4} \\ &\leq \frac{[E_0(d|\, d > \tau + c)]^2 - [E_0(c) + \tau]^2}{4} \\ &\leq \frac{[E_0(d|\, d > \tau + c)]^2 - [E_0(c|\, c < d - \tau) + \tau]^2}{4} \\ &= E_0(pq|\, \mu > \tau), \end{aligned}$$

completing the proof. ■

## Appendix B: Imperfect correlation in export profitability

We show here that our results generalize to the case of positive but imperfect statistical dependence between random variables $\mu^A$ and $\mu^B$. In particular, we emphasize that the third-country result of Proposition 3 (parts a.2 and b.1) holds in the general case.

To keep the model symmetric, we assume distributions $G(\mu^A)$ and $G(\mu^B)$ are identical, although this is not essential. Upper-bar variables denote the counterparts to the variables in the main text under perfect correlation. For brevity, we denote $E\left[\mu^B \middle|\, \mu^A = u^A\right]$ by $E\left(\mu^B \middle|\, \mu^A\right)$, where $u^A$ denotes a particular realization of the random variable $\mu^A$.

**Output choice** Output decisions in $A$ at all times and in $B$ at $t = 1$ are made in the same way as in the main text. Output choice in $B$ at $t = 2$ takes into account the realization of $\mu^A$. From the convexity of the max function and Jensen's inequality

$$\int_{\underline{\mu}^A}^{\overline{\mu}^A} \left[ \max_{q^B} \int_{\underline{\mu}^B}^{\overline{\mu}^B} (\mu^B - \tau^B - q^B) q^B dG(\mu^B |\, \mu^A) \right] dG(\mu^A) \geq \max_{q^B} \int_{\underline{\mu}^B}^{\overline{\mu}^B} (\mu^B - \tau^B - q^B) q^B dG(\mu^B),$$

where $dG(\mu^B) = \int_{\underline{\mu}^A}^{\overline{\mu}^A} dG(\mu^B |\, \mu^A) dG(\mu^A)$. Expected profits are larger when an optimal production decision in $B$ is made taking into account the experience acquired in $A$. By linearity of the expectation operator, optimal output is $\overline{q}_2^B(\tau^B) = \frac{E\left(\mu^B |\mu^A\right) - \tau^B}{2}$.

**Value of the sequential exporting strategy** The conditional expectation of random variable $\mu^B$ can be expressed as

$$E\left[\mu^B \middle| \mu^A\right] = E\mu^B + (u^A - E\mu^A)\underbrace{\int_{\underline{\mu}}^{\overline{\mu}} \left[-\frac{d}{du}G\left(w \middle| \mu^A = u^A\right)\right]\Bigg|_{u=u_0} dw}_{\equiv \varpi}, \tag{28}$$

where $\varpi$ captures the statistical dependence between $\mu^A$ and $\mu^B$.[29]

At $t = 2$ a firm enters market $B$ if

$$\left(\frac{E\left[\mu^B \middle| \mu^A = u^A\right] - \tau^B}{2}\right)^2 \geq F \Leftrightarrow E\left(\mu^B \middle| \mu^A\right) \geq 2F^{1/2} + \tau^B. \tag{29}$$

Define $\overline{F}_2^B(u^A; \tau^B)$ as the $F$ that solves (29) with equality. The firm enters market $B$ at $t = 2$ if $F \leq \overline{F}_2^B(u^A; \tau^B)$. Plugging (28) in (29) yields

$$\overline{F}_2^B(u^A; \tau^B) = \left(\frac{E\mu^B + \varpi(u^A - E\mu^A) - \tau^B}{2}\right)^2,$$

which is strictly decreasing in $\tau^B$. Comparing $\overline{F}_2^B(u^A; \tau^B)$ with its analog under perfect correlation $F_2^B(\tau^B)$, defined on page 7, we have that $E\mu^A = E\mu^B$ implies $\lim_{\varpi \to 1} \overline{F}_2^B(u^A; \tau^B) = F_2^B(\tau^B)$.

Expressed in $t = 0$ expected terms, entering market $B$ at $t = 2$ yields profits

$$\overline{W}(\tau^B; F) \equiv \int_{\mu^{*A}(\varpi)}^{\overline{\mu}} \left[\left(\frac{E\left(\mu^B \middle| \mu^A\right) - \tau^B}{2}\right)^2 - F\right] dG(\mu^A), \tag{30}$$

where

$$\mu^{*A}(\varpi) \equiv \left(\frac{1}{\varpi}\right)(2F^{1/2} + \tau^B) - \left(\frac{1 - \varpi}{\varpi}\right) E\mu^B$$

is the cutoff realization of export profitability in $A$ above which a sequential exporter enters in $B$ at $t = 2$.

For expositional clarity, notice that if $\mu^A$ and $\mu^B$ follow a bivariate normal distribution with parameters $(E\mu, E\mu, \sigma, \sigma, \rho)$, the cutoff varies with $\varpi = \rho$ as follows:

$$\frac{d\mu^{*A}(\rho)}{d\rho} = \frac{E\mu^B - (2F^{1/2} + \tau^B)}{\rho^2}.$$

Thus, when $E\mu^B > (2F^{1/2} + \tau^B)$ the cutoff rises as $\rho$ increases, implying a lower value from experimentation. This simply reflects the fact that, if $E\mu^B > (2F^{1/2} + \tau^B)$, it is optimal to enter market $B$ already at $t = 1$. Conversely, when $E\mu^B < (2F^{1/2} + \tau^B)$ the cutoff falls as $\rho$ rises,

[29] The proof of this claim rests on a stochastic order based on the notion of *regression dependence* introduced by Lehman (1966), and is available upon request. A particular case is when $\mu^A$ and $\mu^B$ follow a bivariate normal distribution with parameters $(E\mu^A, E\mu^B, \sigma_A, \sigma_B, \rho)$. In that case, $\varpi = \rho\frac{\sigma_B}{\sigma_A}$ and $E\left[\mu^B \middle| \mu^A\right] = E\mu^B + \rho\frac{\sigma_B}{\sigma_A}\left(u^A - E\mu^A\right)$.

implying a higher value from experimentation. This indicates that experimentation becomes more worthwhile as the statistical dependence between $\mu^A$ and $\mu^B$ increases. Experimentation is most valuable in the case of perfect correlation assumed in the main text, when it is worth $W(\tau^B; F)$. Experimentation is least valuable when $\mu^A$ and $\mu^B$ are independent, when it has no value.[30]

**Choice of export strategy (extension of Proposition 1)** As in the main text, $\overline{F}^{Sq}$ is the fixed cost that makes a firm indifferent between exporting sequentially and not exporting, whereas $\overline{F}^{Sm}$ makes a firm indifferent between simultaneous and sequential exporting strategies:

$$\overline{F}^{Sq} : \Psi(\tau^A) + \overline{W}(\tau^B; \overline{F}^{Sq}) = \overline{F}^{Sq}, \tag{31}$$

$$\overline{F}^{Sm} : \Psi(\tau^B) - \overline{W}(\tau^B; \overline{F}^{Sm}) = \overline{F}^{Sm}. \tag{32}$$

Since $\Psi(\tau^j)$ is monotonically decreasing in $\tau^j$ and $\tau^A \leq \tau^B$, and since $\overline{W}(\tau^B; F)$ is non-negative, there is a non-degenerate interval of fixed costs where firms choose the sequential export strategy.

**Effects of trade liberalization (extension of Proposition 3)** Differentiating $\overline{W}(\tau^B; F)$, we find

$$\frac{d\overline{W}(\tau^B; F)}{d\tau^B} = -\int_{\mu^{*A}(\varpi)}^{\overline{\mu}} \left( \frac{E\left(\mu^B \middle| \mu^A\right) - \tau^B}{2} \right) dG(\mu^A) \\ + \frac{dG(\mu^{*A}(\varpi))}{\varpi} \underbrace{\left[ \left( \frac{E\left(\mu^B \middle| \mu^{*A}(\varpi)\right) - \tau^B}{2} \right)^2 - F \right]}_{=0} < 0,$$

[30] Under independence between $\mu^A$ and $\mu^B$, entry in $A$ conveys no information about profitability in $B$. Thus, if it is not worthwhile to enter market $B$ at $t = 2$, it is not worthwhile entering at $t = 1$ either. Conversely, if it pays to enter market $B$ at $t = 2$, it must pay to enter also at $t = 1$, to avoid forgoing profits in the first period. Thus, under independence waiting to enter $B$ at $t = 2$ is never optimal.

where the term in brackets is zero by construction of $\mu^{*A}(\varpi)$. Using this result and totally differentiating (31) and (32), we have that

$$\frac{d\overline{F}^{Sm}}{d\tau^A} = 0;$$

$$\frac{d\overline{F}^{Sm}}{d\tau^B} = -\mathbf{1}_{\{E\mu>\tau^B\}} \left\{ \frac{\left[\left(\frac{E\mu-\tau^B}{2}\right) + \int_{\tau^B}^{\overline{\mu}} \left(\frac{\mu-\tau^B}{2}\right) dG(\mu) - \int_{\mu^{*A}(\varpi)}^{\overline{\mu}} \left(\frac{E\left(\mu^B|\mu^A\right)-\tau^B}{2}\right) dG(\mu^A)\right]}{G(\mu^{*A}(\varpi))} \right\} \leq 0;$$

$$\frac{d\overline{F}^{Sq}}{d\tau^A} = -\frac{\left[\mathbf{1}_{\{E\mu>\tau^A\}} \left(\frac{E\mu-\tau^A}{2}\right) + \int_{\tau^A}^{\overline{\mu}} \left(\frac{\mu-\tau^A}{2}\right) dG(\mu)\right]}{2 - G(\mu^{*A}(\varpi))} < 0;$$

$$\frac{d\overline{F}^{Sq}}{d\tau^B} = -\frac{\int_{\mu^{*A}(\varpi)}^{\overline{\mu}} \left[\left(\frac{E\left(\mu^B|\mu^A\right)-\tau^B}{2}\right)\right] dG(\mu^A)}{2 - G(\mu^{*A}(\varpi))} < 0.$$

The sign of all derivatives are as in Lemma 1.[31] The rest of the proof of parts a.2 and b.1. of Proposition 3 proceeds analogously. The probability of sequential entry is equivalent except for the new entry cutoff $\mu^{*A}(\varpi)$. Exports vary at the intensive margin as in the main text. Where intensive margin effects are ambiguous, they are also dominated by extensive margin ones, driven by the above effects of variable trade costs on fixed cost entry thresholds Thus, trade liberalization has positive third-country effects also in the general case of positive statistical dependence between export profitability in $A$ and $B$.

## Appendix C: Descriptive Statistics

There is substantial export growth over our sample period. Figure 3 plots Argentinean total and manufacturing exports since 2000. A dramatic exchange rate devaluation in early 2002 led to a sharp increase in Argentinean aggregate exports (223% from 2002 to 2007). Manufacturing exports, which account for about 68% of total exports, followed a similar growth trend (220%).

As Table 9 reveals, export growth was similar in most industries. The only relevant change in the export structure was that Petroleum increased its relative share (from 23% in 2002 to 30% in 2007) at the expense of the Automotive and Transport industry (17% to 13%).

On the other hand, the distribution of export destinations has changed more significantly during the sample period. Table 10 shows a growing importance of Mercosur after 2003, accounting for 35% of Argentinean exports in 2007, while the participation of Chile and Bolivia has dropped by

[31] The sign of $\frac{d\overline{F}^{Sm}}{d\tau^B}$ when $E\mu > \tau^B$ depends on the sign of the numerator. The numerator is negative under perfect correlation ($\varpi = 1$), as shown in the main text. It is also negative under independence ($\varpi = 0$). To see that, notice that $\int_{\mu^{*A}(\varpi)}^{\overline{\mu}} \left[\left(\frac{E\left(\mu^B|\mu^A\right)-\tau^B}{2}\right)\right] dG(\mu^A)\Big|_{\varpi=0} = \mathbf{1}_{\{E\mu>2F^{1/2}+\tau^B\}} \left(\frac{E\mu-\tau^B}{2}\right)$. Thus, the expression in square brackets is minimized when $E\mu > 2F^{1/2} + \tau^B$, but even in that case it remains positive. Invoking a stochastic monotonicity argument in $\varpi$, by which $\left|\frac{\partial W(\tau^B;F)}{\partial\tau^B}\right| \geq \left|\frac{\partial \overline{W}(\tau^B;F)}{\partial\tau^B}\right|, \forall\varpi \geq 0$, the numerator keeps its negative sign for any other degree of non-negative statistical dependence. Therefore, $\frac{d\overline{F}^{Sm}}{d\tau^B} \leq 0$. The formal proof for the intermediate cases is not shown for being merely technical, but is available upon request.

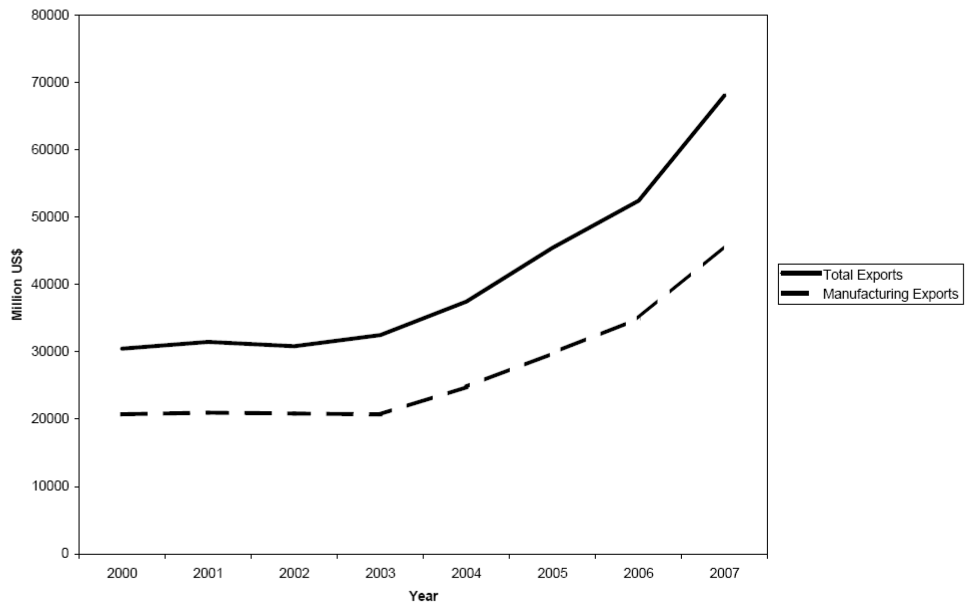


Figure 3: Growth of Argentina's Total and Manufacturing Exports, 2000-2007

Table 9: Argentinean Manufacturing Exports by Industry

| **Industry** | **Exports*** 2002 | **Exports*** 2007 | **Growth** (%) | **Share** 2002 | **Share** 2007 |
|---|---|---|---|---|---|
| Food, Tobacco and Beverages | 4979 | 10884 | 219 | 23 | 23 |
| Petroleum | 4967 | 13863 | 279 | 23 | 30 |
| Chemicals | 1514 | 3466 | 229 | 7 | 7 |
| Rubber and Plastics | 928 | 1845 | 199 | 4 | 4 |
| Leather and Footwear | 829 | 1144 | 138 | 4 | 2 |
| Wood Products, Pulp and Paper Products | 506 | 998 | 197 | 2 | 2 |
| Textiles and Clothing | 533 | 775 | 145 | 2 | 2 |
| Metal Products, except Machinery | 2102 | 4092 | 195 | 10 | 9 |
| Machinery and Equipment | 1127 | 3137 | 278 | 5 | 7 |
| Automotive and Transport Equipment | 3492 | 5894 | 169 | 16 | 13 |
| Electrical Machinery | 385 | 426 | 111 | 2 | 1 |
| Total Manufacturing | 20837 | 45773 | 220 | 100 | 100 |

* Million USD

almost half in the period, to 10% in 2007. Starting from a low level, the importance of China has also increased significantly, having more than doubled its share of Argentinean exports during our sample period, to 7%. Meanwhile the United States, non-Mercosur Latin American markets and the European Union have become relatively less important as destinations for Argentinean exports.

Table 10: Argentinean Manufacturing Exports by Region (%)

| Region | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|
| Mercosur | 32 | 25 | 27 | 28 | 32 | 35 |
| Chile-Bolivia | 17 | 18 | 16 | 15 | 13 | 10 |
| Rest of the World | 16 | 15 | 17 | 17 | 20 | 20 |
| North America | 15 | 19 | 17 | 18 | 13 | 13 |
| EU-27 except Spain-Italy | 6 | 6 | 5 | 5 | 5 | 5 |
| Central America-Mexico | 6 | 6 | 7 | 6 | 7 | 6 |
| China | 3 | 6 | 6 | 5 | 5 | 7 |
| Other South America | 3 | 3 | 3 | 3 | 3 | 3 |
| Spain-Italy | 3 | 3 | 3 | 3 | 2 | 2 |

Finally, Table 11 displays the share of Argentine exporters that each region accounts for (columns DS) and the share of new Argentine exporters that each region receives (columns FMS). The ration FMS/DS is a proxy for the relative importance of the region as a "testing ground" for Argentine exporters. Between 2003 and 2007, the most significant change in this ration happened for China, which still plays a small but increasing role as first destination.

Table 11: Argentinean Manufacturing First Markets by Region (%)

| Region | 2003 | | | 2007 | | |
|---|---|---|---|---|---|---|
| | FMS | DS | FMS/DS | FMS | DS | FMS/DS |
| Mercosur | 29 | 24 | 123 | 36 | 25 | 144 |
| Chile-Bolivia | 20 | 16 | 126 | 17 | 14 | 120 |
| North America | 12 | 9 | 139 | 9 | 7 | 132 |
| Spain-Italy | 11 | 7 | 171 | 8 | 5 | 145 |
| Rest of the World | 8 | 17 | 46 | 12 | 20 | 61 |
| Central America-Mexico | 7 | 11 | 67 | 4 | 10 | 43 |
| Other South America | 7 | 9 | 72 | 7 | 10 | 69 |
| EU-27 except Spain-Italy | 5 | 7 | 74 | 6 | 8 | 71 |
| China | 0 | 1 | 50 | 2 | 1 | 152 |

FMS: share of region $j$ as first export destination by number of firms.
DS: share of region $j$ as export destination by number of firms.

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