Sequential Exporting*

Facundo Albornoz
University of Birmingham

Héctor F. Calvo Pardo
University of Southampton

Gregory Corcos
NHH

Emanuel Ornelas
London School of Economics, CEPR, CEP

January 13, 2012

Abstract

Many new exporters give up exporting very shortly, despite substantial entry costs; others shoot up foreign sales and expand to new destinations. We develop a model based on experimentation to rationalize these and other dynamic patterns of exporting firms. We posit that individual export profitability, while initially uncertain, is positively correlated over time and across destinations. This leads to "sequential exporting," where the possibility of profitable expansion at the intensive and extensive margins makes initial entry costs worthwhile despite high failure rates. Firm-level evidence from Argentina's customs, which would be difficult to reconcile with existing models, strongly supports this mechanism.

JEL Codes: F10; D21
Keywords: Export dynamics, experimentation, uncertainty, learning, option value

*We thank for valuable comments and suggestions: Costas Arkolakis, David Atkin, Sami Berlinski, Jordi Blanes-i-Vidal, John Bluedorn, Holger Breinlich, Svetlana Demidova, Nic de Roos, Peter Egger, Robert Elliott, Daniel Ferreira, Rodrigo Fuentes, Juan Carlos Hallak, James Harrigan, Beata Javorcik, Marc-Andreas Muendler, Peter Neary, Brent Neiman, Dimitra Petropoulou, Horst Raff, Steve Redding, Frédéric Robert-Nicoud, Mark Roberts, Andres Rodriguez-Clare, Ina Simonovska, Thierry Verdier, Eric Verhoogen, Zhihong Yu, as well as seminar audiences at the AEA meeting, Econometric Society World Congress, ERWIT, CESifo Venice Summer Institute, EEA meeting, SED meeting, PEGGED Trade Workshop, IGC Trade and Development Conference, Geneva Trade and Development Workshop, LACEA, ETSG, the World Bank, Princeton, Yale, Oxford, LSE, and other universities. We also thank the support of the Chair Jacquemin of the Université Catholique de Louvain in choosing this paper for its annual award at the 2009 European Trade Study Group Meeting. We gratefully acknowledge financial support from the British Academy and the ESRC (RES-061-25-0327).

E-mails: f.albornoz@bham.ac.uk; calvo@soton.ac.uk; gregory.corcos@nhh.no; e.a.ornelas@lse.ac.uk.

1 Introduction

How do firms break in foreign markets? To understand patterns of international trade and the impact of trade liberalization, answering this question convincingly is of central importance. Recent trade theories, starting with 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 likely to be high.[1] Yet recent empirical research has uncovered patterns of foreign entry that seem difficult to reconcile with high sunk entry costs. For example, describing the behavior of Colombian firms, Eaton et al. (2008) observe that many domestic firms enter foreign markets every year. They often start selling small quantities to a single neighbor country, and yet 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 of the new exporters also expands to other markets.

How can we explain so much entry activity with so little initial sales and so low survival rates? After all, low sales within a short period likely imply negative profits, unless sunk costs are implausibly small. And what could explain the seemingly sequential entry pattern of the surviving exporters? We propose a simple model that rationalizes these recently uncovered empirical findings, while also providing a number of additional empirical implications for the dynamic pattern of exporting firms. The model relies on a basic premise: firms are initially uncertain about their export profitability, but ex ante uncertain success factors are highly persistent and have global scope. In other words, a firm's export profitability is correlated over time within a market and also across destinations. The global scope could reflect, for example, export-specific capabilities that, if possessed, the firm could harness in multiple destinations.

If a firm's export profit in a market is uncertain but correlated over time, entry allows the firm to learn its profit potential there today and in the future. Furthermore, if the profitability uncovered in that market provides information about the firm's profitability in other foreign markets, this too should be taken into account in the decision to start exporting. This can lead to a process of "sequential exporting," in which firms use their initial export experience to infer information on their future success there and elsewhere. Like an option contract, the decision to start exporting gives the firm the opportunity to, in some states of nature, enjoy profits in the future, there and in other markets. In other states of nature, by contrast, there would not be any profit to be made abroad. This reconciles first-market rapid growth and early expansion to other markets with high initial failure rates, even in the presence of high irreversible entry costs.

Our model highlights a distinction that is often overlooked in empirical analyses of exporting firms, namely whether a market is the firm's first foreign market or not. Using firm-level data

[1] For example, 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. Morales et al. (2010) use a different approach but find similarly large magnitudes for chemical manufacturers from Chile.

on all Argentine manufacturing exports between 2002 and 2007, we find strong evidence that this difference is crucial. While firms behave differently in any market after having acquired some experience there, this difference is much more pronounced in a firm's first foreign market. Specifically, conditional on remaining an exporter, growth upon entry at both the intensive margin (the sales in the market) and the extensive margin (the number of markets served) is significantly higher in a firm's first foreign market than in its subsequent markets. The same is true for exit: a firm is more likely to exit from a foreign market right after entering it if that market is the firm's first. These results are not driven by firm heterogeneity, by country-specific shocks, by the possibility of credit constraints, or by learning from rivals. Hence, while uncertainty correlated across time and markets is but one possible force 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."

Our model also implies that the differential effect of the first market should not apply universally to all exporters. For example, if the firm is re-starting to export after a break, there would no longer be a fundamental uncertainty to be uncovered. Similarly, if a firm starts exporting by serving multiple markets, it must be because it is rather confident about its export success, so on average the role of self-discovery should not be as pronounced for such firms as it is for single-market entrants. The uncertainty about export profitability should also be less marked for producers of homogeneous goods, for which reference prices are available. Thus, our mechanism suggests that we should observe rapid first-market export growth, early entry in additional markets and frequent early first-market exit primarily among first-time, single-market exporters of differentiated products. This is indeed what we find empirically.

We sought inspiration for the basic premise of our model in insights from the international business literature, including recent findings on Argentine exporters by Artopoulos, Friel and Hallak (2010). A long tradition in that literature, starting with Johanson and Vahlne (1977), emphasizes the distinct knowledge and competencies—typically related to product adaptation, marketing and distribution—that are required for export success. A firm can properly infer and develop its own "internationalization knowledge," however, only once it starts its foreign operations. Artopoulos, Friel and Hallak (2010) document the importance of this export-specific knowledge with detailed case study analyses of firms from four emerging export sectors in Argentina. Importantly, such export capabilities can be used when accessing different foreign destinations. A similar reasoning applies to firm-specific demand characteristics. For example, trade facilitation agencies place a heavy emphasis on the importance of uncovering foreign demand for would-be exporters, and their advice indicates that the key uncertainty is about persistent demand components,[2] some of which can be present also in different countries. We interpret these observations as suggestive of

[2] See for example the discussion of SITPRO, the British trade facilitation agency, at http://www.sitpro.org.uk. See also Kee and Krishna (2008), who 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.

significant firm-specific export profit uncertainty, which can be resolved only by actual engagement in exporting, but which is informative of a firm's *general* ability to earn profits in foreign markets. Notice that firm level dynamics matter also for aggregates: although new exporters typically start small, they tend to account for a large part of export growth over longer periods (about 50% over ten years in the Colombian sample of Eaton et al. 2008, for example).

The recent documentation of the pattern of firms' foreign sales[3] has been fostering a still incipient (see Redding 2011) but growing research interest on the dynamics of firms' exporting strategies.[4] The current work of Eaton et al. (2010) and Freund and Pierola (2010), who emphasize learning mechanisms, are particularly close to ours. The former 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. In those models, uncertainty is destination-specific and the main goal is to describe firms' export dynamics within a market, without distinction between first and subsequent markets. Here, in contrast, we take a multi-market approach. A central feature of our environment concerns firms' different dynamics in their first and subsequent foreign markets, and the focus is on the option value of a firm's first export experience.[5]

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) 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. Iacovone and Javorcik (2009) find that firms often undertake significant investment before entering foreign markets, as a preparation for exporting. Alvarez et al. (2011) 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) show that

[3]Buono et al. (2008) confirm some of the findings of Eaton et al. (2008) in a study of French firms. Lawless (2009) carries out a related exercise for a survey of Irish exporters.

[4]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. Our work is also related to dynamic export models with idiosyncratic uncertainty. Das et al. (2007) develop an heterogeneous firm model where firm profitability evolves over time according to an exogenous stochastic process determining the firm's entry, exit and production decisions abroad. Arkolakis (2011) proposes a dynamic model with endogenous entry costs that increase with the number of foreign consumers targeted. Eaton et al. (2011) integrate Arkolakis' entry cost structure in a model with different types of firm-specific shocks. The model, which is static (and therefore does not incorporate learning), is set up for studying the role of different types of shocks in determining the geographical pattern of French exports at the firm level.

[5]In recent independent research, Nguyen (2011) develops a related model based on the idea that a firm's foreign demands are uncertain and correlated across markets.

the extensive margins of US exports are key to explain variation at long intervals, but that the intensive margin is responsible for most short-run (i.e. year-to-year) variation. These different contributions of the two margins over time reflect the fact that new exporters start small, but grow fast and expand rapidly across destinations if they survive. Our model helps to rationalize these findings as well.

The remainder of the paper is organized as follows. In Section 2 we present our model. In Section 3 we use Argentine customs data to test the distinguishing features of our theoretical mechanism. We conclude in Section 4.

2 Model

We propose a model whose central assumption is the existence of a fundamental source of uncertainty regarding firms' *general* ability to earn profits abroad, and which can be resolved only through experience in foreign markets.

A direct implication of our central assumption is that a firm's export profitability should be correlated over time and across destinations. Correlation over time can come from persistent but ex ante unknown demand patterns, e.g. related to the appeal of certain product features. It could also represent idiosyncratic but ex ante unknown export costs that are stable over time. For example, shipping and other port activities, distribution of goods in foreign markets, export finance and insurance, maintenance of an international division within the firm—all those activities involve relatively stable idiosyncratic costs that are often unknown to the firm until it actually engages into exporting. In turn, positive correlation across countries in export profitability can come from similarities in either demand or supply conditions. The patterns uncovered by gravity equations—which show that bilateral trade correlates strongly with indicators for common language, religion, colonial origin etc.—partly involve demand similarities across countries. Likewise, some of the costs intrinsic to exporting, like those mentioned above, while ex ante unknown for a firm, are often similar across countries.

This is consistent with evidence from international business studies. Those studies stress the different activities (and costs) that exporting requires. On the one hand, new exporters need to learn about local consumer preferences, business practices and institutional environments. On the other hand, they need to learn about how to establish appropriate routines and fine-tune the allocation of resources to export activities. For example, in a review of international marketing studies, Cavusgil and Zou (1994) list product adaptation, distributor support and commitment of managerial resources to exports as key competencies required for a successful export strategy. Similarly, in a study of several Argentine exporters during the 2000's, Artopoulos, Friel and Hallak (2010) find that export success entails substantial changes in product design, production and marketing capabilities. Crucially, they also find that many new exporters were unaware of those changes prior to exporting, presumably because of the tacit nature of that information. Successful exporters are therefore those who are able to develop effective export-specific processes and routines, which

Eriksson et al. (1997) refer to as a firm's "internationalization knowledge." Such knowledge, which is obtained through export experience, affects a firm's perceived ability to enter new foreign markets successfully, as they shape their capacity to acquire knowledge of institutions and business practices in new markets. The need for new knowledge and competencies makes export success uncertain at the time of entry, but also implies that the uncertainty is resolved through export experience. The tacit nature of knowledge implies that there are no obvious substitutes for that experience.

Naturally, we do not suggest that firms do not face any producer-market specific uncertainty, or that all uncertainty requires actual engagement in exporting to be resolved. Producers surely acquire formal knowledge and observe other exporters prior to their foreign entry decision. We focus on the residual uncertainty because it has not been explored yet in this context, but has potentially large and important implications.

2.1 Basic structure

A risk-neutral producer has the option of serving 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 τ^A and τ^B, $\tau^A \leq \tau^B$. To sell in each foreign market, the firm needs to incur in a one-time fixed cost per destination, $F \geq 0$. 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. We normalize the latter to zero. In the Online Appendix we show that allowing for differences in productivity has no qualitative consequence for our main mechanism. 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 therefore 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 μ^j as the firm's "export profitability" in market j. $\overline{\mu}$ obtains when the highest possible demand intercept ($\overline{d}$) and the lowest possible export unit cost ($\underline{c}$) are realized; $\underline{\mu}$ obtains under the opposite extreme scenario ($d^j = \underline{d}$ and $c^j = \overline{c}$). The analysis becomes interesting when trade costs are such that, upon the resolution of the 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 to the distant market can be profitable. To ensure that equilibrium prices are always strictly positive, we need that $E\mu < 2d^j$ for all d^j, so we assume throughout the paper that $\underline{d} > \frac{1}{2}E\mu$.[6]

Our central assumption is that export profitability is correlated over time and across markets. This correlation could come from either supply or demand components of uncertainty in the parameter μ, as suggested by our discussion above. To make the analysis as clear and simple as possible, we focus on the limiting case. First, as the definition of μ^j without time subscripts indicates, we consider that the μ^j's are constant over time. Second, we look at the case where the draws of μ^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 over time.[7]

To model the decision to enter 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 factor, but this has no bearing on our qualitative 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 μ from its profit.

$t = 2$: At period 2, if the firm has entered market j at $t = 1$, it decides whether to keep serving on that market given the realization of export profits. If so, 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.

Hence, the firm can infer its export profitability parameter μ only by actually engaging in exporting, which requires the firm to pay the fixed entry cost F and sell 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. Clearly, uncovering μ must be costly, or else every firm would, counterfactually, export at least a tiny quantity to gather their export potential. We model this cost 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 (ε) because we require the firm to spend F to sell in a foreign market, but one could for example assume the opposite (i.e. set $F = 0$ and require a larger minimum scale).[8]

[6]Identical results obtain if one adopts instead a demand function of the form $q^j(p^j) = \max\{d^j - p^j, 0\}$, as we show in http://www.economics.soton.ac.uk/staff/calvo/documents/CompleteAppendix.pdf

[7]We show this for the case where the μ^j's are positively but imperfectly correlated in http://www.economics.soton.ac.uk/staff/calvo/documents/CompleteAppendix.pdf.

[8]More general forms of experimentation are compatible with our main mechanism. For example, Akhmetova and

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 deliberately choose to enter a market, or simply wait until they are "found" by a foreign buyer. While our model focuses on the former type of entry, a passive first export experience could also resolve uncertainty and lead to active expansion on foreign markets. Our empirical findings certainly involve both types of first export experiences.

2.2 Firm's export decision

There are three undominated 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 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 μ and will choose its export volumes by solving

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

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 μ. Profits at $t = 2$, expressed in $t = 0$ expected terms, can then be written as

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

$V(\tau^j)$ is the value of continuing to export to market j after profitability in foreign markets has been discovered. If the firm cannot deliver positive profits in a market, it exits to avoid further

Mitaritonna (2010) develop a model of entry in foreign markets where demand uncertainty takes time to be unveiled, as in Aghion et al. (1991). As a result, producers also need to decide their levels of experimentation.

losses. Otherwise, the firm tunes up its output choice to that market.

iii) *Sequential entry.* When the firm exports to country A in $t=1$, at $t=2$ it will have inferred its export profitability μ. Thus, q_2^A is again given by (2): $\tilde{q}_2^A(\tau^A)=\hat{q}_2^A(\tau^A)=\mathbf{1}_{\{\mu>\tau^A\}}\left(\frac{\mu-\tau^A}{2}\right)$, generating second-period profit $V(\tau^A)$. Otherwise, if the firm cannot deliver positive profits in a market it exits market A to avoid further losses.

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 τ^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, τ^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

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

Function $W(\tau^B;F)$ represents the 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 gross profit from entering market B at $t=2$. The other term represents the fixed cost from entering B times the probability that entry in that market is profitable.

Thus, the return from first entering destination A includes the value of waiting to subsequently become an informed exporter to destination B, avoiding the costs from directly "testing" that market. In the presence of uncertainty and the irreversible entry cost F, the possibility of delaying entry into market B corresponds to a real option. If profits were not correlated across destinations, there would not be any gain from delaying entry into B and $W(\tau^B;F)$ would collapse to the unconditional expectation of profits in market B, as in $t=1$. The difference between these two values, which is the value of the real option, would then be zero. While we focus on the case of perfect correlation, it should be clear that as long as the correlation is positive, the value of the option remains strictly positive.

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:

$$\Psi^{Sm}(q_1^A, q_1^B; \tau^A, \tau^B) \equiv \int_{\underline{\mu}}^{\overline{\mu}} (\mu - \tau^A - q_1^A) q_1^A dG(\mu) + \int_{\underline{\mu}}^{\overline{\mu}} (\mu - \tau^B - q_1^B) q_1^B dG(\mu) + \max\left\{ \mathbf{1}_{\{q_1^A > 0\}}, \mathbf{1}_{\{q_1^B > 0\}} \right\} \left[V(\tau^A) + V(\tau^B) \right], \quad (5)$$

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 reveals information about the firm's export profitability in both markets, it is enough to have exported a positive amount in period 1 to either destination.

Maximization of (5) yields outputs

$$\widehat{q}_1^A(\tau^A) = \mathbf{1}_{\{E\mu > \tau^A\}} \left(\frac{E\mu - \tau^A}{2} \right) + \mathbf{1}_{\{E\mu \le \tau^A\}} \varepsilon, \quad (6)$$

$$\widehat{q}_1^B(\tau^B) = \mathbf{1}_{\{E\mu > \tau^B\}} \left(\frac{E\mu - \tau^B}{2} \right), \quad (7)$$

where $\varepsilon > 0$ is an arbitrarily small number. To understand these expressions, notice that there are three possibilities that depend on parameter values. If $E\mu > \tau^B$, $q_1^j = \frac{E\mu - \tau^j}{2}$ for $j = A, B$ is clearly optimal. If $\tau^B \ge E\mu > \tau^A$, $q_1^A = \frac{E\mu - \tau^A}{2}$ and $q_1^B = 0$ is the best choice. If $E\mu \le \tau^A$, setting $q_1^A = q_1^B = 0$ may appear optimal. However, inspection of (5) makes clear that a small but strictly positive $q_1^A = \varepsilon > 0$ dominates that option, since $\lim_{\varepsilon \to 0} \Psi^{Sm}(\varepsilon, 0; \tau^A, \tau^B) = V(\tau^A) + V(\tau^B) > 0$. Clearly, setting $q_1^A = q_1^B = 0$ forgoes the benefit from uncovering a valuable signal of the firm's export profitability.

Define $\Psi(\tau^j) \equiv \mathbf{1}_{\{E\mu > \tau^j\}} \left(\frac{E\mu - \tau^j}{2} \right)^2 + V(\tau^j)$. Evaluating (5) at the optimal output choices (6), (7) and (2), we obtain the firm's expected gross profit from simultaneous entry:

$$\Psi^{Sm}(\tau^A, \tau^B) \equiv \lim_{\varepsilon \to 0^+} \Psi^{Sm}(\widehat{q}_1^A(\tau^A), \widehat{q}_1^B(\tau^B); \tau^A, \tau^B) = \Psi(\tau^A) + \Psi(\tau^B). \quad (8)$$

iii) *Sequential entry.* At $t = 1$, a firm that enters only market A chooses q_1^A to maximize

$$\Psi^{Sq}(q_1^A; \tau^A, \tau^B) \equiv \int_{\underline{\mu}}^{\overline{\mu}} (\mu - \tau^A - q_1^A) q_1^A dG(\mu) + \mathbf{1}_{\{q_1^A > 0\}} \left[V(\tau^A) + W(\tau^B; F) \right], \quad (9)$$

where Sq stands for "sequential" entry. The firm learns its export profitability iff $q_1^A > 0$. A strictly positive quantity 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 $\widetilde{q}_1^A(\tau^A) = \widehat{q}_1^A(\tau^A)$, as in (6). Evaluating

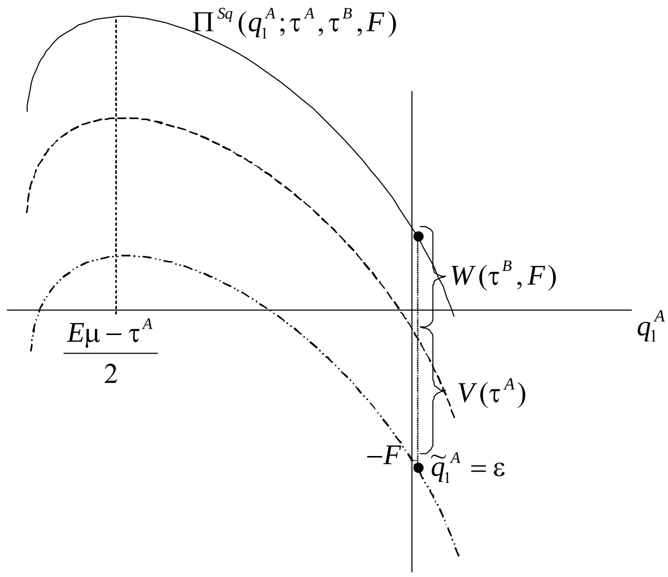

Figure 1: The Profit Function from Sequential Exporting when $E\mu < \tau^A$

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

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

We therefore have that some firms will "test" foreign markets before fully exploring them (or exiting them altogether). Interestingly, experimentation can arise even when the variable trade cost is large enough to render period-1 expected operational profits negative in all markets, 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 *might* 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 experimentation 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 this example, experimentation is worthy only because success in A is informative about success in B; otherwise the value of information would not be high enough to compensate for the sunk costs [i.e., $V(\tau^A) + W(\tau^B; F) > F > V(\tau^A)$].

2.2.3 Entry strategy

We can now fully characterize the firm's entry strategy. Using (8), the firm's net profit from simultaneous entry, Π^{Sm}, is

$$\Pi^{Sm} = \Psi(\tau^A) + \Psi(\tau^B) - 2F. \tag{11}$$

In turn, we have from (10) that the firm's net profit from sequential entry, Π^{Sq}, is

$$\Pi^{Sq} = \Psi(\tau^A) + W(\tau^B; F) - F. \tag{12}$$

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 (11) and (12), we can rewrite these conditions as follows. Simultaneous entry is optimal if

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

Notice that the right-hand side of the second inequality above is strictly greater than the right-hand side of the first inequality, since $W(\tau^B; F) > 0$, $\Psi(.)$ is a decreasing function 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

$$F < \Psi(\tau^B) - W(\tau^B; F). \tag{13}$$

In turn, sequential entry is optimal if

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

Inequalities (13) and (14) define the firm's entry strategy at $t = 1$. The firm enters market A at $t = 1$ if either (13) or (14) are satisfied; it enters market B at $t = 1$ if (13) is satisfied but (14) is not:

$$e_1^A(\tau^A, \tau^B) = 1 \Leftrightarrow F \leq \Psi(\tau^A) + W(\tau^B; F), \tag{15}$$

$$e_1^B(\tau^B) = 1 \Leftrightarrow F < \Psi(\tau^B) - W(\tau^B; F). \tag{16}$$

The condition for $e_1^B = 1$ is evidently stricter than the condition for $e_1^A = 1$. Condition (16) implies $e_1^B = 1$ (in which case simultaneous entry occurs) only if the sunk cost to export is sufficiently small. In Proposition 1 we show this and fully characterize the firm's export decision. The proof is in the Online Appendix (available at http://personal.lse.ac.uk/ornelas/acco_OnlineAppendix.pdf).

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.*

The intuition for these results 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, 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

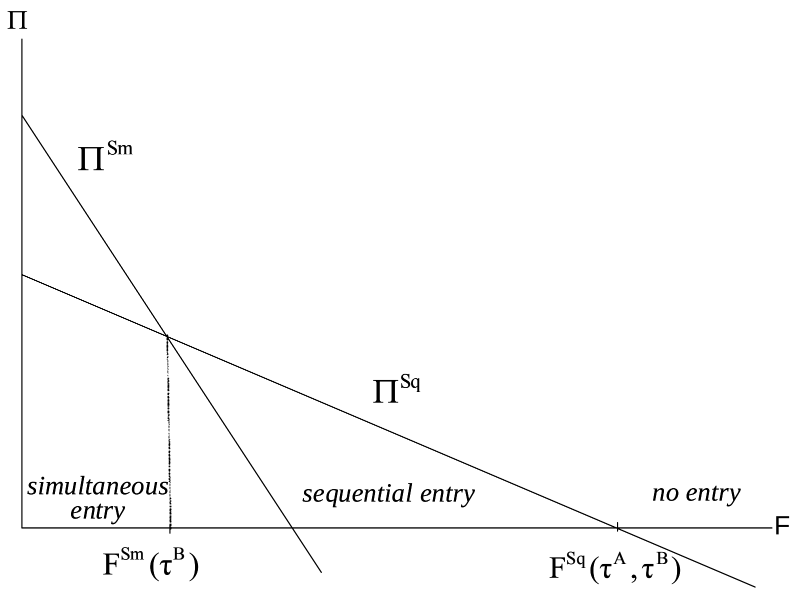

Figure 2: Optimal Entry Strategy ($E\mu > \tau^B$)

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 be optimal only when the firm expects its operational profit in B to be positive ($E\mu > \tau^B$). By postponing entry the firm forgoes that profit but saves the sunk entry cost if it realizes that its export 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. Since trade cost τ^B affects both thresholds but trade cost τ^A only affects F^{Sq}, we can denote the thresholds as $F^{Sq}(\tau^A, \tau^B)$ and $F^{Sm}(\tau^B)$.

Our analysis, as reflected in Figure 2, is for a single firm with a generic productivity level. But it is not difficult to see how the results would extend to firms with different levels of productivity. Essentially, varying productivity levels would shift the thresholds defining sequential and simultaneous entry in foreign markets. Higher productivity increases the expected profits from entering foreign markets simultaneously, as well as the expected profits from exporting at all. Hence the more productive a firm is, the higher its sunk cost thresholds will be, implying that more productive firms are more likely to export, and to start exporting simultaneously to multiple destinations. We show this formally in our Online Appendix.

2.3 Testable implications

Our model is parsimonious in many dimensions. For example, we assume that firms learn fully about their profitability in foreign market j by selling at market i, $i \neq j$. In reality, the correlation of export profitabilities across markets is surely less than perfect. However, if it is not negligible, the main messages of the model remain intact. The same is true about correlation of export profitabilities in a given market over time. Effectively, our running hypothesis is that firms extract the highest informational content from their first export experience. The implications of the model should be interpreted accordingly. Similarly, to derive explicit testable predictions, one would need to extend the model to $T > 2$ periods and $N > 2$ foreign countries. We show this formally in the Online Appendix. Since those proofs are conceptually rather straightforward, here we discuss only informally how they follow from our setup.

The model implies, 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. The reason is simple. Since export profitability is uncertain for a firm before it starts exporting, first-year exports are on average 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 indeed relatively high ($\mu > \tau^A$). Since the relevant distribution of μ becomes a truncation of the original one, conditional on survival firms on average expand sales in their first market. If the firm had entered that market just to learn about its export potential there (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 model abstracts from a range of shocks that are likely to affect firms' export volumes; we discuss and seek to control for them in our empirical analysis. We also adopt the strong assumption that a firm's export profitability is perfectly correlated across markets and time. If the correlation were positive but imperfect, it would imply strictly positive first-to-second year export growth in every market the firm expands to and survives. Accordingly, the hypothesis we test is that firms learn *more* about their export profitabilities in their first markets, so the early expansion of surviving firms is greater in their initial markets than in their subsequent markets.

The second implication of the model relates to entry patterns. Once a firm starts exporting, it will uncover its export profitability. Some new exporters will realize that their export profitabilities are sufficiently high and decide to expand in the next period to other markets where they anticipate positive profits. By contrast, experienced exporters have already learnt enough about their export profitability, and therefore have already made their entry decisions in the past.

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

The third implication of the model refers to the exit patterns of exporting firms. Because an experienced exporter is better informed about its own export profitability than a new exporter, the latter is more likely than the former to find out that it is not worthwhile to keep serving a market. Critically, the model implies that this is also true when comparing firms that have just entered a given foreign destination, but when this is the first foreign market for one firm and not for the other. Generally, while many (un-modeled) factors can cause a firm to abandon a foreign destination, the model shows that being a new exporter creates an additional motivation to do so, in expected terms.

The model also has implications for the dynamic behavior of different types of exporters. First, it implies that the behavior of *simultaneous exporters*—firms that start exporting to more than one destination—should be different from the behavior of the (more prevalent) strict sequential exporters. The model indicates that, if a firm is willing to pay the sunk costs to start its foreign operations in multiple markets simultaneously, it must be because it is rather optimistic about its export profitability (i.e. $E\mu$ must be large relative to τ^B and to F). This implies less volatility (i.e. exiting less frequently and expanding less vigorously) in the behavior of simultaneous exporters relative to the firms that break in a single foreign destination.

Second, some seemingly new exporters are actually *re-entrants*. These are firms that did not export at $t-1$ but did so before $t-1$ and exported again at t. While the model does not explain the behavior of re-entrant exporters, an extension that allows for firm-country temporary shocks would readily do so. But if self-discovery is indeed an important force shaping the dynamic behavior of firms in foreign markets (and barring problems with "short memory"), the effect of being "new" should not be as strong for returning exporters upon re-entry as it is for ("true") new exporters, since they already have a reliable signal of (the permanent component of) their export profitabilities.

Third, uncertainty about producer-specific export profitability is likely to be greater for differentiated products than for *homogeneous goods*, which tend to have a well-defined reference price and whose export procedures are likely to be more standardized. Accordingly, the distinction between the behavior of new and old exporters should be more pronounced for the foreign sales of differentiated products than of homogeneous goods.

3 Evidence

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

3.1 Data

Our data comes from the Argentine Customs Office. We observe the annual value (in US dollars) of the foreign sales of each Argentine manufacturing exporter between 2002 and 2007, distinguished by country of destination.

Over our sample period, Argentine manufacturing exports involved 15,301 exporters and 130 foreign destinations. It grew by 220% between 2002 and 2007, after the steep currency depreciation in early 2002. However, as Table 1 reveals, export growth was similar in most industries. The only relevant change in the export structure was an increase in Petroleum's relative share (from 23% in 2002 to 30% in 2007) at the expense of the Automotive and Transport industry's (17% to 13%).

Table 1: Argentinean Manufacturing Exports by Industry

Industry	**Exports*** 2002	**Exports*** 2007	**Growth** (%)	**Share** 2002	**Share** 2007
Food, Tobacco and Beverages	4979	10884	119	23	23
Petroleum	4967	13863	179	23	30
Chemicals	1514	3466	129	7	7
Rubber and Plastics	928	1845	99	4	4
Leather and Footwear	829	1144	38	4	2
Wood Products, Pulp and Paper Products	506	998	97	2	2
Textiles and Clothing	533	775	45	2	2
Metal Products, except Machinery	2102	4092	95	10	9
Machinery and Equipment	1127	3137	178	5	7
Automotive and Transport Equipment	3492	5894	69	16	13
Electrical Machinery	385	426	11	2	1
Total Manufacturing	20837	45773	120	100	100

* Million USD

The distribution of export destinations has changed somewhat more significantly during the sample period. Let us group Argentina's export destinations in nine relatively homogenous regions: Mercosur, Chile-Bolivia (Argentina's neighbors that are not Mercosur members), Other South America, Central America-Mexico, North America, Spain-Italy (Argentina's main historical migration sources), EU-27 except Spain-Italy, China, and Rest of the World. Table 2 shows a growing importance of Mercosur after 2003 (receiving 35% of all Argentine exports in 2007) and a decline in the participation of Chile-Bolivia, from 17% in 2002 to 10% in 2007. Starting from a low level, the importance of China has increased significantly, more than doubling its share of Argentine exports during our sample period, to 7%. Meanwhile North America, other Latin American markets and the European Union have become relatively less important as destinations for Argentine exports.

Table 2: Argentinean Manufacturing Exports by Region (% of total value)

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

Table 3 shows how relatively important each of those regions are as first foreign market for Argentine manufacturers. It displays the share of Argentine exporters that each region receives, in general (columns DS) and among new exporters (columns FMS). The ratio FMS/DS is a proxy for the relative importance of the region as a “testing ground” for Argentine exporters. If it is greater than one, it suggests the region is relatively attractive as a “testing ground.” The table indicates that this is the case for Spain-Italy, Mercosur, North America, Chile-Bolivia and, recently, China.

Table 3: Argentinean Manufacturing First Markets by Region (%)

Region	2003			2007		
	FMS	DS	FMS/DS	FMS	DS	FMS/DS
Mercosur	29	24	1.23	36	25	1.44
Chile-Bolivia	20	16	1.26	17	14	1.20
North America	12	9	1.39	9	7	1.32
Spain-Italy	11	7	1.71	8	5	1.45
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	1.52

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.

Table 4 reveals interesting features of different types of exporters. First, new exporters, which constitute the focus of our analysis, are quite common in our sample. Defining new exporters as 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 $t+1$), they represent on average 24% of all exporters in a year. Second, many new exporters are single-year (38% on average) and their share rises over time, reaching 47% of all new exporters in 2006. 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.

This highlights how different new exporters are relative to experienced exporters. Such differences are not specific to Argentina; in fact, they echo the regularities observed by other authors in different countries (e.g. Araujo et al. 2012 for Belgium, Eaton et al. 2008 for Colombia, Buono et al. 2008 for France, Lawless 2009 for Ireland). However, none of those authors distinguish between the behavior of exporters in their first and their subsequent foreign markets. As Table 5 illustrates, this distinction is very important.

Table 5 reports 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 exporting elsewhere (“New Market 2003”). To keep the comparison focused, we also look at the sales of the firms from the first group that expand to other markets in 2004 (“Second Market 2004”). The table displays each group’s average export

Table 4: 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 $t-1$, 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 $t+1$. "Single-Year" exporters are firms that exported in t but neither in $t-1$ nor in $t+1$.

Table 5: Firm-level export growth, First Market versus New Market

Year	First Market 2003		Second Market 2004		New Market 2003	
	USD	Growth (%)	USD	Growth (%)	USD	Growth (%)
2003	35465				96541	
2004	102718	190	33831		200799	108
2005	139439	36	69100	104	304295	52
2006	163864	18	87036	26	340015	12
2007	216865	32	95835	10	449147	32

value by year. The average firm from all groups increases exports in every period, especially from its first to its second year in a market. Yet the feature of the table that really stands out is the markedly higher initial growth of the new exporters in their first market (190%), relative both to the initial growth of experienced exporters entering new markets (108%) and to the initial growth of the same firms but in the markets they enter later (104%). As we will show, this distinction is also important at the extensive margin, and remains very salient in the data after controlling for firm heterogeneity, country-year specific shocks and other effects.

Finally, we note that most (79%) new exporters start serving a single foreign market. Around 15% of them enter initially in two or three foreign countries, and 6% start with more than three destinations. On average, exporting firms serve three distinct foreign markets, although around 40% of the exporting firms serve only one market outside Argentina.[9]

3.2 Intensive margin export growth

Our model predicts that, conditional on survival, the growth of a firm's exports is on average highest early in its first foreign market:

Prediction 1 *Conditional on survival, the growth rate of exports to a market is on average higher between the first and second periods in the first foreign market served by the firm than in subsequent markets or later in the firm's first market.*

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 is the firm's first export market. Prediction 1 suggests that $\alpha_1 > 0$. Parameter α_1 indicates whether the growth of continuing exporters is different for fledgling exporters. We also include FM_{ij} and $FY_{ij,t-1}$ by themselves, because there could be other 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, respectively.[10]

Of course, many other factors affect a firm's export growth to a market, such as the general conditions of the destination country, its current economic situation, and the firm's own distinguishing characteristics. To account for those factors, we include a wide range of fixed effects, denoted by

[9] In the Online Appendix we also present a more standard "transition matrix," like the one in Eaton et al. (2008), where we show the empirical distribution of firms entering in and going out of different markets.

[10] Our interest is on the interaction between FM_{ij} and $FY_{ij,t-1}$, but to identify its effect correctly we also need to include each term separately. The coefficient on $FY_{ij,t-1}$ could be significant on top of the interaction for several reasons. For example, firms may start exporting throughout the calendar year, causing the coefficient of $FY_{ij,t-1}$ to be positive because of a simple accounting feature. Similarly, there may be confounding forces that imply a consistently higher or lower intensive margin growth in firms' first markets, so we also want to control for FM_{ij} in our analysis.

$\{FE\}$. They include year, destination—or alternatively, year-destination—and firm fixed effects.[11] Firm fixed effects control for all systematic differences across firms that do not change over time and affect export growth (firm-specific export growth trends). Destination fixed effects subsume all time-invariant characteristics of markets, including standard "gravity" variables often used in empirical trade analyses such as distance from, contiguity to, and same language or legal origin as Argentina. Year-destination fixed effects further control for aggregate shocks that affect the general attractiveness of a market—aggregate demand growth, exchange rate variations, political changes etc. In these and all subsequent regressions, our standard errors allow for clusters in firms.

Importantly, the sample used in this regression 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—and all results are conditional on survival. In this sense, selection is not an issue here.

Table 6 displays the results. Results with different sets of fixed effects are presented in columns 1-4. The coefficients of FM_{ij} and $FY_{ij,t-1}$ suggest 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 market-specific uncertainty (as in Eaton et al. 2010 and Freund and Pierola 2010), or perhaps the building of reputations within business relationships.[12] It also reflects a simple accounting phenomenon: since firms enter markets throughout the year, initial exports appear artificially low in the first year whenever the data are on an annual basis, as here.[13]

Our central finding is that the coefficient associated with the interaction $FY_{ij,t-1} \times FM_{ij}$ is positive and significant in all specifications that include firm fixed effects.[14] Being a new exporter is associated with higher growth over and above the growth of firms in their first year of serving a particular market, or in their initial market. This additional growth component can be explained neither by market-specific uncertainty nor by the above mentioned accounting phenomenon (which applies equally to all markets in a firm's export history).

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 effect jumps to

[11]Naturally, results are likely to be different across industries. Sector fixed effects could be used to control for sector-specific idiosyncrasies. Note, however, that in our sample each firm belongs to a single sector. Hence sector fixed effects would be perfectly collinear with, and therefore controlled for, by the firm fixed effects.

[12]Rauch and Watson (2003) argue that exporters to a market "start small" and are only able to expand once their foreign partners are convinced of their reliability. Araujo et al. (2012) point out that evolving trust levels within partnerships substitute for weak cross-border contract enforcement, implying that export volumes increase over time, conditional on survival, especially to countries with relatively weak institutions.

[13]In the Online Appendix we also show results without destination and year-destination fixed effects but including standard gravity controls, for this and for the other two predictions. Results for our main variables are qualitatively unchanged. And even though ours are not traditional gravity regressions, the gravity controls generally display their usual signs. There are important exceptions, however. For example, the coefficient of GDP is not significant in the intensive margin growth regression, positive but significant only at the 10% level in the entry regression, and significant but positive in the exit regression. This points to potential differences between the forces that shape aggregate trade flows and those that affect the dynamics of exporting firms.

[14]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 tend to enter more markets, washing out the differential first-market effect when the firms' average export growth is not accounted for.

Table 6: Intensive Margin Growth (Dependent Variable: $\Delta \log X_{ijt}$)

OLS	1	2	3	4	5	6
$FY_{ij,t-1} \times FM_{ij}$	-.032	.141**	.098**	.095**	.165**	.171**
	(.028)	(.036)	(.036)	(.036)	(.057)	(.036)
FM_{ij}	.025	-.013	-.009	-.008	-.034	-.069*
	(.018)	(.038)	(.039)	(.038)	(.06)	(.036)
$FY_{ij,t-1}$	.263**	.238**	.233**	.233**	.242**	.237**
	(.014)	(.016)	(.016)	(.016)	(.025)	(.016)
$\log X_{i,t-1}$						-.001**
						(.0001)
Firm FE		yes	yes	yes	yes	yes
Year FE			yes			
Destination FE			yes			
Year-Destination FE				yes	yes	yes
Credit-constrained sectors					no	
Number of obs	107390	107390	107390	107390	43258	107390
R-squared	.01	.09	.10	.10	.10	.10

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

33 percentage points if the market is the firm's first.

It is plausible that this result may be driven by credit constraints, which are likely to affect new exporters more than experienced exporters, since the latter tend to have access to greater retained earnings. To account for the role of credit constraints, we would ideally use credit constraint information at the firm level. Since that information is unavailable to us, we borrow Manova's (2011) 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 results are significantly different in the subsample of credit unconstrained firms. Column 5 shows the results. The coefficient on $FY_{ij,t-1} \times FM_{ij}$ remains highly significant and is in fact larger, suggesting that credit constraints actually *limit* the magnitude of the early expansion of new exporters in their first markets.

A common view in the literature is that firms start exporting after experiencing positive persistent idiosyncratic productivity shocks (e.g. Arkolakis 2011, Irrarazabal and Opromolla 2011). 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 to include the firm's lagged aggregate export level (in millions). Column 6 shows that, when doing so, the effect of $FY_{ij,t-1} \times FM_{ij}$ on export growth remains positive and significant. It is also considerably higher than in the equivalent specification without the control for lagged exports (column 4). Furthermore, summing the coefficients of $FY_{ij,t-1} \times FM_{ij}$, $FY_{ij,t-1}$ and FM_{ij} in columns 4 and 6, we find that the growth differential between old and new exporters is hardly affected by size controls (about 33 percentage points in both cases).

3.3 Entry

Our model also predicts that new exporters are more likely to enter new foreign destinations:

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

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 value 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. When $Entry_{irt} = 1$, that firm-destination pair ir leaves the sample from $t+1$ onwards. The sample consists of all firms that export for at least 2 years.

Entry in a specific country, in a specific year, is a rather rare event for any firm. Thus, to make the analysis more meaningful we focus on entry in the nine regions defined in subsection 3.1.[15] As we discuss below, we obtain qualitatively similar results when using the total number of national markets served by a firm.

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

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

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. Coefficient β_1 indicates whether fledgling exporters are more or less likely to enter new destinations than experienced exporters.

Results with different sets of fixed effects are presented in columns 1-3 of Table 7. $FY_{i,t-1}$ has a positive and highly significant coefficient in all three 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 rare 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.

Again, this may be explainable by credit constraints. For example, if firms face liquidity constraints at entry, 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. Employing a panel of bilateral exports at the industry level, Manova (2011) finds that credit constraints are important determinants of export participation. Similarly, 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

[15] We experimented with alternative groupings of destinations; they yield qualitatively equivalent results. Similarly, notice also that our grouping of countries in regions implies that when a firm enters a new country in a region r that it already serves, this is not coded as entry. Considering entry/non-entry within the region does not make an important difference to the results either.

exporter, we need to check whether they are driving our results. In column 4 we exclude the firms in the sectors more likely to be credit constrained using Manova's measure. Results are unchanged.

Table 7: Probability of Exporting to a New Market

Dependent Variable:	$Entry_{irt}$	$Entry_{irt}$	$Entry_{irt}$	$Entry_{irt}$	$Entry_{irt}$	$Entry_{irt}$	$Entry_{irt}$	$D(ND)_{it}$
LPM	1	2	3	4	5	6	7	8
$FY_{i,t-1}$	.008**	.015**	.009**	.009**	.009**	.009**	.006**	.048**
	(.001)	(.002)	(.002)	(.002)	(.004)	(.002)	(.002)	(.010)
$\log X_{i,t-1}$						-.001*		
						(.0001)		
$\Delta logX_{i,-r,t}$							.006**	.052**
							(.001)	(.003)
$\Delta logX_{i,-r,t} \times FY_{i,t-1}$							-.005**	-.043**
							(.002)	(.008)
$NArgExp_{kr,t-1}$					.095**			
					(.009)			
$\Delta logXArgExp_{krt}$					.004**			
					(.001)			
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	yes
Year FE								yes
Year-Destination FE			yes	yes	yes	yes	yes	
Credit-constrained sectors				no				
Number of obs	235693	235693	235693	87892	227769	235693	220335	29760
R-squared	.0002	.08	.09	.09	.10	.09	.10	.32

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

Another possibility is that FY is just picking up the effects of within-industry learning, as for example in Hausmann and Rodrik (2003) or Krautheim (2011). That is, firms may use the entry of domestic rivals in foreign markets as a signal of their own odds of success as exporters.[16] To consider this possibility, we estimate the following expanded specification of our entry regression:

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

where $NArgExp_{kr,t-1}$ is the number of Argentine exporters (measured in thousands) 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. Column 5 displays the results. Consistently with within-industry learning effects, the number and the growth

[16] The idea of learning from the experience of others in foreign markets extends also to the product extensive margin (Iacovone and Javorcik 2010), as well as to decisions beyond exporting, such as foreign direct investments (Lin and Saggi 1999).

rates of domestic competitors in a given destination help to explain entry there. Nevertheless, the result that a new exporter is more likely to enter a new destination than an experienced exporter remains unchanged.

Now, although we control for time-invariant unobserved heterogeneity by using firm fixed effects, it could be that firms' extensive margin expansion in their early years as exporters simply reflects positive idiosyncratic productivity shocks that induced them to start exporting in the first place. As before, we can control for persistent shocks by including the firm's lagged export level. As shown in column 6, the effect of $FY_{i,t-1}$ withstands this control. Moreover, since idiosyncratic productivity shocks would induce expansion at both intensive and extensive margins, we can also control for them by introducing intensive margin export growth (in the current destinations), by itself and interacted with our indicator for new exporters, $FY_{i,t-1}$:

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

The results are displayed in column 7. The coefficient of $FY_{i,t-1}$ remains positive and significant. But we want to check whether being a new exporter matters for subsequent entry 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 column 8 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 treating all destinations equally. On the other hand, it considers entry in each of the 130 individual markets in the sample. We find that new exporters are 4.8 percentage points more likely to expand the number of markets they serve than experienced ones. This is near a fifth of the overall (unconstrained) probability that a surviving exporter will expand the number of destinations it serves, 22%. As we also include intensive-margin growth in the regression, the point estimates indicate that a new exporter growing at rate g is 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 easily satisfied.

Now, although a full exploration of the characteristics that link export markets is beyond the scope of this paper, we offer here a preliminary inspection of the patterns of sequential exporting firms. Specifically, we ask whether the markets to which a firm subsequently exports are related to the markets the firm exported initially in systematic ways. We test this possibility by interacting the variable FY with dummies for common border, common language and similar income per capita. Importantly, like in Morales et al. (2011), the dummies are not with respect to the country of origin (Argentina), but relative to the firm's initial export destination. That is, we are interested in the effects of the extended gravity on export entry. Additional details are provided in the Online

Appendix.

Table 8 displays the result. They show that Prediction 2 holds strongly, but only for regions connected by a border or by similar per capita incomes to the initial export destination of a firm. This result is related to but distinct from the finding of Lawless (2011), that an exporting firm is more likely to serve new export destinations that are near or contiguous to the firm's current markets, since our focus is on the differential export pattern of fledgling exporters.

Table 8: Probability of Exporting to a New Market and Extended Gravity

Dependent Variable:	$Entry_{irt}$	$Entry_{irt}$	$Entry_{irt}$
LPM	(1)	(2)	(3)
$FY_{i,t-1}$	0.002	-0.001	-0.006*
	(0.002)	(0.002)	(0.002)
$FY_{i,t-1} \times ExtendedBorder_{r,-r}$	0.032**	0.034**	0.031**
	(0.005)	(0.005)	(0.005)
$FY_{i,t-1} \times ExtendedLanguage_{r,-r}$	0.002	0.002	0.007*
	(0.003)	(0.003)	(0.003)
$FY_{i,t-1} \times$ *Extended PC Income Group*$_{r,-r}$	0.009*	0.017**	0.012**
	(0.004)	(0.004)	(0.004)
Extended Border$_{r,-r}$	0.009**	0.002**	0.002
	(0.002)	(0.002)	(0.002)
Extended Language$_{r,-r}$	0.009**	0.019**	0.009**
	(0.001)	(0.001)	(0.002)
Extended PC Income Group$_{r,-r}$	0.021**	0.010**	0.019**
	(0.002)	(0.002)	(0.002)
Firm FE		yes	yes
Year-Destination FE			yes
Number of obs	235,693	235,693	235,693
R-squared	0.01	0.09	0.10

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

Robust standard errors adjusted for clusters in firms.

3.4 Exit

We turn now to the exit patterns of 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 *New exporters are more likely to exit than experienced exporters, including those that are new in a market but have export experience elsewhere.*

To test this prediction, we estimate the following equation:

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

Coefficient γ_1 indicates whether the exit behavior of fledgling exporters is different from the behavior of older exporters. 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 we want to identify 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). But as we show in the next subsection, the behavior of those types of exporters is very different. Since firm fixed effects are not appropriate, we include instead sector fixed effects, to control for industry characteristics that may be associated with the frequency and volume of firm's foreign shipments but that are unrelated to the mechanism we propose.

Table 9 shows the results. Observe first that, in all estimations without firm fixed effects (columns 1-3 and 6-7), 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 a firm's first market and in its early periods of operation in a market. More importantly, the coefficient of the interaction $FY_{ij,t-1} \times FM_{ij}$ is also 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 29 percentage points relative to an exporter with experience and in a market other than its first, by 15 percentage points relative to an experienced exporter operating in its first foreign market, and 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 7% of exiting a market in a certain year.

Table 9: Probability of Exit (Dependent Variable: $Exit_{ijt}$)

LPM	1	2	3	4	5	6	7
$FY_{ij,t-1} \times FM_{ij}$	.122**	.121**	.125**	-.199**	-.197**	.123**	.137**
	(.004)	(.006)	(.006)	(.003)	(.003)	(.008)	(.004)
FM_{ij}	.154**	.149**	.138**	-.015**	-.017**	.133**	.125**
	(.003)	(.004)	(.004)	(.003)	(.003)	(.006)	(.006)
$FY_{ij,t-1}$	.017**	.015**	.025**	-.011**	-.013**	.021**	.025**
	(.001)	(.001)	(.001)	(.001)	(.001)	(.002)	(.001)
$\log X_{i,t-1}$							-.002**
							(.0002)
Firm FE				yes	yes		
Sector FE		yes	yes			yes	yes
Year-Destination FE			yes		yes	yes	yes
Credit-constrained sectors						no	
Number of obs	119610	119610	119610	119610	119610	71349	119610
R-squared	.13	.14	.15	.69	.70	.15	.15

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

Once firm fixed effects are introduced (columns 4 and 5), the sign of the interaction (and of $FY_{ij,t-1}$) shifts to negative. This shows that the exit patterns of firms that re-start to export or start exporting in more than one market simultaneously are indeed 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.

In column 6 we exclude firms from sectors likely to be credit constrained. Estimates are virtually unchanged from those in columns 1-3. In column 7 we control for firms' lagged export levels, since low sales in a year may suggest a low expectation of survival. This is indeed what we find. There is however little change in the coefficient of $FY_{ij,t-1} \times FM_{ij}$. If we interpret a firm's lagged export levels as a proxy for firm size previous to entry, the results in column 7 imply a *conditional* hazard rate decreasing in export tenure.

3.5 Re-entrants, Simultaneous Exporters, Homogeneous Products

As discussed in the previous section, we expect the differential effect between new and old exporters to be less pronounced for firms that are re-starting to export (and therefore are not really "new" exporters), for those that start selling to multiple foreign markets (which according to our model should be more optimistic about their export profitability), and for those that sell homogeneous goods (and are likely to face less uncertainty ex ante).

Since we cannot spot all re-entrants (i.e. some firms that we identify as "true" new exporters may have exported before 2002, the first year of our sample), in the previous regressions we treat all firms that export at t but not at $t-1$ as new exporters.[17] But we can also test explicitly for differential effects between "true" new exporters and the firms that we can identify as re-entrants. To do so, we re-run the main regressions on intensive margin (with firm and year-destination fixed effects), entry (with firm and year-destination fixed effects) and exit (with sector and year-destination fixed effects) restricting the sample to those firms that we can identify as re-entrants. We also run the main regressions restricting the sample to the firms that start to export in more than one country. Further, we run the regressions again by restricting the sample to homogeneous products; we follow Rauch's (1999) "conservative" classification to define a good as homogeneous. Finally, we re-run the regressions excluding all the observations included in the previous "special" samples. We denote the firms in that sample by "SqExp." 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.

Table 10 displays the results for the intensive margin growth. First year-first market growth is not especially higher for any of the three special groups, but it is for the SqExp firms. Simultaneous and homogeneous goods exporters do grow faster early in a market, but this growth is not different in the first market relative to subsequent markets.

Table 11 shows the results for the entry regressions. Only the SqExp firms display a distin-

[17] Observations associated with the activities of identified re-entrants range from 2% to 6% of the observations in the different samples.

Table 10: Intensive Margin Growth (Dependent Variable: $\Delta \log X_{ijt}$)

	Re-entrants	Simultaneous	Homogenous	SqExp
$FY_{ij,t-1} \times FM_{ij}$	.136	.034	-.008	.214**
	(.168)	(.091)	(.155)	(.051)
FM_{ij}	-.405**	-.029	.088	.017
	(.140)	(.069)	(.155)	(.051)
$FY_{ij,t-1}$	-.031	.249**	.352**	.226**
	(.154)	(.075)	(.049)	(.017)
Firm FE	yes	yes	yes	yes
Year-Destination FE	yes	yes	yes	yes
Number of obs	5029	9220	9226	87202
R-squared	.436	.285	.118	.009

**: significant at 1%; *: significant at 5%
Robust standard errors adjusted for clusters in firms.
'Re-entrants' are firms that export in year t, having exported also previously to $t-1$ but not in $t-1$.
'Simultaneous' are firms that sell to more than one foreign destination in their first year of exporting.
'Homogenous' are firms that sell homogenous goods according to Rauch's (1999) classification.
'SqExp' encompasses the firms not included in the other categories.

guishably higher probability of entering a different region right after its first year as exporter.

Table 11: Probability of Exporting to a New Market (Dependent Variable: $Entry_{irt}$)

	Re-entrants	Simultaneous	Homogenous	SqExp
$FY_{i,t-1}$	-.061*	.001	.012	.012**
	(.031)	(.007)	(.008)	(.002)
Firm FE	yes	yes	yes	yes
Year-Destination FE	yes	yes	yes	yes
Number of obs	6884	21564	13844	196389
R-squared	.17	.15	.08	.09

**: significant at 1%; *: significant at 5%
Robust standard errors adjusted for clusters in firms.
'Re-entrants' are firms that export in year t, having exported also previously to $t-1$ but not in $t-1$.
'Simultaneous' are firms that sell to more than one foreign destination in their first year of exporting.
'Homogenous' are firms that sell homogenous goods according to Rauch's (1999) classification.
'SqExp' encompasses the firms not included in the other categories.

Table 12 presents the exit regressions. First year-first market exit rates are especially high for the SqExp firms and also for producers of homogeneous goods; the effect is however twice as large for the former. For simultaneous exporters, the interaction term is also positive and significant. However, the coefficients of FM and FY are themselves negative and significant, and of a magnitude similar to the coefficient of the interaction term. Thus, for firms in their first market, the additional effect on exit rates from being in the first year is given by the sum of the coefficients on FY and $FM \times FY$, which is indistinguishable from zero. The same is true for the additional effect from being in the first market for firms that are new in a market.

In sum, re-entrants are neither more likely to grow if they survive, nor more likely to exit right

Table 12: Probability of Exit (Dependent Variable: $Exit_{ijt}$)

	Re-entrants	Simultaneous	Homogenous	SqExp
$FY_{ij,t-1} \times FM_{ij}$	.032	.233**	.123**	.247**
	(.106)	(.042)	(.017)	(.007))
FM_{ij}	-.125	-.217**	.124**	.138**
	(.108)	(.045)	(.024)	(.005)
$FY_{ij,t-1}$	-.101	-.239**	.010**	.022**
	(.107)	(.043)	(.004)	(.001)
Sector FE	yes	yes	yes	yes
Year-Destination FE	yes	yes	yes	yes
Number of obs	1849	7014	9637	102731
R-squared	.16	.07	.16	.19

**: significant at 1%; *: significant at 5%
Robust standard errors adjusted for clusters in firms.
'Re-entrants' are firms that export in year t, having exported also previously to $t-1$ but not in $t-1$.
'Simultaneous' are firms that sell to more than one foreign destination in their first year of exporting.
'Homogenous' are firms that sell homogenous goods according to Rauch's (1999) classification.
'SqExp' encompasses the firms not included in the other categories.

after re-entering their first market, than later in their export experience. Neither are they more likely to expand to different regions right after re-starting foreign sales than later. Being new does not matter for the dynamic pattern of firms that start selling in multiple markets either. The same is true for producers of homogeneous goods except for their exit rates, which are higher upon entry than later in their export experience. This differential effect for new exporters of homogeneous products is nevertheless not as high as it is for the SqExp group of firms.[18]

3.6 Other robustness checks

We have also run additional regressions to check whether the results we obtain are driven by some omitted variable correlated with FM or FY. These are as follows. (i) We exclude exports of "samples," defined as yearly transactions of less than \$1000, to see whether our results are driven by very small exporters.[19] (ii) We re-define "initial experience" more liberally, setting $FY = 1$ for the first two years of exporting. (iii) We employ different adjustments of robust standard errors, like clustering in destinations and firm-destinations. (iv) We use lagged exports to the same destination ($X_{ij,t-1}$) instead of lagged total exports ($X_{i,t-1}$) to control for size in the growth and exit regressions. None of the results from those alternative specifications change our main messages in an important way. We also test whether experience in the second year is relevant. We find that the coefficients associated with $FY_{ij,t-2} \times FM_{ij}$, for the intensive margin and exit, or $FY_{i,t-2}$, for entry, are either insignificant or considerably smaller than the equivalent for the first year. This

[18] An alternative way to check for the differential effects is to interact dummy variables for each subsample with our key covariates in the growth, entry and exit regressions. This permits a comparison of the strength of sequential exporting behavior in each group relative to the reference group of all experienced exporters. The results from this exercise are, on the whole, similar to those reported here. They are available in a previous working paper version of this article (Albornoz et al. 2010, section 3.3).

[19] We also try \$2000 and \$3000 as alternative thresholds.

suggests that learning takes place mostly in the first year. These robustness checks are unreported to save space but available upon request.

3.7 Alternative mechanisms

Our empirical analysis strongly supports the qualitative predictions from our model. The plausibility of the mechanism is also in harmony with case study evidence on firms starting to export. While there are (obviously) other forces that shape the dynamic behavior of exporting firms, we are unaware of alternative theoretical models that could deliver this set of predictions without adopting the key element of our mechanism, namely export profitabilities at the firm level that are ex ante uncertain but correlated over time and across destinations.

There are forces that could explain some of the empirical findings we uncover. The difficulty is in finding a single mechanism that generates the dynamic patterns in *all* the three margins we explore. Consider for example that not uncertainty, but binding capacity constraints are the key behind the empirical findings we obtain. If a firm faced binding capacity constraints as it entered foreign markets, but capacity could be expanded disproportionately within a year, intensive-margin growth and the probability of expansion to other markets would indeed be disproportionately high in the second year. However, high early exit would remain puzzling, as survival should not depend on (sunk) capacity-building costs. Likewise, a "learning-by-exporting" process by which an exporter's productivity improves with exposure to foreign competition would be compatible with high early intensive-margin growth, provided that most learning takes place in the initial period of foreign activities. A learning-by-exporting process is, however, also difficult to reconcile with our findings about high early exit.[20]

Similarly, the firm fixed effects that we use in the intensive margin and entry regressions imply that there is more to the dynamics of new exporters than deterministic productivity differences in level or trend, although they cannot account for idiosyncratic firm productivity shocks. We attempt to control for time-varying idiosyncratic shocks by adding firms' lagged export volumes and lagged export growth. Still, it is arguable that these proxies do not capture time-varying, firm-specific shocks fully. If so, the portion of the autocorrelated productivity shocks not captured by our proxies might explain why intensive-margin growth and the probability of entry in new destinations are especially high in the early periods of exporting. However, as Ruhl and Willis (2008) point out, models with sunk export costs and persistent TFP shocks predict that the hazard rate out of exporting *increases* with export tenure, as serially correlated shocks die out over time. We find that the opposite is true, when firms break into a new foreign market[21] and especially in their first export destinations.[22]

[20] Since the evidence on learning from exporting indicates that, if it exists, it is likely to be specific to the destination market (see the survey by Wagner 2007), such a mechanism would also be unable to explain why fledgling exporters are more likely to enter new markets than experienced exporters.

[21] As in previous studies focusing on the hazard rates out of exporting, such as Besedes and Prusa (2006).

[22] Recent stochastic models of export dynamics without sunk export costs, such as Arkolakis (2011) or Irrarazabal and Opromolla (2009), fail to generate some of our empirical findings, too. In particular, in those models the growth rate and the hazard rate need not decrease with age, once size is controlled for.

Still, these findings would not be inconsistent with stochastic productivity advances, as Arkolakis and Papageorgiou (2010) show in current work in progress. Their goal is to explain how age, conditional on size, affects firm dynamics in a closed economy. They allow TFP to follow a first-order Markov process, but firms can uncover their demand parameter only by producing, as in Jovanovic (1982). This assumption is crucial to generate growth and exit hazard rates that decline with age, controlling for size. In a multi-market setting like ours, it would be tantamount to assuming that a firm has to export to gauge its export profitability, as we consider.

Another possibility is that firms develop "global reputations." This could be studied, for example, in a framework that extends partnership models like Rauch and Watson's (2003) or Araujo et al. (2012) to a multi-market context. The key element would be that exporters' activities across markets need to become public information to all distributors globally. If this process took place within a short period of time after the first export incursion, then such a model could probably deliver empirical regularities similar to the ones we obtain. If, however, global reputation took longer to build than a single year, this would not be the main force driving our empirical findings.

4 Conclusion

Using data on Argentine exports at the firm-destination-year level, we find that, entry sunk costs notwithstanding, many of the firms that start exporting drop out of the export business very shortly. By contrast, the successful ones grow at both the intensive and the extensive margins. We refer to this empirical pattern as "sequential exporting." This pattern is either weaker or unobserved, however, when firms re-start exporting after a break, or among firms that start exporting simultaneously to multiple markets, or among exporters of homogeneous goods.

While rich in other dimensions, recent trade models based on selection due to heterogeneity in productivity and export sunk costs are often ill-equipped to address these dynamic patterns. Here we argue that export profit idiosyncratic uncertainty and the role of self-discovery are also key ingredients to firms' export dynamics.[23] We develop what is perhaps the simplest model that can address the implications of this mechanism. A firm discovers its profitability as an exporter only after exporting takes place. The firm conditions the decision to serve other destinations on this information. Since breaking into new markets entails unrecoverable costs and export profitability has global scope, the firm has an incentive to enter foreign destinations sequentially. For example, nearby countries may serve as "testing grounds" for future expansions to larger or distant markets.

Sequential exporting strategies could help to rationalize some empirical findings from the trade literature, such as the greater sensitivity of trade flows to trade costs at the extensive relative to the intensive margin (Bernard et al. 2007, Mayer and Ottaviano 2007). Similarly, the sequential exporting process hints that the gains from trade may extend well beyond the static gains typically emphasized in the literature. However, a more general theoretical structure would be required for a thorough evaluation of the implications of sequential exporting.

[23] A step towards integrating some of our insights within a heterogeneous productivity framework has been undertaken by Arkolakis and Papageorgiou (2010) in current work in progress.

Another area where understanding firms' sequential exporting strategies can be far-reaching is trade policy. Our findings hint at the existence of a trade *externality*—i.e. lower trade barriers in a country can induce entry of foreign firms in other markets. The intuition is as follows. The lower tariffs will induce some foreign firms to start exporting. As these new exporters learn about their ability to serve foreign markets, some will be very successful and decide to expand to other foreign destinations. As a result, trade liberalization in a country can promote entry not only in that market but also in *third* markets, albeit with a lag. Trade liberalization could lead to entry in third markets even in the short run, if it raises the value of "export experimentation" for some foreign firms. For the same reason, the impact of trade agreements, at both the regional and the multilateral levels, could be much richer than what existing studies indicate. Although our data are not appropriate for such analyses—since Argentine firms did not face major tariff reductions in their main export destinations during our sample period—this is an area that surely calls for further research.

An equally promising avenue for future research is in exploring the mechanism we lay out in this paper at a more disaggregated level, seeking to identify the types of products, or the sectors, as well as the characteristics of foreign markets, for which the process of sequential exporting is more relevant.[24] For example, it would be interesting to evaluate whether there is a dynamic counterpart to the hierarchy of markets uncovered by Eaton et al. (2011). They find that distant, difficult markets are accessed solely by the highly productive firms; is it also true that those firms sell to difficult markets only later in their internationalization process? To focus on the basic mechanism we abstract from these issues here, taking instead the extreme view that the correlation of export profitabilities across destinations is the same for all sectors and for all pairs of countries. Undeniably, this is a crude approximation. In reality, we should observe instead a matrix of correlations across countries for each sector. Exploring the structure of those matrices is beyond the scope of this paper, but it could prove very useful, making it possible to fine tune the analysis of firms' export strategies. We look forward to advances in those areas.[25]

5 References

Aghion, P., P. Bolton, C. Harris and B. Jullien (1991), "Optimal Learning by Experimentation," *Review of Economic Studies* 58, 621-654.

[24] Alternatively, one could study the sequentiality of a firm's entry modes in a foreign market. This is the approach followed by Conconi et al. (2011) in recent work, where they modify our framework to study whether exporting to a market serves as a testing ground for a firm's (potential) future foreign direct investment in that market. Egger et al. (2011) apply the same logic also to investigate the sequential strategies of firms considering investing abroad and, if they choose to do so, of where to locate the investment.

[25] Three recent papers provide initial steps in this direction. Using our data set and empirical methodology, Elliott and Tian (2010) evaluate the patterns of sequential exporting of Argentine firms in Asia. Defever et al. (2011) generalize our setup to a spatial model to study the geographic spread of Chinese exports between 2003 and 2005. Morales et al. (2011) develop a novel structure based on a moment inequalities approach to estimate firms' fixed and sunk costs of accessing foreign country i after having sold in a different foreign country j. This path-dependence, which the authors refer to as "extended gravity" factors, matters if a firm's export profitability is correlated across markets (in their model through correlation in costs).

Albornoz, F., H. Calvo Pardo, G. Corcos and E. Ornelas (2010), "Sequential Exporting," CEP Discussion Paper 974.

Alvarez, R., H. Faruq and R. Lopez (2011), "Is Previous Export Experience Relevant for New Exporters?" mimeo.

Akhmetova, Z. and C. Mitaritonna (2010), "An Empirical Application of the Model of Firm Experimentation using French Firm-level Export Data," mimeo.

Araujo, L., G.. Mion and E. Ornelas (2012), "Institutions and Export Dynamics," mimeo.

Arkolakis, C. (2011), "A Unified Theory of Firm Selection and Growth," mimeo.

Arkolakis, C. and T. Papageorgiou (2010), "Firm Selection, Growth and Learning", mimeo.

Artopoulos, A., D. Friel and J. C. Hallak (2010), "Challenges of Exporting Differentiated Products to Developed Countries: The Case of SME-Dominated Sectors in a Semi-Industrialized Country," IDB Working Paper 166.

Bernard, A., J. Jensen, S. Redding and P. Schott (2007), "Firms in International Trade," *Journal of Economic Perspectives* 21, 105-130.

Bernard, A., J. Jensen, S. Redding and P. Schott (2009), "The Margins of US Trade," *American Economic Review P&P* 99, 487-493.

Besedes, T. and T. Prusa (2006), "Ins, Outs, and the Duration of Trade," *Canadian Journal of Economics* 39, 266-295.

Buono, I., S. Fadinger and S. Berger (2008), "The Micro-Dynamics of Exporting: Evidence from French Firms," mimeo.

Cavusgil, S. and S. Zou, (1994), "Marketing Strategy-Performance Relationship: An Investigation of the Empirical Link in Export Market Ventures, "*Journal of Marketing* 58, 1-21.

Conconi, P., A. Sapir and M. Zanardi (2011), "The Internationalization Process of Firms: from Exports to FDI?" National Bank of Belgium Working Paper 198.

Das, S., M. Roberts and J. Tybout (2007), "Market Entry Costs, Producer Heterogeneity, and Export Dynamics," *Econometrica* 75, 837-873.

Defever, F., B. Heid, M. Larch, (2011), "Spatial Exporter Dynamics," CEP Discussion Paper 1100.

Demidova, S., H. Kee and K. Krishna (2009), "Do Trade Policy Differences Induce Sorting? Theory and Evidence From Bangladeshi Apparel Exporters," NBER Working Paper 12725.

Eaton, J., M. Eslava, M. Kugler and J. Tybout (2008), "The Margins of Entry into Export Markets: Evidence from Colombia," in E. Helpman, D. Marin and T. Verdier (eds.), *The Organization of Firms in a Global Economy*, Cambridge, MA: Harvard University Press.

Eaton, J., M. Eslava, C. Krizan, M. Kugler and J. Tybout (2010), "A Search and Learning Model of Export Dynamics," mimeo.

Eaton, J., S. Kortum and F. Kramarz (2011), "An Anatomy of International Trade: Evidence from French Firms," *Econometrica* 79, 1453-1498.

Egger, P., M. Fahn, V. Merlo and G. Wamser (2011), "On the Genesis of Multinational Foreign Affiliate Networks," mimeo.

Elliott, R. and X. Tian (2010), "Sequential Exporting: An Empirical Investigation," mimeo.

Eriksson, K., J. Johanson, A. Majkgaard and D. Sharma (1997), "Experiential Knowledge and Cost in the Internationalization Process," *Journal of International Business Studies* 28, 337-360.

Evenett, S. and A. Venables (2002), "Export Growth in Developing Countries: Market Entry and Bilateral Trade Flows," mimeo.

Freund, C. and M. Pierola (2010), "Export Entrepreneurs: Evidence from Peru," World Bank Policy Research Working Paper 5407.

Hausmann, R. and D. Rodrik (2003), "Economic Development as Self-discovery," *Journal of Development Economics* 72, 603-33.

Iacovone, L. and B. Javorcik (2009), "Shipping Good Tequila Out: Investment, Domestic Unit Values and Entry of Multi-product Plants into Export Markets," University of Oxford, mimeo.

Iacovone, L. and B. Javorcik (2010), "Multi-product Exporters: Product Churning, Uncertainty and Export Discoveries," *Economic Journal* 120, 481-499.

Irrarazabal, A. and L. Opromolla (2009), "The Cross Sectional Dynamics of heterogeneous Trade Models," Banco de Portugal Working Paper 24/2009.

Irrarazabal, A. and L. Opromolla (2011), "A Theory of Entry and Exit into Export Markets," mimeo.

Johanson, J. and E. Vahlne (1977), "The Internationalization Process of the Firm—a Model of Knowledge Development and Increasing Foreign Market Commitments," *Journal of International Business Studies* 8, 23-32.

Jovanovic, B. (1982), "Selection and the Evolution of Industry," *Econometrica* 50, 649-670.

Kee, H. and K. Krishna (2008), "Firm-level Heterogeneous Productivity and Demand Shocks: Evidence from Bangladesh," *American Economic Review P&P* 98, 457-462.

Krautheim, S. (2011), "Heterogeneous firms, export networks and the effect of distance on international trade," *Journal of International Economics* (forthcoming).

Lawless, M. (2009), "Firm Export Dynamics and the Geography of Trade," *Journal of International Economics* 77, 245-254.

Lawless, M. (2011), "Marginal Distance: Does Export Experience Reduce Firm Trade Costs?" Central Bank of Ireland, mimeo.

Lin, P. and K. Saggi (1999), "Incentives for Foreign Direct Investment under Imitation," *Canadian Journal of Economics* 32, 1275-1298.

Manova, K. (2011), "Credit Constraints, Heterogeneous Firms, and International Trade," mimeo.

Mayer, T. and G. Ottaviano (2007), "The Happy Few: New Facts on the Internationalisation of European Firms," *Bruegel Blueprint Series vol.3: Brussels.*

Melitz, M. (2003), "The Impact Of Trade On Intra-Industry Reallocations And Aggregate Industry Productivity," *Econometrica* 71, 1695-1725.

Morales, E., G. Sheu and A. Zahler (2011), "Gravity and Extended Gravity: Estimating a Structural Model of Export Entry," mimeo.

Muuls, M. (2009), "Exporters and Credit Constraints. A Firm-Level Approach," mimeo.

Nguyen, D. (2011), "Demand uncertainty: Exporting delays and exporting failures," *Journal of International Economics* (forthcoming).

Rauch, J. (1999), "Networks versus markets in international trade," *Journal of International Economics* 48, 7-35.

Rauch, J. and J. Watson (2003), "Starting Small in an Unfamiliar Environment," *International Journal of Industrial Organization* 21, 1021-1042.

Redding, S. (2011), "Theories of Heterogeneous Firms and Trade," *Annual Review of Economics* 3, 77-105.

Ruhl, K. and J. Willis (2008), "New Exporter Dynamics," mimeo.

Segura-Cayuela, R. and J. Vilarrubia (2008), "Uncertainty and Entry into Export Markets," mimeo.

Wagner, J. (2007), "Exports and Productivity: A Survey of the Evidence from Firm-level Data," *The World Economy* 30, 60-82.

[Not for publication]

Online Appendix for "Sequential Exporting"

Facundo Albornoz
University of Birmingham

Héctor F. Calvo Pardo
University of Southampton

Gregory Corcos
NHH

Emanuel Ornelas
London School of Economics, CEPR and CEP

January 13, 2012

Abstract

This Online Appendix contains proofs and extensions of the model described in the main text, as well as additional empirical results.

A-1 Proof of Proposition 1

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 $\mu \geq 2F^{1/2} + \tau^B$.*

Proof of Proposition 1. Recall from the main text that the firm's entry strategy is fully characterized by conditions :

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

$$e_1^B(\tau^B) = 1 \Leftrightarrow F < \Psi(\tau^B) - W(\tau^B; F). \tag{A-2}$$

Rewrite condition (A-2) for $e_1^B = 1$ as

$$F + W(\tau^B; F) < \Psi(\tau^B). \tag{A-3}$$

[Not for publication]

The right-hand side of (A-3) is independent of F, whereas the left-hand side is strictly increasing in F. To see that, use Leibniz's rule to find that

$$\begin{aligned} \frac{\partial\left[F + W(\tau^B; F)\right]}{\partial F} &= 1 - \int_{2F^{1/2}+\tau^B}^{\overline{\mu}} dG(\mu) \\ &= G(2F^{1/2} + \tau^B) > 0. \end{aligned} \tag{A-4}$$

Defining F^{Sm} as the F that would turn (A-3) 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 (A-3) 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 (A-4), it follows that it does not hold for any $F > 0$.

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

$$F - W(\tau^B; F) \leq \Psi(\tau^A). \tag{A-5}$$

The right-hand side of (A-5) 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 (A-5) 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 μ at $t = 1$ when $F \in [F^{Sm}, F^{Sq}]$, $\mu \geq 2F^{1/2} + \tau^B$ and it enters market B at $t = 2$. ■

A-2 Model Extension: Differences in Productivity

To allow for differences in productivity, define a firm's unit costs as $\frac{1}{\varphi} + c$, where $\varphi \in [0, \infty)$ denotes the firm's (known) 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 φ.*

Proof of Proposition 2. Rewrite condition (A-2) for $e_1^B = 1$ as

$$F < \Psi(\tau^B + \frac{1}{\varphi}) - W(\tau^B + \frac{1}{\varphi}; F). \tag{A-6}$$

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,

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

Totally differentiating this expression and manipulating it, we find

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

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

$$F \leq \Psi(\tau^A + \frac{1}{\varphi}) + W(\tau^B + \frac{1}{\varphi}; F). \tag{A-7}$$

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,

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

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. ■

Figure 1 illustrates Proposition 2. If productivity is too low ($\varphi < \frac{1}{\overline{\mu} - \tau^A}$), there is no hope of making profits through exporting, and therefore the firm does not enter any foreign market even if $F = 0$. Similarly, the firm would never enter simultaneously if it did not expect to make positive operational profits in market B (i.e. if $\varphi > \frac{1}{E\mu - \tau^B}$). By contrast, observe that as the unit production cost falls to zero (i.e. $\varphi \to \infty$), the thresholds approach those defined in Proposition 1.

A-3 Formalization of Empirical Predictions

We derive here the empirical predictions from the theoretical model in the main text. We 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. We keep the convention that $\tau^A = \min\{\tau^j\}$, $j = A, ..., N$, so that market A is the first the firm enters at $t = 1$.

Our model predicts, first, that conditional on survival the growth of a firm's exports is on average highest early in its first foreign market.

[Not for publication]

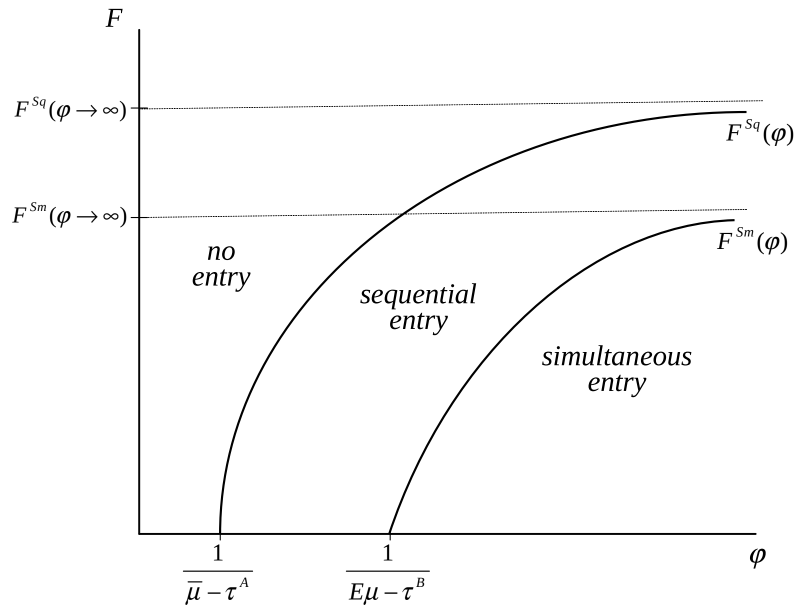

Figure 1: Optimal Entry Strategy with Varying Productivity

Prediction 1 *Conditional on survival, the growth rate of exports to a market is on average higher between the first and second periods in the first foreign market served by the firm than in subsequent markets or later in the firm's first market.*

Proof. Consider the first market, A. Conditional on entry, export volume at $t = 1$ is given by $q_1^A = \mathbf{1}_{\{E\mu>\tau^A\}}\frac{E\mu-\tau^A}{2} + \mathbf{1}_{\{E\mu\leq\tau^A\}}\varepsilon$. 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 $E(q_2^A \big| \, \mu > \tau^A) = \frac{\int_{\tau^A}^{\overline{\mu}}\left(\frac{\mu-\tau^A}{2}\right)dG(\mu)}{1-G(\tau^A)} = \frac{E(\mu|\mu>\tau^A)-\tau^A}{2} > 0$. There are two cases. If $E\mu \leq \tau^A$, export growth from first to second year is $\sigma^A \equiv \frac{E(\mu|\mu>\tau^A)-\tau^A}{2} - \varepsilon > 0$. Otherwise, $\sigma^A = \frac{E(\mu|\mu>\tau^A)-\tau^A}{2} - \frac{E\mu-\tau^A}{2} = \frac{1}{2}[E(\mu|\,\mu > \tau^A) - E\mu]$. We now show that this inequality is strictly positive:

$$
\begin{aligned}
E(\mu|\,\mu &> \tau^A) = \int_{\tau^A}^{\overline{\mu}} \mu dG(\mu|\,\mu > \tau^A) \\
&= \int_{\tau^A}^{\overline{\mu}} \mu \frac{dG(\mu)}{1-G(\tau^A)} \\
&= \frac{1}{1-G(\tau^A)} \left\{ \overline{\mu} - \int_{\tau^A}^{\overline{\mu}} G(\mu) d\mu \right\} \\
&= \frac{1}{1-G(\tau^A)} \left\{ E\mu + \int_{\underline{\mu}}^{\tau^A} G(\mu) d\mu \right\} \\
&> \left\{ E\mu + \int_{\underline{\mu}}^{\tau^A} G(\mu) d\mu \right\} \\
&> E\mu
\end{aligned}
$$

Where the third equality follows from integration by parts and the fourth from rewriting $E\mu = \overline{\mu} - \int_{\underline{\mu}}^{\tau^A} G(\mu)d\mu - \int_{\tau^A}^{\overline{\mu}} G(\mu)d\mu$ as $\overline{\mu} - \int_{\tau^A}^{\overline{\mu}} G(\mu)d\mu = E\mu + \int_{\underline{\mu}}^{\tau^A} G(\mu)d\mu$. Now if $\tau^A \in (\underline{\mu}, \overline{\mu})$ we must have that $G(\tau^A) > 0$, which is equivalent to $1 - G(\tau^A) < 1 \Leftrightarrow \frac{1}{1-G(\tau^A)} > 1$ so that the first inequality follows, and the second. 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 $E(\,q_t^A \big|\, \mu > \tau^A) = \frac{E(\,\mu|\mu>\tau^A)-\tau^A}{2}$ for all $t > 1$.

Consider now foreign market j, $j \neq A$. Since the firm enters market j only if $\mu > 2F^{1/2} + \tau^j$, $E(\,q_{t+1}^j \Big|\, \mu > 2F^{1/2} + \tau^j) = E(\,q_t^j \Big|\, \mu > 2F^{1/2} + \tau^j) = \frac{E(\,\mu|\mu>2F^{1/2}+\tau^j)-\tau^j}{2}$ 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. ■

Second, our model predicts that new exporters are more likely to enter new foreign destinations.

Prediction 2 *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. ■

[Not for publication]

Finally, 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 *New exporters are more likely to exit than experienced exporters, including those that are new in a market but have export experience elsewhere.*

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. ■

A-4 Additional Empirical Results

A-4.1 Results with Gravity Controls

Table A-1 reports results of our three main regressions when we introduce covariates frequently used in gravity regressions as controls, instead of destination or year-destination fixed effects. The estimated coefficients of our main variables are very similar to those estimated with the fixed effects.

Gravity variables are constructed as follows. $Border_{Arg,j}$ takes value one if country j shares a border with Argentina, and zero otherwise. $Distance_{Arg,j}$ measures the geodesic distance between Buenos Aires and the main city in country j, using the great circle method. $SameLanguage_{Arg,j}$ takes value one if Spanish is the main language in country j. Data come from CEPII. In turn, $SamePCIncomeQuartile_{Arg,J}$ takes value one if country j belongs to the same per capita income quartile as Argentina. Data are in purchasing power parity for 2010 and come from the World Bank.

A-4.2 Patterns of Entry: Extended Gravity

Table 8 in Section 3.3 reports the results of a modified entry regression, where we control for the proximity between current and past export markets ("extended gravity").

[Not for publication]

Table A-1: Main Estimations Including Gravity Variables

Dependent Variable:	$\Delta \log X_{ijt}$	$Exit_{ijt}$	$Entry_{irt}$
LPM	(1)	(2)	(3)
$FY_{ij,t-1} \times FM_{ij}$	0.123**	0.120**	
	(0.038)	(0.004)	
FM_{ij}	-0.009	0.149**	
	(0.040)	(0.003)	
$FY_{ij,t-1}$	0.253**	0.021**	
	(0.017)	(0.002)	
$FY_{i,t-1}$			0.012**
			(0.002)
GDP_j	-0.461	0.533**	0.320
	(0.424)	(0.047)	(0.180)
$Population_j$	0.258**	0.015	0.005**
	(0.087)	(0.084)	(0.001)
$Distance_{Arg,j}$	-0.687**	0.104**	-0.005**
	(0.226)	(0.048)	(0.0001)
$Border_{Arg,j}$	0.037*	0.031**	0.007**
	(0.017)	(0.002)	(0.002)
$Same\ Language_{Arg,j}$	0.011	0.017**	-0.002
	(0.016)	(0.002)	(0.001)
$Same\ PC\ Income\ Quartile_{Arg,j}$	-0.025*	-0.002	0.101**
	(0.011)	(0.002)	(0.008)
Firm FE	yes		yes
Sector FE		yes	
Number of obs	103,418	114,739	235,693
R-squared	0.096	0.135	0.094

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

Robust standard errors adjusted for clusters in firms.

[Not for publication]

The "extended gravity" variables are constructed as follows. $ExtendedBorder_{r,it}$, $ExtendedLanguage_{r,it}$ and $ExtendedPCIncomeGroup_{r,it}$ are binary variables. They take value 1 when region r shares a border, language or per capita income group, respectively, with another region in which firm i was exporting at time $t-1$. Regions are as described in Section 3.1 of the article. Data on per capita income are in purchasing power parity for 2010 and come from the World Bank. Details on the matrices of border and language indicators are available upon request.

A-4.3 Export Destination Transition Matrix

Table A-2 describes the transition probabilities between groups of export destinations in years t (columns) and $t+1$ (rows).[1] "None" describes firms that are currently not exporting, while "All" describes firms currently exporting to all possible destination groups. For instance, 12% of all non-exporters in t (column 1) start exporting to a Mercosur country only in $t+1$. The first column and the first row can be interpreted as average rates of entry and exit.

Several patterns emerge. Few firms among non-exporters (5%, column 1, rows $6-16$) start as simultaneous exporters. As noted in the text, most new exporters start serving a destination in the Mercosur or the OtherLA groups, but rarely both. Single-group exporters have significantly higher exit rates than multi-group exporters. The large values on the diagonal show persistence in the groups of destinations served.

[1] We consider a smaller number of groups than in the entry regressions in order to reduce the dimensionality of the matrix. Transition matrices with alternative country groupings are available upon request.

Table A-2: Destination Transition Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) None	64	26	33	30	36	10	5	11	10	10	10	2	5	2	3	1
(2) Mercosur	12	52	2	5	4	18	11	22	2	1	3	3	4	3	0	0
(3) OECD	7	1	42	2	6	11	0	3	15	16	2	1	6	0	5	0
(4) Other LA	10	3	2	43	3	2	9	2	14	1	16	2	1	3	3	0
(5) RofW	2	0	1	1	30	1	0	7	0	7	10	0	1	1	1	0
(6) Mercosur & OECD	1	3	4	0	1	25	1	5	3	2	1	4	10	1	1	1
(7) Mercosur & Other LA	2	11	1	13	1	6	56	8	6	0	8	19	2	21	0	3
(8) Mercosur & RofW	0	1	0	0	2	1	0	20	0	0	1	0	2	2	0	0
(9) OECD & Other LA	1	0	5	3	1	3	1	1	26	2	4	4	1	2	8	1
(10) OECD & RofW	1	0	5	0	7	2	0	0	2	40	3	0	10	0	12	1
(11) OtherLA & RofW	0	0	0	1	4	0	0	1	1	1	19	0	0	3	3	0
(12) Mercosur, OECD & Other LA	0	1	1	1	0	11	9	2	10	1	2	44	5	7	5	9
(13) Mercosur, OECD & RofW	0	0	1	0	1	4	0	5	1	7	1	1	25	1	3	2
(14) Mercosur, Other LA & RofW	0	1	0	1	2	1	4	7	1	0	8	2	2	34	1	5
(15) OECD, Other LA & RofW	0	0	1	0	3	1	0	1	6	9	9	1	4	1	34	3
(16) All	0	0	1	0	1	3	2	6	3	3	5	15	24	20	19	73

Values are percentages. All Latin American countries outside Mercosur are included in "Other LA".

[Not for publication]

Technical Appendix to "Sequential Exporting"

Facundo Albornoz
University of Birmingham

Héctor F. Calvo Pardo
University of Southampton

Gregory Corcos
NHH

Emanuel Ornelas
London School of Economics

Abstract

Here we show that our main results and empirical predictions are robust to: (i) adopting a demand function of the form $p(q) = \max\{d - q, 0\}$ (Non-negative prices), and to (ii) an arbitrary positive correlation across time or destinations (Non-negative correlation).

A-1 Non-negative Prices

Here we show as a result of forcing prices to be non-negative ($p(q) = \max\{d - q, 0\}$), optimal export quantities in $t = 1$ increase, while volumes in $t = 2$ remain unaffected. Since expected export profits also increase, there is also more entry. Intuitively, such a demand function "convexifies" the revenue function, providing implicit insurance to the risk neutral producer against the event of negative prices, inducing the producer to take more risk, producing larger volumes conditional on entry, and becoming more propense to enter. [1] Because the surviving threshold in $t = 2$ remains unchanged ($\mu > \tau$), there is also more exit. Therefore our empirical predictions 2 and 3 are if anything, strengthened. Since optimal export quantities in $t = 1$ increase, while volumes in $t = 2$ remain unaffected, predicted average second year growth is lower, but still positive as long as minimum marginal costs lie above expected willigness to pay. Hence, also our empirical prediction 1 survives.

More entry and larger volumes in $t = 1$ translate into higher expected first period operational profits, inducing more experimentation. And because expected first period operational profits are

[1] Technically, it just introduces a first order stochastically dominant (FSD) shift in first period profitability, irrespective of destinations.

larger, some firms that would have entered sequentially, now enter simultaneously, as well as some non-entrants now will rather enter (sequentially) than not. Therefore our propositions 1 and 2 obtain, and so do their implications for trade policy (proposition 3).

Thus, avoiding negative prices has no effect on the expected value of information either across periods or destinations. This is why in the main text we impose the (minor) technical restriction $\underline{d} > \frac{1}{2}E\mu$, instead of exposing the reader to the cumbersome technicalities displayed here.

Proposition 1 *First period export volumes are larger under a non-negative price restriction*

Proof. We want to show that:

$$q_1^{j*} \geq \widehat{q}_1^j$$

where:

$$\begin{aligned} q_1^{j*} &\in \arg\max_{q_1 \geq 0} E\left[\max\left\{\widetilde{d} - q_1, 0\right\} q_1 - (\widetilde{c} + \tau^j) q_1\right] \\ \widehat{q}_1^j &\in \arg\max_{q_1 \geq 0} E\left[\left(\widetilde{d} - q_1\right) q_1 - (\widetilde{c} + \tau^j) q_1\right] \end{aligned}$$

The corresponding necessary and sufficient FOCs are, under the assumption of independence between demand ($\widetilde{d}$) and supply ($\widetilde{c}$) shocks:

$$\begin{aligned} \underbrace{E\left\{-1_{\{d > q_1^{j*}\}} q_1^{j*}\right\} + E\max\left\{\widetilde{d} - q_1^{j*}, 0\right\}}_{MR|p \geq 0} &= \underbrace{E\widetilde{c} + \tau^j}_{MC} \\ \underbrace{-\widehat{q}_1^j + \left(E\widetilde{d} - \widehat{q}_1^j\right)}_{MR} &= \underbrace{E\widetilde{c} + \tau^j}_{MC} \end{aligned}$$

Noting that

$$E\left\{-1_{\{d>q\}} q\right\} = qE\left\{-1_{\{d>q\}}\right\} = -q\left[1 - K(q)\right] \geq -q, \forall q \in \left[\underline{d}, \overline{d}\right],$$

and

$$E\max\left\{\widetilde{d} - q_1, 0\right\} \geq \max\left\{E\widetilde{d} - q_1, 0\right\} = 1_{\{Ed > q_1\}}\left(E\widetilde{d} - q_1\right) \geq \left(E\widetilde{d} - q_1\right),$$

it follows that the marginal revenue is larger under the non-negative price restriction,

$$(MR|\, p \geq 0)\,(q_1) \geq MR(q_1), \forall q_1 \in \left[\underline{d}, \overline{d}\right]$$

because the marginal revenue is a non-increasing function of the quantity[2]. Since the marginal cost remains the same (MC), we have that $q_1^{j*} \geq \widehat{q}_1^j$. ■

To be able to say if there is more or less (sequential) entry, we would need to know how do expected profits compare under the non-negative price restriction relative to its absence. First, notice that:

Proposition 2 *Conditional on entry, expected first period operational profits are larger when imposing a non-negative price restriction.*

Proof. Expected first period operational profits under a non-negative price restriction are:

$$\begin{aligned}
\Psi(q_1^{j*};\tau^j) - V(\tau^j) &= \left\{\max_{q_1\geq 0} E\left[\max\left\{\widetilde{d} - q_1, 0\right\} q_1 - (\widetilde{c} + \tau^j) q_1\right]\right\} \\
&\geq \left\{\max_{q_1\geq 0}\left[\max\left\{E\widetilde{d} - q_1, 0\right\} q_1 - (E\widetilde{c} + \tau^j) q_1\right]\right\} \\
&\geq \left\{\max_{q_1\geq 0}\left[\left(E\widetilde{d} - q_1\right) q_1 - (E\widetilde{c} + \tau^j) q_1\right]\right\} = \Psi(\widehat{q}_1^j;\tau^j) - V(\tau^j)
\end{aligned}$$

Where the second inequality follows from the convexity of the max operator and Jensen's inequality, and the third from noting that $\max\left\{E\widetilde{d} - q_1, 0\right\} = 1_{\{Ed > q_1\}}\left(E\widetilde{d} - q_1\right) \geq \left(E\widetilde{d} - q_1\right), \forall q_1$. ([3]) ■

Second, it is also true that:

Corollary 3 *Operational profits under a non-negative price restriction are larger ([4])*

Proof. Notice that the definitions of $V(\tau^j)$ and of $W(\tau^B;F)$ in the main text remain unchanged by the imposition of a non-negative price-restriction. The reason being that they constitute the ex-ante evaluation of ex-post optimal entry decisions, which rule out negative prices, i.e. $\mu \geq \tau \Longrightarrow p^* \geq 0$

[2] From Leibniz's rule, we have that $\frac{\partial(MR|p\geq 0)(q_1)}{\partial q_1} = -2(1 - K(q_1)) \geq -2 = \frac{\partial MR(q_1)}{\partial q_1}, \forall q_1$

[3] After some tedious algebra, it can be shown that expected first period operational profits are equal to $\Psi(q_1^{j*};\tau^j) = \mathbb{P}(d > q_1^{j*})\left(q_1^{j*}\right)^2 + V(\tau^j)$.

[4] In the case of imperfect correlation across destinations, second period optimal output of sequential entrants is based on the conditional expectation of prices. As a result, prices can also be negative and the non-negative price restriction also constraints second period optimal outputs to be larger than they would absent the restriction. But because profits are larger, the new entry cutoff would also allow for more entry, and a similar reasoning applies.

:

$$\begin{aligned} V(\tau^j) = \int_{\tau^j}^{\overline{\mu}} \left(\frac{\mu^j - \tau^j}{2}\right)^2 dG(\mu) &= E\left[1_{\{\mu^j > \tau^j\}} \left(\frac{\mu^j - \tau^j}{2}\right)^2\right] \\ &= \Pr(\mu^j > \tau^j) E\left[\left(\frac{\mu^j - \tau^j}{2}\right)^2 \middle| \mu^j > \tau^j\right]; \\ W(\tau^B; F) &= \int_{\tau^B + 2F^{\frac{1}{2}}}^{\overline{\mu}} \left[\left(\frac{\mu - \tau^B}{2}\right)^2 - F\right] dG(\mu) \\ &= \Pr(\mu > \tau^B + 2F^{\frac{1}{2}}) E\left[\left(\frac{\mu - \tau^B}{2}\right)^2 - F \middle| \mu > \tau^B + 2F^{\frac{1}{2}}\right]. \end{aligned}$$

Therefore, the previous corollary implies that:

$$\Psi(q_1^{j*}; \tau^j) \geq \Psi(\widehat{q}_1^j; \tau^j), \forall j$$

■

As a result:

Corollary 4 *Both sequential and simultaneous entry strategies display higher profits under a non-negative price restriction. Therefore, the fixed cost entry thresholds under a non-negative price restriction, F_*^{Sq} and F_*^{Sm}, are less binding.*

Proof. Defining $\Psi(q_1^{j*}; \tau^j) \equiv \Psi^*(\tau^j)$, $\Pi_*^{Sq} \equiv \Psi^*(\tau^A) + W(\tau^B; F) - F$, $\Pi_*^{Sm} \equiv \Psi^*(\tau^A) + \Psi^*(\tau^B) - 2F$, the previous corollary implies:

$$\Pi_*^{Sq} \geq \Pi^{Sq} \text{ and } \Pi_*^{Sm} \geq \Pi^{Sm}$$

Since the profit function is decreasing in the sunk entry cost F, we immediately have:

$$F_*^{Sq} \geq F^{Sq}$$

The definition of F_*^{Sm} and the previous corollary imply that:

$$F_*^{Sm} + W(\tau^B; F_*^{Sm}) = \Psi^*(\tau^B) \geq \Psi(\tau^B) = F^{Sm} + W(\tau^B; F^{Sm})$$

Since $\frac{d(F + W(\tau^B; F))}{dF} = G(\tau^B + 2F^{\frac{1}{2}}) \geq 0$, we immediately have that $F_*^{Sm} \geq F^{Sm}$. ■

Firms that in the absence of a non-negative price restriction did not enter, now adopt a sequential entry strategy, and some of the previous sequential entrants, now would rather enter simultaneously. Therefore:

[Not for publication]

Corollary 5 $F_*^{Sq} > F_*^{Sm}$, *i.e. Proposition 1 survives a non-negative price restriction*

Proof.

$$F_*^{Sq} = \Psi^*(\tau^A) + W(\tau^B; F_*^{Sq}) > \Psi^*(\tau^A) \geq \Psi^*(\tau^B) > \Psi^*(\tau^B) - W(\tau^B; F_*^{Sm}) = F_*^{Sm}$$

where the weak inequality follows from the assumption that $\tau^A \leq \tau^B$, and the strict inequalities obtain because under perfect positive correlation, the option value of entering B sequentially is strictly positive, $W(\tau^B; F) > 0, \forall F$. ■

Consequently, our empirical predictions 2 (entry) and 3 (exit) prevail, and are even reinforced by the adoption of a non-negative price restriction. The next proposition shows that under an economically reasonable condition, also prediction 1 holds despite of being weakened:

Proposition 6 *Empirical prediction 1 holds if* $\underline{c} \geq Ed$.

Proof. From the FOC we obtain the following expression for q_1^{j*} :

$$q_1^{j*} = 1_{\{E\mu > \tau^j + \lambda\}} \frac{E\mu - (\tau^j + \lambda)}{2P(d > q_1^{j*})}$$

where $\Pr(d > q_1^{j*}) \equiv \left[1 - K(q_1^{j*})\right] \leq 1$, and $\lambda \equiv \Pr(d \leq q_1^{j*}) E\left[d | \, d \leq q_1^{j*}\right] \geq 0, \forall q_1^{j*} \in [\underline{d}, \overline{d}]$. We need to show that:

$$\underline{c} \geq Ed \Longrightarrow Eq_2^{j*} - q_1^{j*} \geq 0$$

Noting that $Eq_2^{j*} = E\widehat{q}_2^j = \frac{E[\mu|\mu > \tau^j] - \tau^j}{2}$, omitting the non-negativity restriction on quantities in the profit maximization problem, the above implication is equivalent to:

$$\underline{c} \geq Ed \Longrightarrow \frac{E\left[\mu | \, \mu > \tau^j\right] - \tau^j}{2} \geq \frac{E\mu - (\tau^j + \lambda)}{2\Pr(d > q_1^{j*})}$$

The proof proceeds in 3 steps.

Step 1: Simplifying the RHS of the above implication.

After cancelling common terms and rearranging, we can express the RHS as :

$$\Pr(d > q_1^{j*}) E\left[\mu | \, \mu > \tau^j\right] \geq E\mu - \Pr(d \leq q_1^{j*}) \left(E\left[d | \, d \leq q_1^{j*}\right] + \tau^j\right)$$

[Not for publication]

by definition of λ. Since $E\mu = \Pr(d > q_1^{j*})E\left[\mu|\, d > q_1^{j*}\right] + \Pr(d \leq q_1^{j*})E\left[\mu|\, d \leq q_1^{j*}\right]$, plugging this expression into the above inequality and rearranging yields:

$$\Pr(d> q_1^{j*})\left\{E\left[\mu|\,\mu > \tau^j\right] - E\left[\mu|\, d > q_1^{j*}\right]\right\} \geq$$
$$\geq \Pr(d \leq q_1^{j*})\left\{E\left[\mu|\, d \leq q_1^{j*}\right] - E\left[d|\, d \leq q_1^{j*}\right] - \tau^j\right\}$$

Substituting in the definition of $\widetilde{\mu} = \widetilde{d} - \widetilde{c}$, and taking advantage of the assumption of independence between demand and supply shocks, we get:

$$\Pr(d> q_1^{j*})\left\{E\left[d|\, d > c+\tau^j\right] - E\left[d|\, d > q_1^{j*}\right] + Ec - E\left[c|\, c < d-\tau^j\right]\right\} \geq$$
$$\geq \Pr(d \leq q_1^{j*})\left\{-Ec - \tau^j\right\}$$

Noting that the proof of empirical prediction 1 in the online appendix implies that:

$$\Pr(d > q_1^{j*})\left\{Ec - E\left[c|\, c < d-\tau^j\right]\right\} \geq 0,$$

we can then move this term to the RHS of the inequality to obtain, after some simplifications:

$$\Pr(d>q_1^{j*})\left\{E\left[d|\, d > c+\tau^j\right] - E\left[d|\, d > q_1^{j*}\right]\right\} \geq$$
$$\geq -\left\{Ec - E\left[c|\, c < d-\tau^j\right]\right\} - \Pr(d \leq q_1^{j*})\left\{E\left[c|\, c < d-\tau^j\right] + \tau^j\right.$$

Therefore the RHS of the inequality is negative.

Step 2: The LHS of the inequality is positive if $c + \tau^j > q_1^{j*}, \forall c$.

It follows from an extension of the proof of empirical prediction 1 in the online appendix: [5]

$$\tau' \geq \tau \Longrightarrow E\left[\mu|\,\mu > \tau'\right] \geq E\left[\mu|\,\mu > \tau\right], \forall\left(\tau', \tau\right) \in (\underline{\mu}, \overline{\mu})$$

Step 3: $\underline{c} > Ed \Longrightarrow c + \tau^j > q_1^{j*}, \forall c$.

Notice that

$$c+\tau^j \geq \frac{c+\tau^j}{2\Pr(d > q_1^{j*})} \geq \frac{c+\tau^j - Ec - 2\tau^j}{2\Pr(d > q_1^{j*})} = \frac{c - Ec - \tau^j}{2\Pr(d > q_1^{j*})}$$

[5] The proof proceeds similarly to the proof of empirical prediction 1 in the online appendix: integrate by parts both expressions and subtract them to obtain

$$E\left[\mu|\,\mu > \tau'\right] - E\left[\mu|\,\mu > \tau\right] = \int_{\tau}^{\tau'} G(\mu|\,\mu > \tau)d\mu + \frac{G(\tau') - G(\tau)}{\left[1 - G(\tau')\right]\left[1 - G(\tau)\right]}\int_{\tau'}^{\overline{\mu}} \left[1 - G(\mu)\right] d\mu \geq 0$$

because $G(.)$ is a non-decreasing function.

and also that

$$\frac{Ed - Ec - \tau^j}{2\Pr(d > q_1^{j*})} = \frac{E\mu - \tau^j}{2\Pr(d > q_1^{j*})} \geq \frac{E\mu - (\tau^j + \lambda)}{2\Pr(d > q_1^{j*})} = q_1^{j*}$$

Since the inequality must be true for all realizations of c, if $\underline{c} > Ed$ it must be true that $\frac{c - Ec - \tau^j}{2\Pr(d > q_1^{j*})} > \frac{Ed - Ec - \tau^j}{2\Pr(d > q_1^{j*})}$ and therefore that $\forall c, c + \tau^j > q_1^{j*}$, completing the proof. ■

A-2 Non-negatively correlated export profitabilities

Here we show that our results generalize to the case of positive but imperfect statistical dependence between random variables μ^A and μ^B.

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 μ^A.

A-2.1 Output choice:

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

$$\int_{\underline{\mu}^A}^{\overline{\mu}^A} \left[\max_{q^B \geq 0} \int_{\underline{\mu}^B}^{\overline{\mu}^B} (\mu^B - \tau^B - q^B) q^B dG(\mu^B \middle| \mu^A) \right] dG(\mu^A) \geq \max_{q^B \geq 0} \int_{\underline{\mu}^B}^{\overline{\mu}^B} (\mu^B - \tau^B - q^B) q^B dG(\mu^B),$$

where $dG(\mu^B) = \int_{\underline{\mu}^A}^{\overline{\mu}^A} dG(\mu^B \middle| \mu^A) dG(\mu^A)$. Expected profits are larger when an optimal production decision in B is made taking into account the experience acquired in A. Hence, optimal output is $\overline{q}_2^B(\tau^B) = 1_{\{E[\mu^B|\mu^A] > \tau^B\}} \left[\frac{E(\mu^B|\mu^A) - \tau^B}{2}\right]$.

A-2.2 Value of the sequential exporting strategy:

The conditional expectation of random variable μ^B can be expressed as

$$E\left[\mu^B \middle| \mu^A\right] = E\mu^B + (u^A - E\mu^A) \underbrace{\int_{\underline{\mu}}^{\overline{\mu}} \left[-\frac{d}{du} G\left(w \middle| \mu^A = u\right) \right] \Big|_{u = u_0} dw}_{\equiv \varpi}, \tag{A-1}$$

where ϖ captures the statistical dependence between μ^A and μ^B.[6]

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

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

Define $\overline{F}_2^B(u^A;\tau^B)$ as the F that solves (A-2) with equality. The firm enters market B at $t = 2$ if $F \leq \overline{F}_2^B(u^A;\tau^B)$. Plugging (A-1) in (A-2) 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 τ^B. Comparing $\overline{F}_2^B(u^A;\tau^B)$ with its analog under perfect correlation $F_2^B(\tau^B)$, 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,

$$\begin{aligned}
\overline{W}(\tau^B;F) &\equiv E_{\mu^A}\left[\max\left\{\max_{q^B\geq 0}\left[(E\left[\mu^B\right|\mu^A\right] - \tau^B - q^B)q^B\right] - F, 0\right\}\right] \\
&= E_{\mu^A}\left\{1_{\{\mu^A > \mu^{*A}(\varpi)\}}\left[1_{\{E[\mu^B|\mu^A] > \tau^B\}}\left(\frac{E\left[\mu^B|\mu^A\right] - \tau^B}{2}\right)^2 - F\right]\right\} \\
&= \int_{\mu^{*A}(\varpi)}^{\overline{\mu}}\left[\left(\frac{E\left(\mu^B|\mu^A\right) - \tau^B}{2}\right)^2 - F\right] dG(\mu^A),
\end{aligned}$$

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 μ^A and μ^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 ρ 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 ρ rises,

[6] The proof of (A-1) can be found at the end of this appendix.

implying a higher value from experimentation. This indicates that experimentation becomes more worthwhile as the statistical dependence between μ^A and μ^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 μ^A and μ^B are independent, when it has no value.[7]

Derivation of (A-1)**:** Here we show how the conditional expectation can be expressed as a function of the unconditional expectation, as in (A-1). Integrating by parts both expectations and taking the difference we obtain:

$$\begin{aligned} E\left[\mu^B \middle| \mu^A = u^A\right] - E\left[\mu^B\right] &= \int_{\underline{\mu}}^{\overline{\mu}} \left[G_B(w) - G\left(w \middle| \mu^A = u^A\right)\right] dw \\ &= \int_{\underline{\mu}}^{\overline{\mu}} \left[G\left(w \middle| \mu^A \leq \overline{\mu}\right) - G\left(w \middle| \mu^A = u^A\right)\right] dw \end{aligned}$$

Since $G_B(w) \equiv G\left(\mu^B \leq w, \mu^A \leq \overline{\mu}\right) = G\left(\mu^B \leq w \middle| \mu^A \leq \overline{\mu}\right) G_A(\mu^A \leq \overline{\mu}) = G\left(\mu^B \leq w \middle| \mu^A \leq \overline{\mu}\right)$, $\forall w \in \left[\underline{\mu}, \overline{\mu}\right]$, because $G_A(\mu^A \leq \overline{\mu}) = 1$. By definition, $G\left(w \middle| \mu^A \leq \overline{\mu}\right) = \int_{\underline{\mu}}^{\overline{\mu}} G\left(w \middle| \mu^A = u\right) dG_A(u)$, which inserted above yields:

$$\begin{aligned} E\left[\mu^B \middle| \mu^A = u^A\right] - E\left[\mu^B\right] &= \int_{\underline{\mu}}^{\overline{\mu}} \left[\int_{\underline{\mu}}^{\overline{\mu}} G\left(w \middle| \mu^A = u\right) dG_A(u) - G\left(w \middle| \mu^A = u^A\right)\right] dw \\ &= \int_{\underline{\mu}}^{\overline{\mu}} \left[\int_{\underline{\mu}}^{\overline{\mu}} G\left(w \middle| \mu^A = u\right) dG_A(u) - G\left(w \middle| \mu^A = u^A\right) \underbrace{\int_{\underline{\mu}}^{\overline{\mu}} dG_A(u)}_{=1}\right] dw \\ &= \int_{\underline{\mu}}^{\overline{\mu}} \int_{\underline{\mu}}^{\overline{\mu}} \left[G\left(w \middle| \mu^A = u\right) - G\left(w \middle| \mu^A = u^A\right)\right] dG_A(u)\, dw. \end{aligned}$$

Now assuming that $G\left(w \middle| .\right) \in C^1\left[\underline{\mu}, \overline{\mu}\right]$, by the mean-value theorem,

$$\exists u_0 \in \left[\underline{\mu}, \overline{\mu}\right] : G\left(w \middle| \mu^A = u\right) - G\left(w \middle| \mu^A = u^A\right) = (u - u^A)\left(\left[\frac{d}{du} G\left(w \middle| \mu^A = u\right)\right]\Big|_{u=u_0}\right)$$

we obtain:

$$E\left[\mu^B \middle| \mu^A = u^A\right] - E\left[\mu^B\right] = \int_{\underline{\mu}}^{\overline{\mu}} \int_{\underline{\mu}}^{\overline{\mu}} \left[(u - u^A)\left(\left[\frac{d}{du} G\left(w \middle| \mu^A = u\right)\right]\Big|_{u=u_0}\right)\right] dG_A(u)\, dw$$

[7] Under independence between μ^A and μ^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. For a formal proof of this statement, see F.N. 4 below.

[Not for publication]

Since the term $\left[\frac{d}{du}G\left(w|\,\mu^A\!=u\right)\right]\big|_{u=u_0}$ is a constant, it follows that:

$$\begin{aligned} E\left[\mu^B\middle|\,\mu^A\!=u^A\right]-E\left[\mu^B\right] &= \left(E\left[\mu^A\right]-u^A\right)\int_{\underline{\mu}}^{\overline{\mu}}\left[\left[\frac{d}{du}G\left(w|\,\mu^A\!=u\right)\right]\Big|_{u=u_0}\right]dw \\ &= \left(u^A-E\left[\mu^A\right]\right)\int_{\underline{\mu}}^{\overline{\mu}}\left(-\left[\frac{d}{du}G\left(w|\,\mu^A\!=u\right)\right]\Big|_{u=u_0}\right)dw \end{aligned}$$

We use Lehmann's (1966, p.1143-4) definition of regression dependence, which is in our context:

Definition 7 *μ^B is positively (negatively) regression dependent on μ^A if $G\left(\mu^B\!\le w\middle|\,\mu^A\!=u\right)$ is non-increasing (non-decreasing) in u.*

Our assumption of statistical dependence between μ^A and μ^B implies regression dependence. Thus we can sign the integrand in the last equality above. Finally by rearranging the last equality, we obtain (A-1): if μ^B and μ^A are positively associated, $\left[\frac{d}{du}G\left(w|\,\mu^A\!=u\right)\right]\big|_{u=u_0}\le 0$ and $\left(-\left[\frac{d}{du}G\left(w|\,\mu^A\!=u\right)\right]\big|_{u=u_0}\right)\ge 0, \forall w$ so that $\int_{\underline{\mu}}^{\overline{\mu}}\left(-\left[\frac{d}{du}G\left(w|\,\mu^A\!=u\right)\right]\big|_{u=u_0}\right)dw\ge 0$. Now if export profitability in A was better than expected ($u^A\ge E\left[\mu^A\right]$), expected export profitability to B increases ($E\left[\mu^B\middle|\,\mu^A\!=u^A\right]\ge E\left[\mu^B\right]$).

Example: normal distribution. Consider a joint normal distribution of μ^A and μ^B. It is enough to compute[8]:

$$\int_{-\infty}^{+\infty}\left[-\frac{d}{du}G\left(w|\,\mu^A\!=u\right)\right]\Big|_{u=u_0}dw$$

where

$$G\left(w|\,\mu^A\!=u\right)=\int_{-\infty}^{w}\frac{1}{\sigma_B\sqrt{2\pi}\sqrt{1-\rho^2}}\exp\left\{-\frac{1}{2(1-\rho^2)}\left[\frac{s-(E\mu^B+\rho\frac{\sigma_B}{\sigma_A}(u-E\mu^A))}{\sigma_B}\right]^2\right\}ds$$

is the conditional distribution of μ^B, such that $\left(\mu^B\middle|\,\mu^A=u\right)\sim N(E\mu^B+\rho\frac{\sigma_B}{\sigma_A}(u-E\mu^A),\sigma_B^2(1-\rho^2))$. We note that[9]: (i) $dG\left(s|\,\mu^A\!=u\right)$ is a continuous function of $(s,u)\in R^2$, (ii) $\frac{d}{du}[dG\left(s|\,\mu^A\!=u\right)]$ exists and is continuous, and (iii) $\int_{-\infty}^{w}dG\left(s|\,\mu^A\!=u\right)ds$ is continuous. Therefore we can differentiate

[8] Although expression (A-1) is defined for random variables on bounded supports, we conjecture that it can be extended to random variables over unbounded supports as long as their c.d.f., say $G(\bullet)$, possess an absolute moment of order $\psi>0$, i.e if and only if $|\mu|^{\psi-1}\left[1-G(\mu)+G(-\mu)\right]$ is integrable over $(-\infty,+\infty)$, (see Lemma 2 in Feller (1966, p.149).

[9] Facts (i) - (iii) are stated without proof, but since $\exp(-\frac{x^2}{2})$ is continuous, positive and bounded above by an integrable function $(\exp(-|x|+1):\int_{\mathbb{R}}\exp(-|x|+1)dx=2e)$, on $\mathbb{R}$, the proofs are left to the interested reader.

inside the integral:

$$\begin{aligned}\frac{d}{du}G\left(w|\,\mu^A\!=u\right) &= \int_{-\infty}^{w}\frac{d}{du}\left[dG\left(s|\,\mu^A\!=u\right)\right]ds\\ &= \int_{-\infty}^{w}\left[\frac{1}{\sigma_B\sqrt{2\pi}\sqrt{1-\rho^2}}\left(\frac{\rho\frac{\sigma_B}{\sigma_A}}{\sigma_B(1-\rho^2)}\frac{s-(E\mu^B+\rho\frac{\sigma_B}{\sigma_A}(u-E\mu^A))}{\sigma_B}\right)\times\right.\\ &\left.\times\exp\left\{-\frac{1}{2(1-\rho^2)}\left(\frac{s-(E\mu^B+\rho\frac{\sigma_B}{\sigma_A}(u-E\mu^A))}{\sigma_B}\right)^2\right\}\right]ds\\ &= -\rho\frac{\sigma_B}{\sigma_A}G\left(w|\,\mu^A\!=u\right),\end{aligned}$$

which substituted above yields:

$$\int_{-\infty}^{+\infty}\left[-\frac{d}{du}G\left(w|\,\mu^A\!=u\right)\right]\Big|_{u=u_0}dw=\int_{-\infty}^{+\infty}\rho\frac{\sigma_B}{\sigma_A}G\left(w|\,\mu^A\!=u_0\right)dw=\rho\frac{\sigma_B}{\sigma_A}$$

and hence the well-known relationship:

$$E\left[\mu^B\middle|\,\mu^A\right]=E\left[\mu^B\right]+\rho\frac{\sigma_B}{\sigma_A}\left[\mu^A-E\left[\mu^A\right]\right] \tag{A-3}$$

which is a particular case of (A-1) where $\varpi\equiv\rho\frac{\sigma_B}{\sigma_A}$.

A-2.3 Choice of export strategy (extension of Proposition 1, main text):

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:

$$\overline{F}^{Sq}\!:\ \Psi(\tau^A)+\overline{W}(\tau^B;\overline{F}^{Sq})=\overline{F}^{Sq}, \tag{A-4}$$

$$\overline{F}^{Sm}\!:\ \Psi(\tau^B)-\overline{W}(\tau^B;\overline{F}^{Sm})=\overline{F}^{Sm}. \tag{A-5}$$

Since $\Psi(\tau^j)$ is monotonically decreasing in τ^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.

A-2.4 Comparing imperfect with perfectly correlated export profitabilities

Here we show that when profitabilities are non-negatively regression dependent, the option value of learning one's export profitability in market B by entering in market A first, $\overline{W}(\tau^B;F)$, is bounded by the option values in the two polar cases of i.i.d. distributions (below) and perfect positive correlation (above).

[Not for publication]

We start with the lower bound. With i.i.d. marginal distributions of μ^A and μ^B we have $E\left(\mu^B \middle| \mu^A\right) = E\mu^B = E\mu$ and therefore $\varpi = 0$. Accordingly, the entry condition (A-2) becomes $E\mu \geq 2F^{1/2} + \tau^B$ so that

$$\lim_{\varpi \to 0} \overline{W}(\tau^B; F) = 1_{\{E\mu > 2F^{1/2} + \tau^B\}} \left[1_{\{E\mu > \tau^B\}} \left(\frac{E\mu - \tau^B}{2} \right)^2 - F \right].$$

But then entering market B sequentially is dominated by a simultaneous entry strategy at $t = 1$: $\lim_{\varpi \to 0} \overline{W}(\tau^B; F) < \Psi(\tau^B) - F$. The reason is that by entering at $t = 2$ the firm only sacrifices positive expected profits, $V(\tau^B)$, because under independence, export experience in A is useless in B..Hence $\lim_{\varpi \to 0} \overline{W}(\tau^B; F) = 0$, and the firm will never adopt a sequential entry strategy. Figure 1 below illustrates this case.[10]

Consider now the upper bound. Under perfect positive correlation between μ^A and μ^B, the

[10] Analytically, we only need to examine whether there are values of F such that $\Pi^{Sm} \leq \overline{\Pi}^{Sq}$ when $\varpi = 0$:

$$\Psi(\tau^A) + \Psi(\tau^B) - 2F \leq \Psi(\tau^A) + \lim_{\varpi \to 0} \overline{W}(\tau^B; F) - F$$

Cancelling terms and substituting the expression for $\lim_{\varpi \to 0} \overline{W}(\tau^B; F)$,

$$\Psi(\tau^B) - F \leq \mathbf{1}_{\{E\mu > 2F^{1/2} + \tau^B\}} \left[\mathbf{1}_{\{E\mu > \tau^B\}} \left(\frac{E\mu - \tau^B}{2} \right)^2 - F \right]$$

According to the first indicator function, we must distinguish two cases: (i) if $E\mu > 2F^{1/2} + \tau^B$, the inequality reduces to $V(\tau^B) \leq 0$, which is false. Hence, there is no value of F that satisfies it. (ii) If $E\mu \leq 2F^{1/2} + \tau^B$, the inequality reduces to $\Psi(\tau^B) - F \leq 0$, meaning that the only values of F that satisfy the inequality are those for which early entry in B is not worth ($e_1^B = 0$). Since late entry in B is worth only when $\Psi(\tau^B) - V(\tau^B) \geq F$, $V(\tau^B) > 0$ and the above inequality imply that:

$$F \geq \Psi(\tau^B) > \Psi(\tau^B) - V(\tau^B) \geq F,$$

a contradiction. Therefore, there is no value of F either that satisfies the inequality. Consequently, the sequential entry strategy is never adopted.

[Not for publication]

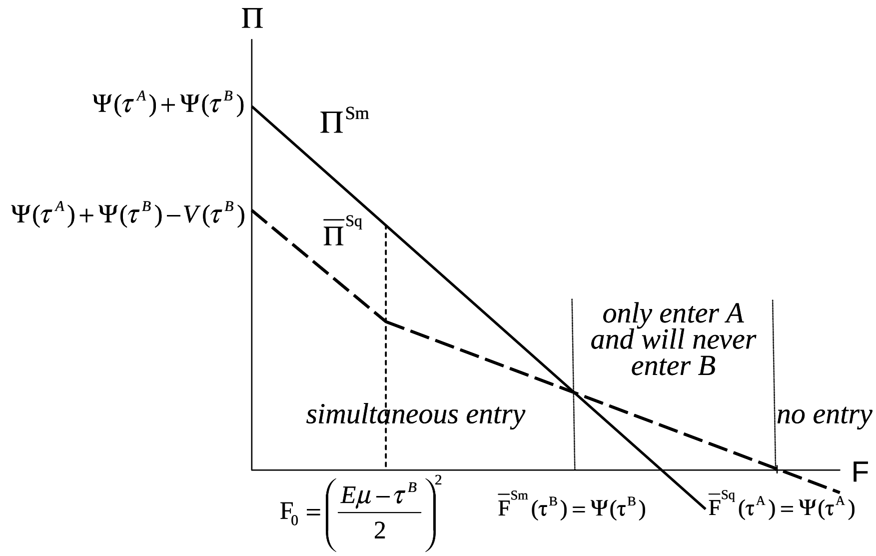

Figure 1: With independent export profitabilities ($\varpi = 0$), a firm will never enter sequentially.

term that captures the degree of statistical dependence ϖ in expression (A-1) becomes [11]:

$$\int_{\underline{\mu}}^{\overline{\mu}} \left[-\frac{d}{du} G\left(w \middle| \mu^A = u \right) \right] \Big|_{u=u_0} dw = 1.$$

Plugging this condition into expression (A-1), and since $E\mu^B = E\mu^A = E\mu$, $E\left(\mu^B \middle| \mu^A\right) = \mu^A$, we obtain that as $\varpi \to 1$:

$$\lim_{\varpi \to 1} \overline{W}(\tau^B; F) = W(\tau^B; F)$$

[11] Under perfect positive correlation between μ^A and μ^B,

$$G\left(w \middle| \mu^A = u \right) = \begin{cases} 1 & \text{if } w \geq u \\ 0 & \text{if } w < u, \end{cases}$$

which is a Heavyside step function (or unit step function) $T(w-u) = \int_{\underline{\mu}}^{u} \delta(w-s)ds$, where $\delta(w-s)$ denotes a Dirac delta function $\delta(w-s) = \begin{cases} +\infty & \text{if } w = s \\ 0 & \text{otherwise} \end{cases}$ such that $\int_{\underline{\mu}}^{\overline{\mu}} \delta(w-s)dw = 1$, $\forall s \left[\underline{\mu}, \overline{\mu}\right]$. Since $\frac{d}{du}T(w-u) = -\delta(w-u)$ we have:

$$\int_{\underline{\mu}}^{\overline{\mu}} \left[-\frac{d}{du} G\left(w \middle| \mu^A = u \right) \right] \Big|_{u=u_0} dw = \int_{\underline{\mu}}^{\overline{\mu}} \delta(w-u_0)dw = 1.$$

which is the expression in the main text. Finally, notice that:

$$\begin{aligned}
W(\tau^B;F) &= E_{\mu^B}\left[\max\left\{\max_{q^B\geq 0}(\mu^B-\tau^B-q^B)q^B-F,0\right\}\right] \\
&= E_{\mu^A}\left[E_{\mu^B|\mu^A}\left(\max\left\{\max_{q^B\geq 0}(\mu^B-\tau^B-q^B)q^B-F,0\right\}\middle|\,\mu^A\right)\right] \\
&\geq E_{\mu^A}\left[\max\left\{\max_{q^B\geq 0}E_{\mu^B|\mu^A}\left[(\mu^B-\tau^B-q^B)q^B\middle|\,\mu^A\right]-F,0\right\}\right] \\
&= E_{\mu^A}\left[\max\left\{\max_{q^B\geq 0}\left[(E\left[\mu^B\middle|\,\mu^A\right]-\tau^B-q^B)q^B\right]-F,0\right\}\right] \\
&= \overline{W}(\tau^B;F), \forall\varpi\geq 0
\end{aligned}$$

where the inequality obtains from applying twice Jensen's inequality and the convexity of the $\max\{.\}$ operator, while the third equality above follows from the law of iterated expectations, i.e. $E_{\mu^B}\left[f(\mu^B)\right] = E_{\mu^A}\left[E_{\mu^B|\mu^A}\left(f(\mu^B)\middle|\,\mu^A\right)\right]$. Therefore:

$$0 \leq \overline{W}(\tau^B;F) \leq W(\tau^B;F)$$

As in the main text, those bounds on the option values correspond to sunk entry cost thresholds above which the exporter prefers to enter sequentially (F^{Sm}), as illustrated in Figure 2. [12]Hence, the region defined by Proposition 1 where it is optimal to adopt a sequential entry strategy shrinks as the statistical dependence of export profitabilities across the two destinations is reduced from

[12] Notice that in figure (in accordance with notation in the main text) $\Pi^{Sq} \equiv \overline{\Pi}^{Sq}\Big|_{\varpi=1}$ whereas, $\overline{\Pi}^{Sq} \equiv \overline{\Pi}^{Sq}\Big|_{\varpi=0}$. Also notice from the figure that $\Pi^{Sq}(F) > \overline{\Pi}^{Sq}(F), \forall F \leq \overline{F}^{Sq}\Big|_{\varpi=1}$. The only non-trivial point is to prove that $\Pi^{Sq}(0) = V(\tau^B) \geq \overline{\Pi}^{Sq}(0) = \Psi(\tau^B) - V(\tau^B)$ which follows from the application of Jensen's inequality and the convexity of the $\max\{.\}$ operator:

$$\begin{aligned}
V(\tau^B) &= E\left[\max_{q\geq 0}(\widetilde{\mu}-\tau^B-q)q\right] = E\left[\mathbf{1}_{\{\mu>\tau^B\}}\left(\frac{\mu-\tau^B}{2}\right)^2\right] \\
&\geq \max_{q\geq 0}E\left[(\widetilde{\mu}-\tau^B-q)q\right] = \mathbf{1}_{\{E\mu>\tau^B\}}\left(\frac{E\mu-\tau^B}{2}\right)^2 \equiv \Psi(\tau^B) - V(\tau^B)
\end{aligned}$$

[Not for publication]

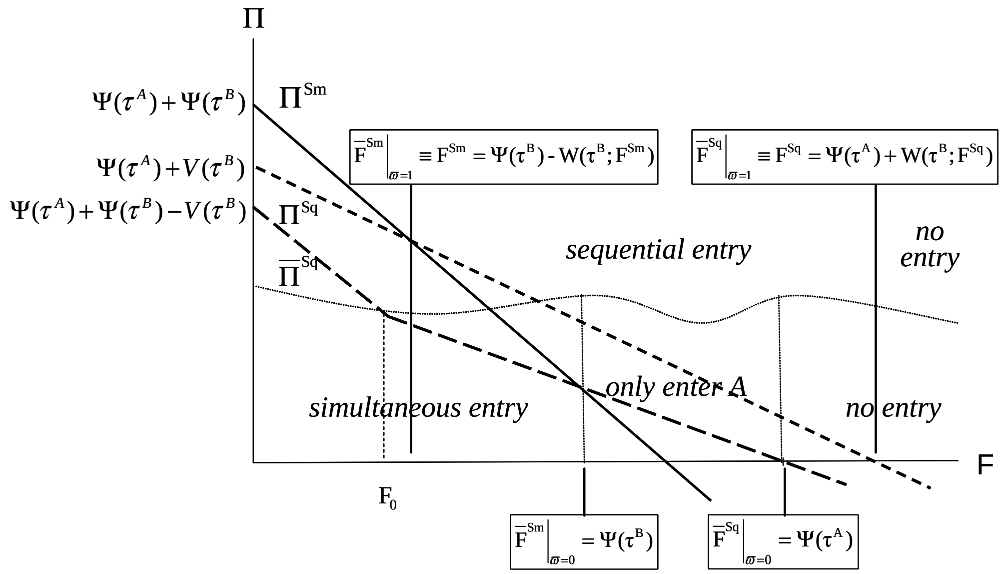

Figure 2: Bounds on sunk entry thresholds, F^{Sm} and F^{Sq}, as a function of the statistical dependence (ϖ) between export profitabilites.

perfect to no correlation:

$$\begin{aligned}
F^{Sq} - F^{Sm} &\equiv \Psi(\tau^A) + W(\tau^B; F^{Sq}) - \left[\Psi(\tau^B) - W(\tau^B; F^{Sm})\right] \\
&= \Psi(\tau^A) - \Psi(\tau^B) + W(\tau^B; F^{Sq}) + W(\tau^B; F^{Sm}) \\
&\geq \Psi(\tau^A) - \Psi(\tau^B) + \overline{W}(\tau^B; \overline{F}^{Sq}) + \overline{W}(\tau^B; \overline{F}^{Sm}) \\
&\equiv \overline{F}^{Sq} - \overline{F}^{Sm}\Big|_{1>\varpi>0} \\
&\geq \Psi(\tau^A) - \Psi(\tau^B) \\
&\equiv \overline{F}^{Sq} - \overline{F}^{Sm}\Big|_{\varpi=0}
\end{aligned}$$

A-3 References

Feller, W. (1966), An Introduction to Probability Theory and Its Applications, Vol. II, Wiley Series in Probability and Mathematical Statistics, John Wiley and Sons.

Lehmann, E. L. (1966), "Some Concepts of Dependence", *The Annals of Mathematical Statistics* 37(5), 1137-1153.