

Survival in Export Markets*

Facundo Albornoz[†], P. Sebastian Fanelli[‡] and Juan Carlos Hallak[§]

May 2013

Very preliminary and incomplete

Abstract

This paper explores the determinants of firms' survival in export markets. In our theoretical framework, firm profitability is characterized by a general parameter that follows a geometric Brownian motion process and a set of market specific components that are fixed over time. Exporting involves sunk and fixed costs, which vary across destinations but are the same across firms. We derive the probability of survival upon entry in a given market. This probability is common to all firms despite their market specific profitability fixed component. Hence, export survival only depends on the magnitude of sunk and fixed costs. The predictions on their effects are opposite: the probability of survival increases with the sunk cost and decreases with the fixed cost, but only if sunk costs are positive. We test these predictions using Argentine customs data. We use distance and export experience as proxies for both fixed and sunk costs. The probability of survival decreases with distance and is higher for experienced firms. These results indicate that fixed costs prevail over sunk costs to explain cross-country variation in survival probabilities and variation in these probabilities between experienced and inexperienced firms.

JEL codes: F10, F12, F14

Keywords: Survival, export dynamics, fixed cost, sunk cost, productivity, firm heterogeneity

*Juan Carlos Hallak thanks the National Science Foundation (grant #SES-05550190) and FONCYT (grant PICT-200801643). We thank Javier Cao for his research assistance.

[†]Universidad de San Andres and CONICET

[‡]MIT

[§]Universidad de San Andres and CONICET

1 Introduction

Recent evidence on the dynamics of aggregate exports shows that a substantial fraction of export growth is explained by new exporters (Eaton, Eslava, Kugler, and Tybout, 2008; Bernard, Jensen, Redding, and Schott, 2009; Lawless, 2009). For example, Eaton, Eslava, Kugler, and Tybout (2008) show that new exporters explain about 50% of export growth in Colombia between 1996 and 2005. Using our dataset of Argentine firms, we find that during the period between 1995 and 2006 new exporters explain 38% of total export growth and 61% of this growth when we add old exporters entering new destinations. New exporters tend to start small and focused on a single, usually neighboring, country. Once they outlive their entry year they tend to expand their sales abroad and reach a larger number of destinations (Albornoz, Corcos, and Ornelas, 2012; Lawless, 2009; Buono, Fadinger, and Aeberhardt, 2009). The occurrence of this process, however, is not guaranteed. Both new exporters and exporters entering new markets exhibit high rates of failure in their exporting activity. Eaton, Eslava, Kugler, and Tybout (2008) show that about half of new exporters discontinue their exporting activity within the first year. Using Argentine firms, we find a survival rate of 24% after two years for exporters - new or old - entering a new export destination. Since export growth critically requires export incursions to be sustained over time, this body of evidence strongly points to the importance of understanding the determinants of firms' survival in export markets. This is our endeavor in this paper.

Since the early work of Baldwin (1988); Krugman (1989); Baldwin and Krugman (1989) and Dixit (1989), the literature on export dynamics has emphasized the importance of sunk and fixed costs in explaining entry and exit in export markets. The effect of these costs on the export activity of firms has been estimated by Roberts and Tybout (1997) and Bernard and Jensen (2004). More recently, quantifying these costs has become one of the most important challenges in this literature. Unfortunately, little consensus has been reached on their magnitude and relevance. Das, Roberts, and Tybout (2007) find that sunk costs are substantial but fixed costs are negligible. Instead, Morales, Sheu, and Zahler (2011) find that fixed costs are higher than sunk costs. While our paper does not produce empirical estimates of those costs, the model yields empirical predictions that can be tested to infer their relative sensitivity to distance and export experience. First, we show that differences in country-specific fixed exporting costs are essential to explain the fact that survival rates upon entry are higher in more proximate countries. Also, the effect of experience on fixed costs has to be stronger than its effect on sunk costs to explain that experienced exporters have a higher survival probability than inexperienced ones when they enter a new market.

We model firms whose profitability follows a geometric Brownian motion process (GBM) in a stable environment. A firm's profitability process can be derived as the combination of firm-specific GBM processes for productivity and demand. While the profitability process of a firm applies equally to all markets, each firm is endowed with a set of idiosyncratic market-specific fixed profitability shifters. Hence, since the markets' relative appeal differs across firms the ordering in which they enter foreign markets also varies. Entering each market imposes paying a sunk cost that is common for all firms. In addition, firms need to

pay market-specific fixed costs - also common to all firms - while they operate in a given market. Once a firm has entered a market by paying the sunk cost it can suspend operations and avoid fixed costs until it decides to operate again. Thus, there is no need to repay the sunk cost to resume operations. Under this environment, we derive the probability of survival upon entry in a given market and we perform comparative statics with respect to sunk costs, fixed costs, and the idiosyncratic demand parameter. A key finding is that the idiosyncratic profitability parameter does not have an effect on the probability of survival upon entry. Hence, this probability is the same for all firms entering a given market and only depends on the magnitude of sunk and fixed costs. Higher sunk costs increase the probability of survival while higher fixed costs decrease this probability albeit only if sunk costs are positive.

While in the baseline model the firm's decision to enter a market is independent of the decision to enter other markets, we also study the case in which export decisions are interdependent across markets through the effect of export experience on sunk and fixed costs. In particular, we allow sunk and fixed costs to be lower for an "experienced" firm, where the relevant experience can be defined to come from previous exports to any other country or, in the spirit of Morales, Sheu, and Zahler (2011) "extended gravity", only to related countries (e.g. by geographical proximity or a common language). We compare the probability of survival upon entry for an experienced firm and for an inexperienced firm. For sunk costs, we find that an experienced firm should have a lower survival probability as the sunk costs it needs to pay are lower. For fixed costs, the result is ambiguous and cannot be obtained in closed form. However, simulations under most parameter configurations show that experience should increase the probability of survival.

A direct test of the model's predictions would require exploiting variation across countries in sunk and fixed costs. Unfortunately, it is not easy to find independent proxies for both types of costs. In fact, observable variables that can proxy for sunk costs also proxy for fixed costs. For example, distance should be positively related to the magnitude of both. Hence, while this variable does not allow us to test the predictions for each type of cost independently, it informs us on their relative importance for explaining variation across countries in survival probabilities. Using Argentine firm-level customs data, our main finding is that the probability of survival decreases with Argentina's distance to the destination country. Since the prediction for higher sunk and fixed costs are opposite, the evidence implies that cross country variation in fixed costs prevails over variation in sunk costs to explain the observed cross-country variation in survival probabilities. Nevertheless, since higher fixed costs imply lower survival probabilities only when sunk costs are positive, the evidence also points to a relevant presence of sunk costs. Other variables such as common language and having a similar per-capita income are also proxies for both sunk and fixed costs. The results using these alternative variables yield a similar conclusion: fixed costs prevail over sunk costs to explain cross country variation in survival probabilities.

Finally, the export experience of a firm can also proxy for the relative magnitude of sunk and fixed costs. In fact, an experienced firm could be expected to face lower sunk and fixed costs. Hence, the effect of experience on the survival probability upon entry depends on its relative effect on these costs. Using

firms' export experience has the advantage that we can control for the common effect of country-level sunk and fixed costs by introducing destination firm effects. Thus, we can focus on the differential impact of firms' export experience. The empirical results show that the probability of survival upon entry is higher for experienced firms. Hence the message coming from differences in experience levels across firms is that fixed costs, once again, prevail over sunk costs to explain systematic patterns of variation in survival probabilities.

Our paper contributes to a growing theoretical and empirical literature on the dynamics of firms' exports. Arkolakis (2012) develops a general equilibrium model of industry and export dynamics and derives the probability of survival for an incumbent cohort. Rather, we focus on the probability of survival of an entering cohort. In addition, we perform comparative statics with respect to sunk and fixed costs, and with respect to the idiosyncratic profitability parameter. One important difference with his model is that he assumes sunk costs away based on evidence that the size of entrants is similar to the size of exiters. Instead, according to our model sunk costs need to be relevant to explain the observed pattern of survival probabilities across countries. Impullitti, Irarrazabal, and Opromolla (2013) build a theoretical model with both sunk and fixed costs, as we do, but they assume that a firm that exits a market needs to pay the sunk cost again to re-enter. While they derive the probability of survival of an incumbent cohort as in Arkolakis (2012) they do not derive survival probabilities for an entering cohort. Nevertheless, they use calibrations to study the response of the "band of inaction"- a monotonic function of the probability of survival upon entry - to fixed and sunk costs.

Starting with the work of Roberts and Tybout (1997), empirical work has attempted to estimate fixed and sunk costs. In particular, Das, Roberts, and Tybout (2007) and Morales, Sheu, and Zahler (2011) have structurally estimated both types of costs. Their findings, however, are mutually contradictory. While Das, Roberts, and Tybout (2007) find that sunk costs are substantial but fixed costs are negligible, Morales, Sheu, and Zahler (2011) find that fixed costs are on average larger than sunk costs. Furthermore, this last paper also finds that sunk costs can differ widely across countries according to geography, language, and income while fixed costs are almost insensitive to variation in these dimensions. Our findings are the opposite. We find that a larger variation in fixed costs than in sunk costs is necessary to explain the observed relationship between distance and probability of survival upon entry.

An incipient literature is focused on the determinants of export survival at the firm level. Görg, Kneller, and Muraközy (2012) exploit a panel of Hungarian exporters and find that firm productivity is positively related to the duration of a new export experience. They also find that multi-product exporters are relatively more successful in exporting their core product. Cadot, Iacovone, and Rauch (2013) use customs data from Malawi, Mali, Senegal, and Tanzania. They find an informational externality according to which the probability of survival upon entry in a new market increases in the number of competitors from the same country already serving that market. Closer to our analysis, Békés and Muraközy (2012) find that firm productivity, financial stability, and GDP of the destination country are determinants of export survival. As we do, they also find that the survival probability upon entry a new destination decreases with distance.

To interpret this result, they propose a model where firms can pay a country-invariant sunk cost to reduce variable trade costs, which increases their survival probability. As firms draw a productivity parameter at the “start of the world”, conditional on their given productivity they have fewer incentives to invest those sunk costs in distant markets, where profits are lower. Hence, firms tend to survive with a lower probability upon entry in those markets. In our model, the effect of distance is explained by sunk and fixed cost that vary across destinations. Furthermore, since we do not force an export decision at the start of the world we show that the general appeal of a market affects the time of entry but not the survival probability. We also contribute to this literature by showing that differences in survival probabilities across firms are explained by differences in their export experience.

The rest of the paper proceeds as follows. In section 2, we develop the case of independent markets and generate predictions about variation in survival probabilities across destination countries. In section 3, we take those predictions to the data by looking at the effect of distance and other “gravity” variables on export survival probabilities. In section 4, we develop the case of interdependent markets and generate predictions about variation in survival probabilities according to firms’ export experience. In section 5, we estimate the effect of different forms of experience on export survival probabilities.

2 Determinants of export survival (I): Independent markets

In this section, we present our dynamic model of export dynamics and study how survival in export markets depends on the characteristics of these markets. We analyze the problem of a firm that has to decide whether and when to enter a foreign market. In section 2.1, we describe the set up of the model. In section 2.2, we find the optimal entry threshold θ_k^* for market k as a function of parameters that characterize that market. In section 2.3, we derive the probability of survival upon entry. In section 2.4, we perform comparative statistics to determine how the survival probability varies across markets. Here, we focus on the case in which the entry decision is independent across markets. Specific cases of interdependence are analyzed in section 4.

2.1 Setup

Each firm is characterized by a general-profitability parameter θ_t and a set of market-specific profitability shifters $\Psi = \{\psi_k\}_{k=1,\dots,K}$ for each of K foreign markets. Although we do not include a firm subindex to simplify notation, it is important to keep in mind that both θ_t and Ψ are firm specific. The general productivity parameter follows a geometric brownian motion (GBM) given by

$$d\theta_t = \alpha\theta_t dt + \sigma\theta_t dz \tag{1}$$

where α and σ are, respectively, drift and volatility parameters and z is a standard brownian motion. Firms are risk-neutral and have a constant discount factor v . We assume $v > \alpha$ to ensure that expected discounted profits are bounded. The profitability parameter θ_t captures both productivity and demand components. Appendix 1 shows that θ can be microfounded as a combination of demand and productivity shocks that follow a multivariate GBM in a stationary monopolistic competition framework with CES preferences.

Market-specific profitability shifters are firm specific but constant over time. They capture differences in the relative profitability of foreign markets across firms arising, for example, from their ability to match idiosyncratic tastes in a given market. Hence, when a firm enters market k , its operating profits (π_{kt}) are given by:

$$\pi_{kt} = \psi_k \theta_t. \quad (2)$$

Using Ito's lemma, it is readily shown that π_{kt} also follows a GBM with the same parameters as the stochastic process for θ .

Each foreign market is characterized by two parameters: (S_k, F_k) . To enter an export market, the firm must pay a sunk cost given by S_k . This is the cost of setting up a distribution network, learning foreign regulations, and undertaking marketing efforts to establish a product or brand in the market. Exporting to market k also entails paying fixed costs F_k . Fixed costs capture the costs of operating a minimum-scale sales office in the foreign country, conducting regular marketing efforts, and maintaining relationships with distributors. In this section, we assume that both S_k and F_k are independent across markets.

We assume that whenever $\pi_{kt} < F_k$, the firm can suspend its activity in market k without cost and resume it when conditions improve without having to repay the sunk cost S_k . Hence, after entering market k , the firm is forever entitled to the flow of net profits $\Pi_{kt} = \max\{\pi_{kt} - F_k, 0\}$.

2.2 Solving for the entry threshold θ_k^*

Formally, the entry problem the firm faces is a standard “optimal stopping” problem in contexts of investment under uncertainty (Dixit and Pindyck, 1994). There are three possible states for the firm regarding its activity in market k . The firm is “outside” market k if it has not yet paid the sunk cost S_k , and it is “inside” that market if it has paid this cost. In turn, an inside firm can be “active” if it is currently operating in the market ($\pi_{kt} \geq F_k$) or “inactive” otherwise ($\pi_{kt} < F_k$). At every instant while the firm is outside market k , it must decide whether to continue in its current state or pay the sunk cost to enter this market. As we will show later, the solution to this entry problem is characterized by a unique threshold value θ_k^* such that the firm stays outside market k if $\theta_t \in [0, \theta_k^*)$ and enters this market if $\theta_t \in [\theta_k^*, \infty)$.

We will approach the problem as follows. First, we will compute the value of an outside firm, $V_{0k}(\theta)$. Then, we will compute the value of an inside firm, $\Omega_k(\theta_t)$. Computing the latter value requires taking into account that the firm will suspend operations whenever $\pi_{kt} < F_k$. Armed with $V_{0k}(\theta_t)$ and $\Omega_k(\theta_t)$, we will use the value-matching and smooth-pasting conditions to find the optimal entry threshold θ_k^* .

The outside firm The firm does not generate any income flow from market k while it is outside that market. However, the option to enter this market and realize positive profits has a value, V_{0k} . The firm is risk-neutral. Hence, within the region where staying outside market k is optimal this value is just the discounted expected profits of the firm in that market. Since there is no current income flow, the Bellman equation is

$$V_{0k}(\theta_t) = \frac{1}{1 + v dt} E(V_{0k}(\theta_t + d\theta_t))$$

which tells us that the value of the firm at time t is just the discounted expected value at time $t + dt$. This equation can be rewritten as

$$vV_{0k}(\theta_t)dt = E(dV_{0k}(\theta_t)). \quad (3)$$

Using Ito's Lemma, we can expand $dV_{0k}(\theta_t)$ to obtain

$$dV_{0k}(\theta_t) = \frac{dV_{0k}}{d\theta_t} d\theta_t + \frac{1}{2} \frac{d^2V_{0k}}{d\theta_t^2} (d\theta_t)^2.$$

It can be shown that $(d\theta_t)^2 = \sigma^2 \theta_t^2 dt$ (all the other terms go faster to 0). Then, using equation (1) to substitute for $d\theta_t$ yields

$$dV_{0k}(\theta_t) = \frac{dV_{0k}}{d\theta_t} (\alpha\theta_t dt + \sigma\theta_t dz) + \frac{1}{2} \frac{d^2V_{0k}}{d\theta_t^2} \sigma^2 \theta_t^2 dt.$$

Taking expectations and noting that $E(dz) = 0$:

$$E(dV_{0k}(\theta_t)) = \frac{dV_{0k}}{d\theta_t} \alpha\theta_t dt + \frac{1}{2} \frac{d^2V_{0k}}{d\theta_t^2} \sigma^2 \theta_t^2 dt.$$

Using (3), cancelling out dt and rearranging, we obtain:

$$\frac{1}{2} \frac{d^2V_{0k}}{d\theta_t^2} \sigma^2 \theta_t^2 + \frac{dV_{0k}}{d\theta_t} \alpha\theta_t - vV_{0k}(\theta_t) = 0. \quad (4)$$

This is a second order homogeneous differential equation which is linear in V_{0k} and its derivatives. Hence, its solution has the general form

$$V_{0k}(\theta_t) = A_{0k1} \theta_t^{\beta_1} + A_{0k2} \theta_t^{\beta_2}. \quad (5)$$

Computing $\frac{dV_{0k}}{d\theta_t}$ and $\frac{d^2V_{0k}}{d\theta_t^2}$, replacing in (4), and using simple algebra we obtain:

$$\frac{1}{2} \beta^2 \sigma^2 + (\alpha - \frac{1}{2} \sigma^2) \beta - v = 0.$$

The roots of this quadratic equation provide the values β_1 and β_2 that solve the differential equation:

$$\beta_{1,2} = \frac{1}{2} - \frac{\alpha}{\sigma^2} \pm \sqrt{\left(\frac{\alpha}{\sigma^2} - \frac{1}{2}\right)^2 + \frac{2v}{\sigma^2}}$$

Using simple algebra and the fact that $\alpha < v$, it can be shown that $\beta_1 > 1$ and $\beta_2 < 0$.¹

From equation (1), we can see that $d\theta_t \rightarrow 0$ as $\theta_t \rightarrow 0$. In other words, 0 is an absorbing state of the GBM. Since $\beta_2 < 0$, we can see in equation (5) that unless $A_{0k2} = 0$ the value of the outside firm would increase without bound as $\theta_t \rightarrow 0$. Therefore (we abuse notation by dropping the last subindex of the constant):

$$V_{0k}(\theta_t) = A_{0k}\theta_t^{\beta_1}. \quad (6)$$

This equation characterizes the dynamics of the value function over the interval $[0, \theta_k^*)$. Since $\beta_1 > 1$, this option value is a convex function of θ_t . The intuition is the following. For low values of θ , increases in its value are irrelevant under most possible trajectories since, despite the increment, this variable will still not pass the entry threshold. As θ grows, increases in this variable affect actual profits under an increasingly larger fraction of possible trajectories. Equation (6) regulates the value of an outside firm. While β_1 is a known parameter, we still need to determine the value of A_{0k} . We will be able to determine this value once we solve for the value of an inside firm.

The inside firm Once the firm has paid the sunk cost S_k , it can be either active or inactive. Since exporting can be temporarily and costlessly suspended, it will be inactive in market k whenever $\pi_{kt} < F_k$ and will resume activity in that market when $\pi_{kt} \geq F_k$. Since $\pi_{kt} = \psi_k \theta_t$, this implies that the firm will be inactive when $\theta_t < \frac{F_k}{\psi_k}$ and will resume activity when $\theta_t \geq \frac{F_k}{\psi_k}$. We will analyze each of the two cases in turn.

In the region $\pi_{kt} \geq F_k$ (active firm), exporting is optimal and the firm generates an income flow of $\pi_{kt}dt - F_kdt$. Then, the Bellman equation is given by:

$$V_1(\pi_{kt}) = (\pi_{kt} - F_k)dt + \frac{1}{1 + vdt} E(V_{1k}(\pi_{kt} + d\pi_{kt}))$$

where $V_1(\pi_{kt})$ is the value of the active firm. Rearranging terms,

$$V_{1k}(\pi_{kt})vdt = (\pi_{kt} - F_k)dt(1 + vdt) + E(dV_{1k}(\pi_{kt})).$$

Discarding the term with dt^2 (which has a negligible magnitude), we obtain:

$$V_{1k}(\pi_{kt})vdt = (\pi_{kt} - F_k)dt + E(dV_{1k}(\pi_{kt})). \quad (7)$$

Expanding $dV_{1k}(\pi_{kt})$ using Ito's Lemma and taking expectations yields

$$E(dV_{1k}(\pi_{kt})) = \frac{dV_{1k}}{d\pi_{kt}}\alpha\pi_{kt}dt + \frac{1}{2} \frac{d^2V_{1k}}{d\pi_{kt}^2}\sigma^2\pi_{kt}^2dt.$$

¹First, using $\alpha < v$ show that $\beta_1 > 1$. Then, simple algebra yields $\beta_1\beta_2 < 0$, which finally implies that $\beta_2 < 0$.

Using (7), cancelling out dt , and rearranging, we obtain

$$\frac{1}{2} \frac{(dV_{1k})^2}{d\pi_{kt}^2} \sigma^2 \pi_{kt}^2 + \frac{dV_{1k}}{d\pi_{kt}} \alpha \pi_{kt} - vV_{1k} + \pi_{kt} - F_k = 0. \quad (8)$$

This is a second order non-homogeneous differential equation. The homogeneous part of this equation is identical to equation (4). Hence the solution is also given by an equation of the form $V_{1k}(\theta_t) = A_{1k1}\theta_t^{\beta_1} + A_{1k2}\theta_t^{\beta_2}$ with identical β_1 and β_2 (remember $\beta_1 > 1$ and $\beta_2 < 0$) but different constants A_{1k1} and A_{1k2} . To solve the non-homogeneous part, we try a particular solution of the form $K_1\pi_{kt} + K_2$. Computing $\frac{dV_{1k}}{d\pi_{kt}}$ and $\frac{d^2V_{1k}}{d\pi_{kt}^2}$ and substituting back into (8), we obtain:

$$(K_1\alpha - K_1v + 1)\pi_{kt} - K_2v - F_k = 0.$$

The values of K_1 and K_2 that solve these equations are, respectively, $K_1 = \frac{1}{v-\alpha}$ and $K_2 = \frac{-F_k}{v}$. Hence, the particular solution to equation (8) is $\frac{\pi_{kt}}{v-\alpha} - \frac{F_k}{v}$. Combining the homogeneous and non-homogeneous solutions for this differential equation, we obtain the general solution:

$$V_{1k}(\pi_t) = A_{1k1}\pi_{kt}^{\beta_1} + A_{1k2}\pi_{kt}^{\beta_2} + \frac{\pi_{kt}}{v-\alpha} - \frac{F_k}{v}.$$

If the firm were required to operate forever, despite any losses, then its value would be $\frac{\pi_{kt}}{v-\alpha} - \frac{F_k}{v}$. This should be precisely the value of the firm as $\pi_{kt} \rightarrow \infty$ since in that case there is no extra value of staying active in the market. Since $\beta_1 > 0$, this implies that $A_{0k1} = 0$. Hence, the general solution of the differential equation for the active inside firm is:

$$V_{1k}(\pi_{kt}) = A_{1k}\pi_{kt}^{\beta_2} + \frac{\pi_{kt}}{v-\alpha} - \frac{F_k}{v} \quad (9)$$

which is valid over the interval $\pi_{kt} \in [F_k, \infty)$. The first term of this solution can be interpreted as the value of the option to suspend activity in the export market when net profits are negative. Since the value of this option is small when π_{kt} is high, this value decreases with π_{kt} ($\beta_2 < 0$). Also, because this option value is positive, $A_{1k} > 0$.

In the region $\pi_{kt} < F_k$ (inactive firm), the firm does not generate an income flow. However, there is a value V_{1k} associated with its potential re-entry and realization of positive profits in market k . Hence, within the region where suspending the export activity is optimal, this value today is just the discounted expected value tomorrow. Accordingly, the Bellman equation can be expressed simply as:

$$vV_{1k}(\pi_{kt})dt = E(dV_{1k}(\pi_{kt})). \quad (10)$$

Following the same steps we followed in the case of the outside and the active firms, we obtain:

$$\frac{1}{2} \frac{d^2 V_{1k}}{d\pi_{kt}^2} \sigma^2 \pi_{kt}^2 + \frac{dV_{1k}}{d\pi_{kt}} \alpha \pi_{kt} - v V_{1k}(\pi_{kt}) = 0.$$

This equation is identical to equation (4) and to the homogeneous part of equation (8). Hence, the solution has the following general form:

$$V_{1k}(\pi_{kt}) = B_{1k1} \pi_{kt}^{\beta_1} + B_{1k2} \pi_{kt}^{\beta_2} \quad (11)$$

with the same roots, β_1 and β_2 , as in those equations. As before, we know that $d\pi_{kt} \rightarrow 0$ as $\pi_{kt} \rightarrow 0$ because π_{kt} is a GBM. Hence, $V_{1k}(\pi_{kt}) \rightarrow 0$ when $\pi_{kt} \rightarrow 0$. Since $\beta_2 < 0$, this implies that $B_{1k2} = 0$. This leaves:

$$V_{1k}(\pi_{kt}) = B_{1k} \pi_{kt}^{\beta_1}. \quad (12)$$

Equation (12) characterizes the value function dynamics over the interval $\pi_{kt} \in [0, F_k]$. In this range, $V_{1k}(\pi_{kt})$ represents the value of the option to resume operations when conditions improve to the point that $\pi_{kt} \geq F_k$. Since this option value is positive, $B_{1k} > 0$. Note again that, as $\beta_1 > 1$, this is a convex function of π_{kt} .

Since the inside firm can costlessly choose to continue or suspend operations, it must be indifferent between any of these two actions at $\pi_{kt} = F_k$. Hence, the value functions of the active and inactive firms must coincide at this point. Equating (9) and (12), and evaluating these equations at $\pi_{kt} = F_k$ (value-matching condition) we obtain:

$$A_{1k} F_k^{\beta_2} + \frac{F_k}{v - \alpha} - \frac{F_k}{v} = B_{1k} F_k^{\beta_1}. \quad (13)$$

Also, since the Brownian motion of π_{kt} can diffuse freely across the boundary F_k , $V_{1k}(\pi_{kt})$ must be continuously differentiable at that point. Therefore, the derivatives of (9) and (12) also need to coincide at $\pi_{kt} = F_k$ (smooth-pasting condition):

$$\beta_2 A_{1k} F_k^{\beta_2 - 1} + \frac{1}{v - \alpha} = \beta_1 B_{1k} F_k^{\beta_1 - 1}. \quad (14)$$

Combining (13) and (14), we obtain

$$(\beta_1 - \beta_2) A_{1k} F_k^{\beta_2} + (\beta_1 - 1) \frac{F_k}{v - \alpha} - \beta_1 \frac{F_k}{v} = 0. \quad (15)$$

Hence, solving for A_{1k} yields

$$A_{1k} = \frac{F_k^{1 - \beta_2}}{\beta_1 - \beta_2} \left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha} \right)$$

and substituting back into (13) yields,

$$B_{1k} = \frac{F_k^{1 - \beta_1}}{\beta_1 - \beta_2} \left(\frac{\beta_2}{v} - \frac{\beta_2 - 1}{v - \alpha} \right).$$

Equations (9) and (12) provide the value function dynamics for the active and inactive firms, respectively, in terms of profits. Since $\pi_{kt} = \psi_k \theta_t$, we can express those equations in terms of the general profitability parameter θ :

$$\Omega_k(\theta) = \left\{ \begin{array}{l} A_{1k}(\psi_k \theta_t)^{\beta_2} + \frac{\psi_k \theta_{kt}}{v-\alpha} - \frac{F_k}{v} \text{ if } \theta \geq \frac{F_k}{\psi_k} \\ B_{1k}(\psi_k \theta_t)^{\beta_1} \text{ if } \theta < \frac{F_k}{\psi_k} \end{array} \right\}. \quad (16)$$

The function $\Omega_k(\theta)$ describes the value function dynamics of the inside firm. This function subsumes the optimal “entry-exit” decisions. Since profits increase across the board when θ increases and V_{1k} increases with π_{kt} , expected profits $\Omega_k(\theta)$ are also increasing with θ . In addition, since θ_t follows a GBM, the cumulative probability distribution $\Phi(\theta'|\theta)$ shifts uniformly to the right when θ increases. These two facts guarantee that the solution to the entry problem features a threshold value θ_k^* that defines a continuation region $[0, \theta_k^*)$ and a stopping region $[\theta_k^*, \infty)$ and thus justifies the approach followed here to solve the entry problem. All parameter values of $\Omega_k(\theta)$ are known. But we need to use this equation to determine the unknown values A_{0k} and θ_k^* . We do that next.

Using the thresholds to solve for the coefficients Since firms are risk-neutral, at the entry threshold θ_k^* the value matching condition states that the value of being outside, $V_{0k}(\theta_{kt})$, should equal the value of being inside, which is given by $\Omega(\theta_{kt}) - S_k$:

$$V_{0k}(\theta_k^*) = \Omega(\theta_k^*) - S_k \quad (17)$$

As it has already been shown in the literature for general optimal stopping problems, the solution also verifies the smooth-pasting condition, which states that the slopes of both value functions must meet tangentially at the thresholds:

$$\left. \frac{dV_{0k}(\theta_t)}{d\theta_t} \right|_{\theta_k^*} = \left. \frac{d\Omega(\theta_t)}{d\theta_t} \right|_{\theta_k^*} \quad (18)$$

Replacing (6) in (17) and (18) yields

$$-A_{0k}\theta_k^{*\beta_1} + \Omega(\theta_k^*) = S_k \quad (19)$$

$$-A_{0k}\beta_1\theta_k^{*\beta_1-1} + \Omega'(\theta_k^*) = 0 \quad (20)$$

Since there is no reason to incur the sunk cost S_k ahead of time to keep the project idle, the firm will not enter unless $\theta_k^* > \frac{F_k}{\psi_k}$. Hence, we can use the appropriate expression for $\Omega(\theta_k^*)$ – the top line in (16) – in (19) and (20) to obtain:

$$-A_{0k}\theta_k^{*\beta_1} + A_{1k}\psi_k^{\beta_2}\theta_k^{*\beta_2} + \frac{\psi_k\theta_k^*}{v-\alpha} - \frac{F_k}{v} = S_k \quad (21)$$

$$-\beta_1 A_{0k}\theta_k^{*\beta_1-1} + \beta_2 A_{1k}\psi_k^{\beta_2}\theta_k^{*\beta_2-1} + \frac{\psi_k}{v-\alpha} = 0 \quad (22)$$

Combining these two equations yields :

$$(\beta_1 - \beta_2)A_{1k}\psi_k^{\beta_2}\theta_k^{*\beta_2} + \frac{(\beta_1 - 1)}{v - \alpha}\psi_k\theta_k^* - \beta_1\left(\frac{F_k}{v} + S_k\right) = 0. \quad (23)$$

Using the expression for A_{1k} and substituting back into (23), we obtain:

$$\left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha}\right)F_k^{1-\beta_2}\psi_k^{\beta_2}\theta_k^{*\beta_2} + \frac{(\beta_1 - 1)}{v - \alpha}\psi_k\theta_k^* - \beta_1\left(\frac{F_k}{v} + S_k\right) = 0. \quad (24)$$

This equation determines the optimal entry threshold θ_k^* . We cannot solve for θ_k^* in closed form. However, the following lemma will help us characterize key features of the implicit solution.

Lemma 1. Let $G_k(\theta)$ be the left-hand-side of equation (24). There is a unique $\theta_k^* \in [\frac{F_k}{\psi_k}, \infty)$ such that $G_k(\theta_k^*) = 0$. Furthermore, since $G'_k(\theta) > 0$ for $\theta \in (\frac{F_k}{\psi_k}, \infty)$, $G'_k(\theta_k^*) > 0$.

Proof. See Appendix 2.

Since we already knew that the entry threshold had to be in the region $\theta_k^* \in [\frac{F_k}{\psi_k}, \infty)$, this is the unique entry threshold. Note that, as ψ_k varies across firms, so does the entry threshold θ_k^* . The second part of Lemma 1 will be useful for obtaining comparative statistics results.

2.3 The probability of survival

We define the probability of survival $P_k(T)$ as the probability that a firm entering market k at time s is still active in that market at time $s + T$. As an initial condition, we assume that all firms are born with an initial value θ_0 that is lower than θ_k^* .² Therefore, the continuity of the process for θ_t ensures that all firms that enter market k do it with the value of the general productivity parameter θ_k^* at their (firm-specific) entry thresholds. In turn, the exit (or suspension) of the firm in market k will occur whenever its operating profits π_{kt} fall below F_k , i.e. when $\theta_t < \frac{F_k}{\psi_k}$. As a result, firms enter the market with $\theta_t = \theta_k^*$ and exit it with $\theta_t = \frac{F_k}{\psi_k}$.

The probability of survival $P_k(T)$ can be written as:

$$P_k(T) = P\left(\theta(s+T) > \frac{F_k}{\psi_k} \middle| \theta(s) = \theta_k^*\right)$$

Since θ_t is a GBM with parameters α and σ , $\log \theta_t$ is a standard brownian motion with drift $\alpha' \equiv \alpha - \frac{1}{2}\sigma^2$ and volatility σ . Hence, the distribution of $\log(\theta_{s+T})$ conditional on $\log(\theta_s)$ is normally distributed with mean $\alpha'T$ and variance σ^2T . Normalizing (wlog) $s = 0$, $P_k(T)$ can be computed as:

$$P_k(T) = 1 - \Phi\left(\frac{\log(\frac{F_k}{\psi_k\theta_k^*}) - \alpha'T}{\sigma\sqrt{T}}\right) \quad (25)$$

²Since we focus on entry into export markets, this assumption implies that firms serve their domestic market first.

Equation (25) displays a closed form solution for the probability of survival in market k as a function of model parameters and the endogenous entry threshold θ_k^* . All the parameters of the model except for the market-specific shifter ψ_k are assumed to be common across firms. Those parameters include the sunk cost (S_k), the fixed cost (F_k), and the parameters of the general profitability process (α and σ). Therefore, only differences in ψ_k – and the differences they induce on θ_k^* – could potentially generate variation across firms in survival probabilities for a given market. However, as we will show next, $P_k(T)$ does not depend on ψ_k and hence will be the same for all firms entering market k .³

2.4 Comparative Statics

This section investigates the relationship between survival probabilities and market characteristics. In particular, we study how $P_k(T)$ varies with parameters ψ_k , S_k , and F_k . The analysis in this section delivers the main empirical predictions of our model. In the next section, under assumptions about how these parameters vary with observable market characteristics such as distance, we will exploit cross-country variation in survival probabilities to infer the relative importance of fixed versus sunk costs.

The first result establishes that differences across firms in their profitability parameter ψ_k do not affect their survival probability in that market. Hence, $P_k(T)$ is constant across firms.

Proposition 1. $P_k(T)$ is independent of ψ_k .

Proof.

Let $\tilde{\theta}_k = \psi_k \theta_k$ and rewrite (24) as follows:

$$\left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha} \right) F_k^{1-\beta_2} \tilde{\theta}_k^{\beta_2} + \frac{(\beta_1 - 1)}{v - \alpha} \tilde{\theta}_k^* - \beta_1 \left(\frac{F_k}{v} + S_k \right) = 0. \quad (26)$$

By analogy to the proof of Lemma 1, it can easily be checked that there is a unique $\tilde{\theta}_k$ that satisfies (26) – just use the proof in Appendix 2 setting $\psi_k = 1$. Hence, the entry threshold is determined by $\theta_k^* = \frac{\tilde{\theta}_k}{\psi_k}$. This implies that differences across firms in the profitability of market k induce a compensating change in their entry threshold to that market such that $\psi_k \theta_k^*$ remains constant. For example, a firm with twice as much market-specific profitability ($\psi'_k = 2\psi_k$) halves its entry threshold ($\theta_k^{*'} = \frac{1}{2}\theta_k^*$).

Similarly, since the exit threshold is given by $\pi_k = \psi_k \theta_k = \tilde{\theta}_k = F_k$, differences in ψ_k will also be compensated by proportional differences in the exit threshold so that $\tilde{\theta}_k$ remains constant. Therefore, both entry and exit thresholds change proportionally in response to ψ_k leaving the survival probability constant. This property can easily be checked by expressing equation (25) as a function of $\tilde{\theta}_k$ alone,

$$P_k(T) = 1 - \Phi \left(\frac{\log\left(\frac{F_k}{\tilde{\theta}_k}\right) - \alpha' T}{\sigma \sqrt{T}} \right)$$

³In section 5, we allow the specific export history of the firm to affect S_k and F_k .

Since differences in ψ_k result in the same $\tilde{\theta}_k$, $P_k(T)$ is independent of ψ_k . *QED*

Proposition 1 plays a crucial role in our empirical analysis. It shows that the probability of survival in market k is the same for all firms even if the relative appeal of export markets (manifest in different ψ_k) differ. This is a “neutrality” result. Its intuition is simple. Suppose that market k is more appealing *ceteris paribus* for firm 1 than for firm 2 ($\psi_{k1} > \psi_{k2}$). Then, firm 1 will enter that market sooner since the entry threshold will be lower. However, due to the larger ψ_k the firm will also stay longer in the market despite a low value of θ – the exit threshold will be proportionally lower. Due to the fact that entry and exit thresholds decrease proportionally with higher ψ_k , survival probabilities are the same for both firms. Note that this result also implies that profitability differences across markets that are general to all firms will not have any effect on survival rates either. For example, market k may be larger or geographically more proximate than market k' and hence be more profitable for all firms. Nevertheless, although entry and exit thresholds will be (proportionally) lower, this fact will not generate a difference in survival probabilities between these two markets. This neutrality result is critical. It implies that even though the sequence in which a firm enters export markets might be idiosyncratic depending on its specific set of market-specific parameters $\Psi = \{\psi_k\}_{k=1,\dots,K}$, the probability of survival in a given market k will be unaffected by this idiosyncratic sequence. This probability is only determined by market-specific parameters S_k and F_k and hence is the same for all firms.

The second proposition relates the probability of survival to the size of sunk costs:

Proposition 2. $P_k(T)$ is increasing in the size of sunk costs (S_k).

Proof.

It is easy to check that $\frac{\partial G_k(\theta)}{\partial S_k} < 0$. By Lemma 1, we also know that $\frac{\partial G_k(\theta)}{\partial \theta} > 0$. Hence, applying the implicit function theorem, we obtain $\frac{\partial \theta_k^*}{\partial S_k} > 0$. Finally, since P_k is increasing in θ_k^* (equation 25), we obtain that $\frac{\partial P(\theta_k^*(S_k))}{\partial S_k} > 0$. *QED*

Proposition 2 establishes that, *ceteris paribus*, firms have higher survival probabilities in markets where sunk costs are higher. The result is intuitive. In markets with high costs, firms require a higher expected profitability to enter. Hence, they enter those markets with a higher value of θ_k^* . Since the exit threshold is unaffected by the level of sunk costs, this implies that upon entry they will tend to survive longer.

The third proposition relates the probability of survival to the size of fixed costs:

Proposition 3. If $S_k > 0$, then $P_k(T)$ is decreasing in the size of fixed costs (F_k).

Proof.

Divide $G_k(\theta)$ by F_k , define $\hat{\theta}_k \equiv \frac{\theta}{F_k}$ and rewrite (24) as

$$\left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha}\right) \psi_k^{\beta_2} \hat{\theta}_k^{*\beta_2} + \left(\frac{\beta_1 - 1}{v - \alpha}\right) \psi_k \hat{\theta}_k^* - \beta_1 \left(\frac{1}{v} + \frac{S_k}{F_k}\right) = 0. \quad (27)$$

Let $H_k(\hat{\theta}_k)$ be the LHS of (27). Since $F_k > 0$, using the results of Appendix 2, it is easy to check that $H_k(\frac{1}{\psi_k}) = \frac{1}{F_k} G_k(\frac{F_k}{\psi_k}) < 0$. Also, $H_k(\hat{\theta}_k) \rightarrow \infty$ as $\hat{\theta}_k \rightarrow \infty$.

The derivative of $H_k(\hat{\theta}_k)$ with respect to $\hat{\theta}_k$ is

$$H'_k(\hat{\theta}_k) = \beta_2 \left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha}\right) \psi_k^{\beta_2} \hat{\theta}_k^{\beta_2 - 1} + \left(\frac{\beta_1 - 1}{v - \alpha}\right) \psi_k \quad (28)$$

and the second derivative is

$$H''_k(\hat{\theta}_k) = (\beta_2 - 1) \beta_2 \left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha}\right) \psi_k^{\beta_2} \hat{\theta}_k^{\beta_2 - 2} > 0.$$

Hence $H_k(\hat{\theta}_k)$ is continuous and strictly convex. Since $H_k(\frac{1}{\psi_k}) < 0$ and $H_k(\hat{\theta}_k) \rightarrow \infty$ as $\hat{\theta}_k \rightarrow \infty$, it follows that there is a unique $\hat{\theta}_k^* \geq \frac{1}{\psi_k}$ such that (27) holds. Strict convexity also implies that $H'(\hat{\theta}_k^*) > 0$. Then, by the implicit function theorem, $\frac{\partial \hat{\theta}_k^*}{\partial F_k} < 0$. Finally, from (25) we get that $\frac{\partial P_k(T)}{\partial F_k} < 0$. *QED*

Proposition 3 establishes that, *ceteris paribus*, firms have higher survival probabilities in markets that require paying higher fixed costs. This result is not as straightforward as Proposition 2 but it is nevertheless possible to build intuition on it. Consider the entry threshold θ_k^* that prevails under F_k . Alternatively, consider a scenario where $F'_k = \gamma F_k$, $\gamma > 1$. As a benchmark, suppose that the entry threshold in this latter case is $\theta_{k'}^* = \gamma \theta_k^*$. Then, $\hat{\theta}_{k'}^* = \frac{\theta_{k'}^*}{F'_k} = \frac{\theta_k^*}{F_k}$. As entry and exit thresholds would move proportionally in this alternative scenario, it is easy to check (see equation (25)) that the survival probability $P_k(T)$ would remain unchanged. However, while under the baseline scenario firms are indifferent at the entry threshold between entering the market and staying outside, they would strictly prefer to enter under the alternative. To see this, consider the probability density for all possible processes of θ_t upon entry. Since θ_t follows a GBM, for any process l under the baseline scenario there is a process l' under the alternative with $\theta'_t = \gamma \theta_t$ such that the density of both is equal. Comparing these two processes, it is easy to conclude that at any time t profits are unambiguously larger under the alternative as $\Pi'_{kt} = \max\{\psi_k \gamma \theta_t - \gamma F_k, 0\} = \max\{\gamma(\psi_k \theta_t - F_k), 0\} \geq \Pi_{kt}$. Since sunk costs remain unchanged, this result implies that the value of entering is larger under the alternative. Hence, firms would exercise sooner the option to enter and the probability of survival would be smaller.

Note that this result only holds if $S_k > 0$. When $S_k = 0$, even if $\Pi'_{kt} \geq \Pi_{kt}$ at any time for any two processes as constructed above, there is no value option to wait in any of the two cases. Thus, the entry thresholds under both scenarios are just the exit thresholds, implying equal survival probabilities.

3 Testing for determinants of export survival (I)

To empirically assess the predictions of the model, we exploit firm-level customs data on the universe of Argentine export transactions during the period 1994-2006. We start by describing the data (section 3.1) and establishing some basic facts about export survival of Argentine firms (section 3.2). The econometric analysis of the predictions obtained under the case of independent markets are discussed in section 3.3.

3.1 Data

The primary source of information that we use comes from Argentine customs data (ACD) and covers the years spanning from 1994 to 2006. The ACD describes every export transaction by Argentine firms. Each transaction record includes a unique 10-digit tax code (national identification tax number, CUIT); the exported good identified at the 12-level NCM (Nomenclador Común del Mercosur); destination country; value of the transaction in US\$; and year of transaction.

It will be clear below that our empirical strategy consists in evaluating the impact of geographical distance and other gravity forces. The CEPII Gravity Dataset puts together gravity variables from a variety of sources. This dataset includes measures of bilateral distances (in kilometers), GDP and population. It also indicates whether a country pair shares a border, an official language, or has signed a preferential trade agreement.

Before turning to the descriptive statistics, we introduce the following terminology to describe exporting and survival in foreign markets:

- (i). **Export Instance** : any firm-destination-year combination. That is, an export instance is defined by a positive value of exports of firm i to destination k in year t .
- (ii). **Export Experience** : a string of consecutive instances over time (it could be only 1 year). Two segments of a string of non-consecutive instances are considered as two distinct export experiences.
- (iii). **Export Incursion** : the first year of a new export experience in a new firm-destination-year combination (i.e. re-entrant incursions are excluded).
- (iv). **Established Experience** : an export experience lasting for at least 3 consecutive years.

We define **Export Survival** as the probability for an Export Incursion to become an Established Experience.⁴

3.2 Facts about Argentine exports and export survival

During the period of our study, Argentine total exports experienced a rather anemic growth from 1994 to the economic collapse of 2001, and boomed following the dramatic currency devaluation of early 2002 (more than 140% in the first quarter of 2002) to increase more than 80% between 2002 and 2006. Figure 1 displays this evolution. We also note a similar trend for manufacturing and differentiated goods.

⁴Alternative measures of survival such as duration of an export spell will be used to check the robustness of our results.

Figure 1: Argentine Exports (1994 - 2006)

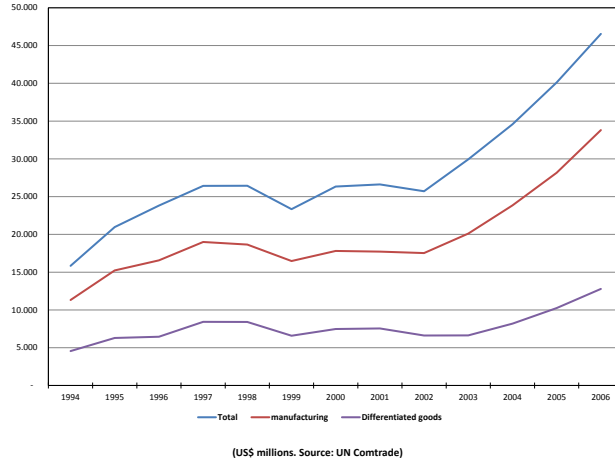


Table 1 provides basic information about exports from Argentina. The value of exports almost tripled during the period, whereas the number of firms selling abroad increased by about 50%; from 9559 exporting firms in 1994 to 14960 in 2006. The number of incursions per year followed a u-shaped trajectory. A peak of 13955 incursions in 1995 was followed by a steady fall until they reached a minimum in 2001 (9022). After the 2002-currency devaluation, the number of incursions resumed growth to reach 13684 incursions in 2004. Incursions involved average sales of about US\$ 12000, exhibiting a decreasing trend over time (the geometric mean of sales per incursion ranges from US\$ 22136 in 1995 to US\$ 9321 in 2004). Finally, the last column reports the probability of survival per year. This probability is generally low (around 24%) and slightly higher during the export booms of 1995 and the years after the 2002 currency devaluation.

3.3 Empirical Analysis: independent markets

Proposition 2 states that the probability of survival increases with S_k . Proposition 3 states that it decreases with F_k . Neither S_k nor F_k are observable. Ideally, we would like to have specific proxies, one for the sunk cost and another one for the fixed cost. However, both costs correspond to similar activities or components. To see this, consider the activities typically associated with sunk costs by the literature. These activities involve, for example, establishing distribution channels, designing marketing strategies, learning about and adapting to exporting procedures and destination country-specific institutional and cultural characteristics, and complying with local regulations. While these activities are justifiably associated with sunk costs, they can also be performed as a fixed cost. For example, distribution networks have to be maintained over time, learning and adapting to an evolving environment is usually done on a continuous basis, and knowledge about regulations has to be continuously updated. Given that both costs share similar components, it is hard to find an observable variable that can serve as an exclusive proxy for one of these costs.

Table 1: Argentine Exports, 1994-2006

Year	Export Value (millions US\$)	# firms	# Incursions	Sales per incursion (geometric mean)	Probability of survival
1994	15800	9559			
1995	20900	11025	13955	22136	0.26
1996	23800	11376	11816	19045	0.24
1997	26200	12107	11772	16281	0.22
1998	26200	12583	11931	8506	0.20
1999	23400	11818	10254	9833	0.21
2000	26400	11433	9239	9373	0.22
2001	27000	11217	9022	10818	0.23
2002	25500	12753	13219	8400	0.24
2003	29300	13602	13962	7899	0.26
2004	34200	13992	13684	9321	0.26
2005	39400	14668			
2006	46000	14960			
Total :	Average:	Total:	Average:	Average:	
364100	12392	118854	12161	0.24	

In our analysis, we first capture variation in both sunk and fixed cost with the distance between Argentina and market k . To do this, we assume that exporting to more distant countries involves higher sunk and fixed costs. The empirical relevance of these assumptions can be supported by a direct implication of our model. A firm will exit a destination whenever net profits become zero, that is when operating profits equal fixed cost. Since profits are proportional to sales under CES preferences, sales of exiting firms have to be larger the higher the fixed costs are. Hence, if distance serves as a proxy for country-specific fixed costs, we should observe that exit export sales increase with distance. This is a testable implication. To do so, we run the following regression:

$$x_{kt}^{exit} = \alpha_1 d_k + \gamma_t + \mu_{kt},$$

where x_{kt}^{exit} is the average (log) exit sales from market k at time t and d_k is the log of distance from Argentina to the destination market. We also include γ_t to capture year fixed effects. Table 2 reports the results excluding (column 1) and including (column 2) the time fixed effect. In both cases, the results show that exit sales increase with distance.

Exit export sales increasing with distance indicates that fixed costs are larger in more distant destinations. As sunk and fixed costs involve similar activities it is reasonable to assume that sunk costs are also increasing in distance. Although we can associate both sunk and fixed costs to distance, our model predicts that their effect on export survival are opposite. Therefore, the implied prediction about the effect of distance on survival is ambiguous. If distance implies more variation in sunk costs, then the effect should be that survival is more likely in more distant destinations. If distance implies more variation in fixed costs, then the effect should be that survival is more likely in closer destinations. Thus, we can use the empirical effect

Table 2: Exit Sales and Distance

	(1)	(2)
d_k	0.571*** (0.129)	0.616*** (0.110)
Constant	0.054 (1.179)	-0.358 (1.005)
Year FE :	no	yes
Observations	2193	2193
R-squared	0.008	0.281

Standard errors in parentheses

*** p<0.01, ** p<0.05

of distance on the probability of export survival to inform us about which of these costs prevails to explain the variation in the probability of export survival across destinations.

Table 3 displays the probability of survival for different country groupings. Panel *A* groups countries according to geographical regions. The most salient feature in this panel is that the survival probability is highest for Argentine firms entering other Latin American countries. Panel *B* groups countries according to different distance ranges from Argentina (Short-distance, Medium-distance and Long-distance) and compute the probability of export survival for each range. The probability is highest in the closest group of countries and is lowest in the farthest group. Additional evidence reported in Panel *B* suggests that sharing borders, language and trade agreements raises the probability of survival by more than 10%. Finally, we group countries according to whether their level of income is Low and Middle or High, following the definition of the World Bank. The probability of survival is about 30% lower for incursions of Argentine firms in High-income countries (Panel *C*).

One of the clearest messages of Table 3 is that distance affects the probability of export survival. We can estimate this relationship by running a linear probability model at the incursion level:

$$P_{ikt} = \alpha_1 d_k + \gamma_t + \mu_{ikt}, \quad (29)$$

where P_{ikt} is the probability of establishing an export experience of T years ($T = 3$) upon an incursion of firm i in market k in period t , and d_k stands again for the log of distance between country k and Argentina. Note that, based on the results of Proposition 1, this probability is the same across firms entering market k regardless of the specific appeal of this market for that firm. We also include γ_t to control for year fixed effects.⁵ Since the main regressor varies at a more aggregate level (k) than the unit of observation (i), in all the remaining regressions we allow the error term (μ_{ikt}) to be clustered at the destination level.

In Table 4, we report the baseline results of this section. As shown in column 1, the coefficient associated

⁵Although the theory does not point to any change that should be controlled for with time fixed effects, we include them to control for the potential effect of movements in the exchange rate. In particular, a devaluation as the one occurred in 2002, may induce a discrete drop in the entry thresholds. Hence, firms may enter a foreign market with a value of θ_t above the new entry threshold and thus have a higher survival probability.

Table 3: Probability of survival by Year and Region

Panel A: Regions	Probability of survival	# Incursions	Sales (gmean)
Latin America	0.27	61918	10091
North America	0.22	100772	8101
EU	0.21	14923	12713
Spain and Italy	0.21	9190	8510
China	0.19	1162	26469
Rest of the World	0.20	20889	20031
Panel B: Gravities			
Short-distance	0.27	27109	9487
Medium-distance	0.25	21066	11883
Long-distance	0.21	70679	12162
Contiguous country	0.27	42674	10925
Same Language	0.26	68210	9918
Preferential Trade Agreement	0.27	40920	10894
Panel C: Income			
Low and Middle Income Country	0.26	73644	12184
High Income Country	0.20	45210	10336
Total	0.24	118854	12161

with distance is negative and significant at the 1% level. This result is almost unaffected with the inclusion of year fixed effects (column 2).

Other country-specific characteristics may also capture differences in fixed and sunk costs across countries. We consider *Common Language_k* (whether country k shares the same language with Argentina), *Contiguity_k* (whether country k and Argentina share a border), and *PTA_k* (whether country k and Argentina have implemented a preferential trade agreement). These three variables can arguably be associated with lower sunk and fixed costs of exporting. A common language, for example, may facilitate the establishment and maintenance of distributions networks, as well as ease understanding of country-specific legal and cultural idiosyncrasies. Similarly, a PTA may reduce exporting costs if the agreement involves harmonizing regulations and/or exporting procedures. Contiguity, in turn, is a proxy for geographical distance and cultural similarities. Column 3 shows that only having a common language has an additional and significantly positive effect on the probability of survival. The effects of a PTA and contiguity are not significant. In any event, the effect of distance persists although the magnitude of the coefficient falls about 40 % once other gravity variables are controlled for.

There is a mismatch between our theoretical results and their empirical implementation. In our model, since time is continuous firms make an incursion into a new destination as soon as export profitability hits the entry threshold. Hence, we calculate the survival probability after T periods since that precise moment. In the data, time is discretized in yearly periods. Thus, the export sales in the year of entry that we observe aggregate through time the implication for sales of a continuum of profitability shocks. Even if firms enter with equal (instantaneous) sales, the yearly figure we observe incorporates a specific trajectory of θ_t once it has passed the entry threshold. In addition, as we do not know the exact moment at which the incursion takes

place within the reported year, the time span over which sales are aggregated may vary across incursions. To control for this mismatch, we include export sales at the year of the incursion (X_{ikt}) and the number of simultaneous incursions by firm i at year t ($NINCUR_{it}$). Both variables capture the combined effect of the profitability trajectory (since entry until the end of the reported period) and the time of entry within the period. For example, a firm that has entered market k at the beginning of the reported period and since then has received positive shocks to profitability will exhibit both higher reported sales in market k during the period and entry into additional export markets. In both cases, these are proxies for a high θ_t , which increases the probability of survival.⁶ As expected, column 4 shows that both variables are positively associated with export survival. Nonetheless, the estimated effect of distance not only survives but also increases by about 29%.

Table 4: Survival and Gravities

	(1)	(2)	(3)	(4)
d_k	-0.025*** (0.0026)	-0.026*** (0.0025)	-0.017*** (0.0029)	-0.021*** (0.0029)
<i>Common Language_k</i>			0.027*** (0.0038)	0.038*** (0.0038)
<i>Contiguity_k</i>			-0.0183 (0.0119)	0.004 (0.0118)
<i>PTA_k</i>			0.019 (0.0109)	0.012 (0.0109)
X_{ikt}				0.006*** (0.001)
$NINCUR_{it}$				0.016*** (0.0004)
Constant	0.447*** (0.0225)	0.456*** (0.0215)	0.361*** (0.0273)	0.337*** (0.0271)
Year FE :	no	yes	yes	yes
Observations	118,776	118,776	118,776	118,776
R-squared	0.004	0.007	0.007	0.024

Robust standard errors in parentheses

*** p<0.01, ** p<0.05

To interpret the magnitude of the effect of distance, consider the difference in survival probabilities between entering a short-distance and a long-distance destination. According to Table 3, the probability of survival upon entering a short-distance country is 0.05552 percentage points higher. Consider now the difference in the average (log) distance from Argentina to each of these two groups of countries. This difference is 2.4733 (not shown). As the coefficient associated with d_k is -0.021 (column 4), the difference in distance between these two country groups implies a predicted variation in export survival of 0.052 percentage points. Thus, it explains 93 % of their observed difference in survival probabilities.

⁶Another source of mismatch is that, empirically, a surviving incursion implies maintaining an active export presence in the market during the next two years following the incursion. In the theory, however, we consider that an incursion survives if the firm is exporting at the end of the period even if the firm did not export in the middle year.

We perform several robustness checks. First, we control for firm-invariant characteristics. In the estimations reported in the first 4 columns of Table 5, we replicate the preceding analysis including firm fixed effects. In all cases, the coefficient associated with distance increases substantially. Also, the effect of a PTA is now positive and significant. In column 4, we exclude single-year incursions from the sample. Thus, this regression considers the survival probability conditional on surviving the first year of the export experience. Although Propositions 1 to 3 do not condition on surviving the first year⁷, this regression is interesting because apparently failed incursions in the data might reflect the realization of occasional export opportunities. If those opportunities occur relatively more often in distant countries our results could suffer from a potential composition problem. Column 4 shows that this is not the case. The coefficient associated with d_k exhibits very little change after dropping single-year incursions.⁸

Table 5: Survival and Gravities: Robustness

	(1)	(2)	(3)	(4)
d_k	-0.061*** (0.0071)	-0.031*** (0.0035)	-0.031*** (0.0035)	-0.018*** (0.0066)
<i>Common Language_k</i>		0.03*** (0.0045)	0.03*** (0.0045)	0.034*** (0.0084)
<i>Contiguity_k</i>		0.005 (0.0146)	0.008 (0.0146)	0.013 (0.0264)
PTA_k		0.048*** (0.0135)	0.045*** (0.0135)	0.042*** (0.0144)
X_{ikt}			0.06*** (0.0006)	0.002*** (0.0007)
$NINCUR_{it}$			0.005*** (0.0007)	0.002** (0.0011)
Constant	0.653*** (0.0624)	0.415*** (0.0335)	0.409*** (0.0335)	0.442*** (0.0341)
Year FE :	yes	yes	yes	yes
Firm FE :	yes	yes	yes	yes
Observations	118,776	118,776	118,776	47,403
R-squared	0.367	0.367	0.368	0.344

Robust standard errors in parentheses

*** p<0.01, ** p<0.05

We interpret that survival is decreasing with distance and other gravity proxies for sunk and fixed costs as a manifestation of the prominence of fixed costs over sunk costs in determining how the probability of survival varies across export markets. In principle, this result supports Arkolakis' (2012) emphasis on fixed costs. However, since our theory shows that the negative relationship between fixed cost and survival probabilities can only exist under the presence of strictly positive sunk costs, the result also contradicts his neglect of sunk costs. Our results also inform an empirical literature that structurally estimates fixed and sunk costs. In particular, Das, Roberts, and Tybout (2007) find that sunk costs are substantial but fixed

⁷We think similar results to those propositions can be obtained even after conditioning for surviving the first year. We plan to work on obtaining those results as this research progresses.

⁸The results are similar to the corresponding ones in Table 3 if firm fixed effects are not included in the estimation.

costs are negligible. Morales, Sheu, and Zahler (2011), instead, find larger fixed than sunk costs. While we do not estimate the magnitude of fixed and sunk costs, as in Morales, Sheu, and Zahler (2011) our results suggest that both are substantial. However, in contrast to their finding that fixed costs do not vary with distance, our results imply that fixed costs are more sensitive to distance than sunk costs.

4 Determinants of export survival (II): Interdependent markets

The framework developed in section 2 implies that entry and exit decisions are independent across markets. Hence, the export experience of a firm does not influence its survival probability upon entry in a new market. This implication rules out the possibility that entry and exit decisions into different markets are mutually dependent. For example, Morales, Sheu, and Zahler (2011) finds that sunk entry costs can be substantially reduced if a firm has previously entered a market with the same language. In this section, we allow entry and exit decisions into different markets to be connected by having common sunk and fixed cost components. In other words, *history matters*. We first develop analytically the case of interdependent sunk costs. Then, we treat the case of interdependent fixed costs.

4.1 Interdependent sunk costs

We assume that the sunk cost required to enter any market k within country group g has two components: a common sunk cost $S_g > 0$, paid only once to enter any market in g , and an idiosyncratic sunk cost \tilde{S}_k :

$$S_k = S_g + \tilde{S}_k.$$

Country group g could be defined, for example, according to language, regional location, or level of income. Therefore, the common component S_g could capture sunk costs associated with the translation of instruction manuals and packaging materials. Those costs may not need to be repaid once the firm has already paid them to enter another country that speaks a same language. Similarly, sunk costs associated with quality upgrading to enter high income countries could be paid only once to serve all markets with similar income levels. Country group g could also be defined to be the entire world. In that case, the interpretation is that export experience – wherever exports have been directed – lowers sunk costs to enter a new export market. For example, a firm might need to pay a sunk cost to learn about customs regulations in its own country only the first time it exports. While the theoretical treatment of group g in this section is quite general, the empirical analysis in section 5 explores the contours of country groups where interdependence matters.⁹

Equation (23) (or equivalently equation (24)) in section 2 implicitly determines the entry threshold θ_k^* for the case of independent markets. We will denote that threshold $\theta_k^*(S_k)$ to emphasize that it corresponds to the case where full sunk cost needs to be paid. With interdependent sunk costs, a firm will need to pay a

⁹Our specification of sunk-costs is not innocuous. If sunk-costs vary in more than one dimension (e.g. language and region), then the analysis is much more complex. In the case of only two markets, however, all the results in this section apply.

lower sunk cost, \tilde{S}_k , to enter market k if it has already entered another country in group g and hence paid S_g . In this case, we will denote the entry threshold $\theta_k^*(\tilde{S}_k)$. Proposition 2 suggests that, in this latter case the firm will enter the market sooner ($\theta_k^*(\tilde{S}_k) < \theta_k^*(S_k)$) because of the lower sunk cost. Also, as exit thresholds should not be affected by the magnitude of sunk costs, the survival probability will be lower. However, the first entry may now have “strategic value” and therefore induce early entry. Thus, the analysis needs to account for this possibility.

We will consider entry into market k when sunk costs are interdependent in the manner described above. We will distinguish two types of firms: (a) the *experienced* firm has already entered another market in group g ; (b) the *inexperienced* firm has not yet entered any market in that group.

The experienced firm The case of the experienced firm is straightforward. To enter market k , this firm must only pay the idiosyncratic sunk cost \tilde{S}_k . Also, entering this market has no implications for further entries into third countries. Hence, there are no strategic gains from entering k (or any other market in g) since no further reductions in sunk costs are to be realized. Therefore, the problem of the experienced firm is just the one described in section 2 with sunk costs $\tilde{S}_k < S_k$. Then, proposition 2 implies that $\theta_k^*(\tilde{S}_k) < \theta_k^*(S_k)$ and $P_k(\theta_k^*(\tilde{S}_k)) < P_k(\theta_k^*(S_k))$.

The inexperienced firm Consider now a firm that enters market k but has not previously entered any other market in group g . This firm may enter market k alone or it may enter a subset of M group- g markets simultaneously. If the firm decides to enter market k alone, then it must be the case that the entry thresholds for entering all other markets in g are higher – even after taking into account that S_g need not be repaid. In this case, entering market k has no “strategic value” and the entry threshold is $\theta_k^*(S_k)$, the one derived in the independent case. Note that a firm with a lower θ would gain by waiting – rather than entering now in market k – until it can realize the strategic value by entering other markets as well. This implies that $\theta_k^*(S_k) < \theta_{k'}^*(\tilde{S}_{k'}), \forall k' \in g$. Hence, if sequential entry is optimal, the inexperienced firm will enter market k when expected profits are worth paying *total* sunk costs. Since $\theta_k^*(S_k) < \theta_{k'}^*(\tilde{S}_{k'})$, we establish that the probability of survival in market k is higher for the inexperienced firm than for the experienced firm.

Now consider the opposite case: $\theta_k^*(S_k) \geq \theta_{k'}^*(\tilde{S}_{k'})$ for all k' in M . In this case, the firm enters market k' “instantaneously” after entering k since the reduction in sunk costs in k' takes place immediately after entering k . Due to this interdependence, entering k has strategic value. Since this is a continuous time model, this case is analogous to entering both markets at a common threshold θ_M^* . This threshold will be different from $\theta_k^*(S_k)$ since the latter does not take into account the benefits from entering more than one market simultaneously. The following proposition compares θ_M^* with $\theta_k^*(S_k)$ and $\theta_k^*(\tilde{S}_k)$

Proposition 4. $\theta_k^*(\tilde{S}_k) \leq \theta_M^*(S_k) \leq \theta_k^*(S_k)$. Hence, $P_k(\theta_k^*(\tilde{S}_k)) \leq P_k(\theta_M^*) \leq P_k(\theta_k^*(S_k))$

Proof.

Let V_{0M} be the option value of entering M markets simultaneously and let θ_M^* be the associated entry threshold. In this case, the value-matching condition is given by

$$V_{0M}(\theta_M^*) = \sum_k \Omega(\theta_M^*) - \sum_k \tilde{S}_k - S_g. \quad (30)$$

Notice that there is a common threshold and a common “option value” of entering the M markets simultaneously. Similarly, the smooth-pasting condition is given by

$$\left. \frac{dV_{0k}(\theta_t)}{d\theta_t} \right|_{\theta_t=\theta_M^*} = \sum_k \left(\left. \frac{d\Omega(\theta_t)}{d\theta_t} \right|_{\theta_t=\theta_M^*} \right) \quad (31)$$

Using the results of section 2, these two equations can be written, respectively, as:

$$-A_{0M}\theta_M^{*\beta_1} + \sum_k \left(A_{1k}\psi_k^{\beta_2}\theta_M^{*\beta_2} + \frac{\psi_k\theta_M^*}{v-\alpha} - \frac{F_k}{v} \right) = \sum_k \tilde{S}_k + S_g \quad (32)$$

$$-\beta_1 A_{0M}\theta_M^{*\beta-1} + \sum_k \left(\beta_2 A_{1k}\psi_k^{\beta_2}\theta_M^{*\beta_2-1} + \frac{\psi_k\theta_M^*}{v-\alpha} \right) = 0 \quad (33)$$

Multiplying (32) by β_1 and (33) by θ_M^* , and subtracting the latter equation from the former, we obtain:

$$\sum_k \left((\beta_1 - \beta_2) A_{1k}(\psi_k\theta_M^*)^{\beta_2} + \frac{(\beta_1 - 1)}{v - \alpha} \psi_k\theta_M^* - \frac{\beta_1 F_k}{v} \right) - \beta_1 \tilde{S}_k - \beta_1 S_g = 0 \quad (34)$$

which parallels (23) for the case of simultaneous entry into several markets.

Now we want to show that $\theta_M^* \geq \max_{k'} \{\theta_{k'}^*(\tilde{S}_{k'})\}_{k' \in M}$. Let $l = \arg \max_{k'} \{\theta_{k'}^*(\tilde{S}_{k'})\}$. To obtain a contradiction, suppose that $\theta_M^* < \theta_l^*(\tilde{S}_l)$. Given that the firm is already entering at least one other market in the region, the extra cost of entering l is just the sunk cost \tilde{S}_l . However, since $\theta_M^* < \theta_l^*(\tilde{S}_l)$, for $\theta_t = \theta_M^*$ the firm would rather wait than enter market l . But then $l \notin M$, which is a contradiction. This establishes that $\theta_M^* \geq \max_{k'} \{\theta_{k'}^*(\tilde{S}_{k'})\}_{k' \in M}$. Based on the results of section 2, this also implies that the probability of survival of an inexperienced firm upon entering market k is always higher than that of a firm with export experience in the group.

Since the experienced firm faces the entry problem analyzed in section 2 for independent markets, we know that $\theta_k^*(\tilde{S}_k)$ solves equation (23). Thus:

$$(\beta_1 - \beta_2) A_{1k}(\psi_k\theta_k^*(\tilde{S}_k))^{\beta_2} + \frac{(\beta_1 - 1)}{v - \alpha} \psi_k\theta_k^*(\tilde{S}_k) - \frac{\beta_1 F_k}{v} - \beta_1 \tilde{S}_k = 0,$$

or $G(\theta_k^*(\tilde{S}_k)) = 0$. Since $G(\cdot)$ is increasing in θ (Lemma 1) and $\theta_M^* \geq \theta_k^*(\tilde{S}_k)$, then:

$$(\beta_1 - \beta_2) A_{1k}(\psi_k\theta_M^*)^{\beta_2} + \frac{(\beta_1 - 1)}{v - \alpha} \psi_k\theta_M^* - \frac{\beta_1 F_k}{v} - \beta_1 \tilde{S}_k \geq 0.$$

The latter inequality implies that every term in the summation of equation (34) is positive or zero. Hence, including only one of these terms rather than the sum, we obtain:

$$(\beta_1 - \beta_2) A_{1k} (\psi_k \theta_M^*)^{\beta_2} + \frac{(\beta_1 - 1)}{v - \alpha} \psi_k \theta_M^* - \frac{\beta_1 F_k}{v} - \beta_1 \tilde{S}_k - \beta_1 S_g \leq 0.$$

The left-hand-side of this equation is again the function $G(\cdot)$, which is increasing in θ . Hence $\theta_M^* \leq \theta_k^*(S_k)$.

QED

Proposition 4 implies that, when a firm enters many markets simultaneously, its probability of survival in market k is bounded, on one side, by the probability of survival of an experienced firm entering the same market; on the other side, it is bounded by that of an inexperienced firm that enters market k only.¹⁰ This establishes that the probability of survival in a given market is always lower for an experienced firm. Also, for an inexperienced firm, it establishes that this probability will be lower for a firm entering other markets simultaneously. Nevertheless, this probability will still be higher than the survival probability for the experienced firm entering the same market.

4.2 Interdependent fixed costs

A formal treatment of the case of interdependent fixed costs is substantially more involved than the case of interdependent sunk costs. The difficulty stems from the fact that while interdependent sunk costs make a firm's entry decision in a market dependent on its entry decisions in other markets, interdependent fixed costs also connect exit decisions across markets. Due to these difficulties, we do not solve the general case but focus instead on a simpler case with only two countries. Even in that simpler case, we can only solve for some of the possible cases that arise by simulating the survival probabilities for different parameter configurations. In contrast to the case of interdependent sunk costs presented above, the comparison of survival probabilities for experienced and inexperienced firms in the case of interdependent fixed costs yields ambiguous results. Nevertheless, for most parameter configurations, experienced firms are predicted to have a higher survival probability upon entry into a foreign market.

Analogously to our treatment of sunk costs, we assume that fixed costs in market k have two components:

$$F_k = F_g + \tilde{F}_k$$

where F_g is a common component of fixed costs paid only once for markets in group g and \tilde{F}_k is an idiosyncratic component only paid in market k . When an experienced firm enters market k , on the margin it only needs to pay \tilde{F}_k . Hence, based on the result of Proposition 3 we might expect this firm to have a higher survival probability than an inexperienced firm that faces F_k . Unfortunately, this intuition may be incorrect.

¹⁰ θ_M^* will generally lie strictly between the independent and experienced thresholds. However, there are singular cases in which the reduction in the sunk cost of the difficult market makes the profitability threshold fall to the level required in the independent case for the easier market.

After entry into k , the fixed cost for an experienced firm could rise to F_k if the firm exited the other market(s) it previously entered. Alternatively, an inexperienced firm will face fixed costs F_k at first but could start imputing lower fixed costs to that market if it later decides to enter additional markets in group g . The full analysis is cumbersome as it involves different cases according to the order in which the firm enters and exits each market. Also, computing survival probabilities given entry thresholds is cumbersome because exit thresholds are interdependent across countries. Given that developing the full analysis would be long and tedious even in a two-market case, we do not present it here. Suffice it to say that in simulation results we find a counterintuitive result under a specific range of parameter configurations in which an experienced firm entering market k can have a lower survival probability than an inexperienced firm entering that market. Hence, it is not possible to obtain an unambiguous result for the effect of experience on survival probabilities in the presence of interdependent fixed costs.¹¹

The counterintuitive result necessarily involves a firm exiting first the market it first entered. This case arises only under a specific range of parameters. In contrast, under most parameter configurations, a firm will tend to enter first and leave last its most appealing market. To simplify the exposition, we present the analysis only for this latter case. Not only is this the case that arises under most parameter configurations but also it is the one that is needed to interpret the empirical results on the effect of export experience obtained in section 5.

Consider two export markets, A and B and two firms, 1 and 2. Assume that firm 1 enters market A before entering market B . Hence, it is an inexperienced firm when it enters market A and it is experienced when it enters market B . Also, assume that having entered both markets, this firm leaves market A after leaving market B . The analysis in this case is greatly simplified by the fact that the firm can assign the common component of the fixed cost (F_g) to market A , which then bears the burden of the full cost (F_A), and can impute only the idiosyncratic component of the fixed cost (\tilde{F}_B) to market B . Hence, the problem becomes equivalent to the problem of independent fixed costs, with F_A in market A and \tilde{F}_B in market B . For another firm (firm 2) that enters market B first and leaves this market last, the problem is the opposite. This firm enters market A as an experienced firm and market B as an inexperienced firm. Thus, it imputes \tilde{F}_A in market A and F_B in market B . Comparing the survival probability of firm 1 in market A (the inexperienced firm) with survival probability of firm 2 in market A (the experienced firm), and the opposite case for market B we obtain:

Proposition 5. Suppose that firm 1 enters market A first and leaves market B first. Suppose that firm 2 enters market B first and leaves market A first. Then, $P_{1A}(T) \leq P_{2A}(T); P_{1B}(T) \geq P_{2B}(T)$.

Proof.

See Appendix

In a regression framework that controls for destination fixed effect, this result implies that the experience

¹¹Details of the full analysis in the two-country case can be obtained from the authors upon request.

of a firm should have a positive effect on its survival probability. This result is the opposite of the result for sunk costs where the effect of experience on the probability of survival is negative. Therefore, as in the case of distance, the data will determine which of the two effects prevail.

5 Testing for determinants of export survival (II): Trajectories matter

The theoretical results obtained in section 4 state that export experience matters. In a context of market interdependency, gaining export experience may reduce country specific fixed and sunk costs in potential new destinations. Thus, variations in experience can explain differences in export survival upon entry across firms and along their exporting path. Our previous analysis established that experience can affect the probability of export survival in two opposite directions. If the empirically relevant effect goes through reductions in sunk costs, then experience should be negatively associated with the probability of survival (Proposition 4). On the contrary, Proposition 5 states that experience should enhance survival if the variation in fixed cost is the one that matters most. We explore now which one of the two effects is dominant in the data.

Identifying the level of firm export experience requires dealing with the fact that experience may take diverse forms and manifest over different domains of influence. We distinguish two essentially different forms of experience. First, we explore the effect of general exporting experience, which is acquired over the life of the firm as an exporter independently of its destination portfolio. Later, in subsection 5.2, we allow the effect of experience to be confined to that acquired by previously exporting to a group of countries related to the one the firm is entering. We denote "specific experience" to this latter form of experience.

5.1 General Exporting Experience

There are different ways to capture general exporting experience. We begin by considering *Exporting Age*. Unfortunately, we do not know the whole history of a firm as an exporter. As a proxy, we use the number of years a firm appears in our dataset before an incursion. Given that exports before 1994 are not observed, firms are constrained to a maximum exporting age of eleven years. This might be a problem as the effect of this variable is likely to be underestimated. In any case, as we can observe in panel A of Table 6, the probability of survival is higher for older firms. We also proxy general experience by the value of past total exports upon entry a new destination. To do this, we define $Exposure_{it} = \ln \left(\sum_{1994}^{t-1} X_{it} \right)$, for a firm i entering a new destination at t . Notice that, as in the case of *Exporting Age*, we miss exports before 1994, which means that there are firms with higher export exposure than what is captured by this variable. In panel B, we distinguish incursions by firms with low (below the median) and high (above the median) values of *Exposure*. We see that incursions with high exposure are associated with a higher survival probability. As firms may enter a new destination with a different history of past incursions, we also consider the number of previous

incursions as an alternative way to proxy for general export experience. Panel C shows that incursions by firms with a higher record of past incursions tend to survive with a higher probability. Once more, we are concerned by the truncation imposed by the unavailability of full information about past exports. The last expression of experience we include in our analysis addresses this concern. Panel D displays the probability of survival according to the number of destinations served by the firm before the incursion. A larger number of destinations upon entry arguably reflects more experience in export markets. As this variable refers only to the previous year of the incursion, we do not need export data before 1994. Notice that the probability of survival increases in the number of previously served destinations.

Table 6: Survival and Experience

Panel A: Export Age	# Incursions	Survival	Sales (gmean)
1	43027	0.23	11409
2-5	54279	0.23	12107
More than 5	21548	0.27	9994
Panel B: Export Exposure			
Low export exposure	59420	0.22	9012
High export exposure	59420	0.25	14535
Panel C: Number of previous incursions			
0	54270	0.24	12812
1	14487	0.21	7905
2	9448	0.22	7962
3-5	16329	0.23	8951
6-15	16776	0.26	11971
More than 15	7544	0.27	25101
Panel D: Number of destinations in $t - 1$			
0	50242	0.22	10458
1	16399	0.21	8407
2	10093	0.23	9702
3-5	16658	0.26	10569
6-15	17764	0.27	14214
more than 15	7698	0.28	35588
Total	118854	0.24	11445

The broad message emerging from Table 6 is that the probability of export survival upon entry in a new destination is higher for experienced firms. To further test this effect, we first run the following linear probability model:

$$P_{ikt} = \alpha_1 d_k + d_{it}^E + \gamma_t + \mu_{ikt} \quad (35)$$

where d_k is the log of distance from Argentina to country k and d_{it}^E is an indicator variable that equals one if firm i exported in the past. Column 1 of Table 7 shows that d_{it}^E is positively associated with a higher probability of survival. Also, the effect of distance remains similar to the estimates reported on Table 4

Since we are interested in the marginal effect of experience on survival, we do not need to find observable proxies for sunk and fixed costs. Instead, we can simply include destination fixed effects to control for country-

specific sunk and fixed costs and rely solely on the variation in survival probabilities between experienced and inexperienced firms *within* a destination. Hence, we run:

$$P_{ikt} = \gamma_k + Experience_{it} + \gamma_t + \mu_{ikt}$$

where $Experience_{it}$ is the general name for any of the four proxies for export experience described above. All the regressions we report include year fixed effects. In column 2 of Table 7, we verify that the effect of d_{it}^E remains positive with a slightly higher coefficient. The magnitude of the coefficient implies that the unconditional probability of survival for experienced firms is about 10 % higher than for inexperienced ones. In the remaining columns, we report the specific effect of each of the proxies for experience we considered above: *Exporting Age* $_{it}$ (column 3); *Exposure* $_{it}$ (column 4); *Number of previous destinations* $_{it}$ (column 5); and *Number of previous incursions* $_{it}$ (column 6). The results state that these different forms of experience imply a higher probability of export survival upon entry a new destination. The implication in terms of the relative importance of fixed and sunk costs is in line with the results obtained by exploiting variation across export destinations: fixed costs prevail over sunk cost to explain the different survival probabilities between experienced and inexperienced firms.

5.2 Specific Experience

The effect of exporting experience on the magnitude of the sunk and fixed costs of serving country k might be confined to the background acquired in other countries related in some way to k . A way to analyze this specific form of experience is to explore the effect of "extended gravities". This concept, introduced in Morales, Sheu, and Zahler (2011), captures the fall in sunk costs for a firm that has previously entered another country sharing the same (official) language, border or income group. We allow extended-gravity variables to affect both sunk and fixed costs. The interest of this extension goes beyond its plausibility. Propositions 4 and 5 imply that the impact of extended gravities on the probability of survival crucially depends on whether they have a larger effect on fixed or on sunk costs. Thus, analyzing the effect of extended gravities is informative about the relative importance of each of these costs as a determinant of the different survival probabilities of experienced and inexperienced firms.

To test whether an export incursion by firm i is more likely to survive upon entry in market k and year t if this firm benefits from an extended gravity, we consider the following variables: $XContiguity_{ikt}$, $XLanguage_{ikt}$ and $XIncome_{ikt}$. These variables are defined as indicators taking the value of one when country k shares a border, language or (per capita) income quartile, respectively, with another country that firm i exported to in $t - 1$. To estimate P_{ikt} , we run the following linear probability model:

$$\begin{aligned}
P_{ikt} = & \gamma_k + \alpha_2 XContiguity_{ikt} + \\
& \alpha_3 XLanguage_{ikt} + \\
& \alpha_4 XIncome_{ikt} + \gamma_t + \mu_{ikt}
\end{aligned}$$

We are interested in the signs of α_2 , α_3 and α_4 . If positive, the associated extended gravity would imply a larger effect on fixed costs than on sunk costs. The opposite should be true when these coefficients are negative. Table 8 reports the results. The first column displays the basic regression controlling exclusively for year fixed effects. The extended-gravity variables are all positively associated with export survival. In column 2, we remove d_k but instead include destination fixed effects (γ_k) to control simultaneously for distance and other country-invariant characteristics. This has no major effect on the three relevant coefficients, except for a higher estimated effect of having exported to a country with the same official language than k ($XLanguage_{ikt}$). In the last three columns we include the value of exports at the moment of the incursion (X_{ikt}) and the number of simultaneous incursions ($NINCUR_{it}$). As explained above, these inclusions control for the mismatch between the theoretical model and the empirical analysis imposed by the limitation of observing the incursions over a discrete period of one year. As shown in column 3, the effect of the extended gravities does not change. In column 4, we drop incursions failing during the first year to verify that the results are not driven by the possibility of occasional exporting. It does not seem to be the case.

Finally, the most stringent test of the effect of experience on the survival probability is to rely only on variation in specific experience for a given firm in a given year. For example, consider a firm entering two new destinations, A and B, in a given year. Let one of the two destinations, say A, be connected via an extended gravity with at least one of the markets already served by the firm. Entry in market B does not enjoy from any extended gravity. Then, we should expect the probability of survival to differ between countries A and B once country-specific characteristic are controlled for. We test this implication by including firm-year fixed effects. This ensures that the effect of extended gravities are tested on firms entering simultaneously at least two destinations differing in whether they have an extended gravity or not. Column 5 reports the result. The extended gravities not only remain positively associated with the survival probability but also the relevant coefficients are higher.

We conclude that the effect of specific exporting experience is to increase the probability of survival upon entry in a new destination. As in the cases of general exporting experience and distance, this result is consistent with specific experience having a larger effect on fixed than on sunk costs. This result contradicts the findings of Morales, Sheu, and Zahler (2011). They assume that extended gravities do not affect fixed costs and they find that $XLanguage_{ikt}$ reduces sunk costs. Our findings have opposite implications. Our results show that the effect of the extended gravities are not confined to sunk costs. If only sunk costs varied

with the extended gravities, their effect on the probability of survival would be the opposite to what we find. In fact, we find that a larger variation in fixed costs than in sunk costs is necessary to explain the observed relationship between distance and the probability of survival upon entry.

6 Conclusions

TO BE WRITTEN

References

- ALBORNOZ, F., H. C. . G. CORCOS, AND E. ORNELAS (2012): “Sequential Exporting,” *Journal of International Economics*, 88(1), 17–31.
- ARKOLAKIS, C. (2012): “A Unified Theory of Firm Selection and Growth,” NBER Working Paper No. 17553.
- BALDWIN, R. (1988): “Hyteresis in Import Prices: The Beachhead Effect,” *American Economic Review*, 78(4), 773–785.
- BALDWIN, R., AND P. KRUGMAN (1989): “Persistent Trade Effects of Large Exchange Rate Shocks,” *Quarterly Journal of Economics*, 104(4), 635–654.
- BÉKÉS, G., AND B. MURAKÖZY (2012): “Temporary Trade and Heterogeneous Firms,” *Journal of International Economics*, 87(2), 232–246.
- BERNARD, A., AND J. JENSEN (2004): “Why Some Firms Export,” *The Review of Economics and Statistics*, 86(2), 561–569.
- BERNARD, A., J. JENSEN, S. REDDING, AND P. K. SCHOTT (2009): “The Margins of US Trade,” *American Economic Review*, 92(2), 487–93.
- BUONO, I., H. FADINGER, AND R. AEBERHARDT (2009): “Learning and the Dynamics of Exporting: Theory and Evidence from French Firms,” .
- CADOT, O., L. IACOVONE, AND M. P. . F. RAUCH (2013): “Success and failure of African exporters,” *Journal of Development Economics*, 101(284-296).
- DAS, S., M. ROBERTS, AND J. TYBOUT (2007): “Market Entry Costs, Producer Heterogeneity, and Export Dynamics,” *Econometrica*, 75(3), 837–873.
- DIXIT, A. (1989): “Hysteresis, Import Penetration, and Exchange Rate Pass-Through,” *Quarterly Journal of Economics*, 104(2), 205–228.

- DIXIT, A., AND R. PINDYCK (1994): *Investment under uncertainty*. Princeton university press.
- EATON, J., M. ESLAVA, M. KUGLER, AND J. TYBOUT (2008): “The Margins of Entry into Export Markets: Evidence from Colombia,” in *The Organization of Firms in a Global Economy*, ed. by E. Helpman, D. Marin, and T. Verdier.
- GÖRG, H., R. KNELLER, AND B. MURAKÖZY (2012): “What makes a successful export? Evidence from firm-product-level data,” *Canadian Journal of Economics*, 45(4), 1332–1368.
- IMPULLITTI, G., A. IRARRAZABAL, AND L. OPROMOLLA (2013): “A Theory of Entry into and Exit from Export Markets,” *Journal of International Economics*, 90(1), 75–90.
- KRUGMAN, P. (1989): *Exchange-Rate Instability*. MIT Press, Cambridge.
- LAWLESS, M. (2009): “Firm Export Dynamics and the Geography of Trade,” *Journal of International Economics*, 77(2), 245–254.
- MORALES, E., G. SHEU, AND A. ZAHLER (2011): “Gravity and Extended Gravity: Estimating a Structural Model of Export Entry,” .
- ROBERTS, M., AND J. TYBOUT (1997): “The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs,” *American Economic Review*, 87(4), 545–564.

A Appendix

A.1 Derivation of the stochastic process of θ_t

Recall the formula for θ_t : Then profits are given by

$$\theta_t = \lambda_t \frac{1}{\varepsilon} c^{1-\varepsilon} \varphi_t^{\varepsilon-1} \left(\frac{\varepsilon}{\varepsilon-1} \right)^{1-\varepsilon}$$

Using Ito’s formula,

$$d\theta = \frac{\partial\theta}{\partial\lambda}d\lambda + \frac{\partial\theta}{\partial\varphi}d\varphi + \frac{1}{2}\frac{\partial^2\theta}{\partial\lambda^2}(d\lambda)^2 + \frac{1}{2}\frac{\partial^2\theta}{\partial\varphi^2}(d\varphi)^2 + \frac{\partial\theta^2}{\partial\lambda\partial\varphi}d\lambda d\varphi$$

Computing the derivatives and discarding higher order terms yields

$$d\theta = \theta(\alpha_\lambda dt + \sigma_\lambda dz_\lambda) + (\varepsilon-1)\theta(\alpha_\varphi dt + \sigma_\varphi dz_\varphi) + \frac{(\varepsilon-1)(\varepsilon-2)}{2}\theta\sigma_\varphi^2 dt + \theta(\varepsilon-1)\rho_{\lambda\varphi} dt$$

$$d\theta = \left((\alpha_\lambda + (\varepsilon-1)\alpha_\varphi + \frac{(\varepsilon-1)(\varepsilon-2)}{2}\sigma_\varphi^2 + (\varepsilon-1)\rho_{\lambda\varphi}) \right) \theta dt + (\sigma_\lambda dz_\lambda + (\varepsilon-1)\sigma_\varphi dz_\varphi) \theta$$

Let $dz_\theta \equiv \frac{\sigma_\lambda dz_\lambda + (\varepsilon-1)\sigma_\varphi dz_\varphi}{\sqrt{\sigma_\lambda^2 + (\varepsilon-1)^2\sigma_\varphi^2 + 2\sigma_\lambda\sigma_\varphi(\varepsilon-1)\rho}}$. Since dz_λ and dz_φ are jointly normal $N(\mathbf{0}, \Sigma dt)$ with $\Sigma = \begin{bmatrix} 1 & \rho_{\lambda\varphi} \\ \rho_{\lambda\varphi} & 1 \end{bmatrix} dt$, $dz_\theta \sim N(0, dt)$. Also, let $\alpha_\theta \equiv (\alpha_\lambda + (\varepsilon-1)\alpha_\varphi + \frac{(\varepsilon-1)(\varepsilon-2)}{2}\sigma_\varphi^2 + (\varepsilon-1)\rho_{\lambda\varphi})$ and $\sigma_\theta \equiv \sqrt{\sigma_\lambda^2 + (\varepsilon-1)^2\sigma_\varphi^2 + 2\sigma_\lambda\sigma_\varphi(\varepsilon-1)\rho_{\lambda\varphi}}$. Then,

$$d\theta = \alpha_\theta \theta dt + \sigma_\theta \theta dz_\theta.$$

A.2 Proof of Lemma 1

We will first characterize the function $G_k(\theta)$. As we have already established, the expression for $G(\theta)$ in equation (24) is only valid for $\theta \geq \frac{F_k}{\psi_k}$. Take the derivative of $G_k(\theta)$ with respect to θ :

$$G'_k(\theta) = \beta_2 \left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha} \right) F_k^{1-\beta_2} \psi_k^{\beta_2} \theta^{\beta_2-1} + (\beta_1 - 1) \frac{\psi_k}{v - \alpha};$$

Taking the second derivative, we can establish that $G_k(\theta)$ is strictly convex:

$$G''_k(\theta) = \beta_2(\beta_2 - 1) \left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha} \right) F_k^{1-\beta_2} \psi_k^{\beta_2} \theta^{\beta_2-2} > 0.$$

Evaluate $G_k(\theta)$ and $G'(\theta)$ at $\theta = \frac{F_k}{\psi_k}$. Using (24):

$$\begin{aligned} G_k\left(\frac{F_k}{\psi_k}\right) &= \left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha} \right) F_k + \frac{(\beta_1 - 1)}{v - \alpha} F_k - \beta_1 \left(\frac{F_k}{v} + S_k \right) \\ &= -\beta_1 S_k < 0, \end{aligned}$$

and

$$\begin{aligned} G'_k\left(\frac{F_k}{\psi_k}\right) &= \beta_2 \left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha} \right) \psi_k + \frac{(\beta_1 - 1)}{v - \alpha} \psi_k \\ &= \psi_k \left(\frac{\beta_2 \beta_1}{v} - \frac{\beta_2 \beta_1 - \beta_2 - \beta_1 + 1}{v - \alpha} \right) \\ &= \frac{\psi_k}{v(v - \alpha)} (\beta_2 \beta_1 (v - \alpha) - v \beta_2 \beta_1 + v \beta_2 + v \beta_1 - v) \\ &= \frac{\psi_k}{v(v - \alpha)} (-\alpha \beta_2 \beta_1 + v(\beta_2 + \beta_1 - 1)) \\ &= \frac{\psi_k}{v(v - \alpha)} \left(-\alpha \left(-\frac{2v}{\sigma^2} \right) - v \frac{2\alpha}{\sigma^2} \right) = 0. \end{aligned}$$

Since $G'_k\left(\frac{F_k}{\psi_k}\right) = 0$ and the function is strictly convex, $G'_k\left(\frac{F_k}{\psi_k}\right) > 0$ for $\theta > \frac{F_k}{\psi_k}$. In fact $G_k(\theta) \rightarrow \infty$ as $\theta \rightarrow \infty$.

Finally, since $G_k\left(\frac{F_k}{\psi_k}\right) < 0$ and $G_k(\theta)$ is continuous and strictly convex, it follows that there is a unique $\theta_k^* > \frac{F_k}{\psi_k}$ such that (24) holds. Drawing on our previous result, this also implies that $G'_k(\theta_k^*) > 0$.¹²

¹²Note that we do not need $G'_k\left(\frac{F_k}{\psi_k}\right) > 0$ to show uniqueness. Since $G_k\left(\frac{F_k}{\psi_k}\right) < 0$, $G_k(\theta) \rightarrow \infty$ as $\theta \rightarrow \infty$, and $G_k(\theta)$ is strictly convex, this function can only cross the horizontal axis once. Furthermore, at this point $G'_k(\theta_k^*)$ must be positive.

A.3 Proof of Proposition 5

Let us first focus on a firm that can enter two markets, A and B with interdependent fixed costs (but independent sunk costs). To match the empirical specification, we will need to compare two firms, 1 and 2, that enter the same market (e.g. market A) with different export experiences, and calculate their respective survival probabilities, $P_{1A}(T)$ and $P_{2A}(T)$. We will develop the analysis for firm 1. We assume that this firm enters market A first and leaves this market last. The case for firm 2 is exactly the opposite so we will not need to develop it.

Set up There is a common fixed cost F_g and an idiosyncratic fixed cost \tilde{F}_k , $k = A, B$. We will study the optimal strategy of the firm as a function of its parameters $\psi_1 \equiv \frac{\psi_{1A}}{\psi_{1B}}$. We normalize $\psi_{1B} = 1$, so $\psi_1 = \psi_{1A}$.

Since we assume that the firm leaves market B first – in case it has entered both markets – it has to be the case that $\frac{\tilde{F}_A + F_g}{\psi_1} < \tilde{F}_B$. First, we will study the "exit-reentry" problem. Then, we will study the "first-entry" problem. Finally, we will study the probability of survival in this context.

The exit-reentry problem Suppose the firm has entered both A and B . Given our assumption about the exit order, if it is making profits in market B , then it is also making profits in market A . This implies that the firm will never be active only in market B . Also, there is a range of θ where it makes positive profits in A (paying the full fixed costs) and yet prefers not to operate in B . Therefore, we have three possible states of the firm $\{AB, A, 0\}$.

AB case

The firm is making profits in both markets and it has the option of leaving B to be only in A (there is no option value when θ goes up). Hence, the value of the active firm is given by

$$V_{AB}(\theta_t) = A_{AB}\theta_t^{\beta_2} + \frac{(\psi_1 + 1)}{v - \alpha}\theta_t - \frac{\tilde{F}_A + \tilde{F}_B + F_g}{v}.$$

A case

The firm is making profits only in A . The value of the firm also captures the option value of reentering B (positive root) and the option value of leaving A (negative root). Hence,

$$V_A(\theta_t) = A_A^{UP}\theta_t^{\beta_1} + A_A^{DOWN}\theta_t^{\beta_2} + \frac{\psi_1}{v - \alpha}\theta_t - \frac{\tilde{F}_A + F_g}{v}.$$

0 case

The firm is not making profits. There is only the option value of entering A :

$$V_0(\theta_t) = A_0\theta_t^{\beta_1}.$$

There are VM and SP conditions at two thresholds. The first threshold, $\bar{\theta}$, determines the transition from AB to A . This threshold is given by $\bar{\theta} = \tilde{F}_B$. The second threshold, $\underline{\theta}$, determines the transition from A to 0. This second threshold is given by $\underline{\theta} = \frac{\tilde{F}_A + F_g}{\psi_1}$. The VM and SP conditions at the first threshold ($\bar{\theta}$) are given by:

$$\begin{aligned} A_{AB}\bar{\theta}^{\beta_2} + \left(\frac{\psi_1 + 1}{v - \alpha}\right)\bar{\theta} - \left(\frac{\tilde{F}_A + \tilde{F}_B + F_g}{v}\right) &= A_A^{UP}\bar{\theta}^{\beta_1} + A_A^{DOWN}\bar{\theta}^{\beta_2} + \left(\frac{\psi_1}{v - \alpha}\right)\bar{\theta} - \left(\frac{\tilde{F}_A + F_g}{v}\right) \\ \beta_2 A_{AB}\bar{\theta}^{\beta_2} + \left(\frac{\psi_1 + 1}{v - \alpha}\right)\bar{\theta} &= \beta_1 A_A^{UP}\bar{\theta}^{\beta_1} + \beta_2 A_A^{DOWN}\bar{\theta}^{\beta_2} + \left(\frac{\psi_1}{v - \alpha}\right)\bar{\theta} \end{aligned} \quad (36)$$

Multiplying the first equation by β_1 , subtracting the second equation from the first, and doing basic algebra, we get:

$$A_{AB} = -\left(\frac{\beta_1 - 1}{\beta_1 - \beta_2}\right)\left(\frac{1}{v - \alpha}\right)\bar{\theta}^{1-\beta_2} + \left(\frac{\beta_1}{\beta_1 - \beta_2}\right)\frac{\tilde{F}_B}{v}\bar{\theta}^{-\beta_2} + A_A^{DOWN}. \quad (37)$$

Similarly, using the VM and SP conditions at the second threshold ($\underline{\theta}$), we obtain:

$$\begin{aligned} A_A^{UP}\underline{\theta}^{\beta_1} + A_A^{DOWN}\underline{\theta}^{\beta_2} + \left(\frac{\psi_1}{v - \alpha}\right)\underline{\theta} - \left(\frac{\tilde{F}_A + F_g}{v}\right) &= A_0\underline{\theta}^{\beta_1} \\ \beta_1 A_A^{UP}\underline{\theta}^{\beta_1} + \beta_2 A_A^{DOWN}\underline{\theta}^{\beta_2} + \left(\frac{\psi_1}{v - \alpha}\right)\underline{\theta} &= \beta_1 A_0\underline{\theta}^{\beta_1} \end{aligned} \quad (38)$$

where again, following similar steps, we obtain

$$A_A^{DOWN} = -\left(\frac{\beta_1 - 1}{\beta_1 - \beta_2}\right)\left(\frac{\psi_1}{v - \alpha}\right)\underline{\theta}^{1-\beta_2} + \left(\frac{\beta_1}{\beta_1 - \beta_2}\right)\left(\frac{\tilde{F}_A + F_g}{v}\right)\underline{\theta}^{-\beta_2} \quad (39)$$

The last equation determines A_A^{DOWN} . Given this value and replacing the thresholds, equation (37) determines A_{AB} ,

$$A_{AB} = \left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha}\right)\left(\frac{\tilde{F}_B^{1-\beta_2} + \psi_1^{\beta_2}(\tilde{F}_A + F_g)^{1-\beta_2}}{\beta_1 - \beta_2}\right)$$

From equation (36) we obtain A_A^{UP} and, lastly, from equation (38) we obtain A_0 . Hence, the value of the firm once it has entered both markets can be fully solved.

The entry problem If the firm has still not entered both markets, it can either be completely inactive or it may have entered market A but not market B . Let us firm consider the latter case. In that case, the firm has only paid the sunk for entering A . For such a firm, there is (i) an option value of entering B , going to the relevant AB case above, (ii) an option value of exiting A (without entering B), (iii) the discounted

profits. To avoid confusion, we will call K_0 and K_1 the associated constants in this case. On the other hand, after entering B the firm would receive the AB payoff derived above.

The VM and SP conditions at the entry threshold for market B (θ_B^*), are given by:

$$\begin{aligned} A_{AB}\theta_B^{*\beta_2} + \left(\frac{\psi_1 + 1}{v - \alpha}\right)\theta_B^* - \left(\frac{\tilde{F}_A + \tilde{F}_B + F}{v}\right) &= \psi_1\left(\frac{\theta_B^*}{v - \alpha}\right) - \left(\frac{\tilde{F}_A + F}{v}\right) + K_0^B\theta_B^{*\beta_1} + K_1^B\theta_B^{*\beta_2} + S_B \\ \beta_2 A_{AB}\theta_B^{*\beta_2} + \left(\frac{\psi_1 + 1}{v - \alpha}\right)\theta_B^* &= \beta_1 K_0^B\theta_B^{*\beta_1} + \beta_2 K_1^B\theta_B^{*\beta_2} + \psi_1\frac{\theta_B^*}{v - \alpha}. \end{aligned}$$

Note that we have two equations in three unknowns (θ_B^*, K_1^B, K_0^B). However, K_1^B is not really an unknown since it comes from the entry-reentry conditions of being only in A , which are analogous to A_1 in the independent case (just note slight difference due to the fact that the value function here is written in terms of θ rather than π):

$$K_1^B = \frac{\psi_1^{\beta_2}(\tilde{F}_A + F)^{1-\beta_2}}{\beta_1 - \beta_2} \left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha}\right).$$

Hence, we can solve for K_0^B and θ_B^* following the usual steps to obtain:

$$(\beta_1 - \beta_2)(A_{AB} - K_1^B)\theta_B^{*\beta_2} + \left(\frac{\beta_1 - 1}{v - \alpha}\right)\theta_B^* - \beta_1\left(\frac{\tilde{F}_B}{v} + S_B\right) = 0. \quad (40)$$

Equation (40) determines the entry threshold for market B . Using the solutions we obtained for A_{AB} and K_1^B we can write:¹³

$$A_{AB} - K_1^B = \left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha}\right) \left(\frac{\tilde{F}_B^{1-\beta_2}}{\beta_1 - \beta_2}\right). \quad (41)$$

Substituting (41) back into (40) yields the equation that determines the solution for the entry threshold into market B , θ_B^* . Comparing the resulting equation with equation (23), which determines the entry threshold in the independent case, we can easily note that they are identical. Hence, we establish that the entry threshold for the experienced firm is the entry threshold in the independent case that corresponds to (lower) fixed costs \tilde{F}_B .

If the firm has still not entered any of the two markets, then the only relevant transition is to enter market A . Hence, the relevant VM and SP conditions are given by:

$$\begin{aligned} K_0^A\theta_A^{*\beta_1} + S_A &= \left(\frac{\psi_1}{v - \alpha}\right)\theta_A^* - \left(\frac{\tilde{F}_A + F_g}{v}\right) + K_0^B\theta_A^{*\beta_1} + K_1^B\theta_A^{*\beta_2} \\ \beta_1 K_0^A\theta_A^{*\beta_1} &= \beta_1 K_0^B\theta_A^{*\beta_1} + \beta_2 K_1^B\theta_A^{*\beta_2} + \left(\frac{\psi_1}{v - \alpha}\right)\theta_A^*. \end{aligned}$$

Following once again the usual steps, we obtain the equation that determines the entry threshold into market

¹³Equation (40) is also valid if the exit order is different than the one we postulate here. For example, the firm could leave market A first or it could leave markets A and B simultaneously. In those cases, however, the constant A_{AB} , which already contains the information about the optimal decision in the exit-reentry subproblem, would be different.

A, θ_A^* :

$$\left(\frac{\beta_1}{v} - \frac{\beta_1 - 1}{v - \alpha}\right) \left[\psi_1^{\beta_2} (\tilde{F}_A + F_g)^{1-\beta_2}\right] \theta_A^{*\beta_2} + \left(\frac{\beta_1 - 1}{v - \alpha}\right) \psi_1 \theta_A^* - \beta_1 \left(\frac{\tilde{F}_A + F_g}{v} + S_A\right) = 0. \quad (42)$$

The interesting finding here is that the entry of the firm in the first market (A) is determined by the same equation that determines entry into market A in the independent case. This implies that the entry threshold into that first market is the same in both cases even when the potential later entry into market B may reduce the firm's imputed fixed costs in A . Hence, we establish that the entry threshold for the inexperienced firm is the entry threshold in the independent case that corresponds to (higher) fixed costs F_A .

The probability of survival Given that F_A are also the fixed costs that determine exit from market A and given that \tilde{F}_B are the fixed costs that determine exit from market B – as in the independent case – we finally establish that the probabilities of survival of firm 1 in markets A and B are those calculated in the independent case when fixed costs are F_A and \tilde{F}_B , respectively.

For firm 2 the results are analogously opposite so we do not need to develop this case. This firm enters market B as an inexperienced firm and market A as an experienced firm. In this case the entry and exit thresholds for market B will be equivalent to those of the independent case with (higher) fixed costs F_B while the entry and exit thresholds for market A will be equivalent to those of the independent case with (lower) fixed costs \tilde{F}_A . Combining these results, we obtain: $P_{1A}(T) \leq P_{2A}(T); P_{1B}(T) \geq P_{2B}(T)$. *QED*

Table 7: Survival and General Exporting Experience

	(1)	(2)	(3)	(4)	(5)	(6)
d_k	-0.027*** (0.0026)					
$D_{i,t}^e$	0.021*** (0.0061)	0.026*** (0.0055)				
$ExportingAge_{i,t}$			0.01*** (0.001)			
$Exposure_{i,t}$				0.004*** (0.0004)		
$Number\ of\ previous\ destinations_{i,t}$					0.006*** (0.0004)	
$Number\ of\ previous\ incursions_{i,t}$						0.004*** (0.0003)
Constant	0.451*** (0.0232)	0.246*** (0.0055)	0.221*** (0.0064)	0.230*** (0.0058)	0.242*** (0.0054)	0.239*** (0.0054)
Year FE :	yes	yes	yes	yes	yes	yes
destination FE :	no	yes	yes	yes	yes	yes
Observations	118,776	118,854	118,854	118,854	118,854	118,854
R-squared	0.005	0.013	0.015	0.015	0.019	0.016

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8: Survival and Specific Exporting Experience

	(1)	(2)	(3)	(4)	(5)
d_k	-0.029*** (0.0031)				
$XContiguity_{kt}$	0.044*** (0.0054)	0.049*** (0.0058)	0.045*** (0.0057)	0.036*** (0.009)	0.061*** (0.009)
$XLanguage_{kt}$	0.02*** (0.0076)	0.036*** (0.006)	0.03*** (0.0059)	.0268*** (0.0081)	0.028** (0.0127)
$XIncomeQuartile_{it}$	0.04*** (0.0056)	0.04*** (0.0057)	0.03*** (0.0056)	0.04*** (0.0096)	0.027*** (0.0091)
X_{ikt}			0.006** (0.0024)	0.003** (0.001)	0.005 (0.0034)
$NINCUR_{it}$			0.017*** (0.0014)	0.01*** (0.0011)	0.014*** (0.0026)
Constant	0.448*** (0.0268)	0.227*** (0.00510)	0.181*** (0.0062)	0.547*** (0.0086)	0.179*** (0.02)
Year FE	yes	yes	yes	yes	yes
Destination FE	no	yes	yes	yes	no
Firm - yearFE	no	no	no	no	yes
Observations	118,776	118,854	118,854	47,425	118,854
R-squared	0.012	0.021	0.037	0.035	0.097

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1