IDB WORKING PAPER SERIES #IDB-WP-140

Survival of New Exporters in Developing Countries: Does it Matter how they Diversify?

Christian Volpe Martincus
Jerónimo Carballo

Inter-American Development Bank
Vice Presidency for Sectors and Knowledge
Integration and Trade Sector

December / 2009

Survival of New Exporters in Developing Countries: does it Matter how they Diversify?

Christian Volpe Martincus
Jerónimo Carballo

Inter-American Development Bank
2009

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library

Volpe Martincus, Christian.
- Survival of new exporters in developing countries: does it matter how they diversify? / Christian Volpe Martincus, Jerónimo Carballo. p. cm. (IDB working paper series; 140)
Includes bibliographical references.
1. Export trading companies—Peru—Case studies.
2. Exports—Peru—Case studies.

I. Carballo, Jerónimo. Inter-American Development Bank. Integration and Trade Sector.
II. Title. Series.
HF1416.6.P4 V65 2009
382.6 V899—dc22

Please address correspondence to Christian Volpe Martincus, Inter-American Development Bank, Stop W0612, 1300 New York Avenue, NW, Washington, DC 20577, United States of America. E-mail: christianv@iadb.org. Tel.: +1 202 623 3199. Fax: +1 202 623 2995.

Remark: We would like to thank PROMPERU and SUNAT for kindly provided us with export, employment, and starting year data. We also owe gratitude to María García Vega, whose comments on a previous study partially inspired this paper, and to the managing editor, one anonymous referee, Juan Blyde, and Antoni Estevadeordal for valuable and useful suggestions.

Abstract

Recent studies have shown that developing countries might have significantly better export performance if they were able to increase the duration of their trade relationships. Evidence on duration of these relationships at the firm level is virtually absent. In this paper, we aim at filling this gap in the literature by analyzing what determines export survival using firm-level data for the whole population of Peruvian new exporters over the period 2000-2006. In particular, we address one question: Does it matter how firms diversify? We find that geographical diversification increases the probability of survival in export markets more than product diversification.

JEL No. F14, L25, C41.
Keywords: Exports, duration, firms, Peru.

1. Introduction

The relevance of both entry and exit of firms in shaping economic performance has been largely recognized in the industrial organization literature. Several papers have characterized the patterns of entry and exit in manufacturing industries and have attempted to identify their main driving forces.[1] Firms' decision to enter into foreign markets, its determinants and its implications are also well documented in the international trade literature.[2] However, evidence on the determinants of firms' duration patterns in foreign market is scarce. This is rather surprising given that the length of survival can be considered one of the most comprehensive measures of firm performance (see Stigler, 1958). This paper aims at filling this gap in the empirical trade literature. More precisely, we examine export duration using highly disaggregated export data as well as other relevant firm-level information such as employment for Peruvian exporters over the period 2000-2006 and assess whether the type diversification contributes to explain the survival of trade flows.

The median duration of a Peruvian firm export spell over the period 2000-2006 is just one year. Exit rates from international markets are accordingly substantial. Thus, 54.4% of the approximately 2,100 Peruvian firms that entered into foreign markets in 2005 cease to export in 2006. Besedes and Prusa (2007) suggest that developing countries might have significantly better export performance, i.e., higher export growth if they were able to increase the duration of their trade relationships. In addition, exit from foreign markets may potentially have significant consequences. Thus, Girma et al. (2003) show that such an exit has a weak negative impact on firm's total factor productivity in the year exit takes place and a strong and quite persistent negative effect on firm's employment and output.

The industrial organization literature has established some stylized facts concerning the factors that affect the probability that a firm ceases to operate or exit particular markets. One of these facts is that the probability of exit decreases with the number of products produced and the number of markets served (i.e., if the firm is an exporter) (see, e.g., Bernard and Jensen, 2002; and Bernard and Jensen, 2007). This result can be rationalized in terms of a portfolio argument. If sales of different products (in different markets, domestic vs. foreign) do not perfectly covariate, then variability of sales should be lower for multi-product (exporter) firms and, as a

[1] See, e.g., Dunne et al. (1988), Dunne et al. (1989), Audretsch (1991), Audretsch and Mahmood (1995), Dunne et al. (2005), and Bernard and Jensen (2007).

consequence, the expected probability of survival should be higher (see Hirsch and Lev, 1971; Bernard and Jensen, 2002). Moreover, diversified firms are more likely to be more productive (see, e.g., Bernard et al., 2006) and may have access to resources, say, external or internal sources of capital, that can help them to avoid closure in case of a negative shock to one product (market) (see Jovanovic, 1993; Bernard and Jensen, 2007).

In this paper, we investigate whether this also applies to exit from export markets. More precisely, we address one main question: Does it matter whether and how firms diversify their exports to survive in international markets?

We apply survival methods to document Peruvian firms' export duration patterns and to assess the role played by diversification in determining these patterns over the period 2000-2006. In doing this, we use a unique firm-level dataset containing data on exports by product and countries, employment, and starting date over this period. Thus, we include relevant time-varying covariates such as size measured by employment, current exports, initial exports, and age group to account for observed firm characteristics that potentially affect the profit stream and henceforth the survival chances. We also control for unobserved heterogeneity.

We contribute to the literature in several ways. First, we provide, to our knowledge for the first time, evidence on export duration patterns at the firm level and explicitly analyze their determinants for a developing country, Peru.[3] More specifically, instead of just looking at the link between these characteristics and the intensity of participation in foreign markets as highlighted in theoretical models featuring firm heterogeneity (see, e.g., Melitz, 2003; Melitz and Ottavaino, 2008; and Helpman et al., 2008) and empirical studies testing their main results, we investigate whether there is heterogeneity in export duration patterns and whether and how this is systematically related to specific firm attributes. This might prove to be insightful for future theoretical developments in the international trade literature. Second, even though survival methods have been widely used to examine the life time of firms (see, e.g., Audretsch, 1991; Mata and Portugal, 1994; Klepper, 2002) and have been recently utilized to describe trade duration at the product level (see, e.g. Besedes and Prusa, 2006; Nitsch, 2007), our paper applies these methods to firm-level trade data. This allows us to account for both whether and when

[2] See, e.g, Roberts and Tybout (1997), Clarides et al. (1998), Girma et al. (2004), and Bernard and Jensen (2004).

[3] Álvarez and López (2008) use plant- level data for a sample of Chilean manufacturing firms, but their analysis of the determinants of entry and exit patterns is confined to the sectoral level. Görg et al. (2008) examine the determinants of the survival of products in the export mix on a sample of Hungarian firms.

exactly firms exit from export markets, thus controlling for the evolution of the corresponding risk over time. Third, unlike most studies on firm export behavior, we consider the whole population of new exporters and accordingly cover all sectors. This is especially important for developing countries such as Peru where exports of natural resources and their products account for a large fraction of the country's total exports (see Giordano et al., 2006).

We find that both geographical diversification and product diversification of exports increase the chances of surviving in export markets. More specifically, selling to a larger number of countries and, in particular, a more uniform distribution of sales across countries are associated with a larger decrease in the risk of failing abroad than selling a larger number of products or having a more balanced export bundle in terms of goods. Furthermore, larger firms as measured in terms of employment are more likely to remain active in international markets.

The remainder of the paper is organized as follows: Section 2 explains the empirical methodology, which is essentially based on survival methods. Section 3 describes the dataset and presents some basic preliminary statistical evidence. Section 4 reports the main estimation results, and Section 5 concludes.

2. Empirical Methodology

We are interested in measuring the duration of firms' exports, i.e., the time elapsed until firms' trade flows are interrupted, and in identifying the factors that affect the risk of these flows to be dropped. When measuring export duration with available data, a common problem is that some observations on the duration of trade flows may be right-censored. This is the case when spells are in progress, i.e., we just know the duration from the inception of the spell to the final year of the sample period. Spells may be also left-censored. In this case, actual duration cannot be determined because the time from the inception of the spell to the first sample year is unknown. In our case, left-censoring is not a problem because we just focus on new exporters.[4]

Survival analysis methods allow addressing the special problems associated with duration data. These methods take into account the evolution of the exit risk and its determinants over time. They are based on the concept of conditional probabilities (e.g., the probability of an export

[4] Further, short spells may be underrepresented in the sample, i.e., there may be length-biased sampling (see Kiefer, 1988). This problem is more relevant for unemployment than for trade flows because firms do not necessarily export every month.

flow to last 7 years, given that it has lasted 6 years) instead of the unconditional probabilities (e.g., the probability of an export flows to last exactly 7 years).[5]

Formally, let $T \geq 0$ denote the duration of exports, which has some distribution in the population and *t* a particular value of *T*. The survivor function *S(t)* is defined as follows:

$$S(t) = P(T \geq t) = 1 - F(t) \qquad (1)$$

The survivor function gives the probability that the duration of the spell *T* equals or exceeds the value *t* and, as such, it is the complement of the probability distribution of duration *F(t)* whose corresponding density function is given by $f(t) = dF(t)/dt$. The distribution of durations can be also characterized in terms of the hazard function. Let $P(t \leq T \langle t + \Delta t | T \geq t)$ be the probability of an export flow to cease in the interval $[t, t + \Delta t)$ given that it has lasted until time *t*. The hazard function is obtained by taking the limit of this probability for small Δt (see Kiefer, 1988):

$$\lambda(t) = \lim_{\Delta t \to 0} P(t \leq T \langle t + \Delta t \,|\, T \geq t)/\Delta t = f(t)/S(t) \qquad (2)$$

$\lambda(t)$ is the (instantaneous) rate at which export flows disappear at duration *t*, given that they last until *t*.[6]

The explanatory variables can affect the distribution of durations in several ways depending on the specification used. We adopt here a proportional hazard specification, so that the effect of the regressors consists of multiplying the hazard function itself by a scale factor, i.e., their effect is a parallel shift of the baseline function, which is estimated for all those firms whose export flows survive up to a particular period (see Kiefer, 1988). Formally:

$$\lambda(t) = \lambda_0(t) exp(x(t)'\beta) \qquad (3)$$

where λ_0 is a baseline hazard, which is an unknown, *x* is a vector of time-varying explanatory variables and β is a vector of parameters, which is also unknown.[7] We estimate this model semi-parametrically using the partial-likelihood approach proposed by Cox (1972). More

---

5 In contrast, traditional cross-section techniques examine the unconditional average probability of occurrence of the event during the sample period (e.g., logit or probit) or the average duration (e.g., OLS) (see Esteve Pérez et al., 2004).

6 The hazard function provides a convenient definition of duration dependence. To see why, this function can be written in the following way: $\lambda(t) = -dlnS(t)/dt$. If $d\lambda(t)/dt \rangle 0$ at point *t*=*t**, then the probability that a spell end shortly increases as the spell increases in length, i.e., there is positive duration dependence at *t**. In contrast, If $d\lambda(t)/dt \langle 0$ at point *t*=*t**, then the probability that a exports cease shortly decreases as the spell increases in length, i.e., there is negative duration dependence at *t**.

specifically, the model is estimated maximizing a partial likelihood function with respect to the vector of coefficients β without specifying the form of the baseline hazard function λ_0.This approach has the advantage of avoiding potential misspecification of this function (see Dolton and von der Klaauw, 1995).

Partial likelihood allows us to easily deal with censoring and ties. Let $t_1<t_2<\ldots<t_n$ be completed export spells ordered according to their length among n observed survival times. The contribution of the *jth* shortest duration is

$$exp\left(x_j'\beta\right)\Big/\sum_{i=j}^{n} exp\left(x_i'\beta\right) \qquad (4)$$

The partial likelihood function is obtained multiplying these contributions together for each of the incidences of exit and accordingly the resulting log-likelihood is (see Kiefer, 1988):[8]

$$L(\beta)=\sum_{i=1}^{k}\left[x_i'\beta-\ln\left(\sum_{j=i}^{n} exp\left(x_j'\beta\right)\right)\right] \qquad (5)$$

The intuition is that, in absence of information on the baseline hazard, only the order of the durations provides information about the unknown coefficients. Maximization of this log-likelihood function yields estimators of coefficients β with the usual properties of maximum-likelihood estimators (see Audretsch and Mahmood, 1994). The estimated coefficients indicate the relationship between the covariates and the hazard function. Thus, a positive (negative) coefficient increases (reduces) the value of the hazard and it therefore indicates a negative (positive) impact on survival.

Note that an individual whose spell is censored between durations t_j and t_{j+l} appears in the summation in the denominator of the contribution to log-likelihood of (ordered, uncensored) observations *1* through *j*, but not in any others. On the other hand, censored spells do not enter the numerator of the contribution at all (see Kiefer, 1988). Ties are handled by including a contribution to log-likelihood for each of the tied observations using the same denominator for each (see Breslow, 1974).[9]

---

7 λ_0 is the baseline hazard corresponding to $\exp(x'\beta)=1$, i.e., when the covariates are equal to 0.

8 Note that the baseline hazard is assumed to be the same for all observations, so that, due to the proportional hazard assumption, it cancels out.

9 Formally, in the case of ties, Breslow (1974) proposes to maximize the following log-likelihood: $L(\beta)=\sum_{i=1}^{k}\left[s_i'\beta-m_i ln\left(\sum_{j=i}^{n} exp\left(x_j'\beta\right)\right)\right]$ where m_i is the number of exits occurring at t_i and s_i is the sum of covariates over the m_i observations.

Firms may enter foreign markets some year, exit the following year, re-enter the next one, and so successively. In particular, in our sample, 845 firms entered, exited, and re-entered export markets, and 416 firms entered, exited, re-entered, and exited again. Hence, there are multiple export spells and two or more events of interest occur to the same firm. In these cases, failure times may be correlated within firms. Thus, a first exit from export markets could make more likely to exit again. On the other hand, we can conceivably argue that re-enter international markets reveals certain abilities of the firm that could be associated with lower risks of exit a second time (see Besedes and Prusa, 2006). In this case, the assumption that export durations are independently distributed over time conditional on observed covariates would be violated (see Kovacevic, 2002). These interdependencies should be therefore controlled for. In order to deal with this issue we estimate the model parameters without explicitly modeling their dependencies, and then correct the covariance matrix to account for the within-individual correlation (see Lin and Wei, 1989).[10]

More generally, there may be unobserved firm heterogeneity, i.e., systematic differences may remain in the distribution of durations across units of observation after conditioning on observed explanatory variables.[11] When this is the case, inferences about duration dependence and the effect of included covariates may be misleading (see Kiefer, 1988). In particular, in the proportional hazard model, ignoring heterogeneity leads to underestimating the proportional effect of the explanatory variables (see van der Berg, 2001). We model the unobserved characteristics as a random effect and assume that it enters multiplicatively on the hazard function (see Clayton and Cuzick, 1985). Formally:

$$\lambda_i(t) = \theta_i \lambda_0(t) exp(x(t)'\beta) \qquad (6)$$

where is θ_i is a random variable that is assumed to be independent of *x(t)*. A log-likelihood is obtained by conditioning on the unobserved θ_i and then integrating over its distribution. In this paper, we assume that θ_i follows a gamma distribution with mean equal to

10 Besedes and Prusa (2006) treat multiple spells as independent and use a dummy to account for higher order spells.
11 Failure to control for firm characteristics shared by export spells precisely results in dependencies among these spells (see Kovacevic, 2002).

one.[12] This distribution has the advantage of giving a closed form expression for the likelihood, thus avoiding numerical integration (see Meyer, 1990).[13]

3. Data, Variables, and Descriptive Statistics

Our dataset consists of two main databases. On the one hand, we have highly disaggregated export data at the firm level over the period 2000-2006. Data cover all new exporters, i.e., firms that registered their first exports from 2000 onwards.[14] These data are reported annually at the firm-product-country level. Specifically, each record includes the firm's tax ID, the product code (10-digit HS), the country of destination, and the export value in US dollars. On the other hand, we have data on employment and starting date from the National Tax Agency, SUNAT, for the same period. Firms are also identified by their tax ID in this case, so that the both databases could be easily merged.

These data enable us to construct the following variables which are identified as key determinants of exit in the empirical literature on industrial organization: number of countries in which the firms sell their products, number of products they sell abroad, number of employees, initial scale of operation (total exports in the first year they appear as exporters), and age.

Table 1 characterizes Peruvian new exporters in terms of these variables over our sample period. The number of firms entering export markets for the first time has been growing steadily, from 1,359 to 2,132 between 2000 and 2006. The average new exporter sells about five products to 1.3 countries (with a total sales volume of more than 100,000 US dollars), has between 10 and 20 employees and is approximately six years old. In 2006 the companies in our sample exported together 3,438 products to 144 countries.

The event of interest of our study is exit from export markets. We define this event as occurring in the year for which there is no register of export activity. Table 2 reports for each year the number as well as the share of firms which having started to export this year do not appear as exporters in the next year and in all subsequent years. We have seen before that the number of newcomers has been rising. This table shows that the number of exiting firms has increased as well. However, the annual export mortality rate has declined in recent years. Thus, while 923 firms out of the 1,546 firms that engaged in international trade in 2002 interrupted

12 The distribution of the random effect converges to the gamma distribution for proportional hazard models with unobserved heterogeneity (see Abbring and van der Berg, 2007).
13 The inverse Gaussian distribution also has this property (see Hougaard, 1984).
14 These firms do not register any exports back to 1995.

cross-border operations in 2003, 1,124 firms out of the 2,132 firms that entered export markets in 2005 ceased to export in 2006, which amounts to a decrease in the exit rate from 59.7% to 54.4%.

Export flow survival patterns can be characterized using the survivor function. This function can be estimated using the Kaplan-Meier or product-limit estimator, which is defined as follows:

$$\hat{S}(t_j) = \prod_{i=1}^{j} [(n_i - k_i)/n_i] = \prod_{i=1}^{j} (1 - \hat{\lambda}_i) \qquad (7)$$

where n_j is the number of spells neither completed or censored before duration t_j, k_j is the number of completed spells of duration t_j, and $\hat{\lambda}_i$ is the number of exits at duration t_j divided by the number of units of observations at risk of exiting at duration t_j, i.e., the estimated probability of completing a spell at duration t_j, given that the spell has reached duration t_j. Hence, the conditional probability of completing a spell at duration t_j is estimated with the observed relative frequency of completion at duration t_j.[15]

The equality of the survivor functions across different groups defined along relevant variables can be formally tested using univariate survival tests, which basically are extensions to censored data of conventional non-parametric rank tests for comparing distributions. We use here the log-rank, which assumes proportional hazard like the estimations whose results are presented below. Under the null hypothesis, there are no differences between the survival patterns of the groups at any failure time and the statistics is distributed as a χ^2 with *h-1* degrees of freedom, where *h* is the number of groups.

Figures 1 and 2 show the survivor functions for firms with different degrees of export diversification in terms of countries and products, respectively. These figures clearly indicate that diversifying external sales over countries and products increases duration in export markets. The relevant test statistics reported in Table 3 specifically indicate that the differences in survival across firms with different degrees of geographical and product diversification of their external sales are statistically significant. Thus, while less than 50% (less than 50%) of the firms exporting to one country (product) survives from the first to the second year, almost 75% (approximately 50%) of the firms exporting to two countries (products) do. More precisely, the

[15] It can be shown that this is a maximum-likelihood estimator (see Kiefer, 1988).

figures suggest that increasing the number of countries served seems to reduce the risk of exiting foreign markets more than increasing the number of products exported.

Figure 3 shows how the other variables relate to survival in export markets. In particular, it displays the survivor functions for employment and age categories and across initial export value segments (i.e., quintiles). Larger and older firms are more likely to survive in export markets. Thus, after six years, more than 50% of the large firms remain in export markets, but less than 20% of the micro firms do. Differences are smaller across age groups, but they are still substantial. While more than 30% of the firms older than 20 years continue operating in export markets after this period, just 20% of the firms created within the last 10 years are able to do so. Finally, larger initial exports are also associated with lower hazards. Note that the differences across these functions are also statistically significant across the relevant tests (see Table 3).

This section has explored unconditional associations between the variables of interest and firm survival patterns in export markets. The next section will assess the impact of these variables in a conditional framework.

4. Estimation Results

Table 4 reports hazard ratios for the main covariates obtained with the Cox's proportional hazard model. In particular, estimates presented in Columns 1 to 5 are based on a specification where all explanatory variables are expressed in natural logarithm, but age, whose influence is captured through binary variables identifying four categories: 1-5 years, 6-10 years, 11-20 years, and more than 20 years.[16] The natural logarithm transformation enables the comparison of coefficients on variables with different scales such as number of destination countries and number of products exported thus allowing us to draw conclusions on which one has the stronger impact. However, this advantage in terms of eased contrast of coefficients does come at a cost, as such a transformation makes impossible to specifically comment on the magnitude of the effects of interest. In order to be able to do so, we show in Columns 6 and 7 estimates which are obtained when the two key variables are entered with their absolute values and remaining variables are defined as before.

[16] Age cannot enter directly in the Cox specification because it would be collinear with the baseline hazard (see Disney et al., 2003).

Notice that, in this case, estimated coefficients larger than one mean that the variable in question is associated with an increased risk of exiting export markets (i.e., reduces expected duration), whereas the opposite holds when the estimated coefficients are smaller than one.

Geographical and product diversification reduces the probability of exiting international markets. Two main explanations can be postulated for this finding. First, there is a portfolio argument. Specifically, if covariance of firm sales across countries (products) is not perfect, then a larger spread of these sales over countries (products) will be associated with more stable total sales and this can be expected to result in higher likelihood of remaining active, in general, and in international markets, in particular (see Hirsch and Lev, 1971; Bernard and Jensen, 2002). Second, there is an efficiency argument. Heterogeneous firm models highlight that only the more productive firms are able to pay the sunk costs to enter export markets. This has a natural extension into a multi-country (multi-product) setting. Thus, if adding a new destination country (product) requires incurring in specific sunk costs of entry, then trading with a larger number of countries (a larger number of products) will reflect higher productivity (see Bernard et al., 2006). Diversified, more productive firms are precisely those which are more likely to survive. Moreover, these firms may have access to resources that can reduce the exit probability in case of a negative shock to one country (product) market (see Jovanovic, 1993; Bernard and Jensen, 2007).

More specifically, selling to a larger number of countries diminishes this probability more than selling a larger number of products. In particular, according to the estimates based on the specification where the these variables are included in absolute levels, adding a new destination country reduces the hazard by approximately 52%, whereas introducing a new product lowers the hazard roughly 16% (see Columns 6 and 7). This implies that a firm would need to incorporate slightly more than 3 (=(1-0.48)/(1-0.84)) products to its export portfolio to match the benefits of reaching a new country. This result may reflect either that shocks are less correlated across countries for given products than across products for given countries, so that exporting to more countries has a larger stabilizing effect on total external sales than just exporting more products, or that firms spreading their exports over more countries are more productive than those diversifying over products, which would be the case if specific sunk costs incurred when incorporating new destinations are larger than those faced when adding new products.

As expected, size (measured by employment) improves the chances of survival. There are several reasons for this to be the case. First, large firms are more likely to operate at a minimum efficient scale and accordingly are *a priori* in a better position to survive. In addition, if firms learn about their abilities and revise their estimations over time, then firms that grow and become larger are those that have received favorable information and have better expectations about efficiency, and should accordingly face a lower likelihood of exit in the next period than those that do not (see Dunne et al., 1989; Mata et al., 1995).[17] Moreover, large firms may have better access to capital or labor markets, which improves their chances of survival (see Esteve Pérez et al., 2004). Further, large firms might be expected to use more capital intensive methods. As a consequence, their variable costs represent a smaller proportion of their total costs. This makes them less sensitive to price declines (see Mata and Portugal, 1994).[18]

Large initial export volumes reduce the risk of exiting. This is line with the literature reporting that the initial scale of operation is negatively related with this risk (see, e.g., Audretsch, 1991; Audretsch and Mahmood, 1994; and Disney et al., 2003). Small initial size can be the consequence of limits from both the supply and the demand size. Thus, entering at smaller scale can be result of lack of internal finance and/or imperfections in capital markets (see Holtz-Eakin, et al., 1994). Further, entrants that are less optimistic about their unknown cost efficiency may rationally decide limit themselves by starting out small. In proceeding this way, they reduce their sunk commitment, but face higher unit costs. These firms are therefore expected to be less able to stay in the market in the event of reactions by incumbents or market developments leading to unexpected losses, even for short periods (see Mata et al., 1995). In contrast, large scale entry may reveal greater a priori expectations of positive profits and more periods with bad results are required to change these expectations (see Frank, 1988; and Caves, 1998). Moreover, in an uncertain environment buyers that must make irreversible investments in training suppliers may opt for starting business relationships at a small scale (see Rauch and Watson, 2003). In this case, smaller initial sizes are also associated with higher exit rates and shorter duration.[19] Finally, we do not observe a clear relationship between age and duration.[20]

---

17 This is also consistent with Lucas (1978), who argues that the size distribution of firms is determined by their relative efficiency.

18 Bernard at al. (2006) find that firms are more likely to drop products the smaller is the production of the good by the firm and the shorter is the firm's tenure in producing the good.

19 Some authors argue that a large entry size for a given post-entry size can be viewed as signaling a slow growing firm facing negative shocks, which eventually lead to exit (see, e.g., Mata et al., 1995). In particular, fluctuations

We have performed several robustness checks. In Table 5, we control both for macroeconomic conditions including year-fixed effects and for unobserved heterogeneity. Estimates shown there confirm our main findings.[21] It is worth mentioning that, in this case, we find that age has a positive effect on duration. More specifically, firms that are more than 10 years old are more likely to survive than younger ones.[22]

In Table 6, we use alternative export diversification indicators. More concretely, we include the Herfindahl and Gini indexes computed over exports by countries and exports by products as explanatory variables instead of the number of countries and the number of products, respectively. Notice that an increase of these indexes corresponds to a decrease in export diversification along the relevant dimension. Thus, as before, larger diversification (smaller concentration) reduces the probability of exiting export markets and this reduction is larger for firms diversifying on the country-extensive margin.[23] The same holds when we proxy diversification with the number of continents that firms export to and the number of industries (at the 2-digit level) in which they appear as active exporters and a combination of the latter with the number of countries. Summing up, there is strong evidence indicating that our main results are robust across alternative specifications.

---

in industry-wide shocks tend to be more common in developing countries such as Peru. In this context, large entry size may become a liability as it may negatively affect flexibility to timely respond to these shocks and thereby firms' survival chances (see Das and Srinivasan, 1997). This would be the case if Jovanovics's (1982) model were extended to allow for contemporaneous shocks such as fluctuations in market demand or costs.

[20] In principle, older firms can be considered to have more precise information on their intrinsic productivity and therefore less likely to fail, i.e., their future expectations of cost efficiency are less likely to be below that level that would induce exit (see Evans, 1987; Fariñas and Moreno, 2000; and Disney et al., 2003). Stinchcombe (1965) identifies four reasons for new firms to be more likely to fail than older firms, i.e., "liability of newness". First, new firms depend on new roles and tasks that have to be learned at some cost. Second, some roles may need to be invented and this may conflict with constraints on resources. Third, social interactions in new firms may lack the required common normative basis or informal information structure. Finally, stable relationships with clients and providers are not established. Some studies have however found that the probability of exit increases with age, i.e., there might be a "liability of senescence" (see Hannah, 1998). This would be the result of erosion of technology, products, business concepts, and management strategies over time or, in the case of owner-managed firms, problems in finding a successor (see Esteve Pérez et al., 2004).

[21] We have also performed these estimations in a discrete time framework. Estimation results, which are similar to those presented here, are available from the authors upon request.

[22] This is the case when firms learn about their efficiency level through production over time as in Jovanovic's (1982) model. Strictly speaking, Jovanovics's (1982) model predicts a negative relationship between age and hazard rates if the required efficiency level below which exit occurs (the failure boundary) does not increase (decrease) rapidly with age (see Dunne et al., 1989; and Disney et al., 2003).

5. Concluding Remarks

While extensive research on entry and exit patterns of firms in manufacturing industries within countries is available, little is known about duration of firms' business relationships with foreign partners and its determinants, especially in developing countries. This is rather striking as recent studies have shown that this factor may have important consequences in terms of firms' employment and output and even in terms of countries' overall export performance. This paper aims at filling the aforementioned gap in the literature by examining export duration on the basis of highly disaggregated export firm-level data from Peru over the period 2000-2006.

We find that both geographical diversification and product diversification of exports increase the chances of remaining an exporter and, specifically, that exporting to a larger number of countries and, in particular, having a less concentrated distribution of exports across countries decreases the exit risk more than exporting a larger number of products or having a more balanced export bundle in terms of goods. Moreover, larger firms in terms of their number of employees are more likely to survive in international markets. We believe that our findings provide valuable insights for an effective export promotion policy in developing countries comparables to Peru.

[23] The coefficients are statistically significantly different from each other in both cases. Test statistics are available from the authors upon request.

References

Abbring, J., and G. van der Berg, G. (2007). The Unobserved Heterogeneity Distribution in Duration Analysis. *Biometrika* 94 (1): 87-99.

Álvarez, R. and R. López (2008). Entry and Exit in International Markets: Evidence from Chilean data. *Review of International Economics*, forthcoming.

Audretsch, D. (1991). New-Firm Survival and the Technological Regime. *Review of Economics and Statistics*, 73 (3): 441-450.

Audretsch, D. and Mahmood (1994). The Rate of Hazard Confronting New Firms and Plants in the U.S. Manufacturing. *Review of Industrial Organization* 9: 41-56.

van der Berg, G. (2001). Duration Models: Specification, Identification, and Multiple Durations. In J. Heckman and E. Leamer, E. (eds). *Handbook of Econometrics*, Volume V. Amsterdam: North-Holland.

Bernard, A., and B. Jensen (2002). The Deaths of Manufacturing Plants. NBER Working Paper 9026. National Bureau of Economic Research, Cambridge, Massachusetts.

Bernard, A., and B. Jensen (2004). Why Some Firms Export? *Review of Economics and Statistics* 86 (2): 561-569.

Bernard, A., S. Redding, and P. Schott (2006). Multi-Product Firms and Product Switching. NBER Working Paper 12293. National Bureau of Economic Research, Cambridge, Massachusetts.

Bernard, A., and B. Jensen (2007). Firm Structure, Multinationals and Manufacturing Plant Deaths. *Review of Economics and Statistics* 89 (2): 193-204.

Besedes, T., and T. Prusa (2006). Production Differentiation and Duration of U.S. Import Trade. *Journal of International Economics* 70 (2): 339-358.

Besedes, T., and T. Prusa (2007). The Role of Extensive and Intensive Margins and Export Growth. Paper prepared for INT-IDB, mimeo.

Caves, R. (1998). Industrial Organization and New Findings on the Turnover and Mobility of Firms. *Journal of Economic Literature* 36 (4): 1947-1982.

Clayton, D., and J. Cuzick (1985). Multivariate Generalizations of the Proportional Hazard Model. *Journal of the Royal Statistical Society*, Serie A (General) 148 (2): 82-117.

Clerides, S., S. Lach, S, and R. Tybout (1998). Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico, and Morocco. *Quarterly Journal of Economics* 113 (3): 903-947.

Cox, D. (1972). Regression Models and Life Tables. *Journal of the Royal Statistical Society* 34 (2): 187-220.

Das, S., and K. Srinivasan (1997). Duration of Firms in an Infant Industry: The Case of Indian Computer Hardware. *Journal of Development Economics* 53 (1): 157-167.

Disney, R., J. Haskel and Y. Heden (2003). Entry, Exit and Establishment Survival in UK Manufacturing. *Journal of Industrial Economics* 51 (1): 91-112.

Dolton, P., and W. von der Klaauw (1995). Leaving Teaching in the UK: A Duration Analysis. *Economic Journal* 105 (429): 431-444.

Dunne, T., M. Roberts, and L. Samuelson (1988). Patterns of Firm Entry and Exit in U.S. Manufacturing Industries. *Rand Journal of Economics* 19 (1): 495-515.

Dunne, T., M. Roberts and L. Samuelson (1989). The Growth and Failure of U.S. Manufacturing Plants. *Quarterly Journal of Economics* 104 (4): 671-698.

Dunne, T., S. Klimek, and M. Roberts (2005). Exit from Regional Manufacturing Markets: The Role of Entrant Experience. *International Journal of Industrial Organization* 23 (5-6): 399-421.

Esteve Pérez, S., A. Sanchis Llopis, and J. Sanchis Llopis (2004). The Determinants of Survival of Spanish Manufacturing Firms. *Review of Industrial Organization* 25(3): 251-273.

Evans, D. (1987). The Relationship between Firm Growth, Size, and Age: Estimates for 100 Manufacturing Industries. *Journal of Industrial Economics* 35 (4): 567-581.

Fariñas, J., and L. Moreno (2000). Firms' Growth, Size and Age: A Nonparametric Approach. *Review of Industrial Organization* 17 (3): 249-265.

Frank, M. (1988). An Intertemporal Model of Industrial Exit. *Quarterly Journal of Economics* 103 (2):.333-344

Giordano, P., C. Volpe Martincus, N. Ianelli, and E. Zeballos (2006). Perú: Documento de Discusión sobre Comercio e Integración. IDB, mimeo.

Girma, S., D. Greenaway, and R. Kneller (2003). Export Market Exit and Performance Dynamics: A Causality Analysis of Matched Firms. *Economics Letters* 80 (2): 181-187.

Girma, S., D. Greenaway, and R. Kneller (2004). Does Exporting Lead to Better Performance? A Microeconometric Analysis of Marched Firms. Review of International Economics 12 (5): 855-866.

Görg, H., R. Kneller, and B. Murakozy (2008). What Makes a Successful Export? Kiel Working Papers 1399. Institute for the World Economy, Kiel.

Hannah, M. (1998). Rethinking Age Dependence in Organization Mortality: Logical Formalizations. *American Journal of Sociology* 104 (1): 126-164.

Helpman, E., M. Melitz, and Y. Rubinstein (2008). Estimating Trade Flows: Trading Partners and Trade Volumes. *Quarterly Journal of Economics* 123 (2): 441-487.

Holtz-Eakin, D., D. Joulfaian, and H. Rosen (1994). Entrepreneurial Decisions and Liquidity Constraints. *Rand Journal of Economics* 25 (2): 334-347.

Hougaard, P. (1984). Life Table Methods for Heterogeneous Populations: Distributions Describing the Heterogeneity. *Biometrika* 71 (1): 75-83.

Jovanovic, B. (1982). Selection and the Evolution of Industry. *Econometrica* 50 (3): 649-670.

Jovanovic, B. (1993). The Diversification of Production. Brooking Papers on Economic Activity. Microeconomics, 1.

Kiefer, N. (1988). Economic Duration Data and Hazard Functions. *Journal of Economic Literature* 26 (2): 646-679.

Klepper, S. (2002). Firm Survival and the Evolution of Oligopoly. *Rand Journal of Economics* 33 (1): 37-61 .

Kovacevic, M. (2002). Modelling Multiple Unemployment Spells from Longitudinal Survey Data. Proceedings of the Survey Research Methods Section, American Statistical Association.

Lin, D., and L. Wei (1989). The Robust Inference for the Cox Proportional Hazards Model. *Journal of the American Statistical Association* 84 (408): 1074-1078.

Lucas Jr., R. (1978). On the Size Distribution of Business Firms. *Bell Journal of Economics* 9 (2): 508-523.

Mata, J., and P. Portugal (1994). Life Duration of New Firms. *Journal of Industrial Economics* 42 (3): 227-245.

Mata, J, P. Portugal, and P. Guimaraes (1995). The Survival of New Plants: Start-up Conditions and Post-Entry Evolution. *International Journal of Industrial Organization* 13 (4): 459-481.

Melitz, M. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica* 71 (6): 1695-1725.

Melitz, M., and G. Ottaviano (2008). Market Size, Trade, and Productivity. *Review of Economic Studies* 75 (1): 295-316.

Meyer, B. (1990). Unemployment Insurance and Unemployment Spells. *Econometrica* 58 (4): 757-782.

Nitsch, V. (2007). Die Another Day: Duration in German Import Trade. CESifo Working Paper 2086. CESifo, Munich.

Rauch, J., and J. Watson (2003). Starting Small in an Unfamiliar Environment. *International Journal of Industrial Organization* 21 (7): 1021-1042.

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.

Stigler, G. (1958). The Economies of Scale. *Journal of Law and Economics* 1: 54-71.

Stinchcombe, A. (1965). Social Structures in Organizations. In J. March (ed.). *Handbook of Organizations*. Chicago: Rand McNally.

Table 1: Characteristics of Peruvian New Exporters

Year	Number of Firms	Average Total Exports	Average Number of Countries	Average Number of Products	Average Number of Employees	Average Age
2000	1,359	87,981.18	1.34	4.16	24.80	6.57
2001	1,456	94,893.43	1.31	4.28	42.06	6.39
2002	1,546	194,991.91	1.29	4.64	16.97	5.77
2003	1,681	70,765.35	1.35	4.96	18.08	6.36
2004	1,811	100,006.26	1.29	4.76	10.78	5.64
2005	2,068	118,632.23	1.30	5.94	17.84	5.46
2006	2,132	129,010.83	1.35	5.53	12.58	7.05

Source: Own elaboration on data provided by PROMPERU and SUNAT.

Table 2: Exit from Export Markets

Year	Firms Not Exporting the Next Year		Firms Not Exporting the Subsequent Years	
	Exit Rate	Number of Exits	Exit Rate	Number of Exits
2000	0.575	781	0.461	626
2001	0.591	861	0.481	701
2002	0.597	923	0.503	777
2003	0.585	983	0.517	869
2004	0.570	1,032	0.526	952
2005	0.544	1,124	0.544	1,124

Source: Own elaboration on data provided by PROMPERU and SUNAT.

Table 3: Test of Equality of Survivor Functions

Variables\Test	Log-rank
Number of Countries	2677.440***
	[0.000]
Number of Products	1272.787***
	[0.000]
Employment	986.363***
	[0.000]
Age	137.122***
	[0.000]
Export Initial Value	3171.175***
	[0.000]

Source: Own elaboration on data provided by PROMPERU and SUNAT.
*The table reports the test statistics and the corresponding p-values (within brackets) of the long-rank for each explanatory variable. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.*

Table 4: Baselines Estimates

Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Number of Countries	0.654***	0.686***	0.690***	0.730***	0.721***		
	(0.011)	(0.012)	(0.012)	(0.013)	(0.013)		
Number of Products	0.987***	0.984***	0.984***	0.986***	0.986***		
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)		
Number of Countries (Absolute)						0.474***	0.460***
						(0.012)	(0.012)
Number of Products (Absolute)						0.835***	0.834***
						(0.008)	(0.008)
Employment		0.881***	0.877***	0.886***	0.893***	0.881***	0.888***
		(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Age 1: 6 to 10 years			1.140***	1.091***	1.043**	1.085***	1.038*
			(0.023)	(0.022)	(0.020)	(0.022)	(0.020)
Age 2: 11 to 20 years			1.01	0.954*	0.950**	0.951**	0.948**
			(0.025)	(0.024)	(0.024)	(0.024)	(0.023)
Age 3: More than 20 years			1.100***	1.033	0.971	1.016	0.956
			(0.035)	(0.033)	(0.032)	(0.033)	(0.031)
Export Initial Value				0.924***	0.923***	0.930***	0.928***
				(0.003)	(0.003)	(0.003)	(0.003)
Year Fixed Effects	No	No	No	No	Yes	No	Yes
Frailty	No	No	No	No	No	No	No

Source: Own elaboration on data provided by PROMPERU and SUNAT.
*The table reports Cox Proportional Hazard estimates (hazard ratios). Columns 1 to 5: All variables but age are expressed in natural logarithms. Age 0: 1 to 5 years is the omitted category. Columns 6 and 7: Number of countries and number of products expressed in absolute levels and remaining variables as in Columns 1 to 5. Robust standard errors clustered on firms are reported below hazard ratios between parentheses. * Significant at 10% level; significant at 5% level; *** significant at 1% level.*

Table 5: Robustness Check I, Macroeconomic Conditions and Unobserved Heterogeneity

Explanatory Variables	(1)	(2)	(3)	(4)
Number of Countries	0.721***	0.716***	0.703***	
	(0.013)	(0.014)	(0.014)	
Number of Products	0.986***	0.983***	0.983***	
	(0.002)	(0.001)	(0.001)	
Number of Countries (Absolute)				0.436***
				(0.029)
Number of Products (Absolute)				0.806***
				(0.011)
Employment	0.893***	0.871***	0.885***	0.878***
	(0.006)	(0.007)	(0.007)	(0.007)
Age 1: 6 to 10 years	1.043**	1.279***	1.250***	1.245***
	(0.020)	(0.025)	(0.025)	(0.025)
Age 2: 11 to 20 years	0.950**	0.886***	0.883***	0.885***
	(0.024)	(0.031)	(0.031)	(0.031)
Age 3: More than 20 years	0.971	0.785***	0.835***	0.847***
	(0.032)	(0.039)	(0.04)	(0.04)
Export Initial Value	0.923***	0.905***	0.900***	0.906***
	(0.003)	(0.004)	(0.004)	(0.004)
Year Fixed Effects	Yes	No	Yes	Yes
Frailty	No	Firm	Firm	Firm
Test Statistic (Chi-Squared)		46.234****	43.367***	41.975***
p-value		[0.000]	[0.000]	[0.000]

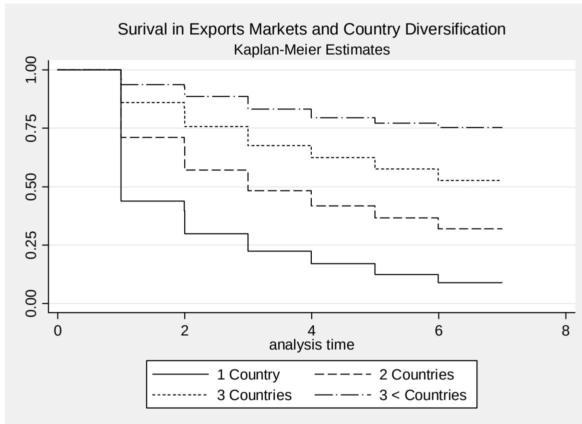
Source: Own elaboration on data provided by PROMPERU and SUNAT.
*The table reports Cox Proportional Hazard estimates (hazard ratios). Columns 1 to 3: All variables but age are expressed in natural logarithms. Age 0: 1 to 5 years is the omitted category. Column 4: Number of countries and number of products expressed in absolute levels and remaining variables as in Columns 1 to 3. Robust standard errors clustered on firms are reported below hazard ratios between parentheses. * significant at 10% level; significant at 5% level; *** significant at 1% level.*

Table 6: Robustness Check II, Alternative Diversification Measures

Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)
Herfindahl Countries	1.012***					
	(0.001)					
Herfindahl Products	1.008***					
	(0.000)					
Gini Countries		1.025***				
		(0.001)				
Gini Products		1.011***				
		(0.005)				
Number of Countries			0.745***			
			(0.014)			
Number of Sectors			0.951***	0.947***		
			(0.004)	(0.004)		
Number of Continents				0.61***		
				(0.026)		
Number of Countries (Absolute)					0.445***	
					(0.043)	
Number of Sectors (Absolute)					0.759***	0.759***
					(0.015)	(0.015)
Number of Continents (Absolute)						0.266***
						(0.016)
Employment	0.882***	0.866***	0.880***	0.866***	0.880***	0.866***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Age 1: 6 to 10 years	1.252***	1.250***	1.256***	1.260***	1.256***	1.260***
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Age 2: 11 to 20 years	0.876***	0.871***	0.877***	0.872***	0.877***	0.872***
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Age 3: More than 20 years	0.827***	0.824***	0.828***	0.833***	0.828***	0.833***
	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)
Export Initial Value	0.904***	0.903***	0.898***	0.900***	0.898***	0.900***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Frailty	Firm	Firm	Firm	Firm	Firm	Firm
Test Statistic (Chi-Squared)	41.465***	42.389***	45.321***	44.620***	41.547***	42.853***
p-value	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

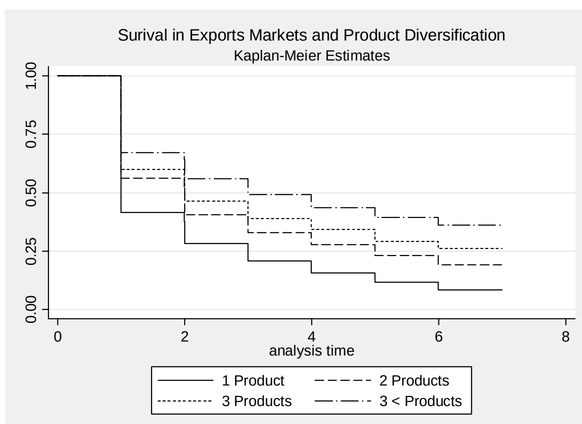
Source: Own elaboration on data provided by PROMPERU and SUNAT.
*The table reports Cox Proportional Hazard estimates (hazard ratios). Columns 1 to 4: All variables, but Herfindahl and Gini Indexes (scaled between 0 and 100) and age, are expressed in natural logarithms. Age 0: 1 to 5 years is the omitted category. Columns 5 and 6: Number of countries, number of continents, and number of sectors expressed in absolute levels and remaining variables as in Columns 1 to 4. Robust standard errors clustered on firms are reported below hazard ratios between parentheses. * Significant at 10% level; significant at 5% level; *** significant at 1% level.*

Figure 1



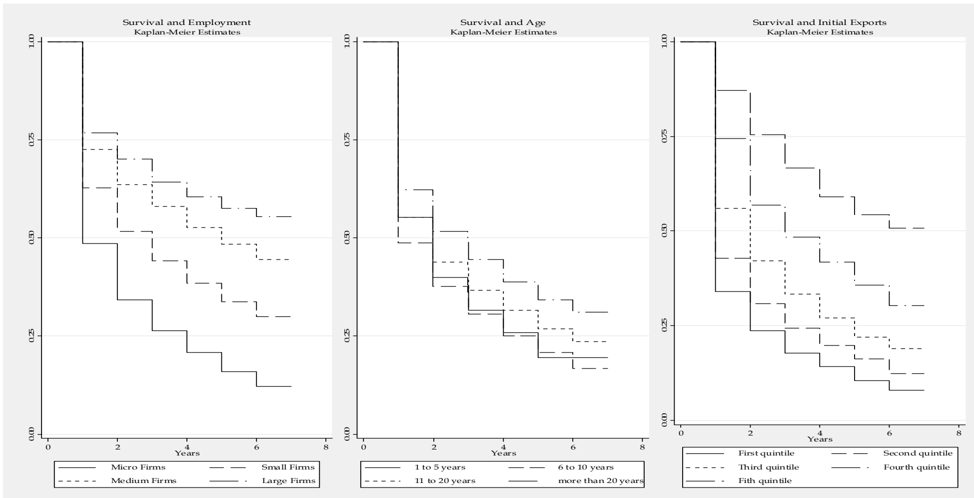
Source: Own elaboration on data provided by PROMPERU and SUNAT.

Figure 2



Source: Own elaboration on data provided by PROMPERU and SUNAT.

Figure 3



Source: Own elaboration on data provided by PROMPERU and SUNAT.