Stayin' Alive: Export Credit Guarantees and Export Survival*

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Abstract

We use survival analysis to analyse the impact of export credit guarantees on firms' export duration, using granular Swedish panel data at the firm-country and firm-country-product levels. The estimation results show that firms' export survival substantially increases with guarantees, at both levels. The associations are particularly strong for smaller firms and contracts as well as in trade with riskier markets. The findings have implications for policies to promote long-run export growth.

Keywords: Survival; Exports; Export credit guarantees

JEL Codes: D22, F14, H81, C14, C41

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1. Introduction

Firms that start to export do rarely survive in the foreign market and this may negatively impact their future growth. The global financial crisis and the COVID-19 pandemic have illustrated the vulnerability of firms' exports to financial distress and heightened uncertainty. In both these crises, governments have increased capacity for offering export credit guarantees (OECD, 2020). We investigate for the first time firms' use of export credit guarantees and export survival, employing non- and semi-parametric survival models on rich Swedish register data on guarantees and trade. Our results indicate that guarantees positively impact export survival, particularly for smaller firms and contracts, as well as in trade with riskier markets.

Our study contributes to the growing literature on export survival. Most export flows have been found to cease already within 2-3 years (Besedeš and Prusa, 2006; Esteve-Pérez *et al.*, 2013). However, export survival is at least as important as export entry. Small differences in survival rates can account for large differences in long-run export growth (Besedeš and Prusa, 2006, 2011).

We add to the limited evidence on factors that promote export duration by analysing the novel factor of export credit guarantees (e.g., Anwar *et al.*, 2019; Chen, 2012; Demir *et al.*, 2021). Such guarantees are prevalent in both developed and developing countries, with the amount of new guarantees almost doubling since 2007 (Berne Union, 2018). Governments provide guarantees to firms for a fee to insure exports against default in trade. Despite the prevalence of countries offering guarantees, there are only a handful firm-level studies on export credit guarantees and firm performance, and none on export survival (e.g., Heiland and Yalcin, 2020).[1]

We expect guarantees not only to promote export entrance and expansion, but also export survival, with the underlying mechanisms being a reduction in default risks and liquidity

[1] For a survey of the literature, which lacks evidence on export survival, see, e.g., Agarwal *et al.* (2018).

constraints that, otherwise demote market-specific investments (Agarwal *et al.*, 2018). By reducing uncertainty in trade, we also expect small export contracts, which are associated with shorter trade relations, to be more likely to survive (Besedeš, 2008).

2. Data and Empirical Framework

We construct a data set for analysis by merging information from the Swedish Export Credit Agency (EKN) and Statistics Sweden (SCB), both which are independent government agencies. From the EKN, we have transaction-level information on the universe of loss on claim guarantees in the pre-period year 1999 and the study years 2000-2015. The guarantees insure export transactions against agents' default.We aggregate these data to the firm-country and firm-country-product level.[2]

Using unique identifiers of firms, we merge the EKN data with SCB register data on firm characteristics in the period 2000-2015. We then construct a database at the firm-country level and another at the firm-country-product level. These data allow us to study the universe of all non-financial firms with at least one employee and their guarantees.

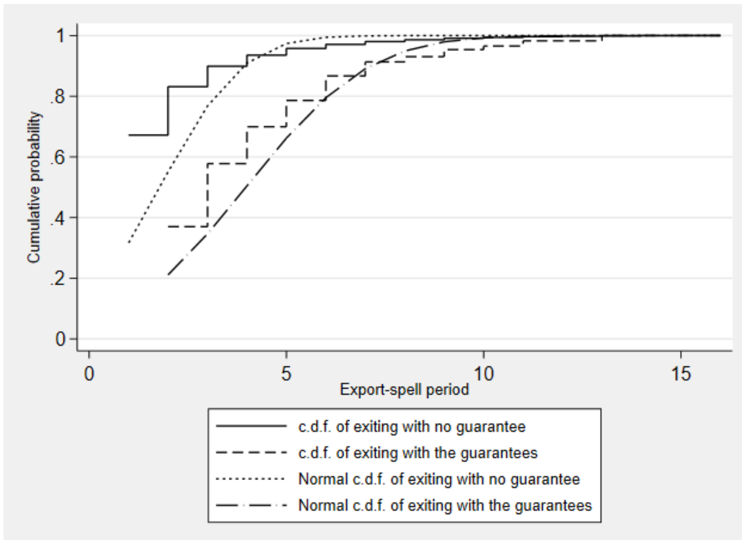
From these data, we create spells of firms' country and country-product exports durations. Entry (exit) is defined as moving from no export (export) in $t-1$ to export (no export) in t. The maximum length of a completed spell in our sample is 16 years. Table A1 presents the duration of export spells for all firms and the subset of firms using guarantees. In the study period, there were 745,805 country and 5,351,873 country-product export spells, with a mean duration of 2 years.

In Figure 1, we display the cumulative distribution functions for firms' export exit. We conclude that export relations are short-lived. However, studying the 37.7% of all firm-country spells and 66.8% of all firm-country-product spells that were accompanied with

[2]Absent specific product information from EKN, we consider product-destination treatment as given, (D)$t-1$=1, if a firm starts to use guarantees for exports to a country while simultaneously starting to export a single 8-digit level product to the same country.

guarantees at entry, we find export spells to be longer. With guarantees, the distributions of duration are positively skewed both at country and product level, with a median survival time of 5 and 2 years, respectively. We will test if these stylised facts hold when using survival analysis.

(A) Firm-country level



(B) Firm-country-product level

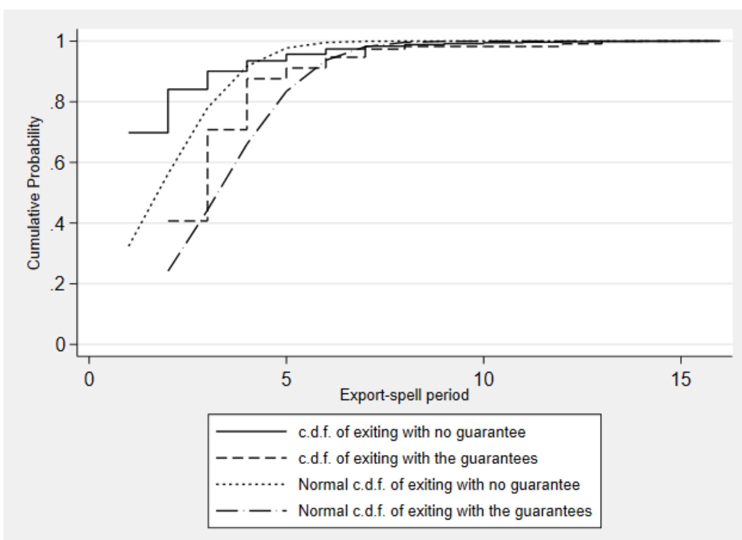


FIGURE 1
Notes: These figures display cumulative distribution plots (cdfs) of exits from export markets and by the usage of guarantees status in the previous year at the country level (A) and the country-product level (B) over 16 years from 2000 to 2015. The best fitting normal (Gaussian) models are also superimposed.

The nature of our data for survival analysis raises two issues. First, we may underestimate export duration because we cannot ascertain if the initial (exiting) year of 2000 (2015) is the first (last) year of a spell. We address left-censoring by exploiting pre-period data for 1999, and right-censoring by using survival analyses (Hess and Persson, 2011). Second, our data are annual and therefore interval-censored, potentially biasing estimates (Hess and Persson, 2012). Therefore, we will use discrete-time survival methods.[3]

Turning to estimation models, we employ both a non-parametric and a discrete-time duration model. In Equation 1, we have our non-parametric estimator, the Kaplan–Meier product limit estimator of the survival function S, which is the probability of survival at least t periods by a trade spell i:

$$\hat{S}(n) = \prod_{i:t_i \leq t} \frac{m_i - d_i}{m_i} \tag{1}$$

where m_i is the number of subjects (firm-country or firm-country-product spells) at risk of failing (exiting exports) at period t_i, and d_i denotes the number of observed failures at t_i. Thus, the function is estimated as the ratio between the number of subjects that survive and the number of subjects at risk.

To evaluate key factors affecting the export duration relation, we estimate a discrete-time duration model while controlling for unobserved heterogeneity. The discrete-time hazard rate h_{ik} of a particular trade relationship in a given time interval (t_k, t_{k+1}) conditional on its survival up to the beginning of the interval and given the explanatory variables, is defined as $h_{ik} = P(T_i < t_{k+1} | T_i \geq t_k, \mathbf{x}_{ik}) = F(\mathbf{x}'_{ik}\boldsymbol{\beta} + \gamma_k)$. Let T_i be a continuous, non-negative random variable measuring the survival time of a particular trade relation. $\mathbf{x}_{ik}$ is a vector of characteristics (firm, industry and macro characteristics) expected to explain observed differences in firm survival in destination markets,[4] $\boldsymbol{\beta}$ is the vector of parameters to be

[3] The results are robust to excluding repeated entries/exits, see Table A5 of the Online Appendix.
[4] See Table A5 of the Online Appendix.

estimated, and γ_k is the interval baseline hazard and summarises the pattern of duration dependence. The hazard rate is assumed to be of a logit form (Hess and Persson, 2012).

Altogether, the final model to be estimated can be expressed as:

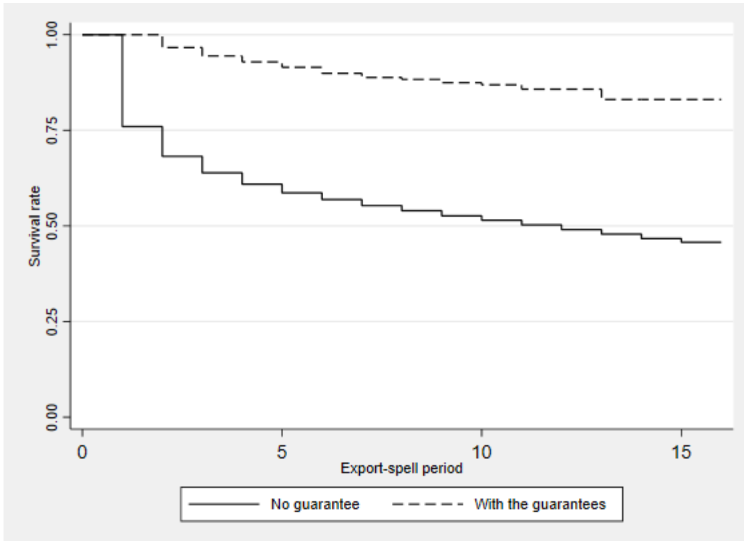
$$logit\, h_{ik} = \mathbf{D}'\boldsymbol{\alpha} + \mathbf{X}'\boldsymbol{\beta} + \mathbf{W}'\boldsymbol{\gamma} + \mu_i \tag{2}$$

where the left side presents a transformed version of the hazard probability (i.e., taking logarithms of the odds ratio). On the right side, **D** is a set of time indicator variables, **X** is a vector of possibly time-varying substantive covariates that are assumed to affect the hazard rate, α, β and γ are parameters to be estimated, and . The set of terms, $\mathbf{D}'\alpha$, include multiple intercepts, one per period. As a group, they represent the baseline logit hazard function, i.e., the value of logit hazard when all the substantive predictors are zero. In addition, we include indicator variables for years and previous spell in **D**. The calendar year indicators control for latent factors common to all trading partners and products in a given year. The indicators for the number of previous spells are assumed to capture the factors that are related to any given trade relationship (Hess and Persson, 2011). The set of terms, $\mathbf{X}'\beta$, represent the shift in the baseline logit hazard function corresponding to unit differences in the associated predictors. **W** represents indicators for frailty, that is, with Gaussian random effects for every firm-country or firm-country-product combination and γ contains the corresponding parameters to be estimated. μ_i is the error term.

3. Results

Our stylised facts of Figure 1 suggested that export flows with guarantees have a higher survival rate. We now investigate this by estimating Equation 1, with the estimates presented in Figure 2. The initial hazard rates are high but rapidly decline, especially for users of guarantees. When using guarantees, the firm-country survival rate is above 75 percent across the whole time span of our study.

(A) Firm-country level



(B) Firm-country-product level

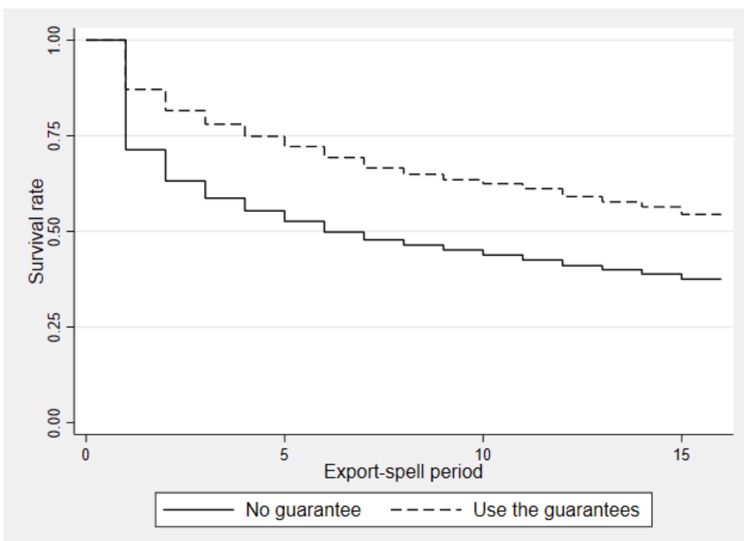


FIGURE 2
Notes: These figures display the Kaplan–Meier survival estimates by the usage of guarantees status in the previous year at the firm-country (A) and firm-country-product levels (B) over 16 years from 2000 to 2015.

Next, in Table 2, we display the country level duration estimates of Equation 2, while the product level ones are in Table A2. All estimates are in terms of hazard ratios, with a ratio

Table 1

Estimates of the discrete-time hazard model, firm-country level

Odds ratio	(1) All	(2) Micro and small	(3) Medium	(4) Large
Guarantees(D)$_{t-1}$	0.443***	0.348***	0.500***	0.491***
	(0.045)	(0.064)	(0.132)	(0.084)
log(employment)$_{t-1}$	1.013***	1.012***	1.042***	0.975**
	(0.002)	(0.003)	(0.007)	(0.010)
Share post Sec.Educ. $_{t-1}$	0.682***	0.815***	0.638***	0.375***
	(0.008)	(0.012)	(0.023)	(0.019)
log(turnover)$_{t-1}$	1.033***	0.967***	1.014**	0.989**
	(0.002)	(0.004)	(0.005)	(0.005)
Export intensity$_{t-1}$	0.955***	0.895***	0.874***	0.906***
	(0.001)	(0.001)	(0.002)	(0.003)
log(distance)	1.061***	1.065***	1.123***	1.125***
	(0.005)	(0.007)	(0.012)	(0.017)
Log likelihood	-453,626.9	-258,861.7	-86,100.8	-42,781.3
Rho	0.0202	0.0104	0.0403	0.0299
Observations	865,214	489,328	184,879	97,760

Notes: The table displays our baseline discrete-time hazard estimates at the firm-country level and by firm size. Response is measured as logit hazard. Baseline indicator, year and spell number dummies are also included (omitted for brevity). The results with all confounders included are displayed in Online Appendix Table A1. Standard errors are clustered at the firm-country level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

< 1 indicating a decrease in hazard, i.e., a longer duration. We find that guarantees are linked to a substantial lowering of the hazard ratios, an average 47-56 percent decrease in the probability of exit in the next year. The association is the largest for micro and small firms, and especially at the product level.[5]

We would expect heterogeneous effects of guarantees (e.g. Agarwal *et al.*, 2018; Badinger and Url, 2013; Besedeš, 2008; Demir *et al.*, 2021), and analyse this in Table A3. We find a stronger association between guarantees and export duration for exports to riskier markets (Col. 1), smaller export contracts (Col. 2 vs. 3) and repeated usage (Col. 4). Using guarantees during the financial crisis also more strongly promoted export duration (Table

[5]The results are robust to alternative assumptions, estimators, and specifications, see the Online Appendix. The presence of a statistically significant positive effect is robust to endogeneity concerns, using a Fuzzy Regression Discontinuity survival estimator that exploits a quasi-natural experiment in Sweden, which is described in Agarwal *et al.* (2018). Since the experiment was short-lived, survival impacts are expected and confirmed to be substantially smaller than our main estimates.

A4 in Online Appendix). Overall, these patterns are suggestive of guarantees reducing uncertainty and associated default risks and liquidity constraints in foreign trade.

4. Concluding remarks

Export flows are short-lived and yet little is known about factors promoting export survival. We employ survival analysis to investigate the role of export credit guarantees for export survival. We find a robust, substantial and statistically significant positive association between guarantees and firm-country and firm-country-product export survival, particularly for smaller firms and contracts, as well as for riskier markets. The results suggest that governments may employ export credit guarantees for promoting firms' sustained export participation and long-run export growth.

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Appendix

Table A1
Exporting Duration

	Obs.	Mean	Median	Std. Dev.	Min.	Max.
(A) All Exporting Spells						
Firm-country						
Export-Spell Duration	745,803	2.3	1.0	2.5	1.0	16.0
Firm-country-product						
Export-Spell Duration	5,351,873	2.1	1.0	2.2	1.0	16.0
(B) Spells with any guarantees used						
Firm-country						
Export-Spell duration	1,210	6.7	5.0	4.6	1.0	16.0
Firm-country-product						
Export-Spell duration	47,060	3.6	2.0	3.5	1.0	16.0

Notes: The table displays the exporting spells of all Swedish firms (domestic and exporting) starting anytime during the period 2000 - 2015 and during which any guarantees were used. If a firm enters a destination market in year t, but is no longer present in that market in year $t+1$, the duration of the exporting spell is set as = 1. That is, a duration equal to 1 means that the firm was continuously exporting to this destination country during only one single year, thus entering and exiting in the same year.

Table A2

Estimates of the discrete-time hazard model, firm-country-product level

Odds ratio	(1) All	(2) Micro and small	(3) Medium	(4) Large
Guarantees(D)$_{t-1}$	0.526***	0.205***	0.329***	0.437***
	(0.067)	(0.068)	(0.108)	(0.116)
log(employment)$_{t-1}$	1.001	1.004***	1.011***	1.048***
	(0.000)	(0.001)	(0.002)	(0.003)
Share post Sec. Educ.$_{t-1}$	1.097***	0.930***	1.239***	1.690***
	(0.005)	(0.006)	(0.014)	(0.021)
log(turnover)$_{t-1}$	0.998**	0.902***	1.006***	0.960***
	(0.001)	(0.002)	(0.002)	(0.002)
Export intensity$_{t-1}$	0.979***	0.932***	0.924***	0.925***
	(0.000)	(0.001)	(0.001)	(0.001)
Import intensity$_{t-1}$	1.007***	1.016***	1.013***	1.014***
	(0.000)	(0.000)	(0.000)	(0.001)
log(distance)	1.044***	0.974***	1.043***	1.053***
	(0.002)	(0.003)	(0.003)	(0.003)
Log likelihood	-4,874,001.5	-1,911,532.4	-1,176,328.7	-1,381,316.6
Rho	0.0332	0.0580	0.0247	0.0831
Observations	8,354,765	3,229,687	2,075,877	2,487,235

Notes: The table displays our baseline discrete-time hazard estimates at the firm-product-country level and by firm size. Response is measured as logit hazard. Baseline indicator, year and spell number dummies are also included (omitted for brevity). The results with all confounders included are displayed in Online Appendix Table A2. Standard errors are clustered at the firm-country-product level. * p < 0.10, ** p < 0.05, *** p < 0.01.

Table A3

Estimates across types of use, firm-country level

Odds ratio	(1) Risk category 4	(2) Contract value (< 50% quantile)	(3) Contract value (> 50% quantile)	(4) Guarantees are used repeatedly
Guarantees(D)$_{t-1}$	0.332***	0.186***	0.332***	0.443***
	(0.073)	(0.045)	(0.080)	(0.045)
Log likelihood	-21.388.5	-453,633.3	-453,652.3	-453.627.9
Rho	0.027	0.020	0.020	0.020
Observations	36,789	865,214	865,214	865,214

Notes: The table displays results at the firm-country level. Column (1) in Panel A shows the results of the guarantees used in the destinations with highest risk category. The country risk categories are on a scale of $0-7$. The lower the number, the better the country's creditworthiness. Risk category 1 $\in [0, 2)$; Risk category 2 $\in [2, 4)$; Risk category 3 $\in [4, 6)$; Risk category 4 $\in [6, 7]$. The results by 2 quantiles of export contract value are presented in Column (2) and Column (3). Column (4) shows the results of the guarantees used more than once under an export duration. Baseline indicator, year and spell number dummy are included. Standard errors clustered at firm-country level. * p < 0.10, ** p < 0.05, *** p < 0.01.