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Old Firms and New Export Flows: Does Experience Increase Survival?

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Abstract

In this paper we present new empirical evidence on the relationship between exporting experience and the duration of export relationships at the firm-product-destination level. Our starting hypothesis that more experienced exporters would have longer lived product-market trade relationships is quite strongly rejected in baseline specifications. However, we find that when we introduce interaction effects between experience and product scope and also between experience and similarity to the firm's core export product, our results change considerably. These findings suggest that at some level of experience as an exporter there is a decline in the marginal return on the positive effects on survival of product diversification and proximity. We suggest that this is evidence that more experienced firms launch product-destination pairs further away from their core competence and/or into more risky markets which therefore increases the risk of failure of any individual product-destination pairing.

JEL Classification: F10
Keywords: Duration of trade; Survival models; Export experience; Multi-product firms

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1 Introduction

Launching a new product, beginning to export or entering a new export market are all risky activities from the perspective of an individual firm. The chances of almost immediate exit have consistently shown to be higher than those of success (see e.g., Besedeš and Prusa, 2006a; 2006b; Iacovone and Javorcik, 2010). Following this initial high hazard, the probability of a firm dropping an export product in a market has been shown to become lower and lower with each additional year that the export relationship is in place (e.g., Aeberhardt, Buono and Fadinger, 2014; Albornoz, Fanelli and Hallack, 2016 and Araujo, Mion and Ornelas, 2016). This work all suggests that increasing experience has a positive impact on the longevity of trade flows beyond the effects of other firm characteristics. This paper examines the role played by export experience in the survival of new export flows at the firm level but adds a further dimension to what constitutes relevant experience. While the existing literature largely focuses on the effect of time spent within a specific market or exporting a specific product, the question we pose is how much does experience built up as an exporter *prior* to launching a new product-destination trade flow impact on the survival of this new flow.

The main focus of this paper is therefore to explore the link between the firm's previous export experience and the survival times of new product-destination flows. The starting hypothesis that more experienced exporters would have longer lived export relationships at the product-destination level due to lower search costs is strongly rejected in our baseline estimations. In fact, more experienced (in years of exporting) firms show higher probabilities of failure associated with their introduction of new trade flows. While experience measured in this way is likely to be correlated with firm age, it cannot be seen simply as a proxy for age as firms do not necessarily begin to export immediately after they are set up. Furthermore, as many of the firms in our data are multinationals, their time exporting from Ireland would be weakly linked to their date of initial incorporation.

In line with other research, firms with broader export scope (in terms of the number of products they already export for example) are more likely to have better survival times for new trade flows. Having uncovered this apparently counter-intuitive pattern relating to export experience, we seek to understand what lies behind it and identify a likely resolution coming from the patterns of expansion of multi-product firms into products and markets less aligned to the firm's core expertise.

Much of the initial research on the survival of new trade flows focused on how survival probabilities changed with each additional year that a particular trade flow was in place. This research showed considerable levels of turnover with new suppliers entering and exiting each year and fairly short durations of trade, regardless of whether the analysis was conducted at the product or firm level. The seminal papers on this topic by Besedeš and Prusa (2006a, 2006b) found that more than half of trade spells are just one year long. This analysis at the country-product level was followed by firm-level studies where evidence of substantial product churning was found, with varieties introduced and dropped by firms on a regular basis (Iacovone and Javorcik, 2010). In addition, survival times of export relationships are found to be short, regardless of whether these are measured at firm-level (see e.g., Volpe-Martincus and Carballo, 2009), firm-product level (see e.g., Görg, Kneller and Muraközy, 2012) or firm-market level (see e.g., Esteve-Pérez, Pallaro-Lopez and Requena-Silvente, 2013).

One of the main conclusions of the firm-level as well as country-level studies is that surviving the first year of exporting activity is the most difficult and that product and geographic

diversification increase export survival (see e.g., Volpe-Martincus and Carballo, 2009). Examining the impact of experience on firm survival after entering a new market, recent work by Aeberhardt et al. (2014) measures experience as the interaction of past export status with firms' total export experience measured in years, while Araujo et al. (2016) define experience as the number of similar destinations the firm already serves.[1] Both papers find that firms with more export experience are more likely to survive one period to another.

The strong empirical pattern identified in this literature on export spell survival is that time spent within a market or exporting a product has a strong relationship with the odds of the export spell ending in any particular time period. The shape of hazard function most commonly found is one with a sharp decline in exit likelihood in the early years (particularly the first year) followed by a shallower but continually downward sloping relationship between time since entry/product launch and hazard of exit. The papers described above focus on the effect of the build-up of experience from the start of a export spell. On the same basis, however, one might expect that experience accumulated as an exporter prior to launching a new export flow would also have an effect on its likelihood of survival and this is where the contribution of our paper is placed.

Most closely related to our analysis, there is a small number of existing papers that consider if there is an effect of prior experience as an exporter in other markets. Albornoz et al. (2016) look at the survival of firm-market relationships and the contribution of export experience to these relationships. They build a model in which gaining export experience can reduce market specific sunk and fixed costs. In the empirical part of their study, they find that export experience (defined as firm export survival time, number of export markets, number of previous incursions and export exposure) increases survival time in new markets. Our work expands substantially on this rationale by including the product as well as the destination dimension and controlling for other firm characteristics including the structure of the firm's export product mix though a measure of similarity to the firm's most important exported product. The only existing analysis of survival of trade relationships at the firm-product-destination by Stirbat, Record and Nghardsaysone (2015) includes some binary indicators of experience to capture if a firm has already sold the product elsewhere (within the last 12 months) or if a firm has already exported to a particular destination but does not consider overall experience as an exporter.

Our contribution is to examine how the survival of new export product-destination launches at the firm level is affected not just by the build-up of firm experience for that individual flow but also by the prior experience the firm has accumulated before launching a new product-destination match. We mainly focus on a direct measure of firm expertise by calculating how long the firm has been an exporter before a new product-destination launch and how this experience affects the survival duration of the new product-destination trade flows. Given that the costs of initial discovery of market opportunities, competition levels and costs would occur as a firm enters exporting or launches a new product, the time dimension of export experience is likely to be important. Furthermore, export sales growth has been observed to be fastest in the early years after firm export entry, further demonstrating a time element to experience. We also examine how expertise coming from firm size, product and market diversification affects the new product-destination survival. This paper therefore extends the

[1] Similarity is defined as sharing the same language, sharing a border, being in the same continent or belonging to the same quartile of world GDP distribution.

existing literature by disentangling the effects of time spent accumulating export experience from measures of size and diversification.

As indicated above, our baseline initial finding is that experience has a negative effect on the subsequent survival of new product-market trade flow for a firm. Although this result initially appears counter-intuitive, we show that including additional features of the firm's exporting mix including, in particular, interaction effects between export experience and other characteristics such as the number of products or markets and product proximity to the firm's core competence can throw light on the channels through which experience is impacting the survival of trade links. While product diversification has a positive direct effect on the survival time of a product-destination pair, we find that the strength of this effect declines as the time a firm has spent as an exporter increases. Likewise, when interaction effects between experience and product proximity are included in a range of econometric approaches, we find that experience has a positive direct effect but then reduces or offsets the other effects of proximity and diversification.

We suggest that these results are consistent with the predictions of models such as the Melitz (2003) exporting threshold model and the multi-product firm models of Eckel and Neary (2010) and Bernard, Redding and Schott (2011). The mechanism in these models is that as more experienced exporters diversify and expand their export ranges, the newly introduced products are likely to be less closely aligned to the firm's core competence. The survival probabilities of these more marginal products are therefore lower, even when the firm itself is a well-established exporter.

Our paper is based on transaction level export data for Irish firms, combining detailed trade records at the firm-product-destination level with firm characteristics from the Census of Industrial Production. The product information is disaggregated to the HS 6-digit level and adjusted to ensure maximum continuity of product definitions over time. Critically for the analysis of survival and experience, the data covers a long time span from 1996 to 2015. This allows us to chose a start date of 2006 from which we examine new product-destination launches and uniquely use information on the firm history prior to the start of this sample period, circumventing one of the most common problems associated with the censoring of this type of data. To test the logic of role being played by firms moving away from their core product expertise as they become more experienced, we incorporate a measure of the "proximity" or similarity of the new product to the core product of the firm. This comes from a product level indicator constructed by Hidalgo, Klinger, Barabási and Hausmann (2007). Similarly to Goya and Zahler (2017), we find that this proximity measure is an important predictor of survival time of new product-destination trade flows.

Finally, with a long data series available, we are also able to validate our results further by carrying out a cohort analysis where we evaluate how trade relationship survival at the product-destination varies across the firm's lifetime. This again allows us to separate the effects coming from time in the export market from changes in other aspects of the firms export performance. The results from this show that, for the same firm, the survival of trade relationships launched at the beginning of its export activity is longer than that of relationships launched later on.

The paper is structured as follows: we begin by describing the main firm data and supporting measures of proximity in Section 2. Section 3 presents the main results on the survival of export products. The alternative estimation strategy based on the analysis of firm cohorts is presented in Section 4. A range of robustness tests are discussed in Section 5 and Section

6 concludes.

2 Data and summary statistics

2.1 Data

Our principal source of information is confidential customs data on Irish firms from the Central Statistics Office (CSO). This covers statistics at the product level on merchandise exports of manufacturing enterprises in Ireland which we match with enterprise accounting variables (collected via the Census of Industrial Production). This linked data set covers the period from 1996 to 2012 on enterprise characteristics and the period from 1996 to 2015 on trade statistics. The availability of data at the enterprise-product-destination level provides a significant degree of additional information on export activity and firm performance which has rarely been available in the past.[2]

We use the data provided by the CSO to calculate the duration of trade as well as firm experience. We define firm experience as the number of years a firm has been an active exporter before launching exports of a particular product-destination trade flow. In addition, we use product and destination diversification as further expertise measures. Finally, we calculate the initial value of exports by product-destination and total exports by firm to account for the fact that more experienced firms face lower uncertainty and therefore tend to have larger values of their initial exports by product and larger trade in general. New firms, on the contrary, start by attempting small-scale projects. This has been shown to affect the products chances of survival (see e.g., Rauch and Watson (2003), Besedeš and Prusa (2006b) and Araujo et al., (2016)). In addition, we allow total exports by firm to vary with time, to account for the fact that firms may be decreasing their exports gradually rather than stopping them abruptly.

We define the duration of exports as the number of years a trade relationship has been active. In survival analysis, a terminological distinction is made between a "relationship" and a "spell". Each export relationship may consist of a single spell or of multiple spells. The latter occurs when exports are stopped and restarted later on. This distinction, however, as reported in Besedeš and Prusa (2006b) has only a very small impact on the results of most of the trade survival studies. In addition, taking focusing on single spells has the advantage of excluding the possibility that a particular trade flow was active but not reported due to the reporting threshold (see below). Therefore, in our analysis we use trade relationships (single spells) rather than multiple spells, meaning that we do not take into account breaks in between spells.[3]

To calculate the duration of firm-product-destination trade we need to take into account several data issues. First, in common with other European countries, the Irish trade data is collected through two different systems. The Extrastat survey collects extra-European trade and the Intrastat survey gathers data for intra-European trade. The threshold for reporting of exports differs between the two systems, with Intrastat requiring an exporting volume of above €635,000 per annum whereas the Extrastat threshold is considerably lower and collects

[2] A detailed description of the patterns of trade - particularly of Irish-owned firms - coming from this data is provided by Lawless, Siedschlag and Studnicka (2019).

[3] We therefore use the terms "spell" and "relationship" interchangeably.

information on all transactions above €254. To account for this issue, as one of our robustness checks we divide export flows into intra and extra-EU trade. Our results show that this issue does not affect our results.

Second, foreign trade data is recorded at the 8-digit level in the CN classification and also allocated a 5-digit SITC code. While the level of detail in the CN classification is a positive feature, it has the inconvenience that some of the categories change every year reflecting changes in products.[4] Since these changing CN codes might bias our calculations of the length of trade spell, we use concordance tables to transform the classification backwards to a constant CN 1996 terminology. We take a conservative approach to this by limiting the product scope to products existing in 1996. Re-coding CN 8-digit products implies replacing code at time t backwards to $t-1$. That means that re-coding the last year in our sample (2015) requires going back year by year from 2015 to 1996, applying 19 transformations. This procedure creates a problem when trying to replace codes from a shrinking category (i.e., when two or more CN codes at the time $t-1$ were replaced by only one CN code at the time t). In this case we merge them into the largest of the former categories (in terms of export value).[5]

In addition, in order to avoid an excessive product entry/exit due to this high level of disaggregation (see e.g., Besedeš and Prusa, 2006a) we aggregate our product level data to HS 6-digit level product categories.

Finally, our last data issue is the fact that we have no information about the trade relationships before 1996 (left-censored observations) and after 2015 (right-censored observations). Survival analysis solves the problem of right-censored observations (see e.g., Hosmer, Lemeshow and May, 2011), but not of the left-censored ones. Left-censoring is not an issue in the first part of our analysis (Section 3) as we exclude first ten years of the data in order to calculate firm experience (as explained below). It is however an issue in our alternative firm cohort analysis in Section 4. To deal with it, that section focuses on a single group of firms - those that started to export in 1999 and built up at least ten years of export experience. This group gives us the largest number of observations available in following a single cohort over time.

2.2 Key variables and summary statistics

The main research question of this paper is the impact of firm experience on trade survival. Therefore, we exclude the first ten years of our data from the calculation of export survival. We do this to generate our experience variable. Hence, we calculate firm experience from 1996 on, and export duration from 2006 on.[6] It means that our maximum firm experience is 19 years whereas our maximum spell length is ten years.[7]

Since the core of our survival analysis takes into account period 2006-2014, we report the

[4] This is not the case of the SITC classification which is more stable over time.

[5] Note that this is similar to the concordance approach taken by Van Beveren, Bernard and Vandenbussche (2012).

[6] Note that there is no need to control for left-censoring to calculate firm level experience as keeping firms active in 1996 makes our main finding even more robust.

[7] Note that in Section 4 we use a different sample analysing product-destination survival of a single cohort of firms, defined as those who started to export in 1999 and subsequently built up at least 10 years of experience.

summary statistics for this period (i.e., single spells starting from 2006). Our final data set consists of 9,566 firms: 1,062 firms on average per year. The total number of firm-product-destination-spells during the analysed period is 107,933 (11,999 spells on average per year, and therefore 11 new spells by firm on average). Each firm exported on average 12 products, to 11 destinations and the average initial value of exports by firm-product-destination was €270,460 (see Table 1). Finally an average experience by firm at the beginning of new product-destination flow was 9.55 years.

Table 1: Summary statistics (2006-2014)

	Mean	Standard dev.	Min.	Max
Number of firms	1,062	62.3	970	1,177
Experience	9.55	5.49	1	19
Number of products exported	12.07	16.93	1	300
Number of destinations	11.43	14.92	1	143
Productivity	399	2,885	0.2	266,667
Employment	125	349	1	7,992
Initial value (EUR)	270,460	10,837,918	1	2,300,456,960
Exports (EUR mn)	56	442	0	14,637
Initial proximity	0.50	0.36	0.01	1

Source: Own calculations based on the CSO data (2018)

Table 2 presents summary statistics for export survival, comparing firm categories based on number of years of exporting, number of products and destinations (at the start of a product-destination spell) and broad divisions of initial value and proximity to the firm's core product.[8] It shows that an average firm-product-destination flow survives 2.21 years. The average duration declines somewhat with years of firm experience and decreases (very slightly) with product range. The average survival changes little with geographic spread. Higher initial values are associated with longer average product duration times, as does closer proximity to the firm's core speciality.[9]

Although we find that average duration has opposite relationships with firm experience and scope, there is summary evidence of a link between the number of products exported and years of experience. A firm with one year of experience exports just under five products on average, whereas a firm with 19 years of experience exports 18 products on average (see Figure 1). Note however that the number of products does not expand linearly with years of experience - firms with two years experience typically export six products, those with five years experience export eight and those with ten years experience export eleven so the pace of additions to the export scope flattens slightly over time.

In addition to the trade data, we use the proximity measure constructed by Hidalgo et al. (2007).[10] It is based on the idea that two products that require similar institutions,

[8] Each of the firm level measures divides firms into three categories containing around 1/3 of firms while the statistics on initial value divides trade spells into groups of even numbers of spells. Proximity group divides products into four quartiles.

[9] Please note that the Intrastat/Extrastat threshold applies to total exports by firm and not to exports of a particular product. Therefore, it is not necessarily the case that intra-EU product exports fall only into the last initial value category.

[10] This indicator uses as its basis the concept of revealed comparative advantage (RCA) developed by Balassa (1965), which measures whether country c exports more of good i as the share of its total exports than the average country. The data is available to download at http://chidalgo.org/productspace/data.htm

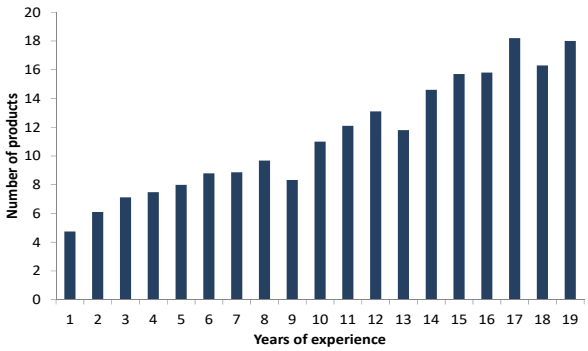
Table 2: Survival summary statistics by firm and product category

Group	Mean	Standard dev.	Median	Min	Max	Number of spells
			Experience			
1-5 years	2.82 (***)	2.31	2	1	10	21,360
6-10 years	2.18 (***)	1.93	1	1	10	18,028
$>$ 10 years	2.03 (***)	1.84	1	1	10	68,605
			Number of products per firm			
1-3 products	2.33 (**)	2.21	1	1	10	4,462
4-10 products	2.24 (*)	2.1	1	1	10	14,964
$>$ 10 products	2.21 (***)	1.37	1	1	10	88,567
			Number of destinations per firm			
1-3 destinations	2.10 ()	2.04	1	1	10	7,955
4-10 destinations	2.09 (***)	1.97	1	1	10	15,011
$>$ 10 destinations	2.24 (***)	1.98	1	1	10	85,027
			Initial value of export flow			
$<$ €896	1.87 (***)	1.64	1	1	10	35,998
€896-€8,267	2.11 (***)	1.93	1	1	10	35,998
$>$ €8,267	2.67 (***)	2.25	2	1	10	35,997
			Proximity to core product			
0-0.25	1.99 (**)	1.77	1	1	10	35,407
0.25-0.5	2.02 (***)	1.80	1	1	10	41,707
0.5-0.75	2.22 (***)	1.96	1	1	10	7,725
$>$ 0.75	2.92 (***)	2.42	2	1	10	23,154
All	2.21	1.98	1	1	10	107,993

*** p<0.01, ** p<0.05, * p<0.1 indicate the significance levels of the Student t-test for the differences in mean between each group and the following group, with the exception of the final group which is compared to the first.

Source: Own calculations based on the CSO data (2018)

Figure 1: Average number of products exported by years of experience



Source: Own calculations based on the CSO data (2018)

capital, infrastructure, technology, etc. are likely to be produced in tandem (similar goods). Dissimilar goods, on the other hand, are less likely to be co-produced.

Formally the proximity ϕ between products i and j is the minimum of pairwise conditional probabilities of a country exporting a good given that it exports another at the SITC 4-digit level.

$$\phi_{i,j} = min\{P(RCAx_i \mid (RCAx_j), P(RCAx_j \mid (RCAx_i)\} \tag{1}$$

Where RCA is revealed comparative advantage.[11]

Hidalgo et al. (2007) generate proximity measures between all SITC 4-digit level products using world trade flows. We apply this to capture the proximity of each new product introduced by firm at time t to its core product. We define the firm's core product as being its product with the largest export value at SITC 4-digit level at the start of a new firm-product-destination trade spell.[12] The proximity measure varies between 0 and 1. In our data, the average proximity is of a new product when it is launched is 0.50 and the median proximity is 0.35.

Figure 2 relates average proximity of a product to a number of firm experience measures based on our descriptive statistics described above: firm export experience, number of products exported, number of export destinations and initial value of exports by product. This figure shows that the average proximity decreases with firm experience, the number of products exported and the number of destination markets and increases with the initial value of exports by product-destination flow. To sum up, more experienced and diversified firms move further away from their core products.

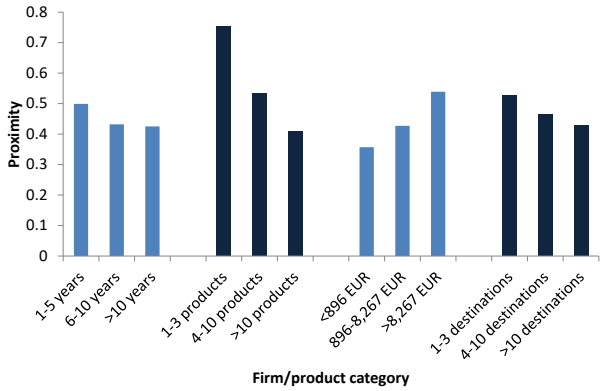
[11] RCA is formally defined as follows

$$RCA_{c,i} = \frac{x(c,i)}{\sum_i x(c,i)} / \frac{\sum_c x(c,i)}{\sum_{c,i} x(c,i)}$$

where c is a country and i is a product.

[12] Note that this allows for the firm's core product to change over time.

Figure 2: Average proximity by firm category



Source: Own calculations based on the CSO data (2018)

Finally, we use country characteristics as well as gravity data. These come from the World Development Indicators, Worldwide Governance Indicators and CEPII. To obtain real values of GDP and trade we use Euro Area GDP deflator expressed in 2010 EUR, coming from the International Monetary Fund (IMF).[13]

3 Analysis of export survival

In the first part of this section we use survivor function estimators to examine export product-destination survival and graph the relationships between survival times and some of the potential explanatory factors described above. In the second part of the section we move to formal regression analysis to look at the determinants of export survival controlling for a wider range of firm characteristics.

3.1 Evidence on product-destination survival

We start our analysis by computing and plotting export survivor function estimators for a number of categories. Since our export data is recorded in one-year time intervals, we estimate the survivor functions using nonparametric lifetable estimator for the period 2006-2014. This method is similar to the Kaplan and Meier (1958) product-limit estimator used for continuous data but adjusts for the fact that exports flows could have ended at any point during the one-year interval.

The survivor function $S(t)$ is obtained, at any point of the time t, as the cumulative probability of survival up to this point. Defining N_k as the number of spells at risk at the beginning of interval t_k, d_k as the number of failures; and n_k the adjusted number of spells at risk at the midpoint of the interval.[14] The life table estimator of the survivor function can be defined as

[13] To covert the data to EUR we use Dollar/Eur exchange rate from Federal eserved Bank of St. Louis.

[14] $n_k = N_k - \frac{d_k}{2}$

$$\hat{S}(t) = \prod_{k=1}^{k_{max}} \frac{n_k - d_k}{n_k} \tag{2}$$

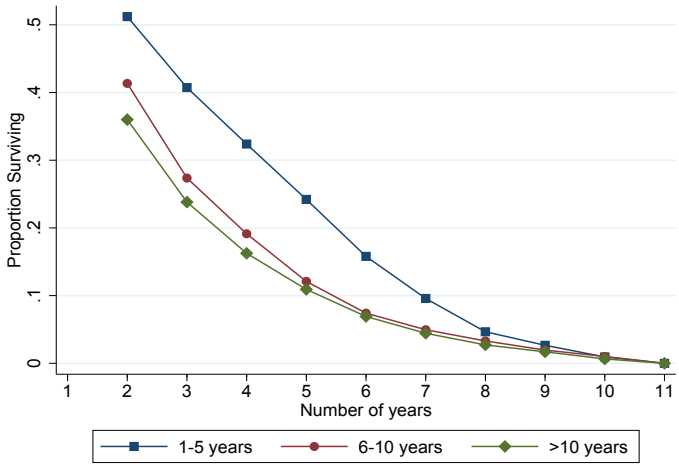
Our first plot (Figure 3) shows the graphical representation of the survivor functions and how they relate to firm experience grouped by years of exporting (firms with up to five years of experience as an exporter, firms with between 6 and 10 years of experience and firms with more than ten years as an exporter). The groups are based on the firms' initial experience that is, we measure experience only at the beginning of each product-destination spell, so it is not impacted by subsequent survival of the specific trade flow. This figure reveals significantly different survival rates for product-destinations spells launched by firms with 1-5 years of prior export experience when compared to the two other groups. Surprisingly, given the expectation from the literature that firms should build export experience over time that would allow them to reduce the costs of launching new products, we find that survival times are higher for the products launched by firms with shorter experience.

Only 35% of flows by the most experienced firms survive the first year, whereas among the least experienced ones more than 51% of spells make it to the second year. The differences across the groups are most marked in the early years after a product-destination trade flow has been launched with the proportion of trade flows surviving gradually converging as the length of the trade spell reaches the longest spells lengths possible in the data.

Figure 4 presents the survivor functions broken down by proximity[15] to the core (left panel) and the initial value of the trade flow (right panel). Again, it shows a high level of heterogeneity of survival rates. Products close to the firms core product (proximity greater than 0.75) are 15 percentage points more likely to survive the first year than firms in the second group. In line with the expectations from work such as Rauch and Watson (2003), we find that export flows starting at a relatively large scale are more likely to survive, particularly in the early years of the trading relationship. In addition, the Appendix presents survival functions for two additional diversification measures the number of products and number of destinations already served by the firm but these show comparatively little variation across groups at this descriptive level with other factors not being controlled for.

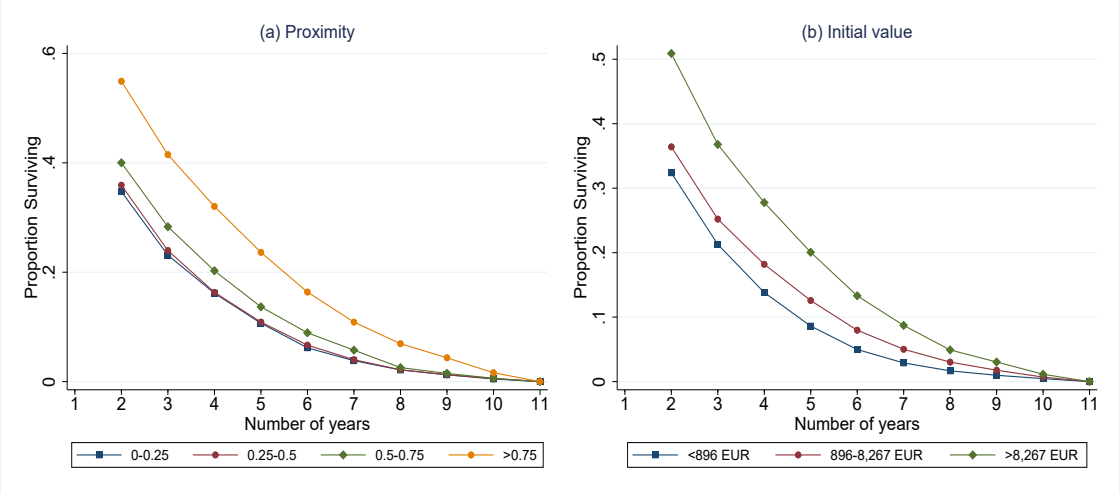
[15] We divide the proximity measure into four equal groups; recall that this is measured on a scale of 0 to 1, with 1 indicating an identical product and 0 an extremely dissimilar one.

Figure 3: Survivor function estimators by initial experience group



Source: Own calculations based on the CSO data (2018)

Figure 4: Survivor function estimators by product proximity and initial value



Source: Own calculations based on the CSO data (2018)

3.2 Product-destination survival determinants

To test the factors driving product survival times at the firm level, we use two alternative econometric specifications. The first that we describe is a complementary log-log (cloglog) to control for unobserved heterogeneity. For comparison, we also use a linear probability approach in order to control for firm or product level fixed effects.

We begin with a discrete-time version of the proportional hazard models - the complementary log-log specification. This empirical approach is commonly used in trade survival

literature (see e.g., Hess and Persson (2011)). In our paper we use a random effects complementary log-log model. We include two different sets of random effects: product and firm effects separately.[16]

The baseline model that we estimate can be represented as follows:

$$h_{ik} = F(x'_{ik}\beta + \gamma_k) \tag{3}$$

where h is the hazard rate, x'_{ik} is a vector of time-varying covariates and γ_k is a function of time that allows the hazard rate to vary across time, and F(.) is the cloglog distribution function. We use the subscript i to denote firm-product-destination export spells. The dependent variable is a dummy equal to one for an ending spell. We treat spells as continuous and ignore breaks between them.

For completeness, we also apply a linear probability model with two sets of fixed effects (product or firm) and we present these results for comparison.[17] The estimated model becomes:

$$P_{ik} = x'_{ik}\beta + \gamma_k + \mu_{ik} \tag{4}$$

Where P_{ik} is the probability of a spell i ending in period k.

Our explanatory variables include the following firm characteristics: size (measured by employment), productivity (measured by value added per worker), ownership (Irish-owned relative to foreign-owned), total exports by the firm, firm export experience, number of products exported by firm, number of destinations, value of new export flow and proximity to the core product. We later include interaction effects between several of these characteristics. A range of standard gravity variables at the destination country level are also included: distance from Ireland, GDP, GDP per capita, rule of law indicator (ROL) and a dummy variable if the country is in the EU.[18] [19] In addition, we include different set of dummies for year, destination and to identify the first year in which the firm exported.[20] We cluster the standard errors at the firm or HS-6 level depending on the random/fixed effects used. The time dependence of the hazard is introduced as log(time) in all models to capture the decline in the hazard with time.

Table 3 presents our baseline results. For the random effects cloglog models in columns 1 to 4, we report the exponentiated coefficients, representing the hazard ratio. These represent how the hazard changes if the explanatory variable increases with one unit. Hence, if a coefficient is greater than one, the hazard of dropping a product-destination trade flow is increasing and correspondingly the lower is the survival. Conversely a coefficient below one indicates a longer survival time. As most of our variables are in log form, the coefficients

[16] From a practical computational perspective, including both firm and product random effects simultaneously was not possible in the cloglog framework.

[17] This keeps the linear probability specifications comparable with the random effects models. We also ran models with both firm and product fixed effects. These are available in the Referee Appendix but do not materially change our results.

[18] See Table A.1 for a detailed description of all data used in this paper.

[19] Note that the distance effect drops out when we include country fixed effects in the linear probability specification but the EU dummy does not as the time period covers the expansion of EU membership into Eastern Europe and therefore has some time variation.

[20] We also ran models without the first year dummies. These are available in the Referee Appendix but do not materially change our results.

can be interpreted as elasticities (with the elasticity equal to 1-coefficient). In the first two specifications (columns 1 and 2), the random effects are at the product (HS-6) level while in columns 3 and 4 the random effects are at the firm level.[21] Looking first at some of our control variables, we find that the relationship between the basic firm characteristics and survival times of individual products is not particularly strong. Firm productivity is significant in most of the specifications, but the coefficients suggest that products exported by more productive firms are actually more likely to be dropped than those of less productive firms. Although this is somewhat unexpected, it can be rationalised as being due to higher productivity firms having greater capacity to launch experimental products even if these are at higher risk of failure. The size of the firm has differing effects depending on whether the random effects are modelled at the product or firm level. In the former, employment has the same negative effect on survival as productivity whereas once firm random effects are used, size has a positive relationship with trade flow survival. The coefficient on Irish ownership is below one, suggesting a lower hazard for trade flows launched by Irish-owned firms relative to foreign-owned firms when other factors are controlled for. This could be attributed to better performance although an alternative interpretation could be that Irish-owned firms exhibit greater caution in the decisions to launch new trade relationships.

The destination level controls suggest that more distant markets come with considerably higher hazard rates while new trade flows with EU members are more likely to survive. Other destination-specific factors common in the gravity literature, such as GDP per capita and rule of law, have limited impact on the specific survival rates of individual product-destination flows once all other factors are included. Total market size (GDP) has somewhat unclear effects, being negative for trade flow survival in the specifications including product level controls (perhaps picking up greater levels of competition in larger markets) but insignificant in the specifications using firm-level random effects.

Moving to our main variables of interest which are the firm-level measures of export experience and diversification, we see that the number of products already being exported by the firm at the time that it launches a new product-destination match has a positive effect on the duration of the new trade flow when product level random effects are chosen as the specification but that this scale effect is reversed when the random effects are at the firm level. While the former result with product controls is consistent with the findings by Volpe-Martincus and Carballo (2009) that diversification reduces the risk of exiting international markets, the firm level random effects specification suggests that the pattern they identify comes from commonality in product survival trends. Thus, controlling for product effects is our preferred specification although most of the other main effects we identify are quite robust to the choice of specification.

In line with Besedeš and Prusa (2006b) and Besedeš (2008), we find that higher initial export values are associated with longer survival times and also that firms with more overall exports tend to have longer survival times of new product-destination flows. Adding the measure of proximity between the new product and the core product shows that greater proximity has a clear positive impact on product survival, confirming the findings of Goya and Zehler (2017).

Along with these measures of firm export diversification and size, we include as our central focus of interest the measure of firm experience coming from the number of years the firm was

[21] Standard errors are clustered at the same level.

an active exporter before launching a new trade flow. Across all of the random effects models, we find that this variable has a significant negative impact on product survival (increasing the hazard of the trade flow being dropped). This is surprising given that experience is generally assumed to have positive effects on the firm's ability to assess market opportunities and to face lower costs of launching an export product. This is the interpretation that would be given to the positive effect of product scope. Our next steps will be to dig into this result in more detail in order to understand why this counter-intuitive result has emerged and if we can identify what drives it.

The right-hand panel of Table 3 presents results from an alternative econometric approach using linear probability specifications with fixed effects at the product level (columns 5 and 6) and at the firm level (columns 7 and 8). As in the random effects models, the dependent variable is a dummy which equals one when a trade spell at the product-destination level ends and all specifications include the length of the spell. The interpretation of the coefficients in the linear probability specifications is different to those of the random effects model as these are standard linear models. The positive coefficients on the firms initial export experience therefore indicate that greater experience increases the probability of a trade spell ending. Thus the direction of the effect is the same as identified in the random effects model despite the change in specification used.

Likewise, the coefficients on most of the other explanatory variables show a consistent pattern across all of the specifications. As in the random effects models, the decision to control for product or firm level fixed effects in the linear probability models has an impact on the effect of product diversification. This suggests that controlling for unobserved product level characteristics can impact the link between diversification and the likelihood of survival for specific product-destination trade flows. The choice of fixed effects also affects the significance level of the coefficient on destination diversification with more destinations making exit less likely only in the cases when product-specific effects are controlled for. The effects of the other explanatory variables including proximity, initial value of the export flow and the total exports of the firm point in the same direction in the linear probability specifications as they do in the random effects models as do the other firm and country control variables.

The overall message from Table 3 is that more experienced exporting firms are more likely to drop individual product-destination pairs and this relationship is robust across multiple econometric specifications. We therefore need to dig a bit deeper into the different aspects of the firm's exporting behaviour to see if we can understand the drivers of this pattern. We saw that some other factors that prolonged the survival of export relationships included the level of similarity between the new product and those already exported by the firm. We also found that the impact of diversification depended to a considerable extent on the inclusion of product-level controls suggesting unobserved heterogeneity in survival probability at the individual product level. Table 4 develops these relationships further by examining if there are interaction effects between experience and product scope that might drive the somewhat counter-intuitive effect of experience found in the baseline specifications.

We continue to include the same set of control variables in Table 4 as in Table 3 but, for brevity, do not report all of the firm and country characteristic coefficients.[22] The focus is on the effects of product proximity and diversification and how they interact with firm experience. Again, we run a number of alternative specifications with panel (a) reporting exponentiated

[22] These are included in the Referee Appendix.

Table 3: Product-destination survival: Baseline results

	(a) Random effects models				(b) Linear probability models			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Initial experience	1.246***	1.201***	1.337***	1.268***	0.057***	0.063***	0.053***	0.061***
	(0.007)	(0.011)	(0.020)	(0.023)	(0.005)	(0.009)	(0.019)	(0.022)
Initial no of products	0.913***	0.912***	1.166***	1.166***	-0.028***	-0.028***	0.037***	0.037***
	(0.006)	(0.006)	(0.013)	(0.013)	(0.005)	(0.005)	(0.012)	(0.012)
Initial no of destinations	0.944***	0.944***	1.002	1.001	-0.015***	-0.015***	0.018	0.018
	(0.006)	(0.006)	(0.014)	(0.014)	(0.004)	(0.004)	(0.013)	(0.013)
Proximity	0.500***	0.425***	0.492***	0.409***	-0.197***	-0.174***	-0.194***	-0.173***
	(0.007)	(0.015)	(0.007)	(0.015)	(0.009)	(0.026)	(0.008)	(0.016)
Initial value	0.933***	0.933***	0.935***	0.936***	-0.020***	-0.020***	-0.019***	-0.019***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Total exports	0.954***	0.954***	0.911***	0.910***	-0.018***	-0.018***	-0.029***	-0.029***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.005)
Experience*proximity		1.079***		1.090***		-0.011		-0.011
		(0.017)		(0.017)		(0.012)		(0.008)
Irish dummy	0.910***	0.910***	0.940**	0.939**	-0.029***	-0.029***	-0.013	-0.012
	(0.009)	(0.009)	(0.026)	(0.026)	(0.006)	(0.006)	(0.032)	(0.032)
Employment	1.014***	1.015***	0.873***	0.873***	0.007**	0.007**	-0.079*	-0.079*
	(0.004)	(0.004)	(0.011)	(0.012)	(0.004)	(0.004)	(0.041)	(0.041)
Productivity	1.067***	1.067***	1.048***	1.049***	0.026***	0.025***	0.011	0.011
	(0.005)	(0.005)	(0.011)	(0.011)	(0.003)	(0.003)	(0.012)	(0.012)
GDP	1.237**	1.233**	1.055	1.055	0.001	0.001	-0.030	-0.031
	(0.129)	(0.128)	(0.111)	(0.111)	(0.042)	(0.042)	(0.070)	(0.070)
Distance	1.262***	1.275***	1.279***	1.299***				
	(0.076)	(0.077)	(0.078)	(0.079)				
ROL	0.945	0.944	0.958	0.956	-0.000	-0.000	-0.005	-0.004
	(0.049)	(0.049)	(0.050)	(0.050)	(0.015)	(0.015)	(0.027)	(0.027)
GDP per capita	0.884	0.886	0.989	0.989	-0.000	-0.001	0.022	0.023
	(0.098)	(0.098)	(0.110)	(0.110)	(0.038)	(0.038)	(0.049)	(0.049)
EU28	0.361***	0.361***	0.288***	0.288***	-0.283***	-0.283***	-0.333***	-0.333***
	(0.036)	(0.036)	(0.029)	(0.029)	(0.034)	(0.034)	(0.036)	(0.036)
Spell length	0.423***	0.422***	0.425***	0.424***	-0.236***	-0.235***	-0.250***	-0.250***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)	(0.016)	(0.016)
Constant	0.209***	0.209***	0.466***	0.470***	1.090***	1.076***	1.670***	1.655***
	(0.010)	(0.010)	(0.026)	(0.026)	(0.241)	(0.245)	(0.473)	(0.476)
Observations	191,742	191,742	191,742	191,742	191,742	191,742	191,742	191,742
Firm controls	no	no	RE	RE	no	no	FE	FE
HS6 controls	RE	RE	no	no	FE	FE	no	no
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Year born FE	yes	yes	yes	yes	yes	yes	yes	yes
Destination FE	yes	yes	yes	yes	yes	yes	yes	yes
log likelihood/R2 within	-110786	-110774	-108473	-108458	0.0590	0.0591	0.0560	0.0560
Number of HS6/firms	3,252	3,252	9,566	9,566	3,252	3,252	9,566	9,566

HS-6 level/firm-level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Panel (a) shows exponentiated coefficients. Dependent variable is a dummy equal to one when a spell ends. All continuous variables are in logs. The time dependence of the hazard is introduced as log(time) in all models.

coefficients from random effects models and panel (b) showing linear probability results with product or firm level fixed effects. In each case we examine first how including an interaction effect between experience and product scope affects the relationship between experience and trade flow survival and then further add an interaction effect between product proximity and firm experience. The addition of an interaction effect between experience and initial number of products in column (1) renders the previously negative direct effect of firm experience on trade flow survival statistically insignificant. The initial number of products has a strong direct effect on reducing the probability of a product-destination pair being dropped but the interaction effect shows a decline in the strength of this effect of product diversification as firm experience increases. When we further include an interaction term between experience and product proximity in column (2), we find that the direct effect of firm export experience is now significantly below one suggesting that greater experience does indeed help reduce the exit probability of newly launched product-destination flows.

The effect identified in the baseline regressions that experience increased the likelihood of dropping an individual trade flow can now be seen to be largely driven by experience having a mitigating effect on the impacts of product diversification and proximity. This could be interpreted as evidence that more experienced firms launching more and more products encounter declining returns to product scope coming at least partially from having to move further away from their core competence. This interpretation of the results is in line with theoretical predictions from models such as Bernard et al. (2011) who show that, after trade liberalization, multi-product exporters are more likely to drop products from their export mix which are further away from their product-level expertise. The remaining columns of Table 4 show that this pattern holds in the alternative random effects model with firm controls and also across the linear probability models although in the latter specifications the direct effect of experience becomes statistically insignificant rather than changing sign.

Table 5 examines if there is an interaction effect between export experience and geographic diversification operating in a similar way to the effect found between experience and product count. For each estimation approach, we first add just this geographic diversification interaction effect to the baseline model and then include it along with the other interaction effects described in Table 4. This shows that there is a similar effect occurring with geographic destinations with more experience as an exporter offsetting some of the positive direct effect of diversification on new trade flow survival. This is not large enough to reverse the direct effect of experience however unless the interactions with product diversification and proximity are also included. As with increasing product range involving moving further from the firms core speciality, increasing geographic coverage is likely to involve moving to more distant or less familiar markets and hence offsetting to some degree the otherwise positive scale effects that larger and more diversified exporters might benefit from. This would be very much in line with the results of Morales, Sheu and Zahler (2017) on the patterns of firm expansion across export destinations.

In Table 6, we test the robustness of this explanation further by also testing for the effect of an interaction between experience and the initial size of the newly launched trade relationship. We find a statistically significant interaction effect that offsets somewhat the positive direct effect that a larger launch size has on export flow survival but it does not change the negative direct effect of experience which stays the same as in the benchmark results. It is when the other interactions with product diversification and proximity are added that we find the change in the direct effect of experience shifting to one that enhances export flow survival.

Table 4: Firm export experience interaction effects

	(a) Random effects models				(b) Linear probability models			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Initial experience	0.995	0.868***	1.056**	0.951*	-0.008	-0.020	0.005	0.011
	(0.014)	(0.016)	(0.024)	(0.025)	(0.008)	(0.012)	(0.021)	(0.023)
Initial no of products	0.776***	0.747***	0.912***	0.887***	-0.072***	-0.075***	-0.007	-0.006
	(0.009)	(0.009)	(0.019)	(0.019)	(0.007)	(0.008)	(0.014)	(0.014)
Initial no of destinations	0.954***	0.955***	1.017	1.017	-0.012***	-0.012***	0.023*	0.023*
	(0.006)	(0.006)	(0.014)	(0.014)	(0.004)	(0.004)	(0.013)	(0.013)
Proximity	0.493***	0.334***	0.490***	0.372***	-0.200***	-0.230***	-0.195***	-0.183***
	(0.007)	(0.013)	(0.007)	(0.014)	(0.009)	(0.024)	(0.008)	(0.015)
Initial value	0.934***	0.934***	0.936***	0.937***	-0.020***	-0.020***	-0.018***	-0.018***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Total exports	0.956***	0.956***	0.915***	0.915***	-0.017***	-0.017***	-0.029***	-0.029***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.005)
Experience*proximity		1.199***		1.136***		0.014		-0.006
		(0.019)		(0.018)		(0.011)		(0.008)
Experience*products	1.078***	1.096***	1.117***	1.131***	0.021***	0.023***	0.020***	0.020***
	(0.005)	(0.005)	(0.009)	(0.009)	(0.003)	(0.003)	(0.007)	(0.007)
Irish dummy	0.909***	0.907***	0.955*	0.954*	-0.029***	-0.029***	-0.010	-0.010
	(0.009)	(0.009)	(0.026)	(0.026)	(0.006)	(0.006)	(0.030)	(0.030)
Constant	0.211***	0.211***	0.438***	0.439***	1.191***	1.215***	1.775***	1.763***
	(0.010)	(0.010)	(0.024)	(0.024)	(0.244)	(0.249)	(0.464)	(0.466)
Observations	191,742	191,742	191,742	191,742	191,742	191,742	191,742	191,742
Firm controls	no	no	RE	RE	no	no	FE	FE
HS6 controls	RE	RE	no	no	FE	FE	no	no
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Year born FE	yes	yes	yes	yes	yes	yes	yes	yes
Destination FE	yes	yes	yes	yes	yes	yes	yes	yes
log likelihood/R2 within	-110631	-110567	-108382	-108351	0.0609	0.0609	0.0563	0.0564
Number of HS6/firms	3,252	3,252	9,566	9,566	3,252	3,252	9,566	9,566

HS-6 level/firm-level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Panel (a) shows exponentiated coefficients. Dependent variable is a dummy equal to one when a spell ends. All continuous variables are in logs. The time dependence of the hazard is introduced as log(time) in all models. Please note that firm and country controls are included in the specification (as in Table 3), but not reported here.

Table 5: Firm export experience and diversification

	(a) Random effects models				(b) Linear probability models			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Initial experience	0.981	0.853***	1.077***	0.928***	-0.003	-0.026**	0.046***	0.027
	(0.012)	(0.016)	(0.023)	(0.024)	(0.006)	(0.012)	(0.017)	(0.019)
Initial no of products	0.914***	0.837***	1.165***	0.974	-0.028***	-0.057***	0.037***	-0.033
	(0.006)	(0.013)	(0.013)	(0.027)	(0.005)	(0.011)	(0.012)	(0.023)
Initial no of destinations	0.796***	0.832***	0.807***	0.898***	-0.053***	-0.034***	0.013	0.059*
	(0.008)	(0.011)	(0.017)	(0.023)	(0.007)	(0.009)	(0.027)	(0.032)
Proximity	0.495***	0.348***	0.493***	0.378***	-0.200***	-0.225***	-0.194***	-0.185***
	(0.007)	(0.013)	(0.007)	(0.014)	(0.009)	(0.025)	(0.008)	(0.016)
Initial value	0.934***	0.934***	0.936***	0.937***	-0.020***	-0.020***	-0.019***	-0.019***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Total exports	0.955***	0.955***	0.915***	0.916***	-0.018***	-0.018***	-0.029***	-0.029***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.005)
Experience*proximity		1.177***		1.128***		0.012		-0.005
		(0.019)		(0.018)		(0.012)		(0.008)
Experience*products		1.040***		1.084***		0.014***		0.032***
		(0.007)		(0.012)		(0.004)		(0.010)
Experience*destinations	1.088***	1.067***	1.111***	1.060***	0.020***	0.011***	0.002	-0.017
	(0.004)	(0.006)	(0.009)	(0.011)	(0.003)	(0.004)	(0.010)	(0.013)
Irish dummy	0.909***	0.907***	0.944**	0.950*	-0.029***	-0.029***	-0.013	-0.010
	(0.009)	(0.009)	(0.026)	(0.026)	(0.006)	(0.006)	(0.032)	(0.029)
Constant	0.213***	0.212***	0.437***	0.435***	1.164***	1.213***	1.691***	1.685***
	(0.010)	(0.010)	(0.024)	(0.024)	(0.238)	(0.248)	(0.444)	(0.446)
Observations	191,742	191,742	191,742	191,742	191,742	191,742	191,742	191,742
Firm controls	no	no	RE	RE	no	no	FE	FE
HS6 controls	RE	RE	no	no	FE	FE	no	no
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Year born FE	yes	yes	yes	yes	yes	yes	yes	yes
Destination FE	yes	yes	yes	yes	yes	yes	yes	yes
log likelihood/R2 within	-110561	-110506	-108380	-108335	0.0609	0.0612	0.0560	0.0565
Number of HS6/firms	3,252	3,252	9,566	9,566	3,252	3,252	9,566	9,566

HS-6 level/firm-level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Panel (a) shows exponentiated coefficients. Dependent variable is a dummy equal to one when a spell ends. All continuous variables are in logs. The time dependence of the hazard is introduced as log(time) in all models. Please note that firm and country controls are included in the specification (as in Table 3), but not reported here.

Table 6: All interaction effects

	(a) Random effects models				(b) Linear probability models			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Initial experience	1.110***	0.778***	1.191***	0.874***	0.067***	-0.018	0.091***	0.054**
	(0.016)	(0.017)	(0.027)	(0.026)	(0.013)	(0.016)	(0.015)	(0.024)
Initial no of products	0.911***	0.829***	1.167***	0.972	-0.028***	-0.056***	0.036***	-0.031
	(0.006)	(0.013)	(0.013)	(0.027)	(0.005)	(0.012)	(0.012)	(0.022)
Initial no of destinations	0.944***	0.837***	1.001	0.904***	-0.015***	-0.035***	0.018	0.055*
	(0.006)	(0.012)	(0.014)	(0.024)	(0.004)	(0.010)	(0.013)	(0.029)
Proximity	0.503***	0.372***	0.496***	0.400***	-0.197***	-0.232***	-0.196***	-0.205***
	(0.007)	(0.015)	(0.007)	(0.016)	(0.009)	(0.023)	(0.009)	(0.020)
Initial value	0.905***	0.909***	0.911***	0.920***	-0.018***	-0.018***	-0.012***	-0.012***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.002)	(0.004)	(0.004)
Total exports	0.956***	0.957***	0.913***	0.917***	-0.018***	-0.018***	-0.029***	-0.029***
	(0.003)	(0.003)	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.005)
Experience*proximity		1.142***		1.102***		0.015		0.004
		(0.019)		(0.019)		(0.011)		(0.010)
Experience*products		1.044***		1.085***		0.014***		0.031***
		(0.007)		(0.012)		(0.005)		(0.010)
Experience*destinations		1.064***		1.056***		0.012***		-0.015
		(0.006)		(0.011)		(0.004)		(0.012)
Experience*initial	1.014***	1.013***	1.012***	1.008***	-0.001	-0.001	-0.003**	-0.003*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Irish dummy	0.913***	0.910***	0.939**	0.950*	-0.029***	-0.029***	-0.012	-0.009
	(0.009)	(0.009)	(0.026)	(0.026)	(0.006)	(0.006)	(0.031)	(0.029)
Constant	0.209***	0.212***	0.468***	0.436***	1.073***	1.199***	1.590***	1.633***
	(0.010)	(0.010)	(0.026)	(0.024)	(0.247)	(0.251)	(0.459)	(0.438)
Observations	191,742	191,742	191,742	191,742	191,742	191,742	191,742	191,742
Firm controls	no	no	RE	RE	no	no	FE	FE
HS6 controls	RE	RE	no	no	FE	FE	no	no
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Year born FE	yes	yes	yes	yes	yes	yes	yes	yes
Destination FE	yes	yes	yes	yes	yes	yes	yes	yes
log likelihood/R2 within	-110749	-110479	-108450	-108325	0.0591	0.0613	0.0563	0.0568
Number of HS6/firms	3,252	3,252	9,566	9,566	3,252	3,252	9,566	9,566

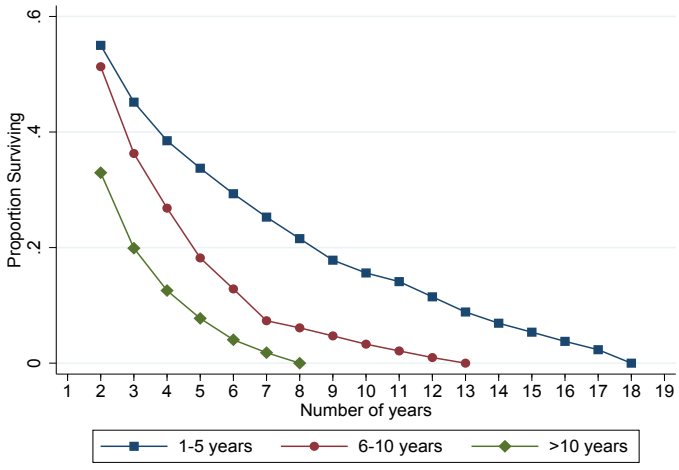
HS-6 level/firm-level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Panel (a) shows exponentiated coefficients. Dependent variable is a dummy equal to one when a spell ends. All continuous variables are in logs. The time dependence of the hazard is introduced as log(time) in all models. Please note that firm and country controls are included in the specification (as in Table 3), but not reported here.

4 Alternative view: firm cohort analysis

In this section we look at the impact of experience on export survival from a firm cohort perspective. To do this we focus solely on one single group of firms and follow the survival probabilities of their newly launched products as they build up time as exporters at the same pace. This allows us to evaluate the impact of export experience on export survival while firms were building it up. To give us as large a set of firms over as long a time span as possible without having to deal with issues of left-censoring in the data, we use the group of firms that began exporting in 1999 and estimate the likelihood of exit of each new product-destination pair that they launch over their observed life as exporters. We should note that this first year of exporting activity when a firm enters our dataset does not necessarily correspond to the year in which the firm was founded. Unfortunately, the age of the firm at its first entry into exporting is not available so we cannot control for prior experience solely on the domestic market.

We start by looking at average and median survival for the experience group categories. Here we are looking at the same firms in their early (1-5 years), middle (6-10 years) and later (over 10) years as exporters so, unlike in the previous section, we can follow the same firms and look at how the survival time of their products evolved. Table 7 confirms our findings from Section 3. The products launched early in the firm's export life are longer lasting than those launched once the firm has been exporting for a number of years. The variation in average spell length by product scope is limited but the pattern of higher initial values being associated with longer spells is also found when we use this alternative set of the data.

Figure 5: Survivor function estimators by cohort



Source: Own calculations based on the CSO data (2018)

We then plot the survivor functions estimators by cohort (Figure 5). Our results confirm our findings from Section 3, export survival of product-destination trade flows launched at the beginning of firm's export activity is longer than export survival of trade relationships launched later on. Almost 60% of products launched within the first five years survive the first year whereas only 31% of products launched after 10 years of activity survive the first

Table 7: Mean and median survival, cohort analysis

Group	Average	Median	Number of spells
	Experience		
1-5 years	5.55	3	3,499
6-10 years	2.87	2	4,354
> 10 years	1.75	1	2,733
	Number of products per firm		
1-3 products	2.65	1	323
4-10 products	4.15	2	1,123
>10 products	3.41	2	9,140
	Number of destinations per firm		
1-3 destinations	3.14	1	658
4-10 destinations	3.40	1	1,005
>10 destinations	3.50	2	8,923
	Initial value of export flow		
< €896	2.52	1	3,466
€896 – €8,267	3.16	1	3,497
> €8,267	4.67	3	3,623
	Proximity to core product		
0-0.25	2.41	1	3,637
0.25-0.50	3.32	1	3,765
0.50-0.75	3.80	2	983
>0.75	5.32	3	2,201
All	3.47	1	10,586

Source: Own calculations based on the CSO data (2018)

year.

In Table 8, we present the results of a range of specifications controlling for product level random effects. In the baseline model presented in column (1), we find that as the firm builds up experience, the probability of each new trade relationship ending increases. As in the previous sets of results, greater product coverage, closer proximity of new products to those already exported by the firm, higher export value at launch and the firms total export level all reduce the probability of a new product-destination relationship ending. The only notable difference in effects in this analysis of a specific cohort compared to the full sample is that greater geographic diversification has a more negative effect on the survival of a specific product-destination trade flow.

The remaining columns gradually add each of the interaction effects described previously to examine their individual and combined effects. Each of the interactions has a significant effect that increases the odds of a trade flow ending offsetting the direct effect of each of the variables (product scope, proximity and initial value) that would otherwise reduce the likelihood of the specific product-destination relationship ending. Including these interaction effects to allow experience to mitigate the effects of these other characteristics of the firms exports changes the direct effect of experience, reversing the effect from the baseline outcome of experience increasing the probability of exit to one where experienced firms have generally lower chances of a specific trade flow ending.

Table 8: Alternative specification: single firm cohort

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Initial experience	1.087**	1.023	0.925	0.813**	0.862**	0.768***	0.925	0.694***
	(0.044)	(0.051)	(0.069)	(0.071)	(0.061)	(0.069)	(0.064)	(0.069)
Initial no of products	0.943*	0.945*	0.850***	0.828***	0.926**	0.910	0.946*	0.917
	(0.031)	(0.031)	(0.044)	(0.043)	(0.030)	(0.056)	(0.031)	(0.057)
Initial no of destinations	1.381***	1.381***	1.383***	1.384***	1.234***	1.232***	1.374***	1.230***
	(0.041)	(0.041)	(0.041)	(0.041)	(0.051)	(0.062)	(0.041)	(0.061)
Proximity	0.562***	0.479***	0.556***	0.444***	0.561***	0.452***	0.557***	0.466***
	(0.037)	(0.049)	(0.037)	(0.047)	(0.037)	(0.048)	(0.037)	(0.049)
Initial value	0.935***	0.935***	0.937***	0.937***	0.936***	0.936***	0.912***	0.917***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.009)	(0.010)
Total exports	0.920***	0.919***	0.922***	0.920***	0.918***	0.917***	0.920***	0.917***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Experience*proximity		1.115**		1.165***		1.158***		1.129**
		(0.060)		(0.064)		(0.064)		(0.064)
Experience*products			1.056**	1.072***		1.010		1.007
			(0.022)	(0.023)		(0.030)		(0.030)
Experience*destinations					1.072***	1.073***		1.072***
					(0.019)	(0.026)		(0.026)
Experience*initial							1.015***	1.012**
							(0.005)	(0.006)
Irish dummy	0.686***	0.687***	0.689***	0.692***	0.676***	0.678***	0.688***	0.679***
	(0.036)	(0.036)	(0.036)	(0.037)	(0.036)	(0.036)	(0.036)	(0.036)
Constant	1.329***	1.328***	1.334***	1.333***	1.341***	1.340***	1.320***	1.333***
	(0.114)	(0.114)	(0.115)	(0.115)	(0.115)	(0.115)	(0.114)	(0.115)
Observations	27,788	27,788	27,788	27,788	27,788	27,788	27,788	27,788
HS6 controls	RE	RE	RE	RE	RE	RE	RE	RE
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Destination FE	yes	yes	yes	yes	yes	yes	yes	yes
log likelihood	-13126	-13124	-13123	-13119	-13118	-13115	-13122	-13112
Number of HS6	840	840	840	840	840	840	840	840

HS-6 level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Exponentiated coefficients presented. Dependent variable is a dummy equal to one when a spell ends. All continuous variables are in logs. The time dependence of the hazard is introduced as log(time) in all models. Please note that firm and country controls are included in the specification (as in Table 3), but not reported here.

5 Robustness checks

In this section we present several robustness checks to examine if the effects identified previously hold for different sub-sets of the data.[23]

In Table 9, the top panel shows results from spliting the sample into firms into (a) intra-EU and (b) extra-EU exporters to account for the difference in reporting thresholds for both kinds of exports described in Section 2. The broad pattern of results remains robust to this split with relatively minor changes in the magnitude of the coefficients. The result are presented using only the product level random effects specification but the other specifications have the same qualitative results.

The lower half of Table 9 then looks at a breakdown of the data by firm nationality of ownership, with panel (c) containing the results for Irish-owned firms and panel (d) the results for foreign-owned firms. This division is motivated by the structure of the Irish exporting sector, which is characterized by a large number of foreign-owned exporters. As our construction of the measure of experience for multinationals only applies to the length of time they have been exporting from their Irish base, it may be understated relative to the firm's overall international experience. However, this issue does not appear to impact the main pattern of our results, with the two panels showing that the hazard of a product being dropped increases with firm experience for both types of firms in the specification without interactions and that this effect reverses sign when we allow experience to operate by mitigating the effects of product diversification and proximitiy.

[23] As in the previous section we estimate a set of complementary log-log models with product random effects.

Table 9: Robustness checks

	(a) Within EU Exports			(b) Non-EU Exports		
Initial experience	1.216***	1.045	0.702***	1.253***	0.956*	0.797***
	(0.013)	(0.029)	(0.032)	(0.023)	(0.026)	(0.039)
Initial no of products	0.944***	0.845***	0.825***	0.900***	0.740***	0.848***
	(0.013)	(0.020)	(0.025)	(0.014)	(0.019)	(0.031)
Initial no of destinations	0.960***	0.968***	0.930***	0.937***	0.950***	0.778***
	(0.012)	(0.012)	(0.023)	(0.014)	(0.013)	(0.035)
Proximity	0.602***	0.598***	0.436***	0.489***	0.481***	0.388***
	(0.020)	(0.020)	(0.034)	(0.017)	(0.017)	(0.038)
Experience*proximity			1.169***			1.103**
			(0.039)			(0.045)
Experience*products		1.054***	1.065***		1.093***	1.027*
		(0.010)	(0.014)		(0.011)	(0.015)
Experience*destinations			1.021*			1.097***
			(0.011)			(0.020)
Observations	65,516	65,516	65,516	126,226	126,226	126,226
	(c) Irish-owned firms			(d) Foreign-owned firms		
Initial experience	1.092***	1.020	0.872***	1.375***	1.079	0.696***
	(0.015)	(0.029)	(0.044)	(0.038)	(0.075)	(0.077)
Initial no of products	0.885***	0.834***	0.799***	0.944***	0.810***	0.919
	(0.017)	(0.025)	(0.031)	(0.019)	(0.038)	(0.060)
Initial no of destinations	0.961**	0.961**	0.983	0.958***	0.965**	0.711***
	(0.016)	(0.016)	(0.034)	(0.016)	(0.016)	(0.048)
Proximity	0.483***	0.482***	0.406***	0.523***	0.518***	0.318***
	(0.020)	(0.020)	(0.035)	(0.026)	(0.026)	(0.061)
Experience*proximity			1.089**			1.242**
			(0.042)			(0.097)
Experience*products		1.029**	1.050***		1.071***	1.010
		(0.012)	(0.017)		(0.020)	(0.025)
Experience*destinations			0.989			1.148***
			(0.011)			(0.031)
Observations	73,885	73,885	73,885	117,857	117,857	117,857

HS-6 level clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The table shows exponentiated coefficients. Dependent variable is a dummy equal to one when a spell ends. All continuous variables are in logs. The time dependence of the hazard is introduced as log(time) in all models. Please note that firm and country controls are included in the specification (as in Table 3), but not reported here. All models control for HS-6 random effects.

6 Conclusions

In this paper we present new empirical evidence on the relationship between exporting experience and the duration of export relationships at the firm-product level. More precisely, we distinguish between the effect of firm expertise coming from product and market diversification and the effects coming from the length of time a firm has been engaged in exports.

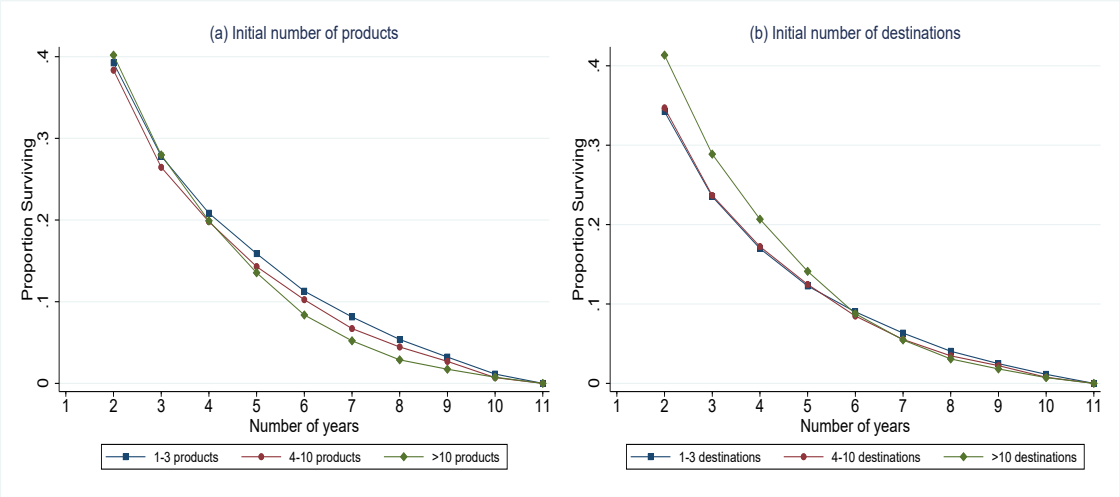
Our starting hypothesis that more experienced exporters (in years of exporting) would have longer lived product-market trade relationships due to lower search costs is quite strongly rejected. On the contrary, more experienced firms show higher probabilities of failure associated with launching new product-destination trade flows. On the other hand, firms with broader export scope are in general more likely to have better survival times for their new trade relationships. Survival probabilities are also strongly increased if new trade flows are in products close to the firms core area of expertise and if the new trade flow is launched at a high initial value. These relationships are robust to a range of different econometric specifications and sample splits suggesting that this counter-intuitive finding is worth investigating in more depth.

We find that when we introduce an interaction effect between experience and product scope and between product proximity and firm experience, our results change considerably. Interacting experience and initial number of products results in a statistically insignificant direct effect of firm experience on trade flow survival. While the initial number of products continues to have a positive direct effect the survival of a product-destination pair, the interaction effect shows a decline in the strength of the effect of product diversification as firm experience increases. Additional interactions between experience and product proximity reverses the baseline finding of a negative impact of firm export experience which is found to have a significantly positive impact on the survival probabilities of newly launched product-destination flows robust to several specification approaches.

These findings suggest that the benefits of scope reach a maximum after some level of experience as an exporter is reached, after which there is a decline in the marginal return on the positive effects of product diversification and proximity. We suggest that this could potentially be evidence that more experienced firms that launch more and more product-destination pairs may be moving further away from their core competence and/or into more risky markets which therefore increases the risk of failure of any individual product-destination pairing. This interpretation of our results would be consistent with the predictions of models in which more experienced exporters diversify and expand their export portfolios. Their additional products are, however, more likely to be smaller, less closely aligned to the firm's core competencies with lower survival rates. This adds a new dimension to our picture of how multi-product firms export and suggests that there is much more to be understood about the linkages between product entry, survival and costs of exporting.

A Appendix

Figure A.1: Survivor function estimators by initial number of products/initial number of destinations



Source: Own calculations based on the CSO data (2018)

Table A.1: Description of variables and data sources

Variable	Description	Source
Initial Experience	Number of years of prior export experience (log), at launch of a new firm-product-destination spell	CSO (Trade Statistics)
Initial number of products	Number of products exported by firm (log), at launch of a new firm-product-destination spell	CSO (Trade Statistics)
Initial number of destinations	Number of destinations served by firm (log), at launch of a new firm-product-destination spell	CSO (Trade Statistics)
Initial value	Initial value of exports by product-dest.(log)	CSO (Trade Statistics)
Total exports	Total exports by firm (log)	CSO (Trade Statistics)
Irish dummy	Binary variable which is equal to 1 for Irish-owned firms	CSO (Census of Industrial Production)
Productivity	Value added per worker (log)	CSO (Census of Industrial Production)
Employment	Number of FTEs (log)	CSO (Census of Industrial Production)
Proximity	Variable measuring the proximity of the newly launched product to the core product of the firm	Hidalgo et al. (2007) http://chidalgo.org/productspace/data.htm
GDP	GDP in 2010 EUR (log)	World Development Indicators
GDP per capita	GDP per capita in 2010 EUR (log)	World Development Indicators
Rule of law	Index reflecting agents' perceptions, confidence and compliance with a country's rules on quality of contract enforcement, property rights etc.	Worldwide Governance Indicators
Distance	Distance in km between Dublin and capital cities (log)	CEPII
Dollar/Euro exchange rate	Average annual US Dollar/Euro exchange rate	Federal Reserve Bank of St. Louis
GDP deflator	2010 Euro Area deflator	International Monetary Fund

References

[1] Aeberhardt, R., Buono, I., & Fadinger, H. (2014). Learning, incomplete contracts and export dynamics: Theory and evidence from French firms. *European Economic Review*, 68, 219-249.

[2] Albornoz, F., Fanelli, S., & Hallack, J. (2016). Survival in Export Market. *Journal of International Economics*, 102, 262-281.

[3] Araujo, L., Mion, G., & Ornelas, E. (2016). Institutions and export dynamics, *Journal of International Economics*, 98, 2-20.

[4] Balassa, B. (1965). Trade liberalisation and revealed comparative advantage. *The Manchester School*, 33(2), 99-123.

[5] Bernard, AB., Redding, SJ., & Schott, PK. (2011). Multiproduct firms and trade liberalization. *The Quarterly Journal of Economics*, 126(3), 1271-1318.

[6] Besedeš, T. (2008). A Search Cost Perspective on Formation and Duration of Trade. *Review of International Economics*, 16(5), 835-849.

[7] Besedeš, T., & Prusa, TJ. (2006a). Ins, outs, and the duration of trade. *Canadian Journal of Economics*, 39(1), 266-295.

[8] Besedeš, T., & Prusa, TJ. (2006b). Product differentiation and duration of US import trade. *Journal of International Economics*, 70(2), 339-358.

[9] Eckel, C., & Neary, JP. (2010). Multi-product Firms and Flexible Manufacturing in the Global Economy. *Review of Economic Studies*, 77(1), 188-217.

[10] Esteve-Pérez, S., Pallaro-Lopez, V., & Requena-Silvente, F. (2013). The duration of firm-destination export relationships: Evidence from Spain, 1997-2006. *Economic Inquiry* 51(1), 159-180.

[11] Görg, H., Kneller, R., & Muraközy, B. (2012). What Makes a Successful Export? *Canadian Journal of Economics*, 45(4), 1332-1368.

[12] Goya, D. & Zahler, A. (2017). 'Distance from the core' and new export survival: Evidence from Chilean exporters. Pontificia Universidad Catolica de Valparaiso Working Paper 2017-01.

[13] Hess, W. & Persson, M. (2011). Exploring the duration of EU imports. *Review of World Economics* 147(4), 665-692.

[14] Hidalgo, CA., Klinger, B., Barabási, AL., & Hausmann, R. (2007). The product space conditions the development of nations. *Science*, 317(5837), 482-487.

[15] Hosmer, D., Lemeshow, S., & May, S. (2011). Applied Survival Analysis: Regression Modelling of Time to Event Data. Wiley-Interscience, Volume 618.

[16] Kaplan, E., & Meier, P., (1958). Nonparametric Estimation from Incomplete Observations. *Journal of the American Statistical Association*, 53(282), 457-481.

[17] Iacovone, L., & Javorcik, BS. (2010). Multi-Product Exporters: Product Churning, Uncertainty and Export Discoveries. *The Economic Journal*, 120(May), 481-499.

[18] Lawless, M., Siedschag, I. and Studnicka, Z. (2019). Firm strategies in expanding and diversifying exports. *World Economy*, 42(2), 349-375.

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

[20] Morales, E., Sheu, G., & Zahler, A. (2017). Extended gravity. NBER Working Paper, 21351.

[21] Rauch, JE., & Watson, J. (2003). Starting small in an unfamiliar environment. *International Journal of Industrial Organization*, 21(7), 1021-1042.

[22] Stirbat, L., Record, R., & Nghardsaysone, K. (2015). The experience of survival: Determinants of export survival in Lao PDR. *World Development*, 76, 82-94.

[23] Van Beveren, I., A.B. Bernard & H. Vandenbussche (2012). "Concording EU Trade And Production Data Over Time," Working Paper 18604, NBER 2012.

[24] Volpe–Martincus, C., & Carballo, J. (2009). Survival of new exporters in developing countries: Does it matter how they diversify? IDB Working Paper Series IDB-WP-140

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