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DURATION AND TEMPORARY TRADE

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Duration and temporary trade

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Abstract: While the theory on the dynamics of trade duration is formulated at the firm level, most empirical analysis has been undertaken with data at a country and industry level. In this study, we have access to firm export data including the importing firm for one industry – Norwegain salmon farming. This allow us to study trade dynamics in greater detail. Trade duration is investigated using two approaches; by estimating hazard rates, and by using a multinominal logit model. In the latter approach, we define the length of a trade relationship by number of transactions, including one category with relationships containing only one transaction – hit and run strategies. As expected, the results indicate that the degree of dynamics increases as the data becomes more disaggregated. These results highlight the importance of firm-level data to understand the full extent of trade duration dynamics. It is of particular interest that trade relationships are shorter in larger markets being served by many companies and where competition, accordingly, seems keen, a feature that is masked in industry-level data.

Key words: aquaculture, salmon, duration of trade, hit-and-run, temporary trade

JEL classification: F10, F14, C41

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1. Introduction

During the last decades there has been an increasing interest in the role of firms and products in international trade. One of the main findings is that the observed trade flows are largely driven by entry into, and exit from, exports at the firm level (Eaton et al., 2008, Bernard et al., 2007). There has also been increasing interest in the duration of trade relationships commencing with Besedeš and Prusa (2006a, 2006b). Besedeš and Prusa (2011) show how trade duration can be analysed through an extended version of the Melitz (2003) model. To trade, heterogeneous firms face two different forms of costs; a fixed cost of entering the export market, and an additional period and market-specific fixed cost. When entering the export market, firms are subject to uncertainty regarding the additional costs. Thus, firms cannot learn the total cost of exporting to a specific market without entering the export market. If a firm faces higher costs than anticipated after exporting for a period of time, the optimal decision for the firm is to exit from the trade relationship. Typically, increased period-specific fixed costs will result in a shorter duration.

With a partial exception of Esteve-Pèrez et al. (2012), the empirical literature on trade duration uses data at the country level. While the insights obtained using country-
level data are important, one needs to use firm-level data if one is to align the analysis with the theory it is based on, as it is firms that start and end trade spells. In addition, the importing firm can also find that the trade costs and frictions vary with different exporters, and end a trade spell. Trade durations can, accordingly, also vary due to the cost of importing firms. That also means that it is not sufficient to look at the end market, but one must look at the specific firm that is buying the product. This is the purpose of the present paper.
Our empirical analysis will investigate trade relationships in a single industry for one product. This allows us to focus on specific details, and prevents characteristics of different product types to influence results. This industry is Norwegian export of salmon. Salmon is the largest product category in Norway's second largest export sector, seafood. More than 80 percent is exported in one relatively homogenous product form, whole fresh, and, as such, differences in export strategies between firms are due to different choices and not products.

In line with previous studies using industry data at a country level (Besedeš and Prusa, 2006a, 2006b; Nitsch, 2009), we find that a large share of trade relations are short-lived. Negative duration dependence is present, i.e. if the trade relationship survives in an export market over a period, the possibility for failure decreases significantly. The estimated survival rates are heavily affected by the level of aggregation in the data. At the firm level, the probability for failure in a trade relationship decreases with the size of the initial trade volume and by the exporters number of trading partners. Moreover, trade relationships are shorter in larger markets being served by many companies and where competition, accordingly, seems keen, a feature that is masked in industry-level data.

Békés and Muraközy (2012) provide a somewhat different approach than Besedeš and Prusa (2006a, 2006b), and argue that models of firm heterogeneity that build on the framework of Melitz (2003) predict that firms are expected to export to a given destination for a long time once the trade relationship is established. Data shows that such stable relationships are relatively rare, and Békés and Muraközy (2012) suggest to separate between two types of relationships, temporary and permanent, by defining relationships with a duration shorter than four years as temporary, and estimate the probability of hit and run behavior with a probit model. The four year period for a temporary relationship is relatively long and may cover substantial short-term dynamics. We have access to data on all transactions, and will utilize this to define three types of relationships; hit and run behavior as a relationship with only one transaction, temporary relationships with up to three transactions, and permanent trade relationships with more than three transactions. With the three categories, a multinomial logit model is used for the empirical analysis. We show that the heterogeneity at the import side of the market can be an additional source for fragile trade relationships. One important finding is that hit-and-run trades are charcterized by large initial volume. Further, increased goegraphical distance between the exporter and importer promotes hit-and-run trades. We also find that sales to importers serving several destinations increases the probability for observing hit-and-run trades.

This paper is organized as follows. In section 2, a brief overview over some relevant literature is offered. The data is described in section 3. Section 4 presents the empirical approach, and the Cox-model estimations are presented in section 5. In section 6, we discuss temporary trade while section 7 concludes.

2. Literature

The analysis of survival and termination of trade relationships commenced with Besedeš and Prusa (2006a, 2006b). Besedeš and Prusa (2006a) show that trade duration for most US imports are relatively short, with substantial dynamics due to numerous entries and exits. Based on 7-digit trade data from 160 different trading partners for the period 1972-1988, they estimate Kaplan-Meier survival functions, and find a survival rate of 67 percent the first year. The median duration when exporting a product to the US is between two and four years. The same import data is used in Besedeš and Prusa (2006b) to investigate whether there are differences in trade duration for homogenous and differentiated products using the classification of products into homogenous or differentiated found in Rauch (1999). They estimate that the hazard rate for homogenous products is at least 23 percent higher than for differentiated products. Besedeš and Prusa (2006b) also estimate a proportional Cox-model based on the model of Rauch and Watson (2003) to investigate important factors explaining trade duration. They found that trade relationships involving homogenous products start out with larger initial purchases, and last for a shorter time than trade relationships involving differentiated products.

Using import data at the 8-digit product level from 1995-2005, Nitsch (2009) explores the duration of import trade in Germany. Most of the observed trade relations in German import last between 1-3 years. To formally analyze the duration of a trade relationship, Nitsch (2009) includes different explanatory variables, such as unit value, GDP, GDP per capita, market share and common language, and estimates a stratified Cox-model. He found that the duration of import in Germany depends on exporter country and product characteristics, market structure, and on the initial size of the transaction. Two-way trade (both export from, and import to, Germany in a given product) tends to increase the probability of survival.

Besedeš and Prusa (2011) investigate the extensive and intensive margin of trade. They decompose growth in export into three parts; establishment of new relationships, higher intensity in existing relationships, and the survival of existing relationships. Using export data for 46 countries at the 4-digit level for 1975-2003, they found the median duration to be between 1-2 years when data is pooled to estimate export survival at the regional level. Export survival is compared between East Asia, Central America, Mexico, Africa, South America and the Caribbean, and the mean survival of trade relationships in these regions is 1-2 years. Besedeš and Prusa (2011) argue that both the extensive and intensive margins are important for export growth, and emphasize the importance of survival of trade relationships. "*Survival of export relationships is a necessary requirement for trade deepening and export growth, as poor survival prevents deepening from taking place"* (Besedeš and Prusa, 2011, p. 372).

Esteve-Pèrez et al. (2012) study the duration of Spanish firms' trade relationships by destination for the period 1997-2006. They found that the median duration of a firm-country relationship is two years, and that 47 percent of all spells end after the first year. The analysis in Esteve-Pèrez et al. (2012) is carried out using data on the 4-digit level for 3803 firms operating in wholesale/retailing, or manufacturing and exporting to 122 different destinations.

Brenton et al. (2009) investigate survival rates of exports from 44 developing countries in the period 1985-2006. They found that export flows from low-income countries have lower survival rates than those for high-income countries. It is also argued that different policy variables may be important determinants for duration. More specifically; variations in bilateral exchange rates between the trading partners, exchange rate misalignment, and tariffs and trade preferences may influence the survival probability. In addition, Besedeš (2008), Jaud et al. (2009), Fugazza and Moliva (2009), Cadot et al. (2013) and Besedeš and Prusa (2011) investigated patterns in duration in the exports of developing countries. Hess and Persson (2011) studied duration in EU imports.

Békés and Muraközy (2012) takes a different approach, and divide observed trade relationships from Hungarian export in two groups; temporary and permanent trade relationships, and estimate the probability of a permanent relationship with a probit model. Using Hungarian firm-transaction level export data for the period 1992-2003, they found that 1/3 of the firm-destination relationships, and 1/2 of the firm-product-destination relationships were short-lived. They argue that firms endogenously choose between variable and sunk cost trade technologies. If the exporting firms pay a large initial fee to establish a relationship, they face lower costs later on, and vice versa. Such a distinction between types of trade technology results in temporary traders choosing the technology that implies the lowest costs. Furthermore, it is shown that well-known gravity variables, such as GDP in the destination market and proximity to the market, as well as firm-specific productivity and capital costs, affect the likelihood of temporary trade.

3. Data and the Norwegian salmon industry

Aquaculture has, in recent decades, been the world´s fastest growing food production technology, and salmon has been one of the most successful species when measured by production growth (Smith et al., 2010). Norway is the world´s largest producer of farmed salmon, with a production share of about 60 percent (Asche et al., 2009). During the last decade, Norway has been one of the world´s three largest seafood exporters, and salmon makes up almost two thirds of the export value. The salmon market is global, and Norway alone exported to 85 countries.

The data used in this paper is custom data, collected, and provided by Statistics of Norway. We focus on the export of "fresh farmed salmon with head" at the 8-digit product level (03021201) in the Norwegian customs tariff, which makes up about 85 percent of total salmon exports. The data spans an 11-year interval, from 1999-2009. We will work within two separate samples, the first covering the years 1999-2009, and the second period covering 2003-2009. In the first sample, we are only able to identify the seller (exporter), while in the second sample, we are able to identify both the seller (exporter) and the buyer (importer). It is important to notice that while some importers serve only one market, others are multinational firms serving many different markets, so we are not able to determine the nationality of the importing firm. In addition to information about the seller (and buyer), our data contains information about the value and volume of each shipment, the invoicing currency, the form of delivery contract, the destination country, and the date of export. For export firms, we also have data on the number of employees in the firm.

The sample for the period 1999-2009 contains a total of 686,664 distinct transactions from 274 Norwegian exporters to 85 different destination markets. In the sample for the period 2003-2009, we observe 461,132 distinct trades from 196 exporters to 4,571 importers in 75 different destination markets. Figure 1, reports the annual total exports of fresh farmed salmon from Norway, and show that the export of fresh salmon has more than doubled in quantity during the period. In figure 2, we show the largest and smallest destination markets in data for the period 1999-2009.[3]

[3] Figure A.1 in the appendix reports the 20 largest markets in total for the period 2003-2009.

Figure 1: Total export of fresh salmon by year

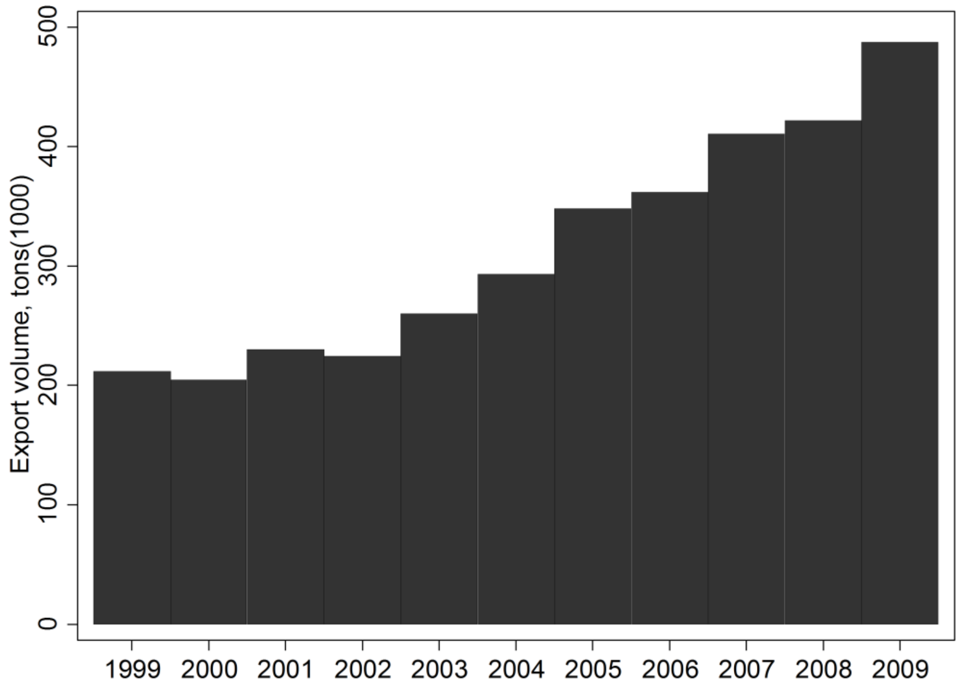
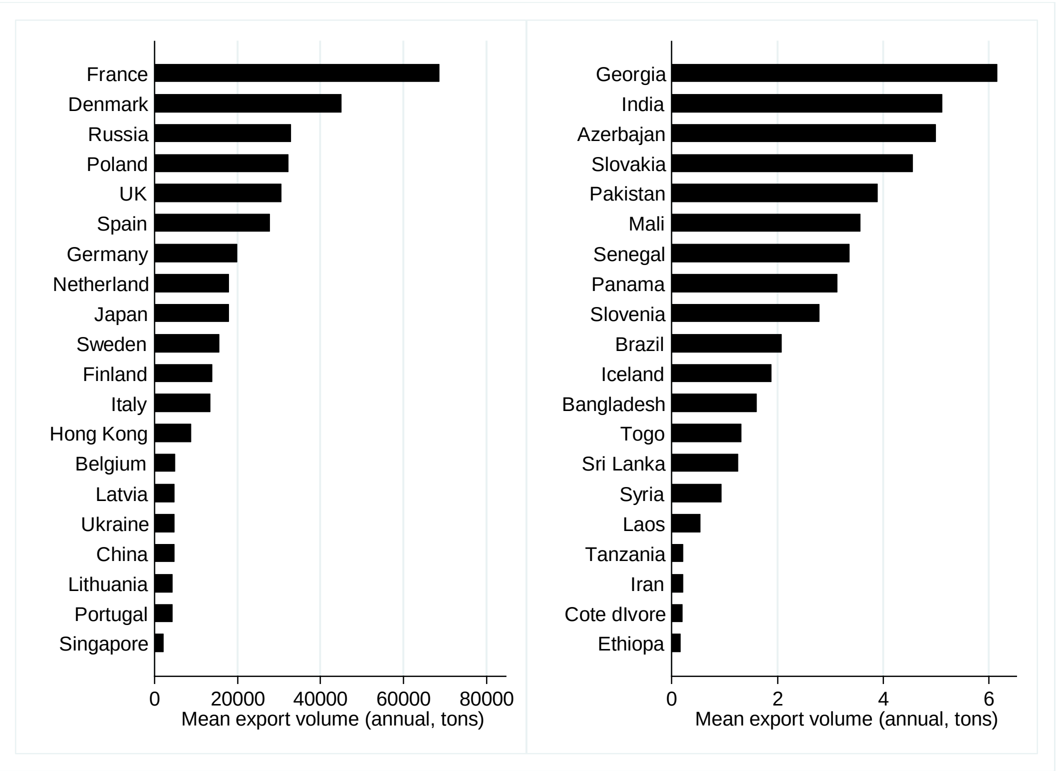


Figure 2: The 20 largest/smallest destination markets for fresh salmon, 1999-2009



From figure 2, it is evident that many of the largest destination markets for Norwegian fresh farmed salmon are located in the EU. The two largest markets, France and Denmark, together account for 32 percent of the total export volume. However, Russia and Japan are also in the top ten list, and several other Asian countries are in the top twenty. There is substantial firm heterogeneity in the data. The first data sample indicates that the 20 largest exporters provide 75 percent of the total volume, and out of the 274 exporting firms, 256 have at least one trade to one of these markets over the period. Moreover, the 20 largest destination markets take 96 percent of the volume (91 percent of the trades).[4]

Of the 4,571 different importers in the data, 3,864 operate in only one destination market indicating that there are many more import firms than exporters. 522 importers serve two destination markets, and 102 importers receive salmon in three different destinations. One single firm receives salmon in 15 different markets; this particular importer is not surprisingly the largest importer in the dataset.[5] The 20 largest destinations are served by 3,781 different importers. The smallest of these imports 0.02 tons of salmon in one transaction, while the largest has a total import over the period of 47,091 tons in 8,842 transactions. The smallest importer is located in Denmark, while the largest importer serves 15 different destinations with Japan being the most important (50 percent). The 100 largest importers take 49 percent of the volume (26 percent of the number of trades). These 100 importers trade with 104 different Norwegian firms, and serve 41 destination markets. In comparison the 20 largest exporting firms have a share of 92 percent of the volume (95 percent of the number of trades), they serve 71 different markets, and trade with 3,713 importers.

[4] Comparable numbers for the second data sample are that the 20 largest destination markets are being served by 184 different exporters and import 94.5 percent of the total volume.

[5] The most important destination markets for the largest importer are France, Japan and Poland. The importer also exclusively trades with one single Norwegian exporter. This Norwegian exporter, on the other hand, trades with 716 different importing firms, serving 50 different markets.

4. Duration analysis

Due to the nature of our data, we define three model specifications to investigate trade duration. These are at the country level (Model 1), the exporter-country level (Model 2), and at the exporter-importer level (Model 3). The first two are analyzed for the period 1999-2009, the third for the period 2003-2009 as information about importing firms are available only for this period.

4.1 Methodology

The duration of a trade relationship is calculated as the number of consecutive years the trade relationship is active without any interruption. A transition between states in a trade relationship (in or out) can occur at any particular time (day of the year), but in our analysis are given a discrete nature through the aggregation into yearly observations. A *spell* is defined as a continuous trade relationship. *Multiple spells* are observations of reoccurring relationships in the data. Such observations will be treated as independent in our analysis. A *failure*, is the event of a terminated trade relationship. These follows the definitions used by Besedeš and Prusa (2006a, 2006b).

The length of a spell is represented by the random variable *T*. Given the discrete nature of the data, *T* will be taking on values $t = 1,2,3 \ldots n$ with a probability density function $f(t)$, and a cumulative distribution function $F(t)$.

(1) $F(t) = \int_0^t f(s)ds = P(T \leq t)$

To determine the probability that the spell lasts for at least *t* periods, we use the survival function given by

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

Hence, if the spell has lasted until time t, the probability for failure within the next time interval, Δt, will be $l(t, \Delta t) = P(t \leq T \leq t + \Delta t | T \geq t)$. The hazard rate is given by (Greene, 2008);

(3) $\lambda(t) = \lim_{\Delta t \to 0} \frac{P(t \leq T \leq t + \Delta t | T \geq t)}{\Delta t} = \lim_{\Delta t \to 0} \frac{F(t+\Delta t) - F(t)}{\Delta t S(t)} = \frac{f(t)}{S(t)}$

The hazard rate is an estimate of the rate at which spells fail after a duration of *t* periods, given that they last up until *t*. The baseline for our analysis will be that the hazard rate is constant over time. This implies that there is no memory in the underlying process, and the conditional probability of failure is the same regardless of what year the observation is made.

The Kaplan-Meier estimator is a non-parametric estimate of the survival function S(t),

(4) $\hat{S}(T_k) = \prod_{i=1}^{k} \frac{n_i - h_i}{n_i}$,

where n_i is the number of objects at risk at time i, and h_i is the number of failures at time i (Greene, 2008). The estimator of the hazard rate is:

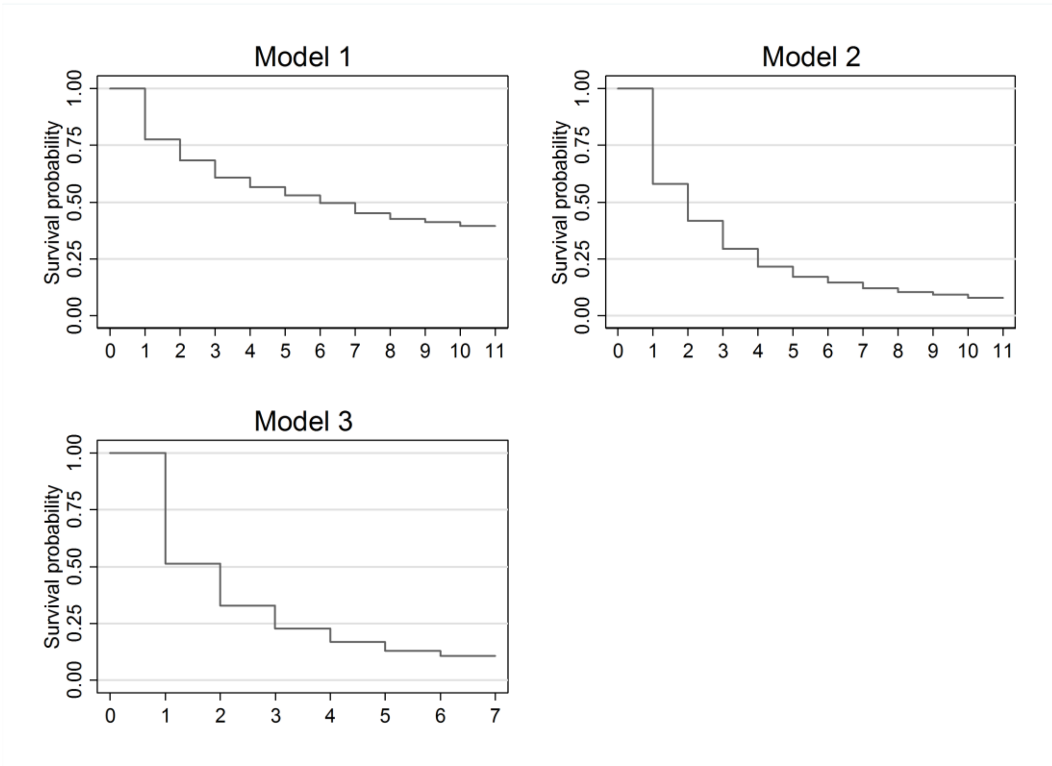
(5) $\hat{\lambda}(T_k) = \frac{h_k}{n_k}$

The hazard function is the conditional failure rate (the flip side of the survival probability). For discrete observations, it can be interpreted as the probability for failure to occur at time t, given that the relationship has survived up to this point.

4.2 Estimated survival rates

Figure 3 below, shows the survival functions for our three different models. It is evident that the level of aggregation is important for the estimated survival rates. In the country relationships (Model 1), 78 percent of the relationships are alive after the first year, and the two-year survival rate is 68 percent. I.e. 68 percent of established trade relationships survive for at least two consecutive years. In the exporter-country relationships (Model 2), 58 percent of the relationships survives after the first year, and 42 percent survive through the second year. In model 3, the firm-firm relationships, the survival is 51 percent after the first year, and 33 percent after the second year.

Figure 3: Kaplan-Meier survival functions



A striking feature of the pattern of the survival functions for all three groups is that the probability for failure decreases sharply as the duration of the trade relationships increase.[6] This feature has been observed in earlier studies, such as Besedeš and Prusa (2006a, 2006b) and Nitsch (2009), and provides empirical support to models that indicate that relationship-specific investments, or knowledge, make it more costly to terminate relationships.

Table 1: Number of trades and length of spells in the data

	Length of spells				Number of trades				# observations
			Percentiles				Percentiles		
	Mean	Median	5th	95th	Mean	Median	5th	95th	
Model 1	10	11	1	11	11291	2463	5	52739	667
Model 2	5	4	1	11	863	109	1	4141	6703
Model 3	3	2	1	7	107	18	1	457	19206

Table 1 presents the mean length of spells, and number of trades in our three models. The difference in the mean survival rate between model 1 and model 2 is as high as 5 years, and indicates substantial dynamics at the firm level relative to the more aggregated levels. When it comes to the trade relationships in model 3, we observe a mean length of 3 years. [7]

Censoring of the dependent variable is a well-known problem when using micro-data. In our case, a trade relationship can have been established before the sample period starts, and may be active for an unidentified time after the sample ends. The first is referred to as left-censored spells, the latter as right censored. In the salmon industry, we find that a large share of the trade relationships will be left-censored, especially in Model 1. Table 2 below, reports the number of trades, and the length of spells in the data when we drop all left-censored observations in the data. We find smaller differences in survival times when all left-censored observations are dropped. E.g. the observed difference between the mean survival in model 1 and model 2 is now only 2 years, while it is 5 years for the sample in table 1. The mean survival time also changes between models 2 and 3 when dropping all left-censored variables. We acknowledge

[6] See figure A.2 in the appendix for similar estimates for different groups of firms.
[7] Table A.1 in the appendix reports similar figures for the 20 largest destination markets.

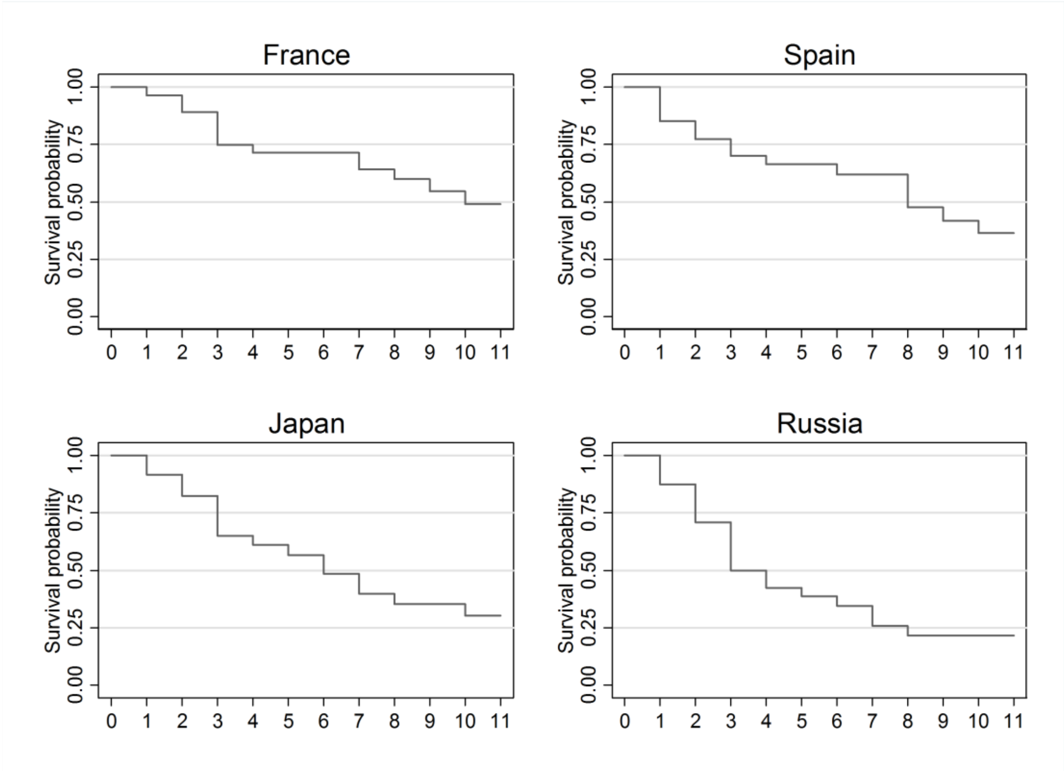
the potential problems of left-censoring in the data, but choose to focus our analysis on the full sample, given the large number of obserations that otherwise must be deleted.

Table 2: Number of trades and length of spells in the data, left-censored observations dropped

	Length of spells				**Number of trades**				**# observations**
			Percentiles				Percentiles		
	Mean	Median	5th	95th	Mean	Median	5th	95th	
Model 1	6	6	2	10	707	65	2	3738	117
Model 2	4	3	1	8	286	48	1	1307	3948
Model 3	2	2	1	6	104	17	1	441	14843

The mean length of the trade spells will also differ between destination markets. In figure 4, we show that there are significant differences in the survival rates from the 20 largest Norwegian exporters to four different important markets. The five-year survival for the large exporters that trades with France are about 75 percent. This is more than the one year survival in model 2 shown in figure 3. For the firms that trade with Russia, we observe a significant drop of almost 25 percent in the survival rates after the 3rd year. For trade relationships for the 20 largest exporters, the overall 5-year survival to France and Spain are over 50 percent, while it is much lower for Japan and Russia.

Figure 4: Kaplan-Meier estimates for the 20 largest exporters in four important markets



5. Determinants of export survival

A Cox (1972) model is the common choice for investigating how different determinants influence duration data. Greene (2008) argues that the Cox model is a reasonable compromise between the semi-parametric Kaplan-Meier estimator and more structured, possibly excessively structured, parametric models. We follow Besedeš and Prusa (2006a, 2006b) and employ the Cox model to analyze the effects of different covariates on the hazard rate.

5.1 The Cox model

The Cox model is given as (Greene, 2008):

(6) $\lambda(t_i) = \exp(\boldsymbol{x}_i'\boldsymbol{\beta})\lambda_0(t_i)$,

where λ_0 is the "baseline" hazard which accounts for individual heterogeneity. The Cox model allows estimation of **β,** without requiring estimation of the "baseline" hazard. This implies that we make no assumptions about the shape of the hazard function.

As independent variables, we include a set of standard variables from the existing literature, and a new set of firm-specific variables which we are able to calculate and include due to the detailed nature of our data. The aggregation level of the data in the different models will, to some extent, determine which independent variables we include.

First, following the existing literature we include geographical distance between Norway and the destination market, GDP in the destination market, the annual average unit value, total imports of salmon from Norway to the destination, the initial transaction volume, and spell-specific share of import as explanatory variables. Data for geographical distance is obtained from the CEPII[8] Geodist-database, and GDP data is taken from the World Bank (World Development Indicators (WDI)). The distance variable is a standard variable used as a measure for transportation costs, while the GDP is measured in real 2000 prices, and reflects the size of the economy in the destination market. The annual average unit value reflects different qualities in shipments in the relevant trade relationship. The total imports of Norwegian salmon in the destination market reflect the importance of the specific market.
Initial transaction volume is included to check if it is an empirical regularity that relationships that starts out with large volumes also tend to last longer. This is in line with the findings in Besedeš and Prusa (2006b) who also show that duration tends to increase with initial trade size. The share of spell-specific imports are included to check if large spells fail more often than smaller spells (in terms of volume). Finally, we address the cases of multiple spells with a dummy variable which takes on the value one for higher order spells as suggested by Besedeš and Prusa (2006a).

For model 2, we also include the number of employees in the exporting firm, the annual frequency Norwegian exporters serve a given market, and the annual frequency of markets active in imports from Norway.[9] The number of employees is included as a control for the size of the exporter. The two frequency variables are included to capture the market activity on both the supply- and demand sides of the market. A dummy variable denoting whether the exports are to an EU-country is included to capture potential advantages of serving the trading block.

In Model 3, we also include the total import volume of the importing firm as a measure of the size of the importer. The annual average number of trades by the importer is included as an activity measure for the importer. Finally, we include a dummy variable that takes on the value 1 if the importer is active in several destinations. These variables are of particular interest in this paper since these enable us to investigate some characteristics of the importing firm when

[8] Centre d'Etudes Prospectives et d'Informations Internationales
[9] For model 3, the latter is included as the annual frequency of importing firms engaging in import of salmon from Norway. I.e. measuring importer activity.

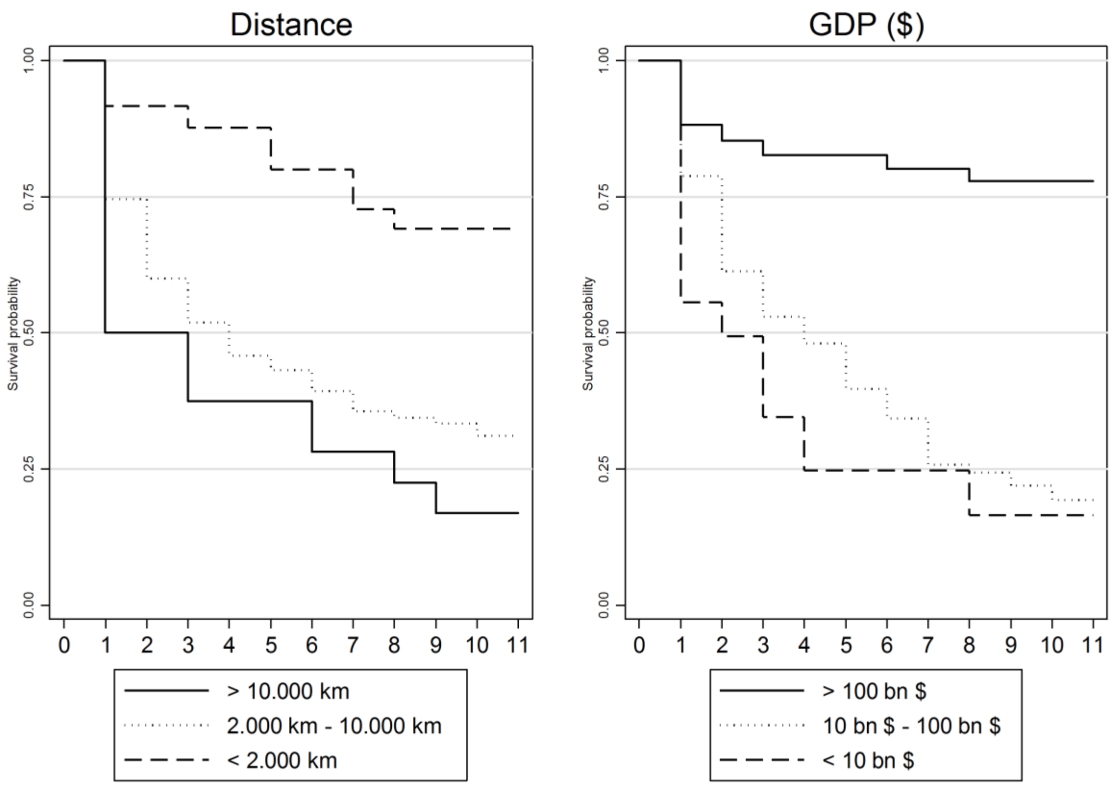
addressing the discussion on duration of trade relationships. Table 3 reports summary statistics for the explanatory variables. The two last varaibles are only calculated for 2003-2009, the others for 1999-2009.

Table 3: Descriptive statistics.

Variable	Mean	SD	Min	Max
Distance (km)	3,220	3,234	417	15,963
GDP (100.000.000 USD)	11,827	15,753	4.38	116,609
Annual unit value (Statistical value in NOK/kg)	28	6.40	0.34	688
Annual import volume (tons)	21,010	19,851	0.05	88,983
Initial volume (tons)	11,6	3,88	0.05	39.428
Spell share	0,8	0,83	0.0002	1
EU	0,21	0,41	0	1
Multiple spells	0,11	0,32	0	1
# employees (model 3)	235	346	1	1211
frequency, importers (model 3)	152	107	1	378
frequency level, exporters (model 3)	24	11	1	51

Figure 5 indicates how some key explanatory variables influence the survival probabilities in model 1. Each line in the panels represents the survival function for a group of countries with certain characteristics. In the left panel, destination countries are grouped by distance from Norway. The survival probability increases with geographical proximity indicating that the hazard rate increases with distance. In the right panel, destination countries are grouped by their economic size (GDP). Again, we observe that the survival probability is influenced by the market size of the destination country. The larger the destination market, the lower the probability for failure.

Figure 5: Kaplan-Meier estimates geographical distance, and GDP



5.2 Results

Table 4 reports the results from the Cox-regressions on all three groups of trade relationships with, and without, accounting for left censoring. All reported coefficients are hazard rates. If the hazard rate takes a value between zero and one, an increase in the relevant independent variable reduces the probability for failure of a trade relationship. If the hazard rate takes on a value larger than one, an increase in the relevant independent variable increases the probability of failure. The hazard rates are the exponential coefficients from the fitted values in a Cox model. This implies that the significance levels reported should be interpreted as the significance level of the log of the hazard rates. E.g. the coefficient determining the significance level of ln Distance in Model 1 - full sample is ln (1.3808)=0.32.

Table 4: Main results, Cox-regressions

	Model 1		Model 2		Model 3	
	Full sample	Left-censored	Full sample	Left-censored	Full sample	Left-censored
ln Distance	1.3808*	2.4824***	1.0811***	1.0847**	0.9663**	0.9665**
	(0.260)	(0.844)	(0.032)	(0.037)	(0.013)	(0.015)
ln GDP	0.8410**	0.8865*	1.0227	1.0110	1.0159**	1.0115
	(0.071)	(0.061)	(0.014)	(0.016)	(0.007)	(0.008)
ln Unit value	0.5548*	0.5218*	1.0282	0.9265	0.8493***	0.8274***
	(0.170)	(0.178)	(0.074)	(0.072)	(0.037)	(0.040)
ln volume import dest	0.6939***	0.8697*	0.9919	1.0229	1.0012	1.0010
	(0.049)	(0.067)	(0.024)	(0.026)	(0.010)	(0.011)
ln Initial volume	1.0998	1.1809*	0.9424***	0.9271***	0.9440***	0.9447***
	(0.083)	(0.106)	(0.008)	(0.009)	(0.005)	(0.005)
ln Spell share	0.7945***	0.7994**	0.8141***	0.8368***	0.8174***	0.8185***
	(0.042)	(0.082)	(0.010)	(0.013)	(0.007)	(0.009)
Dummy, mult.spells	1.1817	0.3531*	1.8079***	2.0710***	1.7321***	1.6520***
	(0.677)	(0.219)	(0.154)	(0.234)	(0.107)	(0.114)
Dummy, EU			1.1265**	1.1714**	0.8267***	0.8189***
			(0.064)	(0.076)	(0.019)	(0.022)
ln # employees exp.			0.9435***	0.9648***	0.9943	0.9927
			(0.012)	(0.013)	(0.005)	(0.006)
ln frequency imp.			0.7308***	0.7544***	0.8964***	0.9029***
			(0.014)	(0.016)	(0.006)	(0.006)
ln frequency exp			0.9156***	0.8944***	1.1343***	1.1375***
			(0.027)	(0.029)	(0.034)	(0.039)
ln total import imp.firm					0.9452***	0.9417***
					(0.004)	(0.005)
ln # annual trades imp.					0.9182***	0.9193***
					(0.008)	(0.009)
Dummy, several mkts					1.2437***	1.2742***
					(0.028)	(0.033)
Observations	667	117	6,703	3,948	19,206	14,843
No. Subjects	85	28	2184	1568	10142	7883
No.Failures	58	33	1951	1315	7912	6096
log-likelihood	-183.8	-81.3	-13399	-8631.1	-67300.0	-50276.7
Year-dummies	No	No	Yes	Yes	Yes	Yes

Robust standard errors in parentheses.
**** p<0.01, ** p<0.05, * p<0.1*

Table 4 reports the estimated hazard rates, both for the full samples, as well as for the samples corrected for left censoring, for all three models. From the table, it is obvious that we drop a large number of observations, especially for model 1, when properly correcting for left-censoring. We believe that the best approach for our study is to rely on the full samples when the hazard rates are calculated. If we drop all left censored observations, too many observations have to be dropped. In particular, for Model 1, we only have the least important destination markets left when all left-censored observations are dropped, as 98 percent of the data will be dropped. Still, with the exception of the effect of distance in Model 1, the parameters reported when excluding the left-censored observations do not change very much.

For the rest of the analysis, we focus the discussion on the coefficients where the left-censored variables are included. An increase in geographical distance increases the risk of failure in a trade relationship in Model 1. An increase in the GDP in the destination market, in the unit values, in the annual import of salmon in the destination market, and in the spell-specific share of total import, reduce the probability for failure of trade relationships in Model 1. All these effects are as anticipated, and in line with previous findings in the literature. The effect from increased GDP is in line with the findings in Besedeš and Prusa (2006b). Larsen and Asche (2011) investigated the use of contract for export of Norwegian salmon to France in 2006. They argue that more sales are carried out using spot prices than using fixed-price contracts, and that fixed-price contracts are primarily used by large firms that trade frequently. Our results with respect to spell-specific share of total export and unit value supports the findings in Larsen and Asche (2011). The variable that controls for multiple spells increases the probability for a failure, as in Besedeš and Prusa (2006b), but is not significant for the relationships defined in model 1. Neither is it clear what sign we should expect from this variable. It can be argued that the re-entry of a firm into the export market may result in lower hazard rates due to past experience for the firm. On the other hand, multiples exits and re-entries of a firm may describe the behavior of a firm that is seeking short-time profit in the market, and has no intension in investing in stable trade relationships.

For the trade relationships defined in Model 2, we find that increased geographical distance, to the destination market increases the hazard rate. This estimated positive effect on the hazard rate from increased GDP may be a result from greater competition among suppliers to the largest markets, as also reported by Nitsch (2009). Thus this effect is not significant. There is no significant effect on the estimated hazard rates in model 2 from increased unit value or from increased import volume to destination. The larger the initial transaction, and the spell specific share of export is, the lower is the hazard rate. We also find that the existence of multiple spells significantly increases the probability for failure in the trade relationships in Model 2. Trade relationships to EU countries increases the fragility of the trade relationships. The EU is a very important market for Norwegian salmon export, and it is not surprising that many of the trade relationships may be of short durations due to keen competition.

In Model 2, we also include the number of employees in the exporting firm, and our market concentration measures. We find that an increase in the number of employees reduces the hazard ratio. Larger firms tend to make more long-lasting relationships. Increased market activity, on both the supply-and demand side, results in lower hazard rates and reduce the probability for failure.

Turning to the most detailed trade relations in model 3, there is a positive significant effect on the hazard rate from increased geographical distance. This result indicates that when controlling for which importer it is that serves the destination, the trade relationships to the more distant markets are the most stable. Another interesting findings are that market size, increase the probability for failure. This indicates that market size increases competition and reduces the value of maintaining relationships. Furthermore, we find that spell-specific share of total export, and the size of the initial transaction, decreased the probability for failure. This is in line with the findings of Besedeš (2008).

In model 3, the existence of multiple spells increases the probability for failure, while trade with firms serving EU-countries reduces the hazard ratio. Importers that are active in more than one destination market are more likely to be exposed to failures. Hence, multinational buyers do not seem to take their suppliers with them to different countries. There is no significant effect from the number of employees in the exporting firm for the relationships in Model 3. We find that the probability for failure decreases as importer activity increases. More competition among the Norwegian exporters also increases the hazard rates.

The two final explanatory variables in Model 3, the total imports by the importing firm and the number of annual trades by the importer, are of particular interest given that unobserved characteristics of the importer can be at least as important for the existence of long-lasting duration of trade as known characteristics from the supply side of the market. From table 4, we see that an increase in the import volume of the importer decreases the probability for failure. This may indicate that the largest buyers have the most stable relationships. Also, an increase in the number of trades carried out with Norwegian exporters by the importing firm decreases the hazard rate. Stable relationships do not necessarily require large transactions since the frequency of trades is also important to decrease the probability for failure in the trade relationship. This is particularly true for a fresh product like salmon that is highly perishable.

6. Temporary trade dynamics

Our results indicate that a large number of the trade spells in Norwegian salmon export are quite short-lived. At the transaction level, roughly 1/4 of the observations are spells with only one trade. The literature indicates that export intensity is positively correlated with firm size. For less productive firms that face different sets of constraints, it may be an optimal strategy to export just once in a while. Békés and Muraközy (2012) address this issue by defining two types of relationships, temporary and permanent, where temporary relationships have a duration shorter than four consecutive years. They estimate the probability of a temporary relationship with a probit model.

The four year period for a temporary relationship used by Békés and Muraközy (2012) is relatively long, and may cover substantial short-term dynamics. Since our data contains all transactions, we will define three types of relationships; *hit and run behavior* as a relationship with only one transaction, *temporary relationships* with up to three transactions, and *permanent trade* relationships with more than three transactions. As many as 26 percent of our observations represent hit-and-run behavior, and hit-and-run and temporary relationships together makes up 52 % of the transactions.

Table 5 reports some descriptive statistics for these three categories of traders. There is a large difference between the mean export volumes for hit-and-run trader's vs. permanent traders, as well as in company size and trade distance. There are small differences in the mean unit prices for the three categories of traders.

Table 5: Descriptive statistics, types of traders

Variable	Hit-and-run	Temporary	Permanent
Mean volume (tons) per trade	7.76	7.87	5.53
Mean unit price (NOK/kg)	27.9	27.5	28
Mean # employees exporter	120	113	240
Mean distance to destination	2804	2613	4000

With three categories, the stability of the relationships is estimated with a multinominal logit model. This is given as:

(7) $$\Pr(Y_{i,t} = m) = \frac{e^{\beta_j x_{i,j,t}}}{\sum_{j=1}^{3} e^{\beta_j x_{i,j,t}}}, \textit{ where } m=1,2,3$$

$Y_{i,t}$ represents the chosen trade relationship (complete hit-and-run, temporary trader or permanent traders for trade between a given exporting firm *i* and a given importer serving a given destination in year *t*. The model is normalized by setting the trade relationships observed with only permanent traders as the base category. The explanatory variables are included in the vector x.[10]

Table 6 reports the marginal effects from this estimation. A positive sign on the coefficients are interpreted as a lower probability for the base outcome, and vice versa. The first column in table 6 reports the estimated coefficients for the choice between a hit-and-run behavior and permanent traders. The second column reports the estimated coefficients for the choice between temporary and permanent traders.

[10] Three variables used in the Cox-estimation are dropped. This is the dummy for multiple spells, spell-specific share of total import and the number of annual trades by the importer. No time dummies are included in the multinomial logit.

Table 6: Multinomial logit model estimation, marginal effects

	Complete hit-and-run vs permanent traders	Temporary vs permanent traders
ln Distance	-0.012**	-0.003
	(0.005)	(0.005)
ln GDP	0.002	-0.000
	(0.003)	(0.003)
ln Unit value	-0.071***	-0.073***
	(0.013)	(0.014)
ln volume import destination	-0.004*	-0.002
	(0.002)	(0.002)
ln Initial volume	-0.028***	-0.034***
	(0.001)	(0.001)
Dummy, EU	-0.008	-0.007
	(0.009)	(0.009)
ln # employees exporter	-0.001	0.006***
	(0.002)	(0.002)
ln frequency imp.	0.020***	0.029***
	(0.002)	(0.002)
ln frequency exp	0.078***	0.118***
	(0.003)	(0.003)
ln total import importer	-0.005**	-0.020***
	(0.002)	(0.003)
Dummy, import to several mkts	-0.130***	-0.136***
	(0.007)	(0.008)
Observations	19.206	19.206
Pseudo-R2	0.24	0.29

Robust standard errors in parentheses.
**** p<0.01, ** p<0.05, * p<0.1*

Increased geographical distance between the exporter, and the market served by the importer, increase the probability for complete hit-and-run behavior relative to being a permanent trader. A unit increase in the price will increase the probability for hit-and-run behavior and temporary traders. A hit-and-run strategy can very well be conducted by an exporter just to harvest short-term profit from the market. Large initial trade volume reduce the probability of being a permant trader. This finding is in line with the findings of Besedeš and Prusa (2006b) who found that trade that starts out with larger purchases are of a more short-lived nature, than trades in more differentiated goods. The estimated effect from the EU-dummy are not significant.

As market activity on either side of the market increases, so does the probability for observing more permanent traders. A possible explanation is that a larger number of importers on the demand side may make it easier for the exporters to build larger distribution networks. Békés ans Muraközy (2012) indicate that such investments would imply larger sunk costs, and thus, promote more permanent trade relationships. Much of both versions of short-run traders seems to be initiated with large importers. As the total import volume to the importer increases, so does the probability for a short relationship. From the last dummy-variable in table 6, we find that trade relationships with importers serving more than one final destination market increases the probability for observing both complete- and partial hit-and-run behavior.

From table 6, we see that there is one explanatory variables that give inconsistent results. Larger exporters (in terms of employees) increase the probability of being a permanent trader relative to temporary trader. We find no effect from this variable relatively to hit-and-run traders.

7. Conclusion

While the theory on the dynamics of trade duration is formulated at the firm level, most empirical analysis has been undertaken with data at a country and industry levels. In this study, we have access to firm export data with some information about the importing firm for one industry – Norwegian salmon farming. This allowed us to study trade dynamics in further detail. We use two approaches to investigate trade duration. We estimate hazard rates as suggested by Besedeš and Prusa (2006a, 2006b), and a discrete choice model building on the work of Békés ans Muraközy (2012). In the latter approach, we define the length of a trade relationship by number of transactions. In this context, it is of particular interest to investigate relationships with one transaction – or hit and run strategies.

It is not surprising that the degree of dynamics increases as the data becomes more disaggregated. Hence, trade duration is more stable for an industry between countries, than between exporting firms and importing countries, and exporting firms and importing firms. However, this result underscores the importance of firm-level data to understand the full extent of trade duration dynamics. It is of particular interest that trade relationships seem to be shorter in larger markets being served by many companies, and where competition, accordingly, seems keen. This is a feature that is masked in industry-level data.

More generally, we find that both market specific- and firm-specific variables have a significant impact on the duration of trade, and on the probability for hit-and-run vs. permanent trade relationships. It is also worth noticing that an increase in the transaction frequency of the importer reduces the probability for failure in a trade relationship. The latter implies a growth in the intensive margin of trade (the number of shipments) from the Norwegian exporters. An implication of this will be that exporters who are aware of the development of the intensive margin of export may experience more permanent trade relationships.

Even though we have documented a large presence of failures in the established trade relationships, such failures may not be unwanted and unexpected by the firms. On the contrary, it may be the result of optimal endogenous choices at the firm level. An exporter serving well-functioning supply chains that face low costs of exporting, who captures signs of increased demand in “new” markets, may increase its profit by serving those markets in the short run.

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Appendix

Figure A.1: The 20 largest destination markets for fresh salmon, 2003-2009

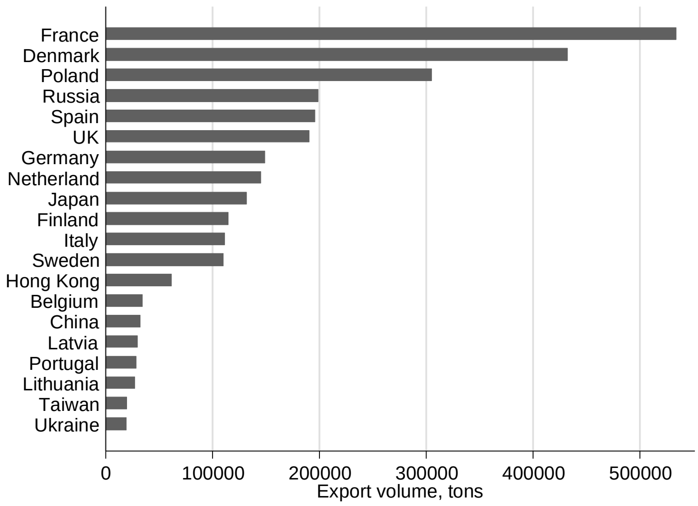

Figure A.2: Kaplan-Meier estimates. Groups of firms.

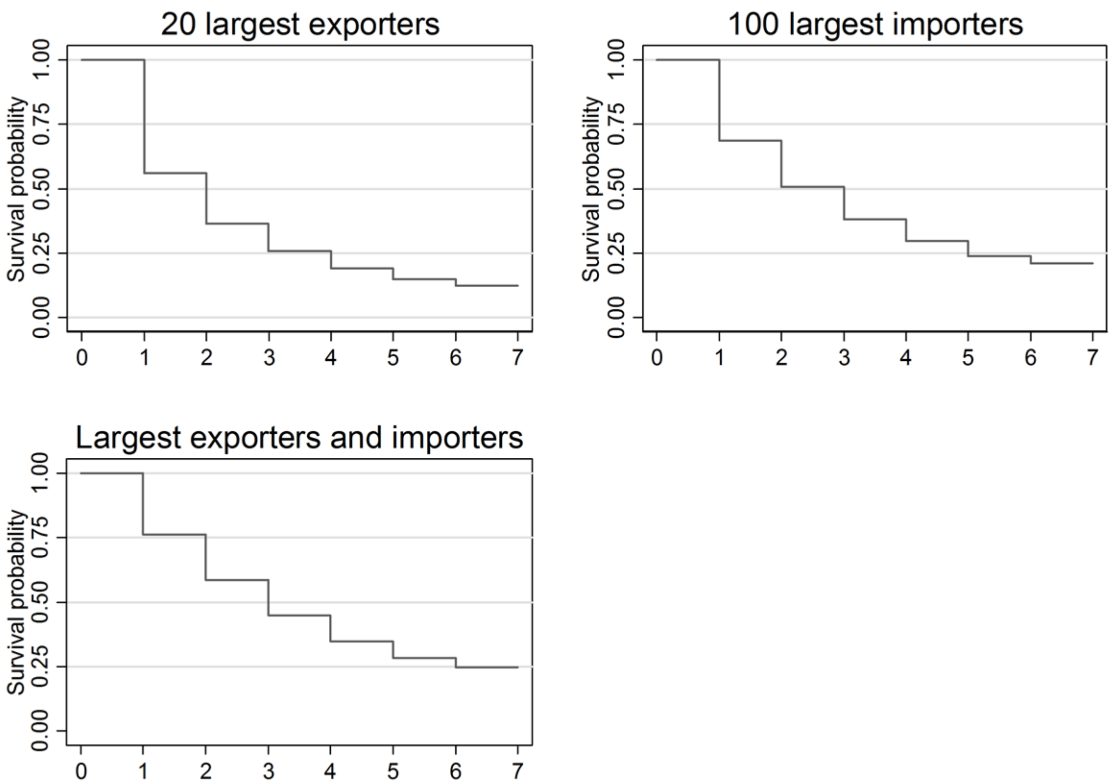

Table A.1: Number of trades and length of spells in the data, sample reduced to the 20 largest destinations

	Length of spells				Number of trades				# observations
			Percentiles				Percentiles		
	Mean	Median	5^{th}	95^{th}	Mean	Median	5^{th}	95^{th}	
Model 1	10.7	11	10	11	31343	23018	3739	84928	215
Model 2	5.3	4	1	11	1145	174	3	5392	4595
Model 3	3	2	1	7	125	24	2	508	14982

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