THE DURATION AND SURVIVAL OF SALMON EXPORT BY NORWEGIAN FIRMS IN THE INTERNATIONAL MARKETS

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Summary

The duration models are tools to understand the persistency in trade market structure for specific commodities and countries. Any decision on entering to trade market can be made easier by knowing the persistency of trade between partners. This study focuses on salmon supply chain relation histories in order to analyse persistence, and thus sustainability of trade and its determinants of business/trade relationships along the salmon international export. The market entry and exit of a certain salmon supply chain actors (e.g., salmon producers, processors, or traders) are analysed as required for the duration model development through time-varying covariates, i.e., the risk of slipping out of a trade relation changes with the length of time an actor spent in this chain. The trade duration is of higher importance for perishable products. In this study, the firm level trade transaction data at the side of importer and exporter for the period 2004-2018 used for trade duration analysis. Kaplan-Meier survival model and Cox proportional hazard model are used for the analysis. The additional impact of a number of available covariates, such as firm's trade characteristics, geographic/regional conditions, and trade or production policies are assessed. In particular, the effects of economic integration agreements on the stability of product-level trade relationships for European export firms, together with the analysis of determinants of trade flow durations, is analysed. Patterns of persistence (i.e., sustainability) of selected supply chains in different countries is identified by comparing the estimation results obtained The results shows that on average the trade duration for salmon trade between firms is 2.39 years which is relatively low for a perishable products such as salmon. Additionally, different markets in different continents show not a tangible different level of persistency back to the nature of salmon. We conclude that the trade duration between partners can be increased if the competition in the market increases which probably possible in markets like US where other exporters such as Chile are available.

Keywords

Trade duration, Norway, salmon, trade spell, Kaplan-Meier survival, Cox proportional hazard model

1 Introduction

Generally speaking, different aspects of trade are normally analysed by asking who, what, when, and why has the international trade taken place. One of the later questions on trade issue is "***how long***" the international trade continues between partners. Are they exchanging products over long or short periods of time? (BESEDEŠ and PRUSA, 2006a). The duration of trade has its roots in transaction cost economics as changing the partners is costly. The transaction cost economics is applied to explain the trade and supply chain management (BERGHUIS and DEN BUTTER, 2017). In a global value chain structure, especially when a company has its powerful headquarter located in a high income country, the buyer needs to have a supplier who is technologically capable of providing right commodities in an appropriate quantity and quality and at low costs. Furthermore, it is important that the supplier does not violate the arrangements and alter the agreed terms, and so on. Finding such a reliable partner is costly (DEFEVER et al., 2016). The same analogy goes for other trading partners on final products or raw materials (BESEDEŠ, 2008). The longer trade between partners is a sign of higher vertical coordination and lower transaction costs (KETOKIVI and MAHONEY, 2020). The duration analysis of trade is based on a main hypothesis: "The longer the trade between partners, the higher the possibility of continuous trade between them". The gravity models are standard models which are developed to analyse the trade intensity. Trade disruption and duration are not an issue for these sort of models which can be studied by trade duration models. Duration, survival, hazard or persistence are all different terms used for the same type of research areas which can be used interchangeably. The studies of BESEDEŠ and PRUSA, (2006a, 2006b) are the pioneer researches on the trade duration. Since then different studies are conducted on different aspects of trade duration and different hypothesis are tested on factors that effecting the duration of trade. Primary researches were more general by covering many commodities and even many countries. The trade duration models are evolving field of trade analysis and as the heterogeneous firm trade model introduced by MELITZ (2003), the trade duration models have got a new ground to study extensive and intensive margins of trade considering the firms heterogeneity (BESEDEŠ and PRUSA, 2011).

The latest development in the trade duration studies is on specific commodities especially agricultural and food products on one side and firm level data for specific commodities on the other side. Specially, the stability of trade for perishable goods is of high interests. For instance, IMAMVERDIYEV et al. (2015) looked to determinants of Kazakhstan's wheat exports. They concluded that trade cost, local production factors, price competitiveness and experience explain the short duration of Kazakhstan's wheat exports. GULLSTRAND and PERSSON (2015) studied the firm level export data on food chains from Sweden. They found that firms tended to stay longer in their core markets, while export decisions regarding peripheral markets were much less long-term. PETERSON et al. (2018a) studied the import duration of fruits and vegetables into US market. They found that changes in US commodity prices and exporter gross domestic product (GDP) have the largest impact, on hazard rate. In contrast U.S. production variability and exporter experience have the lowest impacts on the hazard rate of export duration. Second, sanitary and phytosanitary measures (SPS) treatment requirements have persistent impacts on trade duration. LUO and BANO (2020) analysed the New Zealand dairy export. Approximately, half of the relationships survived for only 1–2 years at the sequence level. Furthermore, they found duration of sequence, left-censoring, initial export, decomposed sequences, New Zealand export price index, and the number of cows available for dairy production, the number of origins and destinations, and destination partner's GDP are the most significant factors reducing the hazard rate of export relationships. Technical barriers of trade (TBT) are found to significantly decrease the hazard rate.

There are some specific studies on seafood export duration. STRAUME (2017) have studied the fresh-farmed salmon export from Norway. He considered firm level data on the side of exporter to different countries. He found that trade duration was remarkably short (average 4 years). Market uncertainty in the form of transportation costs and export to countries in the EU are associated with a larger probability for failure. Factors that are associated with a reduced risk of exiting the market are the size of the initial shipment between the trading partners, continuing large shipments and the size of the exporting firm. WANG et al. (2019) studied seafood export from Association of Southeast Asian Nations (ASEAN). They concluded that if a trade activity can survive for three years, the easier it is for it to survive longer. Additionally, larger seafood output of the ASEAN region decreases the probability of trade failures. Finally, YANG et al. (2020) studied the Shrimps export from China at firm level. Most of trade relationships in the Chinese exports of shrimp were short-lived and influenced by the market as well as product characteristics. The results indicated that it was crucial to account for firm-specific characteristics, large firms have more stable trade relationships. It is also worthwhile to note that the firms located within Special Economic Zones (SEZs) have a shorter trade duration than those outside of SEZs, indicating these firms' opportunistic market behaviour. The studies mentioned above specifically those focused on seafood industry have not investigated the firm to firm trade duration and the factors that affect this sort of relation.

The duration of export of salmon from Norway is the issue of analysis in this paper. Fresh salmon is a perishable product and stable trade relationship should be important for its trade. We apply the survival/hazard approach to analyse the trade duration pattern. We have used firm level transaction data between exporter and importer for this analysis. The available trade duration analysis on salmon are either focused at country to country level trade or firm level data on exporter side to countries as importer. We have considered the firm level transaction trade data at both side of trade relations. The next section presents an overview of the Norwegian salmon trade. Data and methodology are presented in the subsequent sections followed by the results and conclusions.

2 The role of Norway in international salmon trade

Norway is the main producer of salmon in the world. In 2020, from 2.7 million tonnes of Atlantic salmon harvested worldwide, 1.37 million tonnes were from Norway (KONTALI, 2021). The main share of salmon production in Norway is for export (Figure 1). Salmon is the number one species traded on the European market of fish and seafood products in terms of value and the third species consumed (after tuna and cod) (OLAFSDOTTIR et al., 2019). The main part of this export is fresh or chilled salmon (TRADEMAP, 2022).

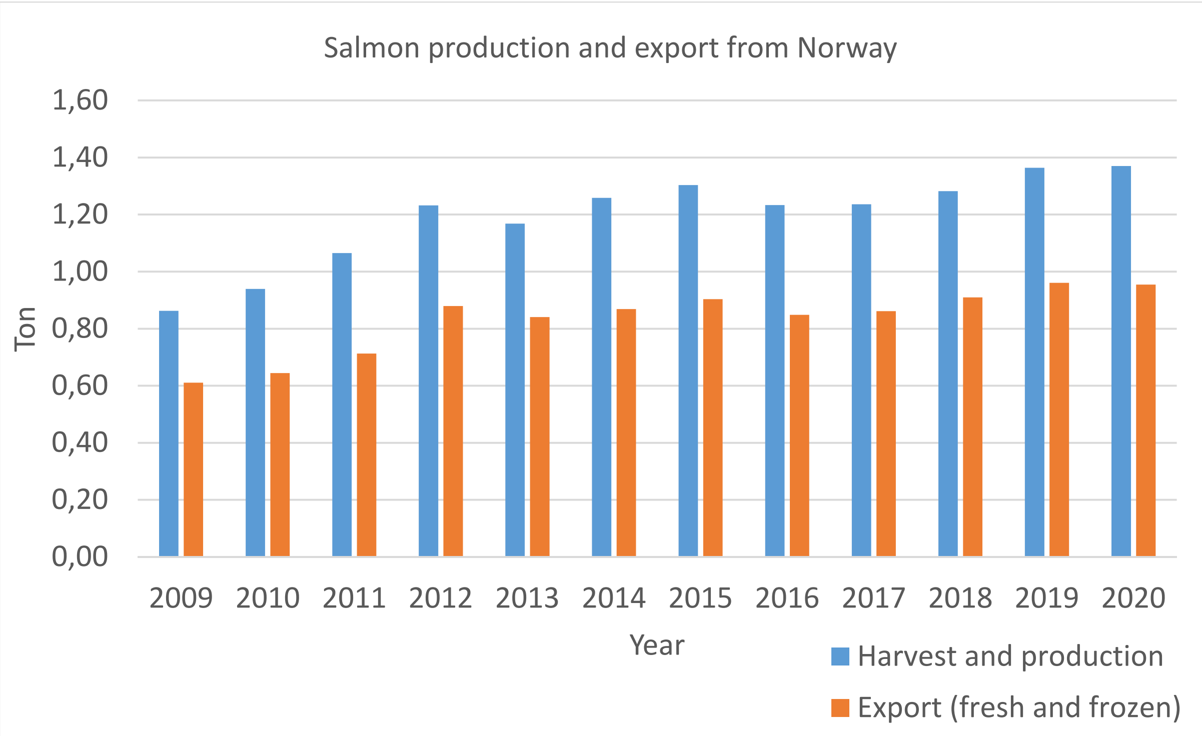

Figure 1: Salmon production and export 2009-2019
Source: KONTALI (2021) and TRADEMAP (2022)

The main part of this export goes to EU countries such as Poland, France, Denmark, Spain, Netherland, Italy and UK (Figure 2). France is the largest consumption market for salmon in the EU. A large part of secondary (value-added) processing of Norwegian salmon takes place in France, Poland and Denmark. The production and export of salmon from Norway is on rise and the Norwegian government is controlling the size of salmon production by issuing licences. The detailed information on the structure of salmon supply chain and its governance can be found in OLAFSDOTTIR et al. (2019). Furthermore, JAGHDANI et al. (2020) studied the market imperfection at primary stages of salmon supply chain in Norway and found that certain market imperfection was available for large producers till 2015. In the next section, the methodology and data which are used for this analysis are presented.

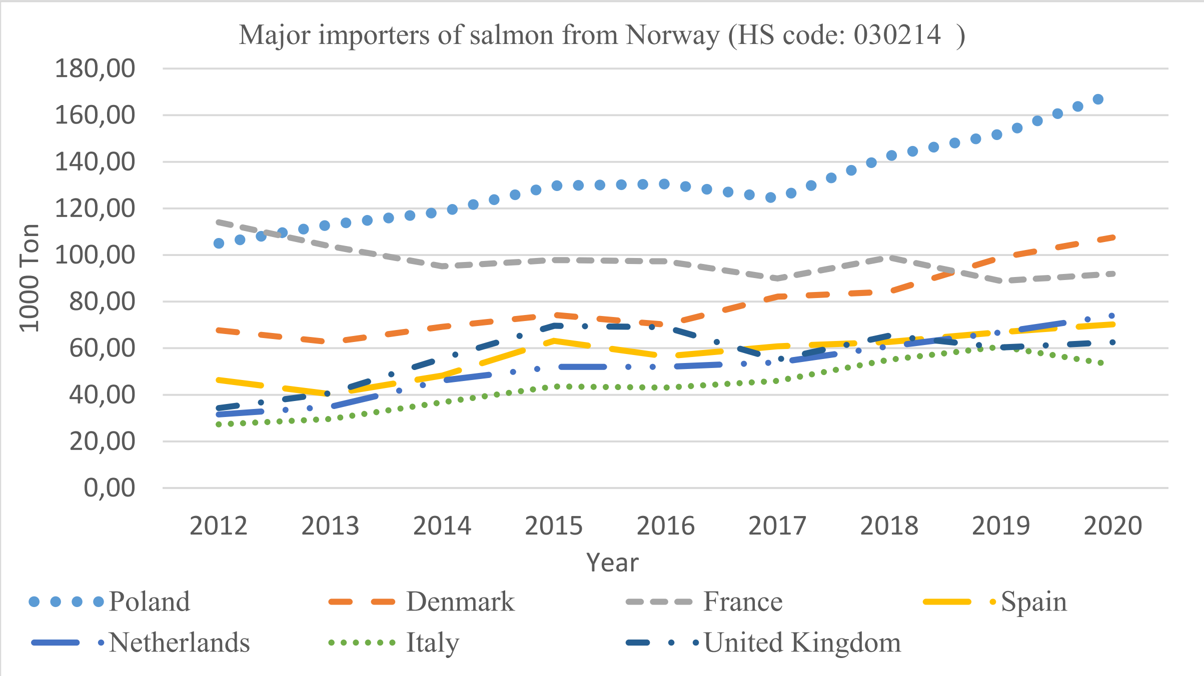

Figure 2: Main salmon importers from Norway
Source: TRADEMAP (2022)

3 Methodology

In this study, we have applied three different models of survival analysis to understand trade persistency. Survival analysis refers to study of survival times and of the factors that affect this survival. Type of studies with survival outcomes include clinical trials, prospective and retrospective observational studies and animal experiments (MOORE, 2016). There are wide variety of survival/hazard functions. The models selected are non-parametric ***Kaplan-Meier survival*** model, semiparametric survival estimate ***Cox proportional hazard*** *(COX PH)* models and ***Cox proportional hazard models with random effect*** which are explained below. LANCASTER (1990), HARRELL and JRL (2001), DAVIDSON and MACKINNON (2004) and MOORE (2016) are used for this part.

3.1 Duration models

The object of interest in this study is the survival/hazard of export of selected commodities ***i*** (salmon in this case) from Norway to another country ***j***. In survival analysis we use T_{ij} as non-negative random variable representing the failure time (or the time until an event) of an individual from homogeneous population. Instead of defining the statistical model for the response ***T*** in terms of the expected failure time, it is advantageous to define survival function, *S(t)*:

(1) $$S(t) = Prob\{T_{ij} > t\} = 1 - F(t)$$

where *F(t)* is the cumulative distribution function. If the event is death, *S(t)* is the probability that death occurs after time ***t***, that is, the probability that the subject will survive at least until time ***t***. *S(t)* is a non-negative right-continuous function of ***t*** with *S(0)=1* means all subjects survive at least to time zero. The survival function must be non-increasing as ***t*** increases.

Another important function is the hazard function, *h(t)*, also called the force of mortality, or instantaneous event (death, failure) rate. The hazard at time ***t*** is related to the probability that the event will occur in a small interval around t, given that the event has not occurred before time t. It is defined as

(2) $$h(t) = \lim_{\delta \to 0} \frac{Prob(t < T_{ij} < t + \delta | T_{ij} > t)}{\delta} = \frac{F(t+\delta) - F(t)}{\delta S(t)} = \frac{f(t)}{S(t)}$$

The hazard rate is an estimate of the rate at which spells fail after a duration of period, given that they last up until time ***t***. By defining the basic statistical model, the empirical model will be presented. The object of interest in this study is the hazard of export of selected commodities in selected countries in Europe ceasing.

3.1.1 Kaplan-Meier survival

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

(3) $$\widehat{S(T_m)} = \prod_{k=1}^{m} \frac{n_k - h_k}{n_k}$$

Where n_k is the number of objects at risk at time ***k***, and h_k is number of failures at time ***k***.

3.1.2 Cox proportional hazard model

To measure the effects of influencing factors on the failure/hazard rate, Cox proportional hazard rate model is commonly used semiparametric method:

(4) $$h(t, \boldsymbol{X}, \boldsymbol{\beta}) = h_0(t) e^{\boldsymbol{X\beta}}$$

where $h_0(t)$ is the baseline hazard rate and ***X*** is the covariate and ***β*** is the vector of coefficients of the covariates. The Cox model assumes a proportional hazard rate, which implies that the ratio of hazard rate of two factors is the same at all-time points.

3.1.3 Cox proportional hazard models with random effect

In the export duration models, there are unobserved heterogeneity of countries or firms that cannot be simply captured. This problem can be solved by considering COX PH model with random effect. By expanding (4 as follow:

(5) $$h(t, \boldsymbol{X}, \boldsymbol{Z}, \boldsymbol{\beta}, \boldsymbol{b}) = h_0(t) e^{\boldsymbol{X\beta + Zb}}$$
$$\boldsymbol{b} \sim G(0, \Sigma(\theta))$$

Additional to (4, ***X*** and ***Z*** are the design matrices for the covariates (and fixed effects) and random effects, respectively. ***β*** is the vector of covariates and fixed-effects coefficients. ***b*** is the vector of random effects coefficients. The random effects distribution G is modelled as Gaussian with mean zero and a variance matrix, which depends on vector of parameters THERNEAU and CLINIC (2020). R statistical software is used for this analysis and packages "survival", "coxme" and "ggplot2" are employed.

4 Data Description

The dataset used in this study consists of import and export transactions of all fish products to and from Norway for the period 2004-2018 which is acquired from Statistics Norway (SSB). The total number of export trade transactions are 3.474.726 and covers all export transactions of fish products out of Norway. Only the transactions for salmon trade are considered in this study, thereby removing around 24 % percent of the dataset. Thus, the final dataset consists of 2.630.008 of salmon trade export transactions. The commodity list in the dataset follows the nomenclature of the Norwegian Customs Tariff, as from 1988 based on the combined tariff/statistical nomenclature, the Harmonized System (HS) and UN standard international trade classification (SITC-Rev. 4)[1]. Comparing the trade pattern in the beginning of the period to the end of the period, some differences in the trade pattern appears. In 2018 Norwegian salmon export was directed towards 99 countries and the total number of trade transactions was 183.967. In 2004 the total number of trade transactions were fewer 144.954 and exported towards 90 different countries. In this dataset, a large drop in the number of trade transactions towards Russia is recognisable. From being one of the core markets in 2004, there are only few reported export transactions in 2018. On the other hand, US and Canada, and more countries in Asia have become more important markets for Norwegian salmon. The dataset shows that three continents are important for the Norwegian market today – US, Europe, and Asia. Traveling distance data between all countries is collelected from the CEPII[2] Geodist database (MAYER and ZIGNAGO, 2011). To provide the right database, we had the challenge of complicated coding system for the importer as SSB has anonymised the identity of exporters and importers. This problem was solved by creating a unified code for the importers of salmon from Norway in the SSB database. Salmon price in Norway is aquired from SSB and International Monetary Fund (IMF). The country level data such as GDP per capita and exchange rate on constant value are acquired from Economic Research Service (ERS)[3] website and World Bank (WB)[4].

5 Results and discussion

Table 1 presents the distribution of active spells across Norway salmon trade relation. A spell of trade is defined as the period of time with uninterrupted imports of a specific product from a specific exporter (Peterson et al., 2018). The average length of each spell is 2.39 years in this case. It shows the short time relation between export and import firms on salmon trade.

Table 1: Distribution of active spells across Norway salmon trade relationship, 2005-2018 with survival rate estimation for different spell length.

Panel A: Total no. of spells in a relationship between importer and exporter firms		
No of spell in a relationships	No. of relationships	Frequency
1	29268	87,82%
2	3404	10,21%
3	569	1,71%
4	82	0,25%
5	3	0,01%
Total	33326	100%

Panel B: Observed spell length in a relationship between importer and exporter firms			
Spell length (year)	Number of relationship	Number of events	Survival rate
1	33326	18038	45,87%
2	12672	4996	27,79%
3	6547	1878	19,82%
4	3901	947	15,01%
5	2574	511	12,03%
6	1702	295	9,94%
7	1230	203	8,30%
8	929	142	7,03%
9	673	92	6,07%
10	489	53	5,41%
11	367	72	4,35%
12	243	27	3,87%
13	177	9	3,67%
14	130	0	3,67%

Source: study results

[1] The commodity codes from Statistics Norway: https://www.ssb.no/294954/statistisk-varefortegnelse-for-utenrikshandelen-2017.

[2] CEPII refers to French center for research and expertise on the world economy or "Le Centre d'études prospectives et d'informations internationales"

[3] ERS International Macroeconomic Data Set: https://www.ers.usda.gov/data-products/international-macroeconomic-data-set/

[4] World Bank Open Data: https://data.worldbank.org/indicator

The maximum number of spells in 14 years of available data is 5. 12% of the trade cases have more than one spell. We considered all levels of trade in this analysis. The trade duration analysis have left and right censoring issues in dataset. There are observations that we could not recognize the beginning of the trade time. They are at the primary stages in sample. If we eliminate those observations, many observation will drop off. Therefore, we kept them and a dummy is added to COX PH to control for those observations which show trade in 2005. The right censoring is controlled in hazard model automatically.

5.1 Kaplan Meier results

The information in panel B of Table 1 are the results of Kaplan Meier estimation which is explained in methodology. By using this results and further expansion of them, we can stablish the survival function (see Figure 3, Figure 4, Figure 5). These graphs show how some explanatory variables influence the survival probability. In all these figures, y-axis refer to survival rate of trade relationship and x-axis is the years of interaction. Figure 3 shows that the survival rate for long term trade relation is low and the difference between EU and non-EU trade relation in the long run is not vastly different. Figure 4 shows that there is not a huge difference between continents considering the length of trade relationship. However, those partners who have diversified means of transport, probably stay in a relation for a long time. Figure 5 shows that after third year, the probability of trade survival between primary producers is lower compare with wholesaler and processors. The probability of long term survival of trade between Norway exporters and Polish and French partners is almost similar. The trade duration between Norway and Russia is low due to having the 2014 ban in the sample. The trade duration with China is not an old trend and could change in the future.

5.2 COX PH model

As it is explained in the methodology, COX PH and COX PH with the random effect are estimated. The results are presented in
Table **2**. We have conducted three COX PH simple model as we recognized strong multicollinearity in different category of variables of interests. The main primary model is re-estimated with COX PH random effect model. The variables considered for the random effect model were the exporters and importers firms separately. However, as the random effect model with importers did not converge, we considered the random effect for exporters and importing countries. In these models, factors that affect the hazard of trade relation are tested. If we consider the end of relation as one (1) and the continuation of this relation as zero (0), the positive coefficients show that how the exogenous factor increases the possibility of hazard and if the negative coefficient show that how the exogenous factor decreases the possibility of hazard. By having this analogy in mind, the coefficients of COX PH model are interpretable. The results of estimation between COX PH main model and COX PH with random effects are in the main part similar. Both model shows that higher level of trade at first year can increase the possibility of long term relation. Higher volume of trade is also a factor which encourage longer relation. Higher prices at consume markets which reflected by FOB price increase the possibility of trade survival. Higher variation of price during a year in Norway cause longer relation. It could be that the decision on import made by observing price change in Norway. Those partners who use different means of transport have higher chance of longer trade relation. The 2005 dummy variable for controlling the left censoring issue is significant and negative. It shows that probably those partners having longer relation that increase the possibility of trade survival. The two dummy variables on type of exporter in both models shows that the possibility of longer trade with wholesaler is higher than processors and primary producers.

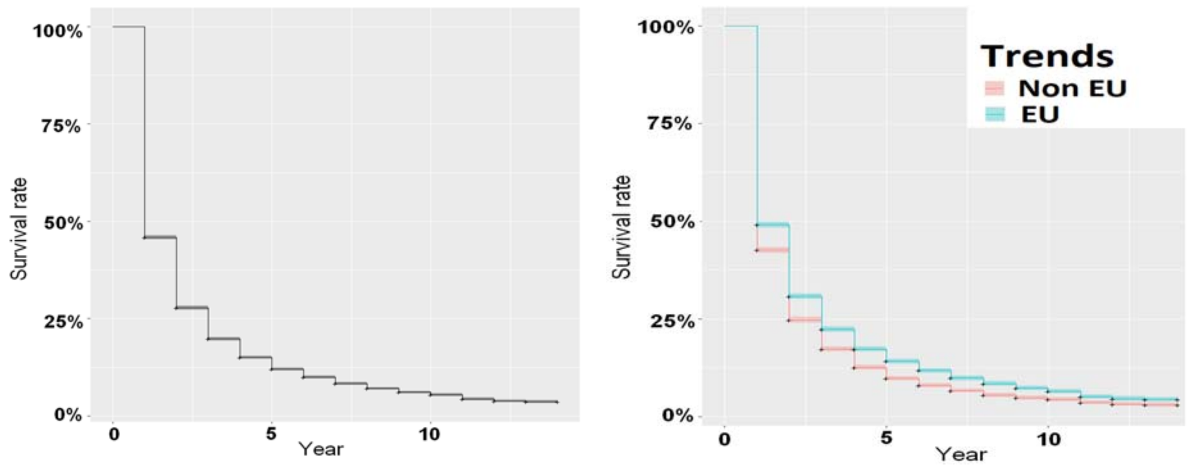

Figure 3: Kaplan-Meier survival function, all firms (left) and EU, non-EU separately (right)
Source: study results

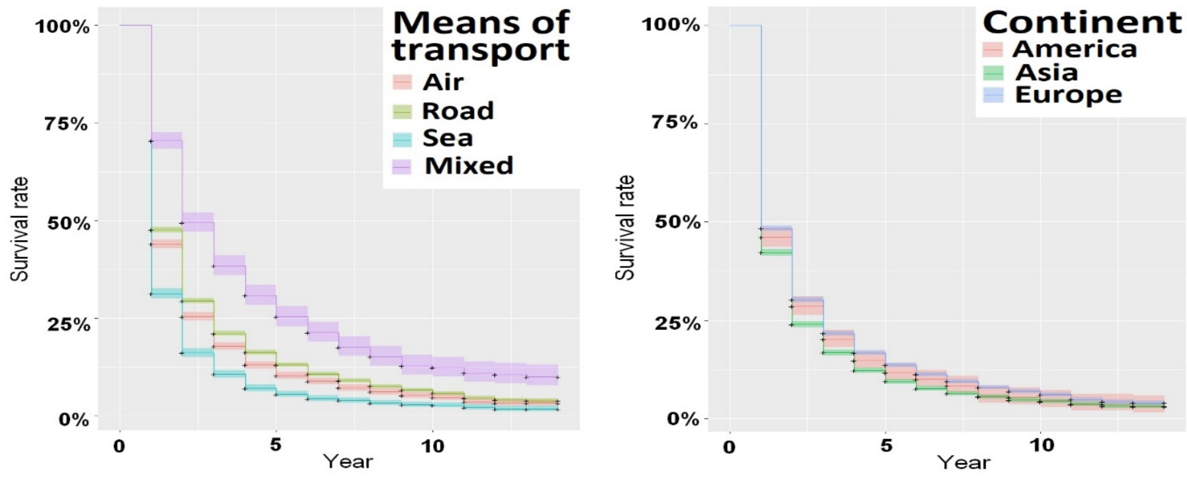

Figure 4: Kaplan-Meier survival function, by means of transport (left) and continents (right) separately
Source: study results

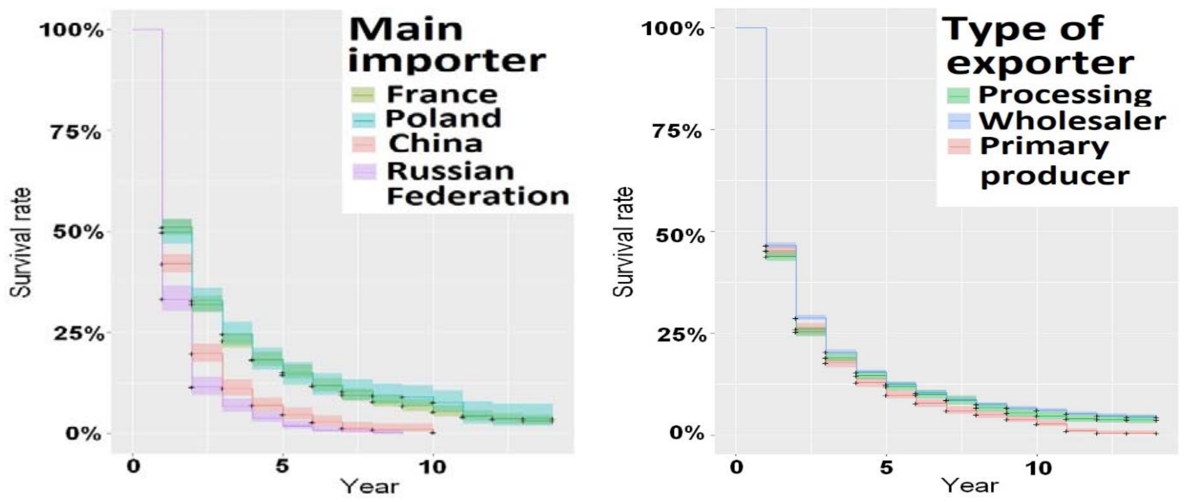

Figure 5: Kaplan-Meier survival function, by main importers (left) and type of exporter (right) separately
Source: study results

Table 2: COX PH estimation for salmon trade duration between Norway and partners

Variables	COX PH(main model)	COX PH (alternative 1)	COX PH (alternative 2)	COX PH with random effect
Ratio of number of transaction in 1st year to last year	-0.039(0.002)***	-0.034(0.002)		-0,036(0,002)***
Trade weigh in last year (KG)	-0.001 (0.00004)***	-0.001(0.000)***		-0,001(0,000)***
FOB price per unit (NOK/KG)	-0.007(0.0003)***	-0.007(0.0003)***		-0,008(0,000)***
SD of salmon price in Norway	-0.201(0.005)***	-0.176(0.004) ***		-0,186(0,005)***
GDPperCapita (log of USD)	-0.048(0.007)***	-0.082(0.007) ***		-2,297(0,065)***
Exporter Processing (dummy)	0.142***(0.022)			0,358(0,124)***
Exporter Wholesaler (dummy)	-0.004(0.018)			0,277(0,123)**
EU dummy(1 EU, 0 nun EU)	-0.084(0.020)***			3,417(0,640)***
Geographical position of producer in Norway (the higher the number, the Northern the region)	-0.002(0.0003)***			0,001(0,002)
Rail trasport_2	-0.271(1.000)			-0,675(1,005)
Road transporte_3	0.010(0.021)			-0,021(0,032)
Ship transport_4	0.148***(0.021)			0,071(0,024)***
Mix transporte_5	-0.464***(0.032)			-0,468(0,034)***
Year effect	0.008(0.002)***			0,072(0,002)***
firstyear_2005 (dummy)	-0.351(0.021)***			
Employees (number)		0.0001(0.00)***		
France importer (dummy)		-0.080(0.024)***		
Poland importer (dummy)		-0.111(0.036)***		
Distance(log of KM)		0.004(0.007)		
County in Norway 2 (dummy)		0.699(0.299)**		
County in Norway _3 (dummy)		0.752(0.261)***		
County in Norway 7(dummy)		0.799(0.158)***		
County in Norway 8 (dummy)		0.503(0.461)		
County in Norway _10 (dummy)		0.416(0.336)		
County in Norway 11 (dummy)		0.471(0.158)***		
County in Norway 12 (dummy)		0.061(0.114)		
County in Norway 14 (dummy)		0.429(0.130)***		
County in Norway 15 (dummy)		-0.041(0.113)		
County in Norway 16 (dummy)		0.0004(0.117)		
County in Norway 17 (dummy)		-0.237(0.114)**		
County in Norway 18 (dummy)		0.087(0.115)		
County in Norway _19 (dummy)		-0.015(0.118)		
County in Norway _20 (dummy)		0.365(0.124)***		
County in Norway _29 (dummy)		-0.068(0.114)		
County in Norway _91 (dummy)		-0.165(0.115)		
County in Norway _99 (dummy)		-0.045(0.175)		
Continent Africa (dummy)			0.050(0.047)	
Continent America (dummy)			0.050(0.030)*	
Continent Asia (dummy)			0.157(0.013)***	
Continent Pacific (dummy)			0.063(0.097)	
Random effect (Exporting firm), sd				**0.415**
Random effect (importing country) sd				**2.862**
Observations	33.236	33.236	33.236	33236
R2	0.201	0.187	0.004	
Max,PossibleR2	1	1	1	
Log Likelihood	-257177.300	-257467.000	-260836.700	-255523.2

Table *2*: continue

	COX PH (1)	COX PH (2)	COX PH (3)	COX PH with random effect
Wald Test	6580.510*** (df=15)	5991430***(df=26)	150.930*** (df=4)	
LR Test	7468.102*** (df=15)	6888.611***(df=26)	149.255*** (df=4)	
Score(Logrank)Testfff	6170.087*** (df=15)	5652.648***(df=26)	151.220*** (df=4)	

*Note: * p < 0.1; ** p < 0.05; ***p < 0.01, inside the () is standard deviation (SD)*

Source: study results

The possibility of longer relation with richer countries is higher. These are the results of the two models. The alternative one model with fix effect factor of region of exporter in Norway shows that we have heterogeneous pattern between exporters and if exporter is stationed in certain regions, the possibility of trade to continue is higher. The same phenomenon is tested in the base model by an index for production region. The Northern the production region, the higher the possibility of trade duration. The model with continent fix factors show that the trade relation with American continent and Asia is at higher hazard rate. The non-expected result is on dummy for EU fix factor effect between COX PH main model and COX PH with random effects. The sign of this variable changes between two models with huge magnitude. It could be due to multi collinearity of random effects and EU fix effect. However, we kept it to show the accuracy that random effect can bring to the estimation. Probably, the EU effect cannot be tested with Random effect model. The exchange rate was not significant. Generally speaking, the random effect model has not improved the model dramatically. To conclude, we can say that certain patterns are recognized in survival possibility of salmon trade between partners. The most unexpected part of Kaplan Meier and COX model was the narrow difference between EU and non-EU partners in Salmon trade and short-run relation in these markets. As salmon is perishable product, we were expecting more stable and long term relation between partners.

5.3 Discussion

We expected longer relation between partners on a perishable commodity such as salmon. However, the results show that the survival rate between the Norwegian salmon exporters and main global importers is rather low. On average, the trade relationship between firms 2.39 years for the period 2004-2018. This is even lower than findings of STRAUME (2017) for firm-country relation which was 4 years. In particular, for most of the firms, the likelihood that the trade in salmon survives after two years is about 28%, and after five years is about 12%. This rate is slightly different between EU and Non-EU countries after five years which largely vanishes in the long run. Most trade relations die out after two-three years on average, independent of the importers' origin (EU–non-EU). As the trade partners are changing fast, at the same time overall trade volume increases, this indicates that entry and exit in trade partnership are not very costly. Decomposing the results by type of exporting firm, after three years of trade, the rate of trade survival is higher for salmon wholesale and processing firms compared to the primary producers. This difference further widens slightly as the duration of continuous trade increases. The results of the econometric models show that countries trading larger amounts of salmon are more often expected to stay longer in a trade partnership. Furthermore, as the prices increases and become volatile, the incentive of having longer trade relationship increases. This shows that stable partners is more on important in turbulent times and markets. To summarize, these results show that the salmon value chain does not depend on stable trading partners, but rather limited production and large demand globally are pushing Norwegian salmon export forward as the producers are able to easily sell salmon on export markets. Entry and exit in this market are fast which only can be changed by availability more long term contracts between partners or more actors on supply side.

5 Conclusion

The duration models are tools to understand the market structure for specific commodity and countries. Any decision on entering to trade market can be made easier by knowing the persistency of trade between partners. There are commonalities and differences between markets. In this study he have used firm level trade transaction data to study the trade duration for Norwegian salmon for the period 2004-2018. We have used Kaplan-Meier survival model and Cox proportional hazard model. Different specifications are defined for each model. Generally speaking, we found low level survival rate for Norwegian salmon trade at the firm levels. In this study, we have seen different structure of trade persistency. Similarities and differences are recognised between exporters, means of transport, level of quantity and continents. In Kaplan-Meier survival model we could see slightly higher survival rate of trade relation between Norway and EU. Additionally, we see that the higher prices has positively affected the trade duration. This is also the case for annual price volatility and we have seen higher standard deviation of annual prices has positively affected the trade duration. The GDP per capita is positively affecting the trade duration in all models. The richer the importer, the higher the probability of trade duration. The higher the number of transaction in first year of trade to last year, the higher the probability of trade duration. Norwegian salmon production and export is free from competitors.

We can conclude that Norway salmon export enjoys the natural monopoly of salmon production, and it shows slightly different trade persistency with different markets. However, if trade to the regions with other competitors such as US increases, we could expect other patterns of trade duration for these markets. Norway has been excluded from US market for many years and Chile plays more important role in those markets at the moment.

This research can be expanded by including new dimensions. The regional differences between exporters in Norway that we found in econometric model was a sign that issues such as disease outbreak in the salmon farms can be studied further in next stages of duration analysis. Furthermore, we suggest applying spatial analysis in duration model when regional differences are recognised. In this study, we have focused more on firms. However, for the next stages of research, the effects of the difference between fresh and frozen salmon and their duration can de differentiated. Furthermore, the effects of COVID19 pandemic for the period 2020-2021 on trade duration can be studied in the next stages of this research upon an update of our database.

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