Four essays in international trade:

Trade flows in food products

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Summary

This thesis consists of four essays within the field of international trade economics, as well as an introduction chapter. All four papers are empirical studies of trade flows in food products using transaction data. The first chapter introduces the data used in the papers, and provides a brief review of the general literature. During the last decades, the focus in international economics has shifted from studies of trade flows using aggregated data to studies of firm behavior. Historically, the starting point for the analysis of trade flows has been the gravity model of international trade. All four papers in this thesis use a set of regressors commonly used in this literature. The papers aims to go beyond the existing literature in dealing with transaction-level data for trade flows of highly perishable food products. Three of the papers relate to export of salmon, while one of the papers investigates the import of apples. All transaction data is based on customs declarations at the firm level.

The first paper studies the effect of trade costs on the export of Norwegian salmon. Trade of salmon is a rapidly growing industry, and fresh salmon is a highly perishable product. Trade in such products tend to be highly vulnerable to trade costs, e.g. in the form of transportation and transaction costs. The paper studies the evolvement of export growth within the industry for the period 2003-2009. In total, 483,956 individual transactions are studied. Two different versions of the gravity model of trade are estimated to study trade growth. In addition, the paper studies how different trade costs affect the extensive and intensive margins of trade. The extensive margin is defined as the number of exporters, while the shipment (transaction) frequency is used as a measure to capture the intensive margin of trade. A Poisson model is used to estimate the extensive margin, while both a Poisson model and a Negative Binomial model are used to estimate the intensive margin. I find a significant negative effect from transportation costs on trade values. Transportation costs are measured, both as geographical distance from Norway to the destination market, and as the internal size of the destination market. In addition, I find that shipments towards densely populated areas, large markets, and shipments with air transport are positively related to trade values. Transportation costs are shown to choke off both the extensive and intensive margins of trade. Trade to markets within the EU negatively affect the extensive margin, while the opposite

effect is found for the intensive margin. This result could indicate that it is the largest exporters that are dominant in the European markets. Further, the results indicate that much of the negative effect from distance on trade is an aggregation effect.

The second paper investigates the duration of trade relationships, and hit-and-run behavior in Norwegian salmon export. In the literature on international trade, much has been said about why firms start to export, less has been said about which factors may induce termination of trade relationships. In this paper, we investigate trade duration by two different approaches. First, we use a Cox model to estimate hazard rates to study the probability for termination of trade relationships. Second, we estimate the probability for a firm to choose different lengths of the trade relationships by using a multinomial logit model. In the first approach, trade duration is calculated by the number of subsequent years a trade is observed between the trading partners. In the latter approach, we categorize trade duration by the number of transactions. We define a hit-and-run strategy as a trade relationship that is only observed with one single transaction. Our findings reveal a large presence of short-lived trade relationships, and that estimated survival rates are heavily dependent on the level of aggregation. We show that trade relationships are shorter in large markets served by many firms. Hence, keen competition seems to be a substitute to deeper relationships. Hit-and-run strategies are characterized by large initial trading volumes, and by large transportation costs between the trading partners.

The third paper studies the choice of invoicing currency for Norwegian salmon exporters. In today's seafood markets, salmon is the species with the most varied transaction modes. Unilateral contracts with different specification, standardized future contracts, and a number of other transaction modes, are used in addition to traditional spot transactions. The exporters' choice of invoicing currency affects which part in the trade relationship that takes on exchange rate risk, and can thus be an important factor for an exporter's competitiveness. The paper discusses the empirical patterns of use of different invoicing currencies observed in the data, and uses a multinomial logit model for estimating the firms' choice of invoicing currency. I find that all common invoicing strategies from the literature of international trade are present in the industry. The exporters use local currency pricing (LCP) for 47 % of the exported quantity, and producer pricing (PCP) in 19 % of the exports. As vehicle currencies, the producers use both euros and American dollars. A

Norwegian exporter that invoice the trades in Norwegian kroner are not subject to exchange rate risk. I find that for the choice between PCP and LCP factors such as the economic size of the destination market, total import of salmon in the destination country, the frequency of trades from the exporter to the destination market, the size of the exporter, and trades to countries within the EU increases the probability for invoicing in Norwegian kroner.

The fourth, and final paper, investigates the import prices obtained by Norwegian firms importing apples. Apples are a particular interesting product, as they can be imported free of tariffs during one season of approximately half of the year, while being subject for import tariffs for the reminder of the year. In the paper, we set out to investigate if the largest and most specialized firms obtain the lowest import prices, if invoicing currency is important for the prices, and how gravity variables affect the prices received by the Norwegian importers. The import prices vary markedly between the different firms. We find that largeness and specialization result in significantly lower import prices. We find that it is costly for the firms to use local currency pricing in the transactions. Increased transportation costs result in higher import prices.

Chapter 1: Introduction

1. Introduction

This thesis covers topics in international trade that, in different ways, investigates aspects of trade at the firm-level using transaction-level data. The focus is on trade in two relatively homogeneous food products: export of farmed salmon and import of apples. I study trade costs, duration and choice of invoicing currency for export of salmon, as well as import prices for import of apples. A key characteristic that distinguishes seafood and agricultural products from manufactured goods is the high degree of perishability. To ensure prompt delivery of a fresh product from the seller to the buyer, trade in such products needs to adopt modern trade technology. Trade in fresh products may be vulnerable to variables influencing transaction costs, such as distance between the market of origin and the final destination market, and choice of transportation mode. I also suspect that established relations between an exporter and importer are more or less permanent once they know that the trading partner meets the required standards regarding quality, as there can be substantial relationship-specific investments involved in maintaining a reliable supply of a fresh product.

Though some authors have claimed that globalization has made "the world flat" (Friedman, 2006), the international trade activity is still relatively small compared to all the economic activity that is going on inside countries. To stimulate economic growth, it is of great importance to study the factors that may choke off trade, for both exporting, as well as for importing firms. We know that factors such as transportation costs, income, cultural affinity, technology, fuel costs, infrastructure, and a variety of political factors are important determinants of trade flows. From the existing literature on international trade, it is clear that e.g. transportation costs, in terms of geographical distance, still choke off trade; the world today is far from "flat." Furthermore, the presence of large trade costs affects economic welfare through distortion of trade flows.

This thesis consists of four different essays that all study issues related to trade flows at the firm level. All four essays are empirical studies using methodology well established within the field of international trade. There are two common features. First, all empirical models include some explanatory variables that are standard in the gravity literature of trade (e.g. geographical distance and GDP). Second, all the empirical analyses build on transaction-level data. The

second feature of particular interest is that access to such detailed data is rare in the existing literature. The four essays in this dissertation add to the existing literature by discussing the implication of firm-level data when estimating a variety of models that usually are studied using more aggregated data. Chapters 1, 2 and 3 study research questions related to export of salmon from Norway. The focus of the papers are on industry-specific trade costs, duration of trade relationships observed within the industry, and firms' choice of invoicing currency. Chapter 4 studies the obtained import prices for Norwegian firms importing apples.

Following the seminal paper of Melitz (2003), most of the theories of firm behavior in international trade have incorporated firm heterogeneity, but these theories have been empirically investigated at a more aggregated level due to lack of detailed data. Section 2 in this introduction briefly introduces gravity models, and some relevant literature on firm heterogeneity and international trade. Section 3 briefly presents the data used in the thesis, while section 4 finally provides the abstracts of the chapters in this thesis.

2. The gravity model of trade and firm heterogeneity

2.1 The gravity model of trade

The gravity model has been the workhorse in international trade since Tinbergen (1962) first introduced it in empirical research. The gravity model has exhibited both high explanatory power and robustness in explaining international trade flows for more than four decades. The evidence in international trade for the model is strong (Chaney, 2013). The literature on international trade contains a considerable amount of papers employing the gravity equation in an effort to improve the theoretical fundament for the model, to measure the effect of different trade costs on trade flows, or to analyze the impact of different policy changes on trade.

In its simplest form, the gravity model of trade is given as (Chaney, 2013)

$T_{X,Y} = \alpha \frac{GDP_X^{\beta} \cdot GDP_Y^{\gamma}}{dist_{X,Y}^{\sigma}}$, and is estimated as

$$lnT_{X,Y} = ln\alpha + \beta lnGDP_X + \gamma lnGDP_Y - \sigma lndist_{X,Y} + \varepsilon.$$

At the most aggregated level, the gravity equation states that trade is positively related to the economic mass between the trading partners, $GDP_X^{\beta}.GDP_Y^{\gamma}$, and inversely proportional to the

geographical distance between them.[1] The empirics suggest $\beta, \gamma \sim 1$ and $\sigma \sim 1$ (Chaney, 2013). The negative effect from geographical distance on trade has been remarkably strong, and stable over time and space, as the world has experienced massive changes in different trade costs (e.g. transportation costs, tariffs and administrative hurdles). Common additional explanatory variables used in the literature are related to different trade barriers, such as borders and trade unions.

The negative effect from distance on trade is present both between countries and within countries. Leamer (2007) shows that increased geographical distance to the trading partner negatively affects German trade. Eaton and Kortum (2002) find a similar result for trade in manufacturing in the OECD. Hillberry and Hummels (2008) show a negative relationship between trade and distance within the U.S. The large negative effect from geographical distance, and the fact that the effect has not died out as the world has become more global, is a puzzling result from the empirical models that use the gravity models. It also suggests that transportation costs remain an issue.

One strand of the literature focuses on the effect on trade from sharing a border with the partner country. Engel and Rogers (1996) studied the effect from a common border on retail prices in the US and Canada. They found that crossing the border between the US and Canada has a tremendous negative effect on trade. McCallum (1995) estimates the effect of a common border between the U.S. and Canada on aggregated trade flows and finds a tremendous border effect. Anderson and Van Wincoop (2004) argue, using a more sophisticated gravity model than McCallum (1995), that national borders reduce trade between industrialized countries by an amount between 20-50 percent. This part of the literature suggests that transaction costs are still important.

All of these papers focus on explaining aggregate variables of trade, and do not address either trade frequencies or choice of transportation mode. In the three decades after Tinbergen (1962), gravity models analyzed aggregate trade flows at the country level. Today, the spearhead of models used to study international trade builds on the theoretical contribution of Melitz (2003).

[1] This is similar to the definition of the gravity force between two objects found in physics.

2.2 Firm heterogeneity and trade

In his seminal paper, Melitz (2003) adds firm-level productivity to the classical framework of Krugman (1980), and shows that firms that are more productive earn a higher profit. The most productive firms are able to pay the fixed costs of exporting, and increase profits by the opening up to trade. By including firm heterogeneity, Melitz (2003) explains micro-level facts inconsistent with previous theories. Does such firm heterogeneity have further implications at the macro-level? The answer is a clear yes. E.g. selection of heterogeneous firms into export matters for trade volumes (Chaney, 2008; Helpman et al., 2008).

Firms, not countries, are the executers of world trade. As more firm-level data have become available, trade economists have discovered a variety of stylized facts about trade at the firm level. First, exporting is extremely rare (Bernard et al., 2007). A small number of firms are behind most of the exports (Bernard et al., 2011). Eaton et al. (2011) show that only about 14 % of French firms export across the French border. Second, exporting firms are more productive, in line with the predictions of Melitz (2003). Firms have to have a productivity over a given threshold level to be able to export. Recently, Chaney (2013) has offered a theoretical explanation for the negative effect of distance on trade. He argues that the effect depends on the size distribution of exporting firms. Larger firms endogenously trade over longer distances. The communication between the exporter and importer can also be of importance.

Melitz (2003) made it obvious that models of international trade should incorporate firm heterogeneity. Earlier models, such as the Anderson and van Wincoop (2004) model, build on the assumption that firms are homogeneous, and that consumers' taste of variety ensures that all goods are being traded. The productivity threshold prediction of Melitz (2003) is linked to the margins of trade (Lawless, 2010). In the literature, the extensive margin is measured as the evolution of the number of firms exporting, and/or the number of products traded, while the intensive margin measures the evolvement of the average traded values, see, for example, Crozet and Koenig (2010) for a discussion of the margins of trade for French firms, and Hillberry and Hummels (2008) for the U.S. Other strings of the literature have been linked to the effects from trade liberalization on the extensive margin of trade(Eaton et al., 2011; Helpman et al., 2008). When the margins of trade are estimated, it is a common practice in the literature to regress the margins on a set of gravity-variables. Bernard et al. (2011) report a

negative effect from distance on the extensive margin of trade when measured as the number of exporters. Crozet and Koenig (2010) found that distance negatively affects both the intensive and extensive margin of trade. Such findings are in line with the theoretical predictions of Melitz (2003) and Chaney (2008) who argues that a reduction in trade costs increases both margins of trade. Some authors (e.g. Hummels and Klenow, 2005) argue that the extensive margin is the most significant margin for export growth, while others (e.g. Helpman et al., 2008) find that the intensive margin is the most important margin. Besedeš and Prusa (2011) find support for the intensive margin as the primary margin of trade evolvement, and argue that this is partially caused by survival, and deepening of trade relationships.

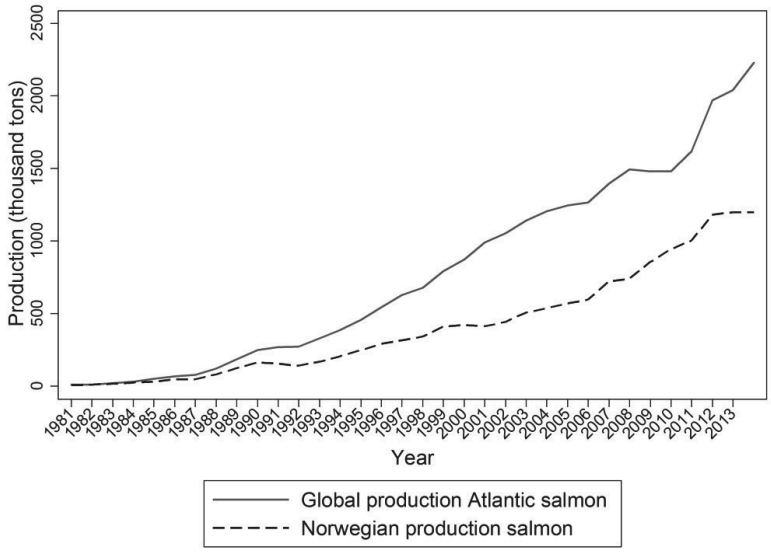
Recently, a new strain of literature has suggested that when estimating gravity models at the firm level, one should employ prices as the dependent variable, not values (volume). Baldwin and Harrigan (2011), Mayer and Ottaviano (2008) and Bastos and Silva (2010) found that export prices increase with geographical distance. These papers argue that the distance premium is explained by self-selection into distant export by high-quality firms. Export prices are positively correlated with quality. Manova and Zhang (2012) investigated Chinese export prices and found that export prices to developed countries increase with distance, income and centrality. For export to developing countries, they found that both distance and income reduces export prices.

OECD (2011) reveals several interesting characteristics of OECD-exporters. Only 2.7 % of firms in the EU trade with destinations outside of the union. Large firms have higher propensity to export and account for most of the trade values. Firms with more than 250 employees are exporters in more than 50 % of the observed cases. The corresponding number for firms with less than 50 employees are 25 %. For most OECD-countries, the large firms account for more than 50 % of the export. Exports from OECD-countries are also concentrated to a relatively small number of partner countries. For example, most Canadian exporters have one partner country (USA). The same pattern exists for most EU exporters. In addition, most importing firms display many similar characteristics as exporting firms (rare, larger and more productive).

3. Background and data

Three of the four papers in this thesis are related to export of Norwegian salmon. Aquaculture is the world's fastest growing food production technology (Smith et al., 2010), and trade with seafood has also increased substantially (Asche et al., 2015). Salmon is the leading species in a number of dimensions in production (Asche et al., 2009; Roll, 2013), as well as supply chain organization and transaction modes (Kvaløy and Tveterås, 2008; Olson and Criddle, 2008; Larsen and Asche, 2011; Oglend, 2013). Increased global supply of fish, and population growth, change trade patterns. Norway is the world's second largest exporter of seafood. More than 90 % of the Norwegian production of salmon is exported. In 2014, the net worth of export of salmon was about 43.9 billion NOK. Figure 1 shows the development in the Norwegian production of Artic Salmon compared to the world production of Artic salmon in the period 1981-2014. From figure 1, it is evident that Norway plays a crucial role in the world supply of Artic salmon.

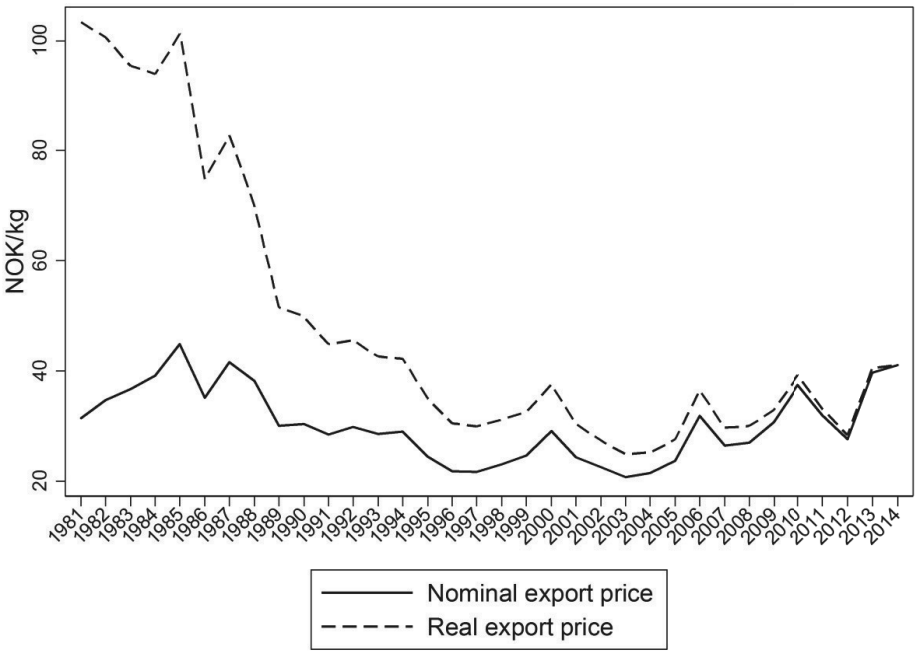
Figure 1: Production of Artic salmon. 1981-2014



(Source: FAO and Norwegian seafood council)

Aquaculture accounts for about 40 % of the total global production of seafood, and 50% of what is used for human consumption (FAO, 2014). Anderson (2002) and Asche (2008) claim that the aquaculture industry has benefited from new knowledge and technology used in the agricultural sector. Asche, Guttormsen and Nielsen (2013) also point out that the industry has benefited from increased demand. This increased demand is partly caused by product development and partly by expanding the geographical market (Asche and Bjørndal, 2011). Figure 2 below indicates the development in export prices of salmon in the period 1981-2014.

Figure 2: Export prices, Norwegian salmon. NOK/kg. 1981-2014 (2014=1)



(Source: Norwegian seafood export council)

In the figure above, we have given information on the nominal, as well as the real price. The real price is based on numbers for the consumer price index (CPI). Figure 1 shows that production has grown in the period of interest; while figure 2 shows that the real price, measured in Norwegian kroner, has declined. The large productivity growth in the sector has lowered production costs and made salmon a more competitive product (Asche et al., 2013). Within the aquaculture sector, salmon is widely regarded as the most successful species when it comes to production growth. Asche et al. (2013) argue that the Norwegian salmon industry consists of

many heterogeneous firms, and shows that the largest firms take a disproportionate share of the total growth in production.

Apart from salmon, we have also analyzed the import of apples. In 2013, consumption per capita of fruits in Norway was 66.6 kg. A significant share of this is consumption of apples (Opplysningskontoret for frukt og grønt, 2014). Of the total consumption of fruit in 2013, apples accounted for 17 %. As much as 88 % of this consumption was based on imports. From 2012-2013 apples were the leading product for growth in retail sales of fruit. The Norwegian consumption of apples will be affected by factors such as quality and retail prices. Retail prices can be affected by the import price obtained by the importing firm.

Statistics Norway has provided the underlying data used in all empirical studies in this thesis. The data is transaction-level data for all international transactions (trades) made by Norwegian sellers of fresh and frozen farmed salmon, and buyers of fresh apples. The data for the Norwegian firms cover the period 1999-2009, while for the period 2003-2009 we are also able to identify the foreign part in the transaction. Each shipment that crosses the border results in a custom declaration, and it is the recorded information from these documents that are reported to Statistics Norway from the customs authorities. This official documentation provides us with information on firm identifiers on both sides of the transaction, destination country/country of origin, volume in kilos, statistical value in the Norwegian currency, contract form, invoicing currency, and form of transportation. Table 1 below, reports descriptive statistics for the data.

Table 1: descriptive statistics, dataset

Product	HS-code, custom tariff	No. observations	Share of product total	Trade direction
Salmon, fresh farmed, with head	*03021201*	*510.905*	*94.54 %*	*Export*
Salmon, fresh farmed, other	*03021202*	*8.247*	*1.53 %*	*Export*
Salmon, frozen farmed, with head	*03032201*	*17.137*	*3.17 %*	*Export*
Salmon, frozen farmed, other	*03032202*	*4.122*	*0.76 %*	*Export*
Apples, tariff period	*08081011*	*16.564*	*46.22 %*	*Import*
Apples, no-tariff period	*08081022*	*19.270*	*53.78 %*	*Import*

(Source: Statistics Norway)

From the table, we see that in the case of salmon, it is the export of fresh-farmed salmon with head that constitutes most of the product category. Apples are reported for two different HS-codes. The reason for this is that import of apples is subject to a fixed tariff in the period 1st of May to 30th of November. This is referred to as the tariff period. The import is free of tariffs in the period from 1st December until 30th April. Note that the Norwegian Agricultural Authorities sometimes expand the no-tariff period for some time in May.

Given the detailed transaction data we have available, we can link a Norwegian firm's export (import) activity to a given importer (exporter) in a given destination country (source country). We are also able to link all transactions going from a foreign importer (exporter) to all the firms he conducts trades with in Norway. Such characteristics are not commonly observed in the empirical literature on international trade. One exception includes, but is not limited to, Bernard et al. (2014).

Increased availability of transaction-level data makes it possible for international trade economists to study the firms' business dimension in detail. It allows the researcher to investigate questions such as: Which factors are most important for the presence of trade costs at the firm level? What are the determinants for entry and exit into trade relationships in different industries? Which factors affect the trading parts' choice of invoicing currency they use in the specific transaction? Do firms that price their products in the home currency outperform similar firms choosing to expose themselves to more exchange rate risk? Are the large firms more successful in obtaining low import prices than their smaller counterparts? The answers to such questions are a key to good policymaking. The remaining four chapters in this dissertation are empirical studies that, in various ways, build on transaction-level data.

4. Abstracts

Chapter 2: Trade costs and Norwegian salmon export

Recent research indicates that transportation costs are more important for foods than other products due to food´s perishability. This paper uses transaction-level data to analyze the effect of trade costs on trade growth of a highly perishable good, fresh-farmed salmon. I investigate trade growth, as well as two distinct margins of trade, the number of exporting firms, and the shipment frequency. I find that trade growth is influenced by traditional gravity variables, such as distance and GDP. Further, the paper explores how variables, such as internal transportation costs and the exporters' choice of transportation mode, impact export of salmon. To estimate the two margins of trade, two different count-data models are estimated. The results indicate that increased transportation costs have a remarkably large negative effect on trade growth of salmon export from Norway, but that this effect is also highly dependent on aggregation level.

Chapter 3: Duration and temporary trade

Co-authored with Frank Asche

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 – Norwegian 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 multinomial 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.

Chapter 4: Currency Invoicing in Norwegian Salmon Export

Published in: Marine Resource Economics (2014)

The purpose of this paper is to examine the choice of currency for Norwegian salmon exporters. The choice of invoicing currency will affect prices in different markets as well as risk, factors that are increasingly important as the supply chain for salmon is becoming more sophisticated, and more transaction mechanisms are introduced. The results indicate that destination-specific market characteristics have impact as to the choice of invoicing strategy. Norwegian salmon exporters primarily invoice in the export market currency (47% of the exported quantity), but also use a vehicle currency and producer pricing (19%) in a significant number of transactions. The euro is the preferred vehicle currency (18%), closely followed by US dollar (USD) (16%). The USD is the dominating invoicing currency for exports beyond Europe.

Chapter 5: The performance of large versus specialized firms: A study of firms importing apples into Norway

Co-authored with Erling Vårdal

We use highly disaggregated Norwegian customs data of importing firms to investigate differences in obtained import prices in the period 2003-2009. In addition to the importing firm, we are also able to identify the foreign exporter. The obtained import prices are related to firm characteristics such as size of the firm, degree of specialization, and also the chosen invoicing currency. Our focus is on one single product; fresh apples. We find a surprisingly high variation in import prices. It turns out that the firm-specific variables, largeness and specialization, result in significantly lower import prices. In addition, if apples are priced in the currency of the exporter, he must accept a 13-18 percent drop in the price he obtains. This effect proves to be highly significant.

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Chapter 2: Trade costs and Norwegian salmon export

Trade costs and Norwegian salmon export

Hans-Martin Straume*

Abstract: Recent research indicates that transportation costs are more important for foods than other products due to food´s perishability. This paper uses transaction-level data to analyze the effect of trade costs on trade growth of a highly perishable good, fresh farmed salmon. I investigate trade growth, as well as two distinct margins of trade, the number of exporting firms and the shipment frequency. I find that trade growth is influenced by traditional gravity variables, such as distance and GDP. Further, the paper explores how variables, such as internal transportation costs and the exporters' choice of transportation mode, impact export of salmon. To estimate the two margins of trade, two different count data models are estimated. The results indicate that increased transportation costs have a remarkably large negative effect on trade growth of salmon export from Norway, but that this effect is also highly dependent on aggregation level.

Keywords: salmon aquaculture, transaction-level data, gravity, margins of trade, count data models

JEL Classification : F10, F14, Q22

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1. **Introduction**

During the last decades, trade liberalization and income growth, as well as better and cheaper means of transport and logistics, have facilitated a global expansion of trade in food and agricultural commodities. Better transportation and logistics technologies reduces delivery time, and secures delivery of higher quality products to the end user (Coyle et al., 2001). This development has also made producers that are more distant increasingly competitive, even for perishable goods. Transportation costs include the actual physical shipping of a product, unfamiliarity with foreign markets, and time-related costs (Linnemann, 1966). Behar and Venables (2011) argue that trade is being choked off by geographical distance and underline the importance of understanding transportation costs to understand global trade patterns. The objective of this paper is to shed light on how trade costs, in the form of direct and internal transportation costs, and mode of transportation, influence trade of a highly perishable food product such as fresh farmed salmon. Production and trade of salmon have increased dramatically during the last two decades, from less than 100,000 tons in 1985 to 2.5 million tons in 2013, with Norway as the leading producer. Since Norway is a country located in the outskirts of Europe, it is particularly interesting to shed light on transportation costs. Several factors are potentially important, and trade with salmon will be investigated in three dimensions; in terms of export value, the number of exporting firms, and the number of shipments of fresh salmon.

Geographical distance between two markets is the most commonly used proxy for transportation costs. Increased geographical distance increases both the actual freight cost, and potentially the time spent in transit. At the same time, as production methods become increasingly sophisticated, and "just-in-time" production extends to a global level, the choice of transportation method is becoming increasingly important for transportation costs (Behar and Venables, 2011). Such developments call for a better understanding of how transportation costs and transportation mode alter trade values, and the margins of trade, particularly for highly perishable bulk commodities like food. This is even more so since technology development has made the absolute effect from geographical distance more important in recent years (Behar and Venables, 2011).

The gravity model is the standard approach to study how trade costs affect trade values. Seminal studies on the gravity model and aggregate trade flows include, but are not limited to, Tinbergen (1962), Krugman (1980), McCallum (1995), and Anderson and van Wincoop (2003). More

recently, firm-level exports, and the role of firm heterogeneity, have received much attention, maintaining the importance of many of the same factors. Bernard et al. (2007) and Redding (2011), provide surveys of this literature. In this paper, gravity-models are estimated. I use transaction-level data to investigate how trade costs affect the value of a highly perishable product, such as fresh salmon, as well as two distinct margins of trade of salmon, the number of firms exporting the product, and the shipment frequency of the exporters. The analysis is conducted at two aggregation levels, the country level, and the firm-to-country level.

During the last decades there has been a shift in the composition of agricultural trade from primarily trade in bulk commodities to non-bulk items, including more perishable products (Coyle et al., 2001). It has become possible for exporters of perishable products, such as fish, meat and fruits, to deliver their product with low costs to final consumers thousands of miles away without experiencing loss of freshness and quality. This has made highly seasonal products, like fresh salmon, blueberries and asparagus, available year around. Hornok and Koren (2014) studied export of foods from the U.S. and Spain, and argue that shipping costs are most disruptive for perishable products. They also argue that in the presence of shipment costs, exporters would choose to ship fewer, but larger, shipments. However, this is problematic for highly perishable products, like fresh fish. From empirical studies of trade flows in food, we know that increased transportation costs reduce imports of seafood to the U.S (Rabbani et al., 2011), reduce retailers sales in foreign markets (Cheptea et al., 2012), and has a negative effect on export market participation (Kandilov and Zheng, 2011).

The rest of this paper is organized as follows. A brief literature review of the Norwegian salmon industry is presented in section 2. Data and regression models are discussed in section 3. Section 4 presents the estimation results, while section 5 concludes.

2. The Norwegian Salmon industry

As previously noted, this paper focuses on the export of one single commodity; fresh farmed salmon. There are a number of reasons why it is interesting to study trade with salmon in more detail. It is a rapidly growing industry as production has increased from less than 20 thousand tons in 1980 to about 2.5 million tons in 2014 (FAO, 2015). The industry is at the forefront when it comes to development of technology, knowledge and innovation in aquaculture, the

world´s fastest growing food production technology (Smith et al., 2010; Tveterås et al., 2012). This is largely due to the control with the production process in aquaculture that has allowed substantial productivity growth at the farms (Asche et al., 2009; Roll, 2013), and in the supply chain (Asche et al., 2007). Control over the supply of the product has allowed the producers to target the most valuable markets and improve logistics, in contrast to what is possible in most fisheries. This has changed the market for salmon substantially from a relatively small market in North America and Japan to a large global market (Asche and Bjørndal, 2011).

Technology development, as highlighted by Behar and Venables (2011), is a key factor for this development at the production stage, as well as for logistics. There has also been a substantial development in supply chain organization and sales mechanisms improving logistics and facilitating trade (Kvaløy and Tveterås, 2008; Olson and Criddle, 2008; Larsen and Asche, 2011; Oglend, 2013; Straume, 2014). The two largest salmon producing countries, Norway and Chile, export salmon to more than 150 countries. Moreover, with more than 90% of the production occurring in four countries, Norway, Chile, Canada and the UK, it is largely an export driven industry with a highly perishable product, fresh salmon, as the main product (Asche and Bjørndal, 2011).

3. Data and methodology

3.1 Data

The transaction data is collected from the salmon exporters' customs declarations for the period 2003-2009. Statistics Norway has made the declarations available. The data set identifies the traders (exporting firm and importing country), the weight (kilos), and statistical value in Norwegian kroner (NOK), the mode of transportation, and the shipment date for each shipment in the period. The data set contains 483,956 unique transactions from 248 Norwegian exporters, serving 83 different destination markets. The single largest destination market in the data set is France, with Denmark being the second most important.

For the firm-destination level, the average number of trades is 862, with a minimum of one, and a maximum of 4832. Approximately 80 % of the exporters report trade relationships involving only one shipment to a specific country. But these shipments make up only 0.5% of the total export volume. The final destination for the maximum number of shipments is France. Table

1 below, reports average value per shipment, and average total value exported to a given destination.

Table 1: Shipment frequencies and average export values. 2003-2009

# Shipments to destination	Average value per shipment to destination (10,000 NOK)	Average total value to destination (100,000 NOK)
1	2.23	1,039
1< # shipments ≤ 10	2.54	806
10 < # shipments ≤ 1,000	2.24	1,267
1000 < # shipments ≤ 10,000	1.45	4,745
# shipments > 10,000	1.07	17,424

We see that the value, and thereby the size, of each shipment is substantially lower when the number of shipments exceed 10. The corresponding numbers for the total export value to the destination increases as the number of shipments increases. These numbers are calculated as averages over the entire period. Hence, as trade relationships deepen over time, trades becomes more frequent, with lower average values per shipments, but with substantially larger total values.

The customs declarations include information about the transportation mode across the Norwegian border. In general, the exporters' choice of transportation mode affects factors, such as the size of the shipment, inventory costs, and the actual freight cost. For a perishable product such as fresh salmon, a major concern for the exporter is to ensure a timely delivery of the product to the final market. Table 2 describes the different modes of transportation for export of fresh salmon.

Table 2: Mode of transportation at the border, 2003-2009

Mode of transportation	Share of total volume	Share of total value	Share of total transactions	# exporters using mode
Truck	86 %	90 %	75 %	240
Aircraft	14 %	10 %	25 %	82

For the export of fresh salmon, 86 % of the volume is transported by truck and 14 % by air. We see that almost all of the exporters use truck as the mode of transportation for at least one trade, while only 33 % (82 out of 248), use air transport for at least one shipment. As shown above, 75 % of the total number of shipments are by truck. Eaton (2008) argues that, measured by weight, nearly all trade between countries that do not share a border occurs by maritime transport. In this paper, maritime transport is not included as a distinct mode of transportation since most transactions that are registered as maritime transport will be trucks on a ferry. The high perishability make slow ship transport useless.

To get a better understanding of the dynamics between the final destination markets, the number of exporters to different markets, shipment frequencies, and different destinations are grouped according to whether they are members of the EU, and by the size of their GDP. In addition, the exporters are grouped according to the number of employees.

Table 3: Descriptive statistics, number of exporters and shipment frequencies - Total

	# of exporters	Shipment frequencies
Total	248	483,956
EU	205	305,615
Non-EU	178	178,341
Large GDP	217	362,679
Small GDP	182	121,277
Large exporters	54	279,624
Small exporters	194	204,332

From table 3, we see that 205 of the exporting firms trades with the EU, and 217 of the exporting firms trade with countries with "Large GDP." A destination market has a Large GDP if the GDP is above the first quartile of the distribution of the GDP of the various countries, and vice versa. An exporter is large if it has more than 138 employees (the median value of number of employees) over the period. Not surprisingly, there is a large difference between the numbers

of shipments by firms to the EU countries compared to non-EU countries. Destinations with a large GDP will represent markets with relatively higher demand than destinations with a small GDP, thus we expect to observe more firm-destination trades to the large destinations. The large exporters are, as anticipated, more active measured by the number of shipments than the smaller exporters.

3.2 Econometric approaches

The purpose of the empirical analysis is twofold. First, gravity models are estimated, using OLS, to explain the value of the traded salmon from Norway to different markets. This analysis is conducted on both the aggregate country-to-country level, as well as on the firm-country level. Second, margins of trade are investigated more closely using count data; i.e. the yearly number of Norwegian exporting firms in a market, and the exporters shipment frequency to different countries.

3.2.1 Baseline model

I estimate the following version of a standard gravity-model:

$$(1)\ \ln(S_{j,t}) = \beta_0 + \beta_1 \ln(Distance_j) + \beta_2 \ln(GDP_{j,t}) + \beta_3 DEU + u_{j,t}$$

Here, $S_{j,t}$ is the export value of fresh salmon from Norway to destination j in year t. $\ln(Distance_j)$ is the log of the geographical distance between Norway and the destination market. $\ln(GDP_{j,t})$ is the log of the GDP in fixed USD-prices in destination market j in year t. DEU is a dummy variable for trades to a destination market within the EU. Data for distance is taken from the CEPII-database.[1] Data for GDP is taken from the World Bank Development Indicators (WDI).[2]

From a standard gravity-model perspective, the geographical distance is included to capture transportation costs. As distance increases, so do transportation costs, and sales are expected to drop. GDP measures the economic size of the destination market, and is expected to be positively correlated with sales. The EU-dummy captures potential effect from membership in a trade union. We know that a large share of export of salmon from Norway is targeted for EU-

[1] The CEPII-database is found at http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp
[2] The WDI-database is found at http://data.worldbank.org/data-catalog/world-development-indicators

countries, so the dummy for trade to an EU-market is expected to be positively correlated with sales.

3.2.2 Extended model

In this paper, the square kilometers in the destination country (*ln size*), the share of urban population (*ln urban population*)[3], as well as a dummy-variable for the mode of transportation for the destination country *j,* is included in the extended gravity model.

$$(2)\ ln(S_{j,t}) = \beta_0 + \beta_1 ln(Distance_j) + \beta_2 ln(GDP_{j,t}) + \beta_3 DEU + \beta_4 ln(size_j) + \beta_5 ln(urban\ population_{j,t}) + \beta_6 DMode\ + u_{j,t}$$

The log of the area (measured in square kilometers) of the destination country is included to supplement geographical distance as the proxy for transportation costs. This variable adds the role of internal transportation costs. The share of the population living in the largest cities could mitigate such internal transportation costs. For the exporter, costs are saved if he can concentrate on serving a couple of large cities relatively to many smaller distant cities. Following Lawless (2010b), it is expected that sales will be negatively impacted by increased internal transportation costs, and positively correlated by the share of urban population. Both these two additional variables are taken from the World Bank Development Indicator database. Finally, a dummy for the mode of transportation at the border is included in the model. The dummy takes on the value 1 if the mode of transportation is by air, and 0 otherwise. Table 4 below, summarizes the explanatory variables for models (1) and (2).

Table 4: Descriptive statistics, explanatory variables aggregated data

Variable	*Mean*	*SD*	*Min, Max*	*Max*
Distance (km)	3,202	3,190	417	15963
GDP (100.000.000 USD)	11,898	16,576	11,31	111,609
Dummy, EU	0.63	0.48	0	1
Internal distance (1000 sq.km)	1285	3487	0.028	16,376
Urban population (millions)	24	49	1.03	250
Transportation mode	0.24	0.43	0	1

[3] See Lawless (2010a, 2010b)

3.2.3 Estimation of the margins of trade

Traditionally, the margins of trade are divided into the extensive margin and the intensive margin. The extensive margin of trade, is measured as the number of firms exporting, or as the number of products being exported (Lawless, 2010a). The most common interpretation of the intensive margin of trade is the evolvement of trade values within established trade relationships, over time. Hornok and Koren (2014) use the number of shipments as an additional margin of trade.[4] I argue that the number of shipments is an additional element of the intensive margin of trade. This is an expansion of the extensive margin of trade. From table 1, it is evident that as the shipment frequency increases, the average total export value of the trade relationship increases**.** Thus, the intensive margin of trade will expand through an increase in shipment frequency.

To investigate the number of firms exporting salmon, and the number of shipments, (1) and (2) are estimated with these two measures as dependent variables. Both the number of firms exporting to a given destination market, and the number of transactions from a firm to a destination, are count variables. To estimate the number of firms, I choose a Poisson model, while I will use both a Poisson model, as well as a Negative Binomial model, to estimate the shipment frequency. Greene (2008) presents the Poisson regression model as the most widely used to study models where the dependent variables are of a discrete nature.[5]

There is no evidence for over-dispersion for the number of firms, so an appropriate choice is the standard Poisson model. The Negative Binomial model is an appropriate choice as long as the dependent variable is over-dispersed, and does not contain an excess of zeroes. [6]

There is evidence for over-dispersion in the shipment frequency variable (see figure A.1 in the appendix). We count only observed trades between the exporting firm and the importing country. Thus, there are no inclusions of zeros in the data matrix.

[4] Békés et al. (2014) also proposes the shipment frequency as an additional margin of trade.
[5] See Greene (2008) for some shortcomings of the Poisson model. Microeconomic data are likely to introduce heterogeneity in both the mean and variance of the response variable, and a negative binomial model is suggested as a more flexible model than the Poisson regression model when estimating a model with a discrete dependent variable (Greene, 2008).
[6] In the presence of zeros in the trade matrix Santos Silva and Tenreyro (2006) suggests the Pseudo Poisson Maximum Likelihood (PPML) estimator as an alternative.

4. Empirical results

4.1 Country level exports

Table 5 presents the estimated coefficients for equation (1) at the country level.

Table 5: Value of Norwegian salmon export. Country level.

	(1) Baseline model	*(2) Extended model*
ln Distance	*-1.803****	*-1.568****
	(0.267)	*(0.336)*
ln GDP	*1.569****	*1.923****
	(0.088)	*(0.208)*
Dummy, EU	*1.872****	*1.699****
	(0.485)	*(0.639)*
ln size	-	*-0.689****
	-	*(0.100)*
ln urban population	-	*-0.065*
	-	*(0.332)*
Transportation mode	-	*0.655*
	-	*(0.450)*
Constant	*-11.144****	*-12.802****
	(3.185)	*(3.751)*
Observations	*481*	*381*
R-squared	*0.543*	*0.614*
F-test	*120.5*	*89.0*
Year FE	*Yes*	*Yes*

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.10*

For the baseline model, the results show a large significant negative effect from increased geographical distance on the total export sales of salmon. The average distance coefficient in the baseline model is substantially larger than the average distance elasticity of -0.9 reported in Disdier and Head (2008) from their meta-analysis of 103 gravity model papers. However, this finding is not too surprising given the highly perishable nature of fresh salmon. The larger the distance, the more effective supply chains must be in order to ensure loss of quality. As expected, there is a significant positive relationship between the GDP in the destination market and export sales. Anderson and van Wincoop (2004) survey a number of gravity studies on aggregate data, and also argue that the "normal" coefficient on the distance variable is about -0.9, that GDP is a significant variable, and that distance and GDP together account for about

70% of the observed variations in trade. Islands trade more, and landlocked countries trade less, than their coastal counterparts. Jayasinghe et al. (2010) argue that next to tariffs, geographical distance is the trade cost that has the largest negative impact on the export of U.S. corn seeds. From table 5, we also see that sales of Norwegian salmon increases when the destination is a country within the European Union.
Turning to the extended model reported in column two of table 3, there is still a highly negative effect from distance on sales, and a positive effect on sales from GDP in the destination country. The EU-dummy is significant, as in the baseline model.

It is important to note that the sample used in the extended model differs somewhat from the sample in the baseline model. This is because WDI lacks some data for countries for the additional explanatory variables included in (2).[7] None of the dropped countries is among the 15 most important destination markets.[8] The results further show that large internal transportation costs affect export sales negatively. There is no significant effect from the urban population variable, or from transportation mode.

4.2 Firm-level exports

The distribution of firms across destination markets are skewed. Many firms export only to a small number of markets. The mean number of markets penetrated by the firms are 48, with a minimum of one, and a maximum of 60. Figure A.2 in the appendix, describes the number of firms active over different categories of destinations. It is evident from the figure, that a large share (76 %) of the exporters are active in the range of 1-10 markets. Only five firms (0.02%) are active in the range of 51-60 destination markets. Such high skewness in the distribution of firms across markets are in line with the findings in Eaton et al. (2004) for French exporters, and Bernard et al. (2009) for US exporters. Eaton et al. (2004) reports that 20 % of the firms export to more than 10 markets, and 1.5 % to more than 50 markets. Bernard et al. (2009) report an average of 3.3 markets per firm. More recently, firm-level exports, and the role of firm heterogeneity, have received attention, maintaining the importance of many of the same factors (see e.g. Bernard et al. (2007) and Redding (2011) for surveys of this literature).

[7] Countries that drop out of the sample when additional explanatories are included are: Bahrain, Belize, Barbados, Cote d'Ivore, Colombia, Costa Rica, Cyprus, Estonia, Georgia, Iceland, Laos, Sri Lanka, Lithuania, Latvia, Luxemburg, Macedonia, Malta, Oman, Qatar, Slovakia, Slovenia, Togo and Tunisia.
[8] See Straume (2014) for a comprehensive list of the largest destination markets for export of fresh salmon from Norway.

In table 6 below, equations (1) and (2) are estimated at the firm-country level. Export sales are calculated as firm-destination specific sales, and firm fixed effects are introduced in the model.

Table 6: Gravity model of Norwegian salmon export - Firm level.

	(1) Baseline model	*(2) Extended model*
ln distance	*-1.085****	*-1.467****
	(0.070)	*(0.100)*
ln GDP	*0.636****	*0.429****
	(0.028)	*(0.066)*
Dummy, EU	*0.014*	*0.194*
	(0.139)	*(0.186)*
ln size	-	*-0.278****
	-	*(0.031)*
ln urban population	-	*0.417****
	-	*(0.092)*
Transportation mode	-	*0.629****
	-	*(0.159)*
Constant	*-5.548****	*-0.894*
	(0.750)	*(1.113)*
Observations	*5,621*	*4,992*
R-squared	*0.433*	*0.452*
F-test	*15.96*	*15.31*
Firm FE	*Yes*	*Yes*
Year FE	*Yes*	*Yes*

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.10*

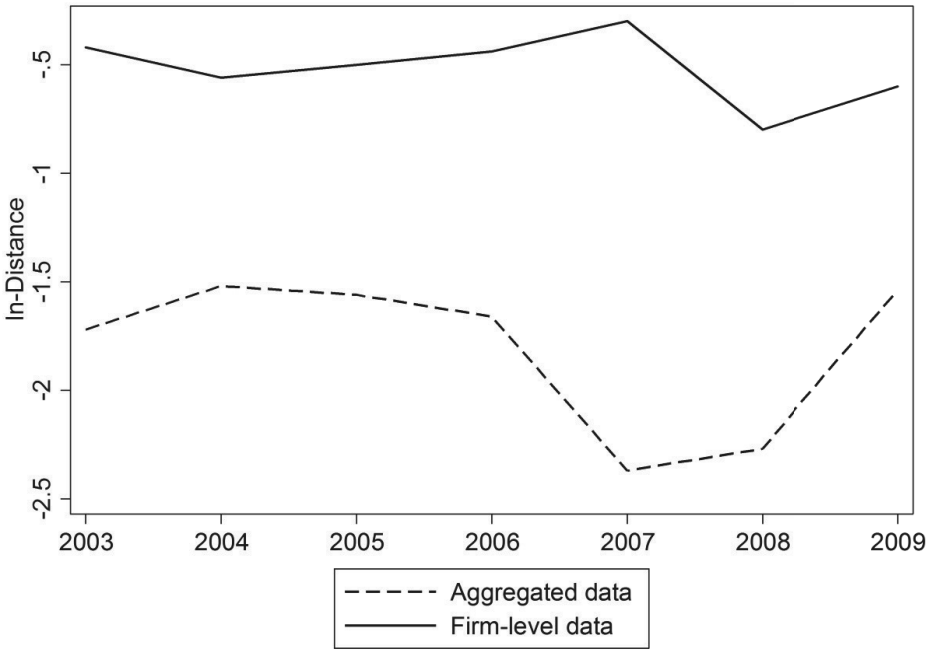
First, there is still a significant negative effect from the distance variable on sales, and a positive effect from the economic size of the destination market. However, the magnitude of the estimated parameter of distance is substantially lower than in the country-to-country model. Hence, the firm effects capture a substantial part of the distance effect. This indicates that some firms specialize in long-distance exports. At the firm level, there is no significant effect from the EU-dummy on export sales, but the positive sign on the variable is as expected. In addition, we see that increased internal transportation costs in the destination markets significantly lower export sales on the firm-destination level. There are two other interesting effects found when turning from the aggregate to the firm level. First, we see that export to countries with large urban areas increases sales. Second, we see that there is a now a highly significant positive effect on export sales from the dummy for choice of transportation mode. This dummy is

constructed so that it takes on the value one if the mode of transportation is air cargo, and zero if truck is the preferred mode of transportation.

Following the results presented in tables 5 and 6 above, it can be concluded that increased transportation costs, when used as a proxy for geographical distance, have a negative impact on export sales. Our findings are in line with those of Lawless (2010b) for aggregated Irish exports.

Further, it is of interest to check if the negative effect from distance has changed over time. Figure 1 below, presents the estimated distance coefficient over time.

Figure 1: Distance coefficient over time



I ran the benchmark regression in equation (1) for each year, and plotted the distance coefficient in figure 3. From the figure, it is evident that there is a much larger variation in the distance coefficient for the aggregated data than for the firm-level data. For aggregated data, it seems like this variable is becoming increasingly important after 2006, but with an adjustment again towards the "normal" in 2009. On average, the distance coefficient, over time, for the firm-level

regression is substantially different from the average effect of -0.9 presented in Disdier and Head (2008).

4.3 Shipment frequency and trade growth

In this section, trade growth of salmon export is decomposed into the number of active exporters (extensive margin), and the yearly number of shipments from the individual firms to a given destination market (intensive margin). When domestic fish farms seeks to sell some of the harvested stock on the foreign market, they need to gain a price high enough to cover their variable- and fixed-costs of exporting. Increased trade costs should thus have a negative impact on the number of exporting firms. Adjusting the number of shipments is a way for the exporters to react to uncertainty in the destination market, and adds flexibility to the firms' export activity. Higher shipment frequencies deepen trade relationships, as shown in table 1.

Eaton et al. (2008) employ trade data from Colombia in the period 1996-2005 to analyze the number of transactions at the firm-destination level. They find great heterogeneity in the number of transactions across firms. As much as 35 % of the firms report only one single transaction over the period. For firms that report multiple transactions, the time between shipments is less than a month. Some of this dispersion is explained by geographical distance to the destination market. The further away the destination is, the less shipments are sent to the destination. Such a result indicates the presence of a fixed cost of exporting, indicating a marginal cost that is declining with shipment volume. The authors argue that at the aggregate level, the number of transactions is an important source of variations in exports.

When analyzing the number of shipments from the exporter, Eaton et al. (2008) emphasize the importance of investigating if the exporters use of different transportation modes is important for the number of shipments. Eaton et al. (2008) further argue that the variability in exports for firms involved in seafood activities, to a higher extent, is explained by the transaction margin than for firm exports in other sectors. Asche and Straume (2015) find that if salmon exporters expand their intensive margin through an increased number of shipments, such a strategy may promote more long-lasting trade relationships.

Table 7 below, shows how the number of active exporters are impacted by changes in the set of gravity-variables used in section 4.2.

Table 7: The number of firms.

	(1) Baseline model - Poisson	*(2) Extended model – Poisson*
ln Distance	*-0.435****	*-0.548****
	(0.009)	*(0.014)*
ln GDP	*0.171****	*0.095****
	(0.003)	*(0.007)*
Dummy, EU	*-0.214****	*-0.205****
	(0.018)	*(0.021)*
ln size		*-0.041****
		(0.004)
ln Urban population		*0.156****
		(0.011)
Transportation mode		*0.014*
		(0.018)
Constant	*2.586****	*3.505****
	(0.075)	*(0.114)*
Observations	*5,621*	*4,992*
Pseudo-R2	*0.360*	*0.362*
Year FE	*Yes*	*Yes*
Firm FE	*Yes*	*Yes*

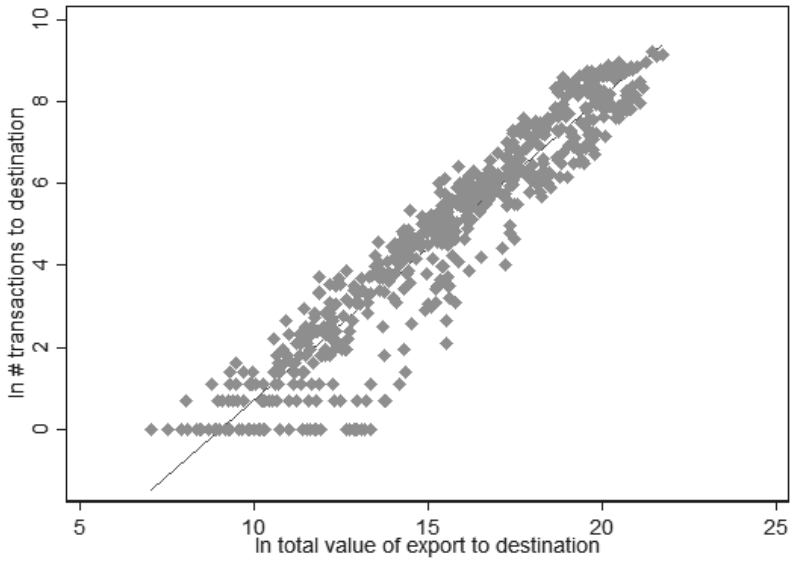
Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.10*

Increased geographical distance reduces the number of active firms, and the number of exporters' increases as the GDP in the destination market increases. These results are in line with the findings of Bernard et al. (2007). When the destination country is a EU-country, the number of exporting firms decreases. This result can indicate that it is the largest Norwegian salmon exporters that are able to penetrate the EU markets. One benefit from penetrating these geographically closest markets may be deeper relationships, and a larger use of contracts (Kvaløy and Tveteras, 2008; Larsen and Asche, 2011), resulting in large traded volumes and values. All results mentioned so far are common for both the baseline model, as well as for the extended model.

When internal transportation costs are introduced in the model, we see that large internal transportation costs reduced the number of firms. A large urban population in the destination market increases the number of active exporters. There is no significant effect found from transportation mode.

To motivate the second margin of trade, the shipment frequency, the correlation between the number of shipments and the value of salmon export to different markets at the most aggregated level, are described in figure 2 below.

Figure 2: Number of transactions and value of export to destination. 2003-2009.



There is a strong positive correlation between the number of shipments to a destination country and the total export value to the destination. This is as expected, and clearly underlines the importance of studying this element of the extensive margin to get a better understanding of which factors determine shipment frequencies at the firm level.

For the estimation results presented in table 8 below, the dependent variable in equations (1) and (2) above, are here replaced by the yearly number of shipments from exporting firm *i* to destination *j*. The first two columns report the results from a Poisson regression for both the baseline and the extended models, while the two last columns reports the results from a negative binomial regression on the two models.

Table 8: The number of shipments

	(1) Baseline model - Poisson	*(2) Extended model – Poisson*	*(3) Baseline model – Negative binomial*	*(5) Extended model – Negative binomial*
ln Distance	*-0.141***	*-0.448***	*-0.318***	*-0.832***
	(0.053)	*(0.073)*	*(0.031)*	*(0.044)*
ln GDP	*0.359***	*0.311***	*0.317***	*0.212***
	(0.018)	*(0.037)*	*(0.014)*	*(0.030)*
Dummy, EU	*0.644***	*0.724***	*0.132**	*0.264***
	(0.096)	*(0.131)*	*(0.059)*	*(0.073)*
ln size	-	*-0.182***	-	*-0.130***
	-	*(0.019)*	-	*(0.013)*
ln Urban population	-	*0.193***	-	*0.208***
	-	*(0.053)*	-	*(0.039)*
Transportation mode	-	*0.555***	-	*1.070***
	-	*(0.120)*	-	*(0.073)*
Constant	*-8.602***	*-6.351***	*-5.700***	*-1.478***
	(0.559)	*(0.743)*	*(0.371)*	*(0.543)*
Alpha	-	-	*0.336***	*0.266***
	-	-	*(0.015)*	*(0.016)*
Observations	*5,621*	*4,992*	*5,621*	*4,992*
Pseudo-R2	*0.56*	*0.59*	-	-
Year FE	*Yes*	*Yes*	*Yes*	*Yes*
Firm FE	*Yes*	*Yes*	*Yes*	*Yes*

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.10*

Overall, we see that there is no significant differences between the effects from the set of explanatory variables on the dependent variable in these regressions, though some minor differences in significance levels do exist.

As distance to the destination and the internal transportation costs increases, the shipment frequency decreases. This is indicated through the elasticity of the distance variable, which is well below unity, and thereby suggests a diminishing effect on the number of shipments with respect to distance. This finding is in line with Hornok and Koren (2014) who argue that the presence of trade costs are associated with less frequent shipments for food products, and especially for perishable products. As distance increases, the exporters may prefer to ship less frequently, but in larger shipments. Further, we see that the large destination economies receive shipments that are more frequent, and there is more shipment activity to EU-destinations than

to destinations outside the EU. Trade to large urban areas increases the shipment activity. Finally, the use of air transport results in more frequent shipments than the use of trucks.

The results presented in section 4 tell us that increased trade costs have a clear negative effect on the margins of trade. The Norwegian exporter may promote deeper trade relationships if they concentrate on trade towards relatively close geographical markets, which may very well be within the EU. For trade towards more distant markets, exporters will experience the possibility for deeper relationships if they ship the goods by air transport to urban areas with a dense population.

5. Conclusion

Transportation costs are important to consider when the pattern of trade for a commodity shall be explained. This is in particular true for highly perishable commodities like seafood. In this paper, Norwegian transaction-level data has been used to study the impact of transportation costs on the export value, and margins of trade, for fresh salmon in a gravity model setting. The analysis is conducted at the country level as well as at the firm level.

The results highlight the effect of aggregation level for the analysis as much as the importance of distance. When geographical distance is used as a proxy for transportation costs, it is shown to have a significant negative effect on trade values. Importantly, much of the distance effect is caused by aggregation of the data. The effect of distance on export value is almost cut in half when we turn our analysis from the country to the firm level. In addition, export values increase by the economic size (GDP) of the destination market.

Another important feature of the trade flow is the number of exporting firms operating to various destinations. In the literature, this is often referred to as the extensive margin. The results indicate that border-to-border as well as transportation costs inside the importing country have a negative impact on the number of firms operating in a given destination market. These effects are highly significant. The exports of salmon destined for the most important market, the European market seems to be predominantly carried out by the largest exporters. When it comes to the exporters' shipment frequencies, referred to as an element of the intensive margin

of trade, the results are much the same as for the extensive margin. Trade costs have a negative effect on the intensive margin of trade.

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Appendix

Figure A.1: distribution of the number of shipments

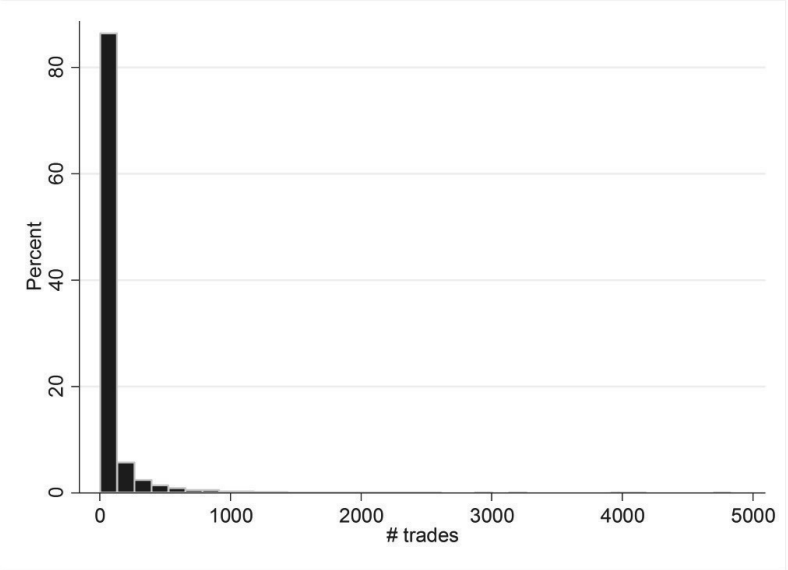
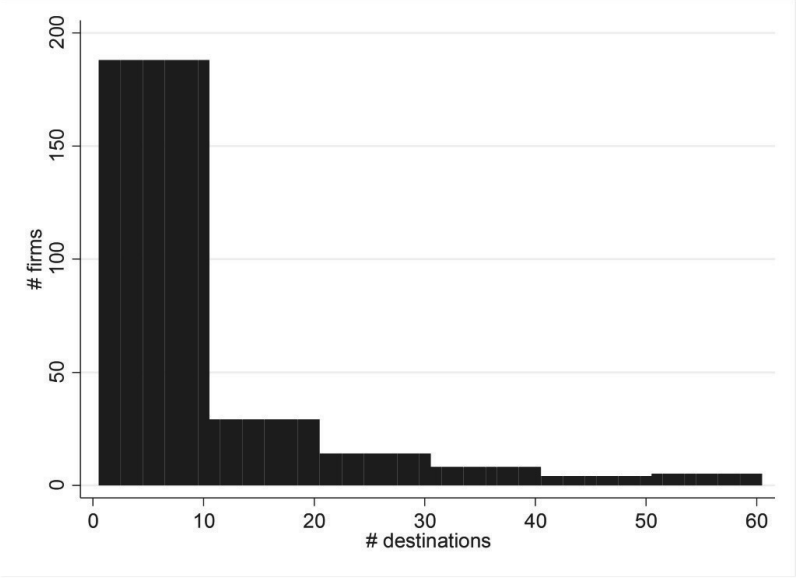


Figure A.2: Distribution of firms over destination markets



Chapter 3: Duration and temporary trade

Duration and temporary trade

Hans-Martin Straume[1], Frank Asche[2]

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

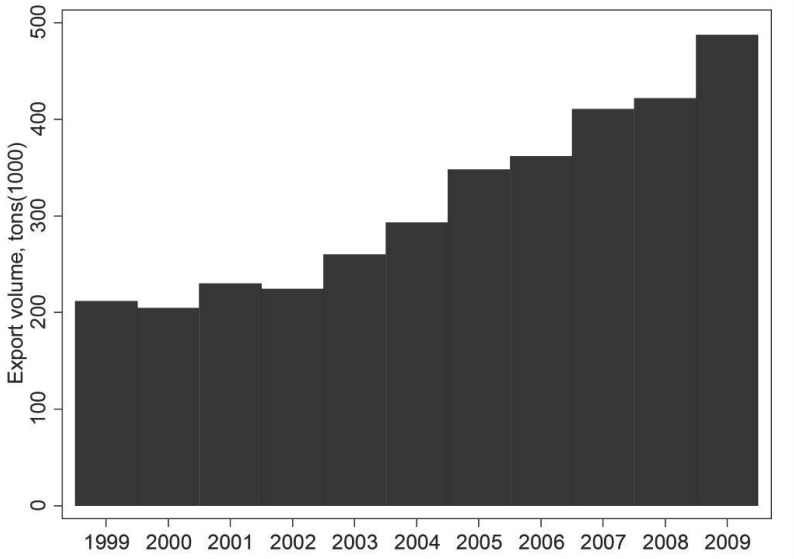
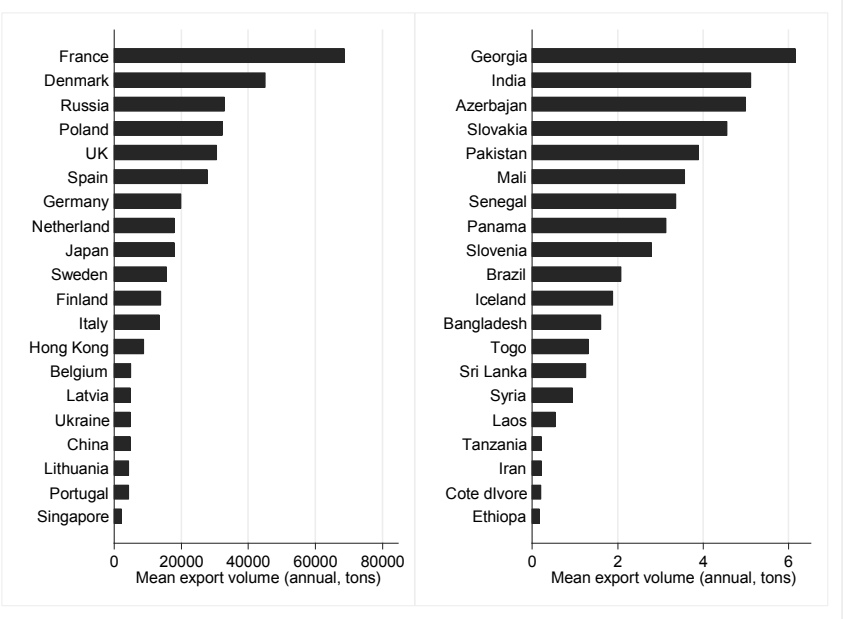


Figure 2: The 20 largest/smallest destination markets for fresh salmon, 1999-2009



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 $t = 1,2,3 \dots n$ 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:

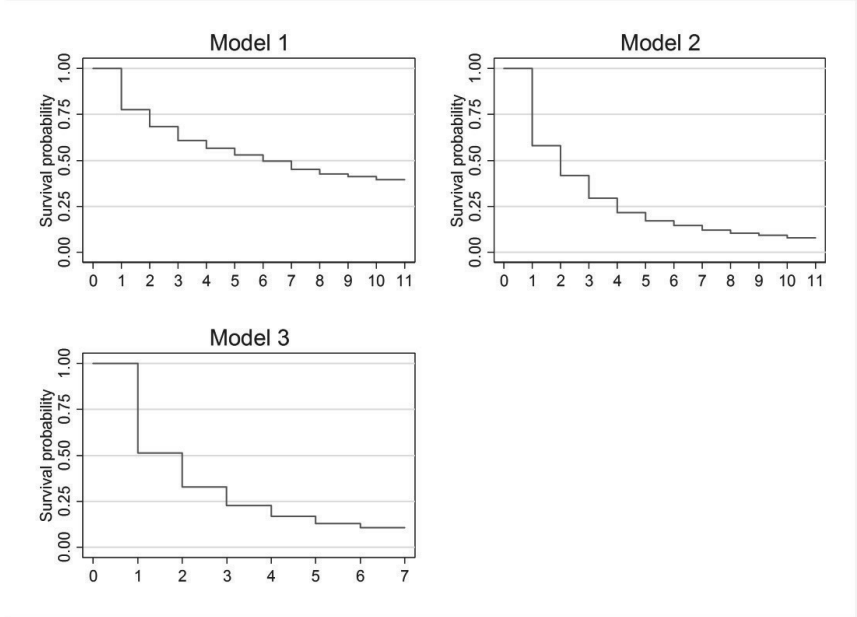
(5) $\hat{\lambda}(T_k) = \frac{h_k}{n_k}$

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.

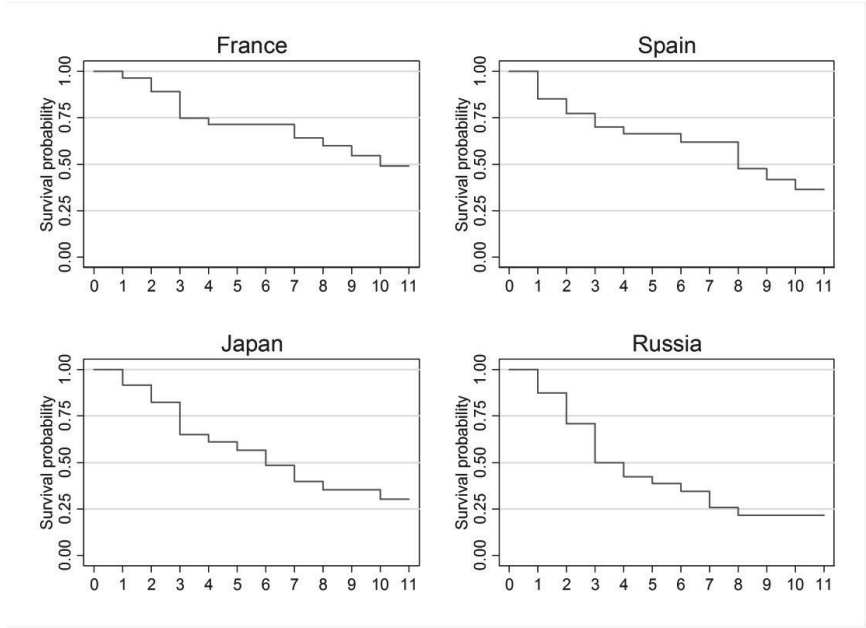
the potential problems of left-censoring in the data, but choose to focus our analysis on the full sample, given the large number of obserations that otherwise must be deleted.

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.

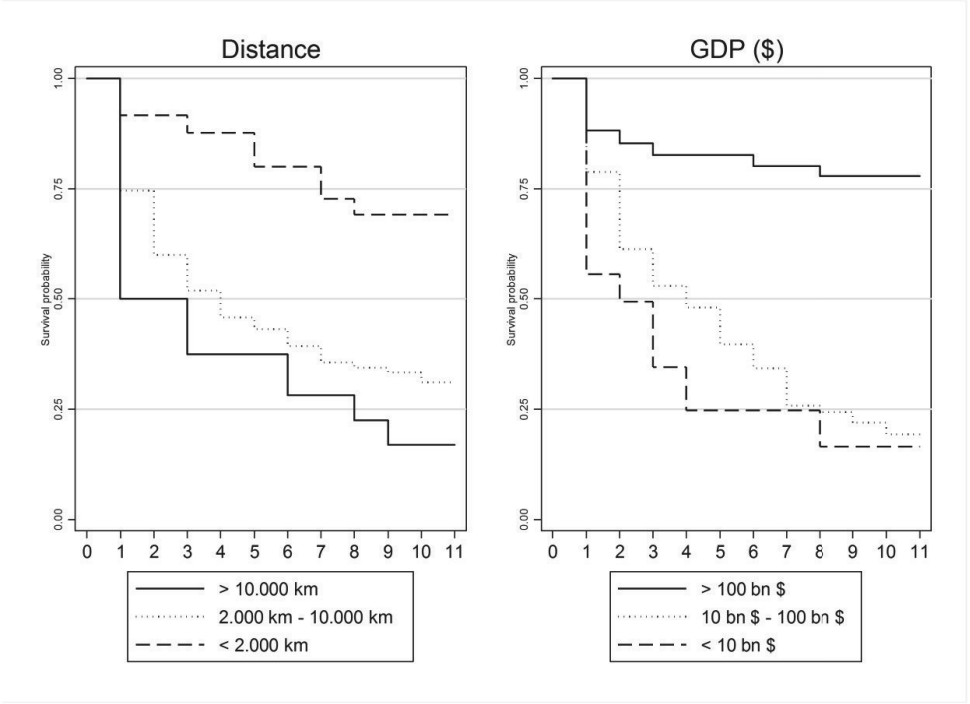
addressing the discussion on duration of trade relationships. Table 3 reports summary statistics for the explanatory variables. The two last varaibles are only calculated for 2003-2009, the others for 1999-2009.

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:

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

$Y_{i,t}$ 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

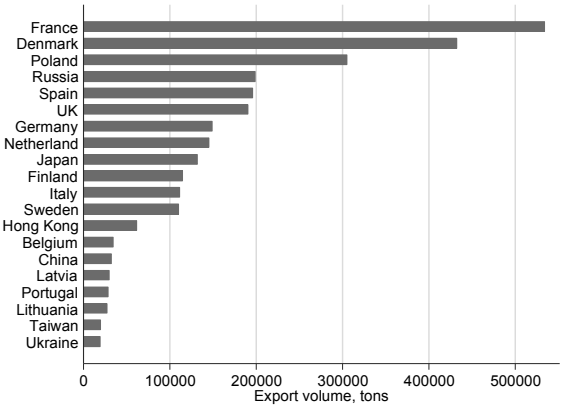

Figure A.2: Kaplan-Meier estimates. Groups of firms.

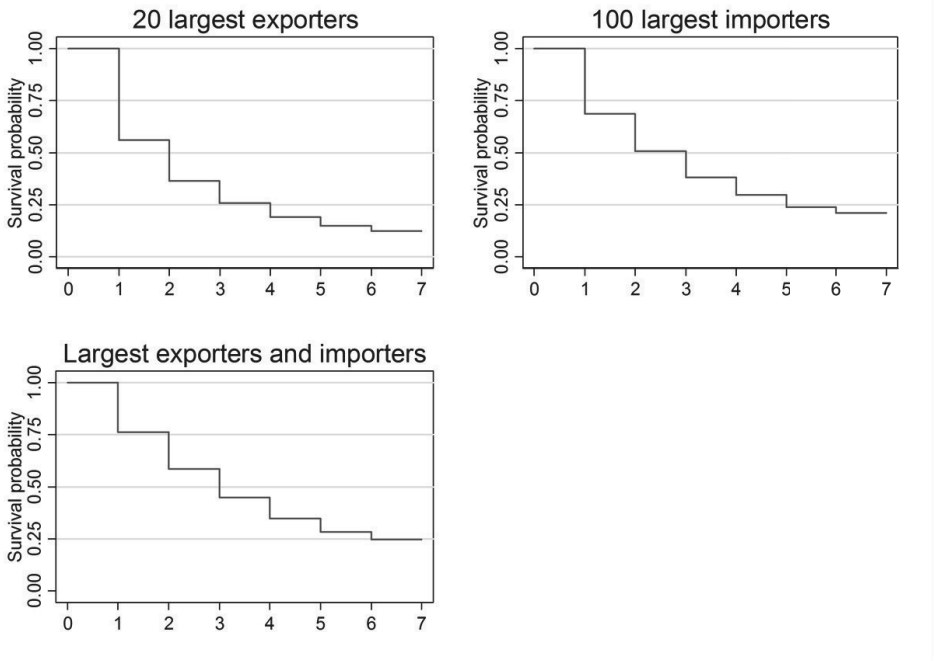

Table A.1: Number of trades and length of spells in the data, sample reduced to the 20 largest destinations

	Length of spells				Number of trades				# observations
			Percentiles				Percentiles		
	Mean	Median	5th	95th	Mean	Median	5th	95th	
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

Chapter 4: Currency Invoicing in Norwegian Salmon Export

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Currency Invoicing in Norwegian Salmon Export

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Abstract: The purpose of this paper is to examine the choice of currency for Norwegian salmon exporters. The choice of invoicing currency will affect prices in different markets as well as risk, factors that are increasingly important as the supply chain for salmon is becoming more sophisticated and more transactions mechanisms are introduced. The results indicate that destination-specific market characteristics have impacts as to the choice of invoicing strategy. Norwegian salmon exporters primarily invoice in the export market currency (47% of the exported quantity), but also use a vehicle currency and producer pricing (19%) in a significant number of transactions. The euro is the preferred vehicle currency (18%), closely followed by US dollar (USD) (16%). The USD is the dominating invoicing currency for exports beyond Europe.

Key words: Invoicing currency, Multinomial logit, Salmon Aquaculture, Vehicle currencies
JEL Classification Codes: F14, Q22

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Introduction

Choice of invoicing currency is a topic that has gained much attention in the theoretical literature in international trade for several decades. If one assumes that an exporter is free to determine the invoicing currency, three different strategies are available. An exporter who is concerned about exchange rate risk would set the prices in the domestic currency. This is known as "producer currency pricing" (PCP). The prices can also be set in the importer's currency, a "local currency pricing" strategy (LCP). This would be the case for an exporter who can exercise market power or conduct so-called "pricing-to-market" (Krugman 1987), but can also be due to other factors that do not imply oligopolistic behavior, such as currency convertibility. Finally, the exporter could set the price in a major "world" currency, a "vehicle currency pricing" strategy (VCP), which is typically the US dollar (USD), euro, or Japanese yen. McKinnon (1979) argues that trade in homogenous primary goods should be conducted in a single vehicle currency as market efficiency increases if prices are expressed in the same currency.[1]

The theoretical literature holds a number of insights with respect to the choice of invoicing currency that depends on market and product characteristics. As more detailed data on the transaction level has become available for some countries/industries, empirical testing of the different predictions has become possible. Goldberg and Tille (2009) study invoicing strategies for Canadian imports. They argue that when the traded goods have close substitutes, the trades are rarely invoiced in the exporters' currency, with the exception of exporters from the US[2], and that exporters with a volatile exchange rate make little use of their own currency. Goldberg and Tille (2009) also establish a relationship between transaction size and choice of invoicing currency, where large volumes are generally invoiced in the importers' currency. This finding may indicate that the bargaining power between the exporter and importer matter for the choice of invoicing currency and that the relevant bargaining tool for the importer is transaction size.

In recent years, there have been dramatic changes in the supply chains for many seafood products. The market has become global for a number of species (Asche et al. 2012; Tveterås et al. 2012), and growth of large retail chains has led to increased concentration downstream (Murray and Fofana 2002; Guillotreau, Le Grel, and Simioni 2005; Guillotreau and Jiménez-Toribio 2011; Asche et al. 2011a,b). The focus of retail chains on efficient logistics has led to

increased coordination upstream (Kvaløy and Tveterås 2008; Olson and Criddel 2008) as well as the creation of very large production companies (Asche et al. 2013).[3] Salmon is among the most successful aquaculture species in terms of increased production growth. This is largely due to substantial productivity growth through the supply chain from suppliers (Tveterås and Heshmati 2002), at the farms (Nilsen 2010; Vassdal and Holst 2011; Roll 2013; Asche and Roll 2013, Asche, Guttormsen, and Nielsen 2013) and in the supply chain (Asche, Roll, and Tveterås 2007). Increasingly, more sophisticated transaction methods are being used such as contracts (Larsen and Asche 2011) and futures contracts (Sollibakke 2012; Oglend 2013), as well as integration through mergers (Asche et al. 2013).[4] This has made salmon the species with one of the most varied transaction modes in the seafood market. It also means that the strategy with respect to invoicing currency can be an important factor for a producer's competitiveness.

This article analyzes different determinants of currency invoicing in the exports of fresh and frozen salmon from Norway, the leading salmon producing country.[5] There are two main topics herein; first a descriptive analysis is provided for the invoicing pattern from Norwegian exporters to different destination regions. This is to shed light on issues such as the importance of vehicle currencies in different regions. Second, results from a more stringent empirical analysis, for which more factors can be controlled is conducted using a multinomial logit model. This is a widely used approach in empirical analysis of invoicing currency (Donnenfeld and Haug 2003; Wilander 2006). In this analysis, the effect of factor such as firm size, transaction size, distance, import market size, wealth, exchange rate volatility, trading frequency and competitive pressure in the destination market will be investigated.

Literature Review

There exists a rich theoretical literature on the choice of currency in international trade.[6] Some highlighted findings from theoretical studies is that if the firm's choice of invoicing currency depends on the currency choice of its competitors, it is optimal to invoice their trades in the same currency as its competitors, that currencies from countries with monetary stability are most likely to be chosen as invoicing currencies, and that elasticity of demand and exchange rate volatility are important factors behind currency choice (Kamps 2006).

Grassman (1973) provides the first empirical analysis of choice of invoicing currency. He finds that when there is trade between an industrialized country and a developing country, the trades are mainly invoiced in the currency of the industrialized country or in a third currency, and that invoicing patterns differ by product type. McKinnon (1979) suggests that trade in homogeneous products, such as oil and primary commodities, will mainly be invoiced in USD or another vehicle currency with low transaction costs, while in trades of differentiated products, invoicing in the exporters' currency is preferred. Page (1981) shows that a high share of international trade flows are invoiced in major currencies, some of them used as vehicle currencies. This first strain of empirical studies, which are at an aggregated level and descriptive in nature, indicates that the use of a vehicle currency will be most important for trades between advanced economies and developing countries. Trades between advanced economies are mainly invoiced in the currency of the exporter.

More recently, better data combined with improved econometric techniques have increased the number of empirical studies investigating the choice of invoicing currency. The impact of different explanatory variables on currency choice is not straightforward. In many cases the econometric results seems to depend heavily on the aggregation level, the direction of the trade (import or export), and whether the trading partner country is known. The econometric study by Donnenfeld and Haug (2003) is the first on the choice of invoicing currency. They investigate Canadian import data for 12 different industries at the 6-digit HS-level for the period 1989Q1-1994Q4[7]. They establish a positive relationship between exchange rate risk and the use of LCP in some of their estimations, but they are not able to establish such a relation as an overall finding for all industries. They also argue that a large gross domestic product (GDP) in the exporting country (large home market) relative to the importers' GDP favors PCP.

Kamps (2006) explores the use of the euro as invoicing currency and offers a comparison of the use of the euro and the USD as world vehicle currencies. Not surprisingly the euro has become more important both as a vehicle currency, and for LCP and PCP over the last decade. However, Kamps (2006) argues that relative to the USD, the role of the euro as a vehicle currency is limited. If a country exhibits high exchange rate volatility with respect to the euro, the probability for its use as a vehicle currency increases. Kamps (2006) states that, "this is particularly true for the countries with the prospect of adopting the euro at some point in the future".

Goldberg and Tille (2008) also document increasing importance of the euro as invoicing currency for the EU and accession countries. Ito et al. (2010) discuss limited use of the yen in trade invoicing for Japanese exporters. They find that Japanese exporters commonly use LCP in exports to advanced economies, and the USD in exports to East-Asia. One possible reason for regional invoicing differences in the case of salmon can be that the exporters make use of historically dominant vehicle currencies in specific markets. Another possible reason is that firms seek to set prices that do not deviate from the prices of their competitors (Fukuda and Ono 2006). In this setting, if one leading (or sufficiently many) exporter(s) invoices in a vehicle currency on a regular basis, the probability for other exporters to also invoice in the third currency increases.

Wilander (2006) studies the choice of invoicing currency in Swedish exports at the industry level for the period 1999-2002. In his study, exchange rate risk is measured as exchange rate volatility, and he finds a negative relationship between exchange rate volatility and the use of LCP. Wilander (2006) also argues that low inflation will favor LCP, and that increased efficiency in financial markets in the importing country decreases the probability for PCP. In the case of the Swedish export industries, it is found that about 25% of the trades in paper and pulp are invoiced in Swedish krona (SEK), while about 60% of the trades in motor vehicles are invoiced in SEK. This finding may indicate that there is a lower probability for using producer currency pricing for less differentiated products. Friberg and Wilander (2008) survey the currency choice of Swedish exporters. Some interesting findings in this study are that negotiations between the parts in the transaction are important for both choice of currency and price. The most used currency is the currency of the customer. Posted prices are only used by a few firms; almost all export prices are set after negotiations between the parts. The firms also report that in nearly all cases the settlement currency is equal to the invoicing currency. Ito et al. (2010) investigate the choice of invoicing currency for 23 Japanese exporters in 4 different industries and find that Japanese firms tend to favor LCP when the destination country is an advanced economy. They argue that the USD is the most common currency for trades in Asian markets, among exporters of highly differentiated products who tend to invoice in yen as the main exception. Ligthart and Werner (2012) analyze the effect of the introduction of the euro on the pattern of currency invoicing by investigating imports to Norway from different OECD-countries in the period 1996Q1-2006Q4. Their results indicate that the euro has overtaken the role of the USD as the main vehicle currency, as well as an increase in the use of PCP in the export from Eurozone countries. The main reason for the

increased use of euro is explained by lower inflation volatility. They observe a decline in the share of PCP in the Non-Eurozone countries.

Invoicing structure in Norwegian salmon exports

While Norwegian salmon exports are global, with exports to 113 countries, some markets are more important, and this will influence the choice of invoicing currency. About 50% of the total export (volume) of Norwegian seafood products is destined for markets within the EU, with France being the single largest market. In addition, both Russia and the Ukraine are important growth markets in the East, and the Asian market has always been important. In this section an overview with respect to the choice of invoicing currency of Norwegian salmon exports to different destinations is provided. Table 1 summarizes the overall use of different currencies observed in the data[8].

The Euro is the dominant invoicing currency for fresh salmon. It is used in 48% of all observed trades, accounting for 56% of the total export volume over the period 2003-2009. The USD is second most important (12% of the volume), with NOK being the third most favored invoicing currency by the sellers (20% of the total export volume). Of the total volume being invoiced in USD, only about 2% are destined for the US; almost 98% of the volume invoiced in USD employs USD as a vehicle currency. The situation is remarkably different for exports to the EU. The use of the euro as a vehicle currency applies only to about 22.50 % of the total volume invoiced. The use of SEK and GBP are almost 100% LCP[9]; e.g. the currencies are used almost exclusively for export to Sweden and the United Kingdom.

In the case of frozen salmon, the USD is used in 61% of the trades, accounting for 69.5% of the volume. Approximately 8% of the trades invoiced in USD have the US as their destination. The USD is frequently used as a vehicle currency for trades to Russia, the Ukraine, and several Asian markets. For frozen salmon, most of the trades invoiced in NOK are destined for Israel, Sweden, and Russia. About 8% of the trades in euro are those where euro is used as a vehicle currency, with Russia being the most important destination. Hence, the USD is clearly the most common vehicle currency for Norwegian salmon; in some areas the euro is also used as a vehicle currency. In total, the euro is the most important currency due to LCP pricing. As the NOK is the third most common currency, there is also substantial evidence of PCP, indicating that all forms of invoicing strategies are used on a relatively large scale in Norwegian salmon exports.

Considering fresh and frozen salmon combined, PCP is being used for 19% of the volume (16% of the transactions) and LCP is used for 47% of the export volume (55% of the transactions). For the two types of vehicle currencies, the euro is used for 18% of the volume (10% of the transactions) and the USD for 16% of the export volume (19% of the transactions).

The sum of annual export averages of fresh salmon by destination is reported in the left panel of figure 1, with frozen salmon in the right panel. The single most important destination for fresh salmon in the period is France, followed by Denmark and Poland. Russia clearly dominated the demand for frozen salmon.

Figure 2 provides a description of the composition of invoicing currencies to different regions for fresh salmon. The figures indicate substantial heterogeneity in the invoicing pattern to different destination markets when focusing on the major currencies in each region. For fresh salmon, most of exports to Scandinavian countries are invoiced in euros and NOK, but there are also some transactions to Sweden and Denmark where LCP is used. More LCP is used in Sweden, rather than Denmark. One can also observe a decline in the use of PCP (NOK) to the Scandinavian countries over time.

The euro has overtaken as the dominant invoicing currency for exports to Eastern Europe over time, primarily at the expense of NOK, while the use of the USD is relatively stable. Thus the latter has a small decline over the period. In the case of Asia, the use of the USD increased during the period. The use of Japanese yen has declined; a reflection of Japan's reduced share of the exports rather than a shift in invoicing strategy. In the EU, the euro dominates, although there are also a number of transactions in NOK.

Data and model specification

The data used is transaction data on all Norwegian exports of fresh and frozen salmon, and is provided by Statistics Norway. The data is recorded from the custom's declaration for each individual export transaction of fresh and frozen salmon in the period 2003-2009. The total number of reported trades of fresh salmon during these years is 519,149, while it is 21,251 for frozen salmon. In each observation it is possible to identify both the exporting firm and the

destination country for the shipment. There are 343 different exporters represented in the data, who supply a total of 113 different destination markets[10]. Other important variables are the date of the transaction, quantity in kilos, transaction value (in NOK), and invoicing currency.[11]

The choice of invoicing currency is assessed using a multinomial logit model (Greene 2008). Thus, the choice of currency made by the firm for each transaction must be made from one of four options: PCP, LCP, euro as a vehicle currency, or USD as vehicle currency. This gives a dependent variable coded with the values 1, 2, 3, or 4, respectively. Formally, the model takes the following form:

$$\Pr(Y_{i,t} = k) = \frac{e^{\beta_j \mathbf{x}_{i,t}}}{\sum_{j=1}^{4} e^{\beta_j \mathbf{x}_{i,t}}}, \text{ where k=1,2,3,4,} \quad (1)$$

Where $Y_{i,t}$ represents the chosen currency for trade between a given firm, *i*, and a given destination in year *t*. The model is normalized by setting invoicing in NOK (PCP) as the base category. The independent variables are included in the vector x. The reported coefficients will be the marginal effects of the individual specific characteristics on the choice probability. The size of the marginal effects in a multinomial logit model can be somewhat difficult to interpret, so in the results section the focus will be on the estimated sign and significance levels.

The following independent variables are used. Total yearly import volume in the destination market is included as a measure of the importance of the market. The number of trades is included as a measure of trade regularity and is expected to work in disfavor of the use of a vehicle currency. The variance in the exchange rate is calculated as the variance of the difference in the log-monthly exchange rates between Norway and the destination country. This variable is included to capture the potential effect of exchange rate variation on choice of currency. The real exchange rate is measured as the real value of the Norwegian currency; i.e., an increase in the real exchange rate means a real depreciation of NOK. A real depreciation of NOK may make it more favorable for the importer to use PCP when the NOK becomes cheaper relative to the local currency. To control for the size of the destination market we include GDP, and GDP per capita is included as a control for consumer wealth. Two dummy-variables are included. One is to control for the EU-countries that have not adopted the euro

as their local currency, as these countries are expected to to have a stronger preference for euros as a vehicle currency. A second dummy is included to control for trade of frozen salmon, which, because of its storability, may differ from fresh salmon. The inflation rate difference between Norway and the destination country is included as a measure for monetary stability. One would expect that high inflation in the destination country will make it less favorable for the importer to use LCP. Data for exchange rates, inflation, GDP and GDP per capita is taken from International Monetary Fund (IMF) and the World Bank[12]. Geographical distance is included, as the literature indicates that this is often an important variable. Data for geographical distance is obtained from CEPII.[13] Most of the explanatory variables are standard in the literature. However, the fact that firm data is available allows some additional factors to be investigated. The firm-specific factors included as independent variables are firm size (total exports), firm to destination-specific export, the number of Norwegian competitors in the destination market, and trade frequency. The number of exporters to a given destination market is included to control for competitive pressure in the destination market. To measure trade frequency, the firm's total number of trades to destination is included.

Finally a set of regional control dummies is included. The data is aggregated to yearly observations and sorted by invoicing currency.

Empirical results

The results from the multinomial logit model outlined above are reported in table 2, with different columns for the probability of pricing in LCP, euro as vehicle, and USD as vehicle relative to PCP in NOK, respectively. Hence, a positive effect indicates that it is less likely that invoicing is in NOK. As one can see, most estimated parameters are statistically significant, and all explanatory variables have a statistically significant impact for at least one of the choices. However, in a few cases the estimated sign of the coefficients is not in accordance with what we would expect.

In table 2 the independent variables are grouped in three categories. In the first group, the estimates from the standard explanatory variables used in the literature are reported. The second group reports the average marginal effects on the choice of invoicing currency from firm-specific variables. Finally, the effects from a set of dummies are reported in the third group.

Geographical distance between the exporter and the destination market is used as a proxy for transportation costs. The probability of invoicing in the producer currency (NOK) increases with distance[14]. This effect is not in accordance with what we expect, since increased distance from home should make the home currency less familiar.[15] We see that increased distance also decreases the probability for the use of the euro as a vehicle currency, and increase the probability for the use of the USD as a vehicle currency. This result is in accordance with what we expect. Increased GDP and GDP per capita increase the probability of invoicing in the importers' currency. One possible explanation for this result is offered in Krugman (1984), who argues that firms from small countries may be more experienced dealing with exchange rates, so when they trade with larger countries the probability of using the large country's exchange rate may increase. This finding is also in line with the findings of Donnenfeld and Haug (2003). Higher GDP and GDP per capita also decrease the probability of using vehicle currencies.

Increased exchange rate variation decreases the probability for the use of LCP[16] and the euro as a vehicle currency, but increases the probability for use of the USD as a vehicle currency relative to the use of NOK (PCP). The latter indicates that if the variation between the NOK and the exchange rate of the importer increases and the firm substitutes towards a vehicle currency, the USD will be the preferred choice. This result is in line with the findings in Wilander (2006), but the opposite is found in Donnenfeld and Haug (2003)[17]. Kamps (2006) also discusses the link between exchange rate variation and the use of LCP and argues that "high exchange rate risk only leads to LCP if the products are not highly differentiated". This may also be interpreted as a preference for hard currencies, which may be particularly prevalent in the seafood trade where the EU, Japan and the USA makes up about three quarters of all seafood imports (Smith et al. 2010; Tveterås et al. 2012).

The inflation difference will be significant at the 10% level, with a positive sign for invoicing in the importers' currency and at the 1% level for use of the USD as a vehicle currency. The finding that increased inflation difference increases the probability for LCP is opposite of the finding in Wilander (2006). But one must be aware that while Wilander (2006) includes inflation in the importing country as his independent variable, it is the inflation difference between Norway and the importing country that is the variable of interest in this study. One explanation for why increased inflation may cause more LCP is that macroeconomic volatility may shift the firms' invoicing strategies towards more stable international fundamentals. The

negative sign on the real exchange measure in the first column of table 2 indicates that a real depreciation of the NOK makes it more favorable for invoicing in PCP than LCP. If a vehicle currency is being used a real depreciation of the NOK decreases the probability of using the USD and increases the probability for using the euro as the vehicle currency. The last independent variable included in the first category in table 2 is the log of the total import of salmon in the destination country. Higher imports of salmon in the destination country increase the probability for invoicing in the importer's currency, and decrease the probability for use of one of the vehicle currencies at the expense of pricing in the domestic currency (PCP).

To control for firm size, the exporters' total yearly export volume to all destination markets, as well as to a specific destination market, is included. The findings reported in the second category in table 2 indicate that increased firm size increases the probability of using LCP or one of the vehicle currencies relative to invoicing in the NOK. This can be interpreted as an indication that larger firms have a greater capacity to engage in specific markets and fits well with the drivers of horizontal and vertical integration described by Asche, Roll, and Tveterås (2007) and Kvaløy and Tveterås (2008), as well as the creation of larger firms due to scale and scope economies at levels in the supply chain downstream from production (Asche et al. 2013). However, the choice of LCP relative to PCP and export volume can also be due to different factors on the import side of the market. For instance, a shift from many small importers to a handful of large retail chains could result in more use of the importer's currency, a development observed in many seafood markets (Murray and Fofana 2002; Guillotreau, Le Grel, and Simioni 2005; Guillotreau and Jiménez-Toribio 2011; Asche et al. 2011a,b). The exporter's yearly number of trades to a destination is included to control for trade frequency. The results indicate that an increase in the firm's overall number of trades increases the probability for invoicing in the importer's currency, which also fits into this picture. However, when destination-specific volume is controlled for, the results indicates that firms that ship large volumes to a given destination prefer PCP at the expense of LCP or the USD as the vehicle currency. The number of Norwegian exporters to a given destination is included as a measure of market concentration. An increase in the number of exporters to a destination increases the probability for PCP instead of LCP or the use of the euro as the vehicle currency. This finding is in line with the prediction in the theoretical model of Bacchetta and van Wincoop (2005). A lower probability for invoicing in the importer's currency when the number of exporters increases is also in line with arguments provided by

Goldberg and Tille (2009). They argue that higher market shares for an exporting country reduce the use of the importers currency. One would expect that an increased market concentration implies higher market shares. Goldberg and Tille (2009) also argue that a firm may have a motive to invoice in the same currency as its competitors to limit fluctuations in relative prices; such a motive is strongest when the traded goods are close substitutes.

The estimated, average marginal effects related to the dummy variables are reported in the third category in table 2. Export to an EU-country that has not adopted the euro decreases the probability for use of LCP relatively to PCP. And export to such countries increases the probability for the use of the euro as a vehicle currency. It is not surprising that there is no tendency to increase use of the USD as the vehicle currency for these destination markets. Bacchetta and van Wincoop (2005) argue that if a firm exports to a currency union, one would expect that the likelihood of choosing LCP would increase. Export of frozen salmon increases the probability for use of the USD as a vehicle currency and decreases the probability for the use of the euro as a vehicle currency.

Furthermore, region-specific dummies have a significant effect on a firm's choice of invoicing currency. For trades destined for Asia, firms prefer PCP relative to LCP, and when their choice is between PCP and the USD, they choose use of the USD. For trades to Nordic countries, LCP is preferred over PCP. This effect is not what we expected to find. A common border should, ceteris paribus, tend firms to use PCP rather than LCP. When it comes to EU countries LCP, is a more common choice than PCP, and firms that trade with EU countries also prefer to use PCP than one of the two vehicle currencies. In the case of Eastern-European countries, the firms choose PCP over LCP and prefer to use the USD over PCP as a vehicle currency.

To check the robustness of the coefficients table 2 is reestimated without the observations from 2008, a year with much volatility in exchange rates. This exercise causes only minor changes in the coefficients. In addition, a multinomial probit model on the full sample is estimated. This additional estimation is reported in table A.2. For most of the independent variables this exercise causes only minor changes in the estimated coefficients[18]. One difference is that there is no longer any significant effect from exchange rate variation and inflation difference for the choice between PCP and LCP in the multinomial probit estimation.

In the multinomial logit reported in table 2, these two variables are significant, but only at the 10% level.

Conclusion

As salmon production continues to increase the market is becoming increasingly global, and transaction modes are becoming more sophisticated. This article provides an empirical analysis of one topic that has been shown to be important in the general international trade literature. An overall description of patterns shows that a number of modes are being used and that a substantial number of transactions are taking place using all the three main invoicing strategies described in the general literature. Given the importance of the European market it is not surprising that euro is the most commonly used currency, this is evidence of substantial LCP in this market. It is somewhat surprising that the USD is so frequently used in the export of salmon, indicating a substantial use of it as a vehicle currency given the moderate exports to the US. The euro is also used as a vehicle currency. But while the euro is confined to trades in Europe, the use of the USD is global. Surprisingly, yen is used (almost) only in trades to Japan, so it is not as a vehicle currency. With the NOK used for 15% of all transactions (19% of volume), PCP is also prevalent. However, most of these trades are with firms located in neighboring countries.

A number of factors influence salmon exporters choice of invoicing currency, and these does not seem to follow any absolute laws. The results indicate that as salmon export have grown over the last decade and new markets have been established, invoicing strategies have changed. An important factor for changes in the use of different currencies is probably the establishment of the euro. As more countries adopt and incorporate the euro, invoicing in euro becomes more attractive for Norwegian exporters. Such invoicing strategy lowers the risk regarding price volatility. Specifically, in the case of fresh salmon, the importance of the NOK as an invoicing currency has largely been overtaken by the euro. In Asia, the role of the Japanese yen has decreased as use of the USD as a vehicle currency has become more prevalent. This is partially due to the declining importance of the Japanese market. For exports of frozen salmon to Asia, the use of the NOK became more important after 2007, at the expense of the USD. Variation in invoicing patterns in different markets and over time, shows that this is another dimension that can influence competitiveness through the supply chain, and is an important factor in the competitiveness of salmon aquaculture (Asche, Roll, and Tveterås 2007). Invoicing strategy is thus one element in the transaction strategy of

salmon exporters in addition to contracts, vertical integration, and futures contracts as investigated by Kvaløy and Tveterås (2008), Larsen and Asche (2011), Solibakke (2012), and Oglend (2013).

NOTES

[1] McKinnon (1979) also argues that highly differentiated products should be invoiced in the home currency.
[2] It is argued that this could be due to industry "herding" behavior in a common invoicing currency.
[3] Increased coordination in the supply chain has also led to more focus on different product attributes that also have value (Roheim, Gardiner, and Asche 2007; Roheim, Asche, and Insignaris 2011; Sogn-Grundvåg, Larsen, and Young 2013).
[4] These tools are also used to address production risk (Asche and Tveterås, 1999; Tveterås 2000; Tveterås and Battese 2006) and price risk (Guttormsen 1999; Oglend and Sikveland 2008) is prevalent. Industry structure can also be used to address risks (Oglend and Tveterås 2009; Hermansen and Heen 2012). More inelastic demand and suppy has also contributed to increased price risk (Asche 1996; Andersen, Roll, and Tveterås 2008; Aasheim et al. 2011).
[5] There has been little focus on the impact of exchange rate movements in the seafood literature in general. Tveterås and Asche (2008) show that exchange rates do not impede market efficiency for salmon and fishmeal, while Larsen and Kinnucan (2009) show efficient price transmission for salmon. Xie, Kinnucan, and Myrland (2009) show that exchange rate movements are split according to slopes of the demand and supply schedules. As demand for salmon becomes more inelastic, consumers take a larger share of the burden (Asche 1996).
[6] A non-exhaustive list of important studies is Baron (1976), Giovanni (1988), Donnenfeld and Zilcha (1991), Johnson and Pick (1997), Friberg (1998), Devereux, Engel, and Storgaard (2004), Bacchetta and van Wincoop (2005), Engel (2006), Floden and Wilander (2006), and Witte (2010).
[7] They do not investigate differences between the industries.
[8] Table A1 summarizes the choice of PCP, LCP, and vehicle currencies, for export to the 25 largest destination markets for fresh farmed salmon. Specifically, we see that exports of salmon from Norway to the largest destinations are predominantly invoiced in the currency of the trading partner (LCP), or USD. Only a little less than 15 % of the trades to the 25 largest destinations are invoiced in Norwegian kroner (PCP). Important destination markets in the EU, such as France, Spain, and Germany, almost exclusively denominate the import of salmon in euro (LCP). Another striking feature is the use of Japanese yen in the imports to Japan; 95% of all trades in the period are being denominated in LCP.
[9] As an example, of all fresh salmon shipments in Swedish kronor (SEK), only 5 are registered with a different destination country.
[10] In some cases, both firms and destinations may contain only one observation.
[11] Given the result of the investigation of settlement currency vs. invoicing currency in Friberg and Wilander (2008), it is assumed that the currency reported as the invoicing currency is also the currency used in the actual settlement of the transaction.
[12] More specifically IMF's "International Financial Statistics", and the World Bank's "World Development Indicators".
[13] CEPII's GeoDist databse (http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=6).
[14] For the choice between LCP and PCP, the distance variable is significant at the 10% level.
[15] I have done experiments introducing a dummy variable for Denmark and Sweden. Firms from these countries are supposed to be familiar with the use of NOK, and, therefore are less reluctant to use it. In this case, the sign of the distance coefficient goes from negative to positive. However, using this dummy variable interferes with the use of the region dummies. I have, therefore, not reported these results.
[16] For the choice between LCP and PCP, the variable for exchange rate variation is significant at the 10% level.
[17] Donnenfeld and Haug (2003) are able to establish only a significant positive relationship between exchange rate volatility and local currency pricing for 2 out of 24 estimations. This is a fragile result (Kamps 2006).
[18] A well-known problem associated with the multinomial logit model is the independence of irrelevant alternatives assumption. The multinomial probit reported in the appendix relaxes the IIA-assumption (Cameron and Trivedi 2010).

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Table 1: Types and shares of currencies and volume by product, 2003-2009

	Fresh Salmon				Frozen Salmon			
Currency	# Obs.	Share, Currency	Tons	Share Tons	# Obs.	Share, Currency	Tons	Share Tons
Euro	249,008	47.96	1,689,821	56.04	2,390	11.25	20,901	6.61
USD	108,815	20.96	362,086	12.01	12,959	60.98	219,581	69.48
NOK	78,959	15.21	608,145	20.17	4,871	22.92	59,441	18.81
Japanese yen	43,778	8.43	129,343	4.29	394	1.85	6,684	2.12
Swedish kr.	14,816	2.85	24,406	0.81	63	0.30	293	0.09
British pound	12,105	2.33	171,502	5.69	509	2.40	8,985	2.84
Swiss franc	7,147	1.38	6,004	0.20	12	0.06	10	0.00
Singapore dollar	2,372	0.47	3,958	0.13	0	0	0	0.00
Danish kr.	2,072	0.40	19,694	0.65	28	0.13	0	0.00
Australia dollar	46	0.01	45	0.00	20	0.09	92	0.03
Polish zloty	16	0	201	0.01	0	0	0	0.00
Canadian dollar	10	0	14	0.00	5	0.02	27	0.01
Latvian Lat	2	0	25	0.00	0	0	0	0.00
Estonian Kroon	1	0	20	0.00	0	0	0	0.00
Pakistani Rupi	1	0	2	0.00	0	0	0	0.00
Indian Rupi	1	0	17	0.00	0	0	0	0.00
Total	519,149	100	3,015,281	100	21,251	100	316,014	100

Figure 1: The 25 Most Important Destinations by Product (annual averages over the whole period)

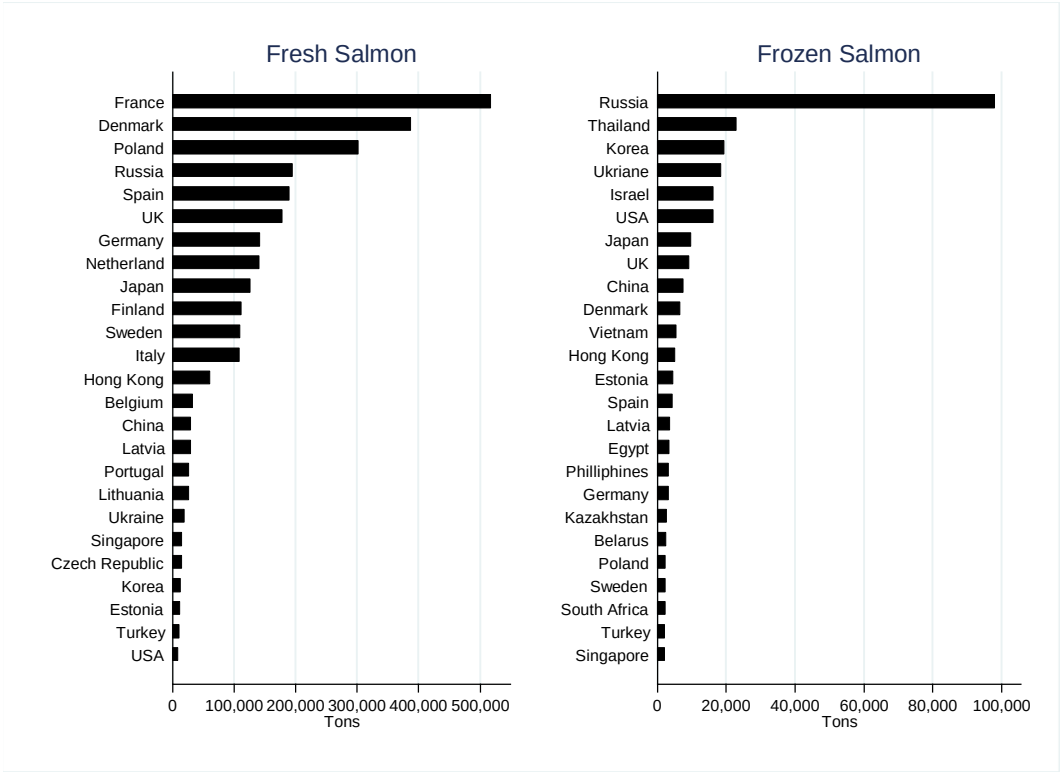

Figure 2. Regional Invoicing Differences, Fresh Salmon

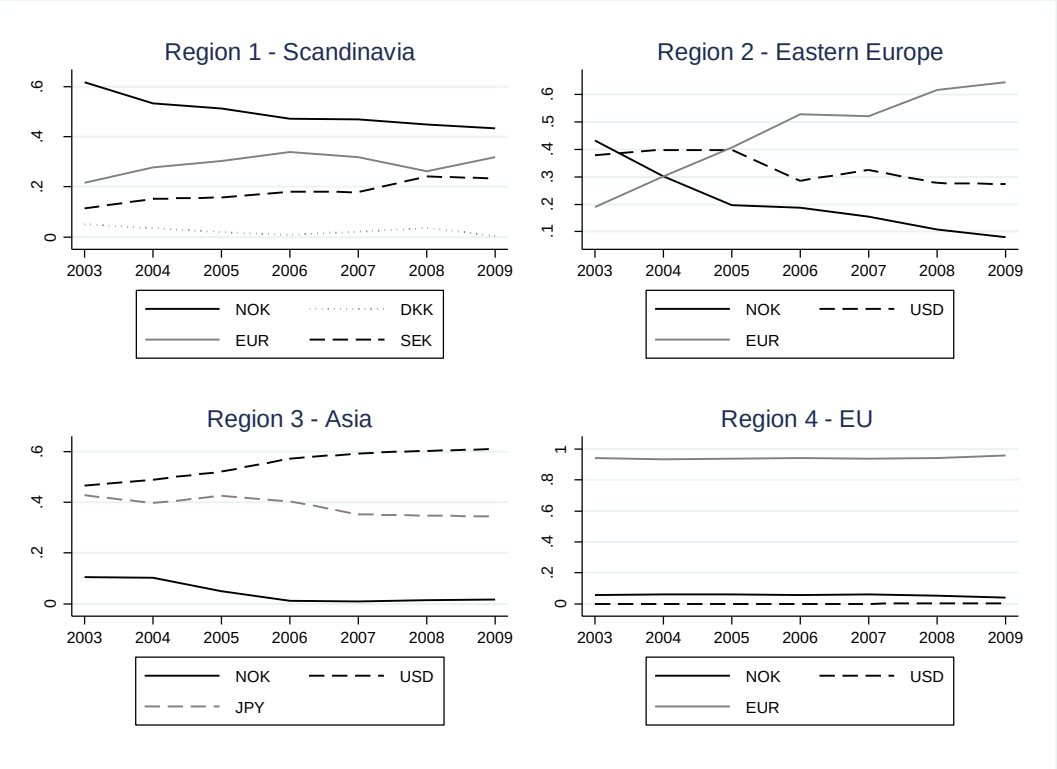

Table 2. Average Marginal Effects, Choice of Invoicing Currency

	PCP vs. LCP	PCP vs. Vehicle (EUR)	PCP vs. Vehicle (USD)
ln Geographical distance	-0.028	-0.110***	0.088***
	(0.015)	(0.013)	(0.013)
ln GDP	0.061***	-0.013**	-0.026***
	(0.006)	(0.005)	(0.005)
ln GDP per capita	0.114***	-0.032***	-0.014**
	(0.016)	(0.009)	(0.007)
Exchange rate variation	-0.009	-0.015***	0.026***
	(0.005)	(0.005)	(0.006)
Inflation difference	0.005	-0.000	0.006***
	(0.003)	(0.002)	(0.002)
ln-diff. Real Exchange Rate	-0.250***	0.298***	-0.192***
	(0.041)	(0.047)	(0.055)
ln Total import in destination country	0.016***	-0.011**	-0.015**
	(0.006)	(0.005)	(0.007)
ln Total export firm	0.012***	0.007**	0.013***
	(0.003)	(0.003)	(0.003)
ln Firm-to-destination volume	-0.034***	0.013***	-0.025***
	(0.005)	(0.004)	(0.006)
ln # trades to destination by firm	0.021***	-0.006	0.003
	(0.003)	(0.003)	(0.003)
ln # competitors in destination market	-0.038***	-0.023***	0.047***
	(0.012)	(0.009)	(0.012)
EU-member, no euro	-0.151***	0.093***	-0.011
	(0.022)	(0.013)	(0.017)
Trade of frozen salmon	-0.015	-0.090***	0.124***
	(0.013)	(0.010)	(0.012)
Asia	-0.200***	0.001	0.143***
	(0.059)	(0.034)	(0.022)
Nordic countries	0.082***	-0.098***	-0.058
	(0.028)	(0.023)	(0.038)
EU	0.133***	-0.177***	-0.115**
	(0.023)	(0.037)	(0.038)
East-Europe	-0.205**	-0.035	0.183***
	(0.032)	(0.025)	(0.028)
Obs.	7,425		

Note: Clustered standard errors in parentheses (exporting firm, destination country). Year dummies included. *** and ** denote significance at 1% and 5%, respectively.

Appendix

Table A 1: Share of Invoicing Currencies used in the 25 Largest Destination Markets. Fresh Salmon (Number of trades in parentheses)

Country	PCP (=NOK)	LCP	Vehicle (EUR)	Vehicle (USD)	Other Currencies, # Obs. in Parentheses	No.Obs.
France	*9.36 (6,191)*	*90.55% (59,888)*	*0*	*0% (2)*	*Swiss franc (1), British pound (44), Swedish kroner (2), Danish kroner (7)*	*66,135*
Denmark	*43.90 % (14,065)*	*6.34 % (2,032)*	*48.74 % (15,617)*	*0.11 % (35)*	*Swiss franc (256), British pound (27), Swedish kroner (2), Polish zloty (1)*	*32,035*
Poland	*23.23 % (5,600)*	*0.06 % (15)*	*76.63 % (18,471)*	*0.08 % (16)*	*British pound (1), Danish kroner (1)*	*24,104*
Russia	*11.73 % (1,568)*	*0*	*6.95 % (929)*	*81.30 % (10863)*	*British pound (1), Indian ruupi (1)*	*13,362*
Spain	*2.78 % (1,093)*	*97.20 % (38,168)*	*0*	*0.01 % (4)*	*Swedish kroner (1)*	*39,266*
United Kingdom	*7.25 % (961)*	*90.10% (11,941)*	*2.02 % (268)*	*0.60% (79)*	*Danish kroner (4)*	*13,253*
Germany	*1.91 % (399)*	*98.06% (20,528)*	*0*	*0*	*British pound (4), Danish kroner (4)*	*20,935*
Netherland	*7.27% (1,322)*	*90.88% (16,527)*	*0*	*0.86% (157)*	*Estonian kroon (1), British pound (3), Japanese yen (172), Swedish kroner (1)*	*18,186*
Japan	*3.67 % (1,672)*	*95.36% (43,447)*	*0% (1)*	*0.97 % (440)*	*Pakistani ruupi (1), Singapore dollar (1)*	*45,562*
Finland	*14.21% (1,271)*	*85.15% (7,618)*	*0*	*0.65% (58)*		*8,947*
Sweden	*62.36 % (25,794)*	*35.81% (14,810)*	*2.59% (658)*	*0.14% (59)*	*Danish kroner (20), British pound (7), Japanese yen (14)*	*41,362*
Italy	*7.36 % (2,069)*	*92.64% (26,051)*	*0*	*0% (1)*	*British pound (1)*	*28,122*
Hong Kong	*1.72% (544)*	*0*	*0.12% (39)*	*98.02% (30942)*	*Japanese yen (42)*	*31,567*
Belgium	*0.60% (89)*	*99.38% (14,672)*	*0*	*0.01% (1)*	*Japanese yen (1)*	*14,763*
China	*0.38% (63)*	*0*	*0.46% (77)*	*98.66% (16434)*	*Japanese yen (84)*	*16,658*
Latvia	*0.31% (14)*	*0.04% (2)*	*65.70% (2,948)*	*33.94% (15223)*		*4,487*
Portugal	*0.02% (2)*	*99.98% (9,212)*	*0*	*0*		*9,214*
Lithuania	*0.56% (18)*	*0*	*68.50% (2,185)*	*30.94% (987)*		*3,190*
Ukraine	*0.53% (11)*	*0*	*0.76% (16)*	*98.71% (2066)*		*2,093*
Singapore	*7.85% (675)*	*27.47% (2361)*	*0.01% (1)*	*64.63% (5554)*	*Danish kroner (1), Japanese yen (2)*	*8,594*
Czech Republic	*1.50% (44)*	*0*	*98.39% (2,879)*	*0.07% (2)*	*Swiss franc (1)*	*2,926*
Korea	*21.07% (1,581)*	*0*	*0.15% (11)*	*78.76% (5910)*	*Japanese yen (2)*	*7,504*
Estonia	*69.19% (1,534)*	*0*	*13.08% (290)*	*17.73% (393)*		*2,217*
Turkey	*95.42% (1,854)*	*0*	*4.27 (83)*	*0.31% (6)*		*1,943*
United States	*39.53% (1,532)*	*60.37% (2,340)*	*0.08% (3)*	*0*	*Japanese yen (1)*	*3,876*
Total (25 largest)	*14.76% (69,966)*	*56.88% (269,612)*	*9.38% (44,476)*	*18.82% (89,232)*	*0.15% (712)*	*473,998*

Table A.2. Average Marginal Effects, Choice of Invoicing Currency

	PCP vs. LCP	PCP vs. Vehicle (EUR)	PCP vs. Vehicle (USD)
ln Geographical distance	-0.028**	-0.105***	0.089***
	(0.014)	(0.012)	(0.013)
ln GDP	0.062***	-0.014***	-0.027***
	(0.006)	(0.005)	(0.005)
ln GDP per capita	0.112***	-0.028***	-0.019***
	(0.015)	(0.008)	(0.007)
Exchange rate variation	-0.007	-0.014***	0.025***
	(0.005)	(0.005)	(0.006)
Inflation difference	0.003	-0.000	0.006***
	(0.003)	(0.001)	(0.002)
ln-diff. Real Exchange Rate	-0.230***	0.270***	-0.200***
	(0.041)	(0.044)	(0.055)
ln Total import in destination country	0.013**	-0.010	-0.011
	(0.006)	(0.005)	(0.006)
ln Total export firm	0.012***	0.006**	0.014***
	(0.003)	(0.003)	(0.003)
ln Firm-to-destination volume	-0.033***	0.012***	-0.020***
	(0.005)	(0.004)	(0.005)
# Trades to destination by firm	0.021***	-0.005	-0.000
	(0.003)	(0.003)	(0.003)
# Competitors in destination market	-0.033***	-0.020**	0.040***
	(0.011)	(0.009)	(0.012)
EU-member, no euro	-0.141***	0.092***	-0.011
	(0.021)	(0.013)	(0.017)
Trade of frozen salmon	-0.018	-0.085***	0.123***
	(0.012)	(0.010)	(0.012)
Asia	-0.161***	0.014	0.132***
	(0.041)	(0.026)	(0.021)
Nordic countries	0.076***	-0.113***	-0.044***
	(0.026)	(0.022)	(0.032)
EU	0.140***	-0.174***	-0.081***
	(0.022)	(0.029)	(0.030)
East-Europe	-0.042	-0.053**	0.147***
	(0.059)	(0.023)	(0.026)
Obs.	7,425		

Note: Clustered standard errors in parentheses (exporting firm, destination country). Year dummies included. *** and ** denote significance at 1% and 5%, respectively.

Chapter 5: The performance of large versus specialized firms: A study of firms importing apples into Norway

The performance of large versus specialized firms: A study of firms importing apples into Norway

Hans-Martin Straume[1], Erling Vårdal[2]

Abstract: We use highly disaggregated Norwegian custom data of importing firms to investigate differences in obtained import prices in the period 2003-2009. In addition to the importing firm we are also able to identify the foreign exporter. The obtained import prices are related to firm characteristics as size of the firm, degree of specialization and also the chosen invoicing currency. Our focus is on one single product; fresh apples. We find a surprisingly high variation in import prices. It turns out that the firm specific variables, largeness and specialization, result in significantly lower import prices. In addition, if apples are priced in the currency of the exporter, he must accept a 13-18 per cent drop in the price he obtains. This effect proves to be highly significant.

Key words: import prices, firm specific factors, transaction data, tariff regimes

JEL classification : F15, Q17

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1. Introduction

An essential factor for the performance of importing firms is the price they obtain from their foreign connections. How successful firms are in this respect varies, as one can observe that the purchase price of almost homogenous commodities can differ markedly between firms. Firm-specific factors may be important in explaining this difference. Large firms, for example, can possess resources that make them able to outperform smaller firms in negotiating for a good price. But size is not the only relevant factor. Small, specialized firms can also be observed to do well. Such firms choose a narrow product line, and make a profit by concentrating on what they do well.

In this paper, we analyze if firm-specific factors, such as those mentioned above, matter for the purchase price of importing firms. As to line of business, we shall look at Norwegian firms that trade in fruits and vegetables, and we will study, in detail, firms that import apples to Norway. Next to bananas, apples come in as the largest imported product among fruits and vegetables, both according to volume, and in value. In Norway, the yearly per capita consumption of fresh apples is 12.1 kilos, which is close to the world average of 12.26 kilos (US International Trade Commission, 2010). Consumption of fresh apples from imports was 90%, and in 2009, the value of imported apples to Norway was approximately 60 million dollars.

The last decades have seen an increased attention towards the role of the firm in international trade. Focusing on US firms, Bernard et al. (2009) found that imports into, and exports from, the US are concentrated on a relatively small number of firms, and that the trading firms account for a disproportionate large share of total employment. This focus on the firm has led to an interest into studying the price behavior of firms trading internationally. Based on Hungarian customs data, Halpern and Koren (2007) have presented detailed research on the import price relating it to such characteristics as firm size and market power. This is the thread we will pursue in this paper.

In empirical studies of international trade in agricultural commodities, it is common to control for gravity variables such as distance, GDP and common borders. Atici and Guloglu (2006) found that distance had a strong negative effect on export of fresh fruits and vegetables from Turkey to countries in the EU. In a recent study, Allen (2014) also found this to be the case for trade in agricultural commodities between regions in the Philippines. While those studies

explored bilateral trade values, we focus on prices. Engel and Rogers (1996) are among the first to use the gravity model in price studies. They found that both distance, and crossing borders, matter for differences in consumer prices between US and Canadian cities. More recently, Manova and Zhang (2012) studied Chinese export prices for 6908 different products exported to 231 different destination markets from 96,522 Chinese firms in 2005. They found that distance plays a significant role in explaining price differences between destination markets.

Our research is based on customs data obtained from Statistics Norway. The novelty of our data set is that we are able to identify both the buyer and the seller in each shipment of apples from different countries of origin. In a recent paper, Bernard et al. (2014) also used buyer-seller linked customs data. Their study covers every Norwegian foreign trade, and looked for the importance of the foreign traders' heterogeneity in explaining trade patterns. The aim of our paper is different. Our focus is to study the price behavior of Norwegian importers within a specific industry. We examine how various types of firms fare in the competition to gain advantageous prices on the commodity they buy. Firm types are identified according to size and specialization. Furthermore, we know the invoicing currency, so we can measure the effect of the choice of invoicing currency on the import price. Lastly, we allow standard gravity variables to affect the import price received by the Norwegian importers.

In the season for Norwegian apples, from May through November, the authorities try to stabilize the price of apples. This effort is supported by a season-specific tariff. In Section 2, we describe, in detail, how this regulation of the market is conducted. Since the market functions quite differently during the two periods, we will also investigate the price formation in both periods.

In Sections 3-4, we present descriptive statistics for the main variables, and find some revealing features. First, we find considerable variation in our transaction-based price data. This feature does not conform to findings elsewhere in the literature. Based on survey data, Fabiani et al. (2005), for example, observed stable prices between buyers and sellers in the Euro Area. Second, we present descriptive survival rates that seem to indicate that relationships of importing firms are characterized by instability. The presence of short-lived trade relations on aggregated trade flows are well known in the literature, see for example Besedeš and Prusa (2006a) and Nitsch (2009). In addition, Besedeš and Prusa (2006b) found that trade relations are shorter for trade in homogeneous products than for trade in differentiated products. The

results from the econometric analysis are presented in Section 5. Lastly, in Section 6, we offer concluding remarks.

2. Institutional characteristics

It is well known that international trade in agricultural commodities, including apples, is heavily regulated. In this section we give the details of how this regulation is conducted in Norway. Last we give an overview of the size and pattern of the imports of apples into Norway.

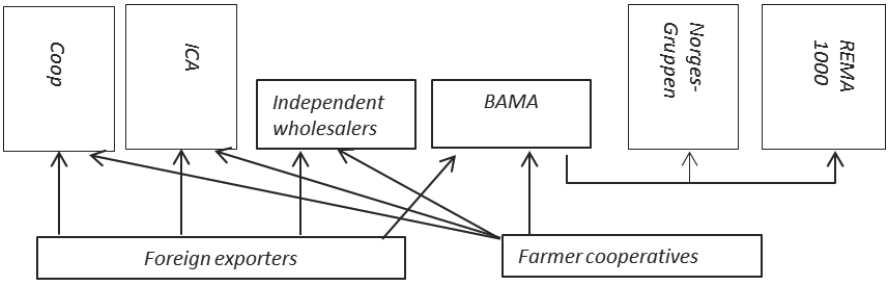
2.1 Market participants (Traders)

In the Norwegian market for fruits and vegetables we find five large wholesalers, as illustrated in Figure 1. BAMA is the largest with a market share of around 60 %. Moreover, we have four large vertically integrated firms; the consumer cooperative, Coop, the two private firms ICA and REMA 1000, and NorgesGruppen.[3] In addition, we have a small group of independent wholesalers. As shown in the figure, the wholesalers are connected to Norwegian farmers through farmer cooperatives.[4]

BAMA has an arrangement to deliver fruit to NorgesGruppen and REMA 1000.[5] Among the independent wholesalers, we have several firms that are specialized into imports of fruits and vegetables.

[3] NorgesGruppen is a cooperation of private shops; Meny/Ultra, Spar/Joker and Kiwi, in addition to other local shops.
[4] There are four farmer cooperatives of which Gartnerhallen SA is largest.
[5] The delivery of apples to REMA 1000 takes place through a separate distribution company.

Figure 1: Traders in the Norwegian market for fruit and vegetables



2.2 Market regulation

The import of apples into Norway is currently protected by a tariff during the period between May 1st and November 30th. With exceptions the tariff is set to NOK 4.83 per kg.[6] There are a small EU quota, and three WTO quotas, that are auctioned away.[7] Traders that participate in these auctions pay no tariff which means that the auction price is always below or equal to the tariff. In the period from December throughout April, the tariff is symbolically set to NOK 0.03 per kg.

The tariff is administered by the Norwegian Agricultural Authority (NAA). NAA also organizes the auctions, and can also reduce the tariff on a temporary basis.[8] Prices of products from Norwegian farmers are stabilized around target prices.[9] The target price for apples is tied to the price farmers receive on their sale to the farmer cooperatives. A stabilized price means that this wholesale price is +/-12 % around the target price. NAA organizes the practical details around stabilization of the wholesale price. If the wholesale price surpasses 12 % for two consecutive weeks, NAA will reduce the tariff on a temporary basis. If the price is below 12 %, the authorities will either finance storing of apples or try to motivate farmers to send apples into

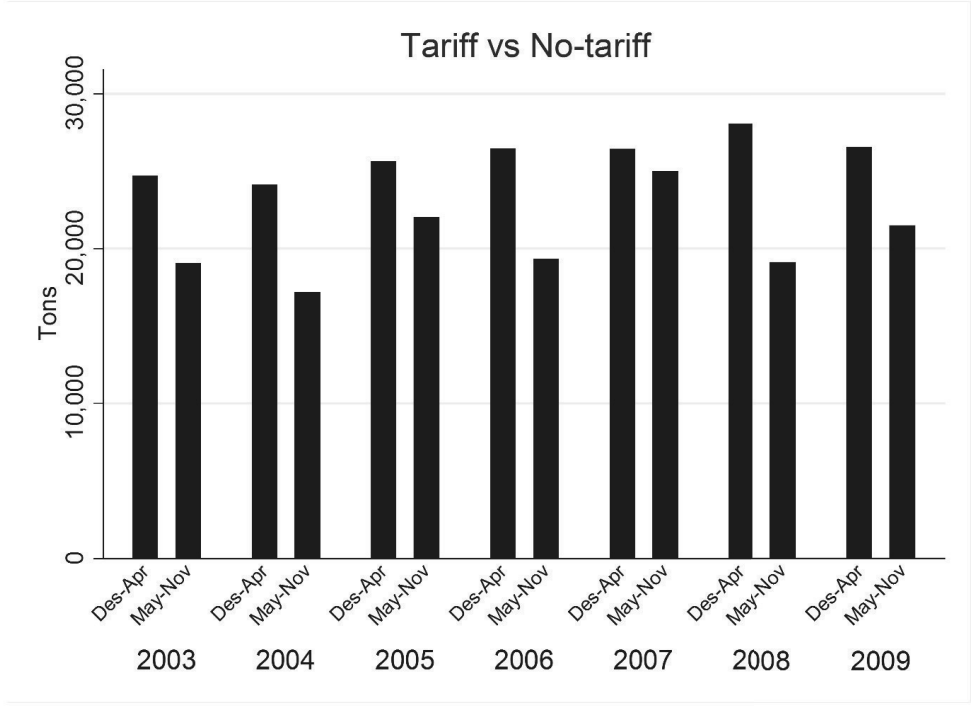
[6]The tariff for imports from Turkey and Tunis is 4.58 NOK/kg, and for imports from GSP and SACU-countries 4.11 NOK/kg.
[7]On a yearly basis, the quotas add up to 10 000 tons. For the sake of comparison, average yearly import (2003-2009) during the "tariff period" is 23 104 tons.
[8]As an example: If the Norwegian production period of apples is assumed to be late one year, NAA can open for tariff-free import of apples in, for example the first two weeks of May. In Table A.1 in the Appendix, we have specified the use of administrative tariff reduction for apples.
[9]The target prices are determined annually in negotiations between the Norwegian government and the two farmers' unions Norges Bondelag (the Norwegian Farmers' Union) and Norsk Bonde- og Småbrukarlag (the Norwegian Farmers' and Smallholders Union).

processing activities, such as juice. Usually, the wholesale price closely follows the target price. In Figure A.1 in the Appendix, we illustrate this for the year 2009.

2.3 The size and pattern of import

Figure 2 gives information on the yearly import of apples. In the figure, each year is divided into the tariff-free (December 1st-April 30th) and the tariff (May 1st-November 30th) period. It is striking that import of apples is not a seasonal phenomenon. It takes place evenly over the entire year with the import in the tariff-free period somewhat above that in the tariff period.[10]

Figure 2: Norwegian import of apples in tons, tariff and no-tariff period 2003-2009



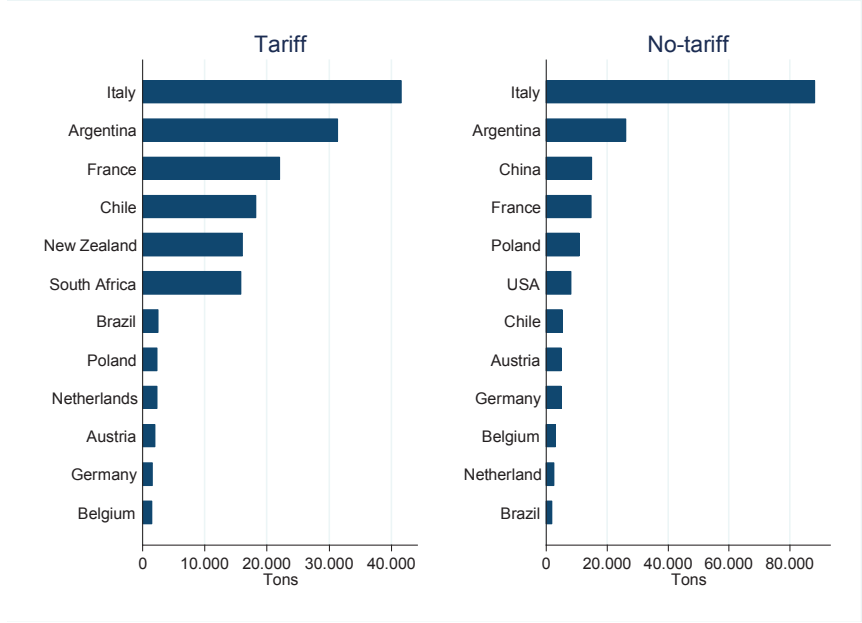
(Source: Statistics Norway)

Figure 3 below, lists the most important countries of origin for Norwegian importers. Most of the imported apples come from Italy, Argentina and France. For some countries, like New

[10]In Figure A.2 in the Appendix, we give further details in the form of domestic production and auction data.

Zealand and South Africa, almost all the import takes place in the tariff period. Naturally, the explanation is seasonal variations in production between countries in the southern- and northern hemispheres. According to the "Apples Industry and Trade Summary" from the US International Trade Commission (2010), the largest global markets for fresh apples are China, the US, and the EU. These are also the world's largest producers of apples.

Figure 3: The largest exporting countries 2003-2009



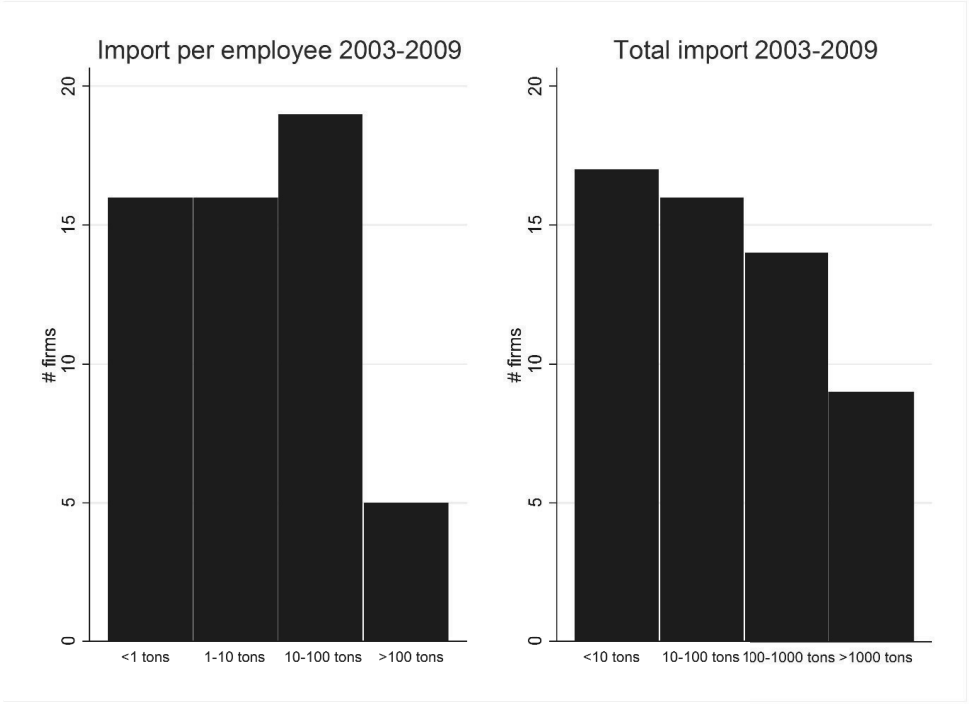
(Source: Statistics Norway)

3. Data and descriptive statistics

Our data set contains all the information we find in the customs declarations for import of fresh apples, collected by Statistics Norway, for the years 2003-2009. Fresh apples are covered by two different HS-codes in the Norwegian customs tariff; one for the tariff-free period, and the other for the tariff period. From the custom declarations, we take out the import date, the importing firm, the exporting firm, the country where the apples are harvested, the volume and value, and the invoice currency. In addition, Statistics Norway has provided us with the number of employees in the importing firms.

The data sample consists of 34,553 transactions, of which 18,516 belong to the tariff-free period.[11] The transactions originate from 36 different countries. A total of 1,533 foreign exporters and 56 different Norwegian firms are involved. The importing firms vary in size, as shown in the right panel in Figure 4, where the firms are grouped according to total import during the period. Most of the firms are in the smallest category. In the left panel, firms are grouped according to how large the import per employee is,[12] and we interpret this as the degree of specialization. Again, most of the firms are placed in the smallest category.

Figure 4: Firms' import per employee 2003-2009, and firms' total import 2003-2009.



In our study, we use the unit value (statistical value divided by volume in kilo) as a measure for the import price. Neither tariffs nor auction price are included in this price. Table 1 shows the distribution of the import price. We see that the variation in the apple price is high. In the tariff period, as much as 4.86 % of the transactions have kilo prices above NOK 20, while 6.42 %

[11] In the original data set we had 35 834 transactions. We had to delete 1281 of the transaction because of lack of GDP data for some of the foreign countries and lack of employment data for some of the importing firms.
[12] We have computed this as the total import during the period divided by the average number of employed persons over the period.

have kilo prices below NOK 5. Naturally, some of the variation is caused by price variation between years (see Figure 5). But even within a given month, in a given year, prices do vary considerably.[13]

In Table A.2 in the Appendix, we have grouped prices after country of origin. The price of apples from some countries is surprisingly high. For example, in the tariff period, the import of apples from Sweden is NOK 54.65, which is more than 5 times higher than the average. The reason for this variation might be preferences for rare types of apples, e.g. preferences for apples grown in a specific way (for example ecological). Naturally, the most expensive apples take a small part of the imported volume.

Table 1: Unit price. Share of transactions (%). 2003-2009

Unit price (NOK/kg)	No-tariff period (%)	Tariff period (%)
> 20	2.40	4.86
15-20	3.00	4.23
10-15	11.53	13.91
5-10	74.48	70.58
< 5	8.59	6.42
Average price	8.76	10.28
Standard deviation	7.91	10.74

The type of currency used in the transaction plays a role in our analysis. From Table 2, we see that the euro is the single most used invoicing currency (56 %), while the Norwegian kroner is the second most important (38 %). 36 % of the trades invoiced in NOK originates from Italy, while 13 % come from France (not reported in the table). The use of American dollars is only observed in 1.8 % of the trades. We also see that vehicle currency pricing is important. An example of a vehicle currency is when euro is used in a trade between Argentina and Norway.

[13] We illustrate this by looking at September 2006. Average price this month is NOK 11.51. Standard deviation is 15.87, which is higher than the standard deviation for the whole sample. 1.19 % of the prices are below NOK 5, while 5.55 % is above NOK 20.

Table 2: Type of currency. Share of transactions (%). 2003-2009

Currency	No-tariff period (%)	Tariff period (%)
Euro	55.30	56.71
Norwegian kroner	39.71	37.12
Other	4.99	6.17
Exporter currency pricing	46.85	37.98
Importer currency pricing	39.71	37.12
Vehicle currency pricing	13.44	24.90

Data for geographical distance is obtained from the CEPII[14] Geodist-database, and GDP data is taken from the World Bank (World Development Indicators (WDI)).

4. Firms' characteristics

The number of importing firms varies from 28 to 36, depending on year, as reported in Table 3. As shown in Figure 4, few of the importers are large. Over the years 2003-2009, we find that 7 firms take 96 % of the imports, of which the three largest take 77 %. In the second column of Table 3, we report the number of foreign firms involved in the apple trade to Norway. We see that the number of exporting firms is much larger than importing firms, meaning that Norwegian firms source from many foreign sellers.

Table 3: Active firms. 2003-2009

Year	Active importers	Active Exporters
2003	32	380
2004	30	397
2005	28	352
2006	36	374
2007	30	369
2008	33	383
2009	30	297

[14] Centre d'Etudes Prospectives et d'Informations Internationales

Table 4, gives firm specific information, first for the three firms with the highest import volume, named as A, B and C. Thereafter, we offer information for the firms that are specialized in international apple trade. Since the product line of these firms is narrow, they will typically be of smaller size. Based on the highest (volume) import of apples per employee, we have in Table 4 labeled the three largest specialized firms as D, E and F.[15]

From the first column in Table 4, we see that for most firms, Italy is the most important source country. Given the information in Figure 3, this is not surprising. The next two columns give information on the firms from which the Norwegian importing firms buy apples. For example, we see that the most important foreign partner for Firm C provides 21 % of its trade, and that 20 of its relationships have a trade share of more than 1 %. Firm C then trades with many firms, none of which is dominating. We see that the same is true for the other Norwegian importing firms. In the fourth column, we have given the average price that the various firms have obtained over the period. We see that there is a tendency for the specialized firms to obtain a lower purchase price (average NOK 7.20) than the high volume firms (average NOK 8.10). From Table 1, we see that the average price for the whole data set is NOK 8.76, and NOK 10.28 for the tariff-free, and tariff period, respectively. Those prices are higher than the import prices the largest firms obtain. So even if specialized firms perform best, the large firms also fare better than the average.

The last column in Table 4 offers information on the invoicing currency. We see that the majority of specialized firms choose the euro, while among the high volume firms there is a mix between Norwegian krone and the euro.

[15] They account for 12 % of the total Norwegian apple import. None of the high volume firms are among the three largest specialized firms.

Table 4: Firm specific features of important Norwegian importers

	Largest market	Largest Foreign trader	# firms > 1 %	Average price (NOK)	Preferred currency
High volume				8.10	
Firm A	Italy	24 %	20	8.26	EUR (95 %)
Firm B	Italy	17 %	17	8.10	NOK (99.8 %)
Firm C	Italy	21 %	20	6.56	EUR (99 %)
Specialized				7.20	
Firm D	France	16 %	14	7.10	EUR (88 %)
Firm E	Italy	23 %	18	7.00	EUR (76 %)
Firm F	France	16 %	26	7.30	EUR (89 %)

Table 5 gives characteristics of the 10 largest foreign firms in the data set. As the first two columns show, most of the exporters trade only with one importer. This is the opposite of what we found was the case for the Norwegian importers. The main reason is presumably that the Norwegian importers buy apples from several countries. But even if we take the export from one particular country, for example Italy, Norwegian importers usually buy from many Italian exporters, while the Italian exporters usually trade with only one Norwegian firm. From the last column in Table 5, we see that for the foreign exporting firms, there is a balance in the choice of invoicing currency between Norwegian krone and the euro.

Our main findings so far, are that the Norwegian importers show a diversified trading pattern. This is the case, even if we narrow our study to a single country. Furthermore, we find no significant difference in this pattern between high volume and specialized firms.

Table 5: Firm specific features of important foreign exporters

	Total # of Norwegian partners	The most important Norwegian partners	Preferred invoicing currency
Firm A	1	100 %	NOK (99.8 %)
Firm B	2	97 %	NOK (98.7 %)
Firm C	5	58.8 %	EUR (99.8 %)
Firm D	1	100 %	EUR (100 %)
Firm E	7	75 %	NOK (75 %)
Firm F	1	100 %	NOK (100 %)
Firm G	3	88 %	NOK (81.5 %)
Firm H	1	100 %	EUR (99.7 %)
Firm I	1	100 %	NOK (100 %)
Firm J	1	100 %	EUR (100 %)

In the following, we look closer into the stability of trading patterns between firms. Besedeš and Prusa (2006a, 2006b) studied the duration of international trade relationships and found that there exists a substantial amount of entries, and exits, in trade relationships, and that the average duration for trade of a given product between two countries is very short-lived. We define duration as the number of consecutive years an importer purchases apples from a given exporter, and estimate different Kaplan-Meier survival rates.[16] The estimates are reported in Table 6.[17]

Table 6: Survival rates

	Mean survival (years)	1 year	3 year	5 years	share of volume in the long-lived relations
1) All firms	3.0	68 %	20 %	8 %	63 %
2) Firms with high import volume (Firm A,B,C)	4	74 %	30 %	13 %	77 %
3) Firms with high import per employee (Firm D,E,F)	3.7	68 %	20 %	5 %	22 %

[16] The Kaplan-Meier estimator is a non-parametric estimate of the survival function. To investigate the survival rates we could have estimated the hazard rates using a Cox-model. Such an exercise lies outside of the scope of this paper.

[17] For this basic descriptive exercise, we choose not to problematize issues regarding left-censoring and the existence of multiple spells.

The Kaplan-Meier survival estimates give us important information on how the duration of trade differs between different importer-exporter pairs in our data set. We find that the firms with high import volume have a higher mean survival rate with its trading partners than the overall survival rate in the data set, and for firms with high import per employee. After the first year, more relations are active for the high-volume firms than the overall number for the data set. The same is the case after three years. In the long run (5 years), 13 % of the trade relations for the high import volume firms have survived.[18] Even if this survival rate is substantial higher than in the overall sample, it seems to be rather low. But even if 87 % of the relations have ended after five years, the surviving 13 % accounts for 77 % of the traded volume during the entire period. Observe that for the specialized firms, the opposite is the case. The remaining 5 % of the relationships after 5 years take only 22 % of the volume traded during the 2003-2009 period. So the relationships of the specialized firms have more of a hit-and-run nature than for the high-import volume firms. This might be one of the explanations for why the specialized firms trade at lower prices than the high volume firms.

Our finding that the lowest prices are observed for the group of firms that are least likely to change their trading partner is not in line with the findings in the literature. Monarch (2014) found that reduced buyer-supplier friction resulted in lower prices.

5. Econometric analysis

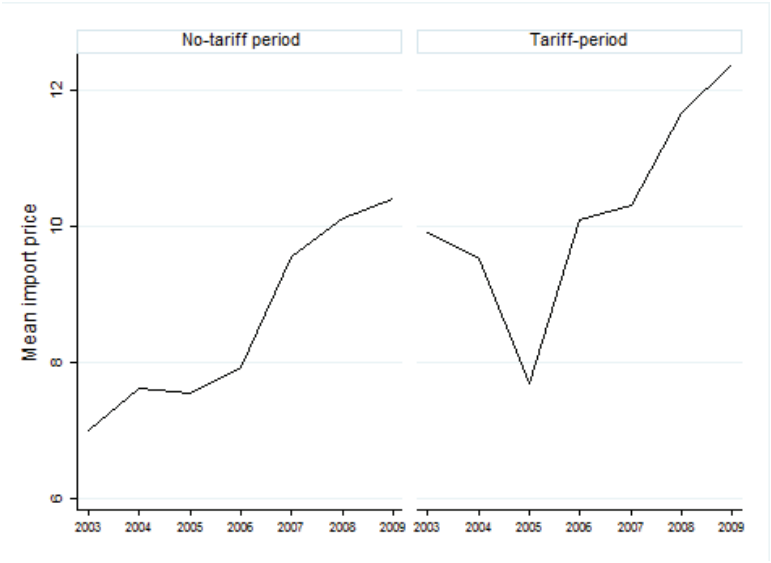
Firms can affect the outcome of their business in various ways. Besides efforts to reduce operating costs, decisions tied to purchase and sales are important. We have no firm-specific information available on the selling price, or operating costs. But from our dataset, we are able to identify the purchase price of the importing firms. So when we try to explain the economic success of importing firms, we relate that to the purchase price they have been able to obtain.

In Section 2.2, we noted that the competition in the apple market differs between trade regimes, i.e. the tariff-free (December 1.–April 30.) versus the tariff period (May 1.–November 30.). Figure 5, gives the development of the import price for the two trade regimes computed as yearly averages. Except for 2004 and 2005, we see that the average import price for the two trade regimes follows a similar pattern. However, there is a tendency for the import price in the

[18] Rudi et al. (2012) investigate different factors that impacts the duration of trade relationships in US. fresh fruits and vegetables import. Their sample period is 1996-2008, and their data is at the country level. For apples, they report an average duration of 5.1 years, which is in line with our findings. Their study is not directly comparable to ours since it is based on country-level data.

tariff period to be substantially higher than in the non-tariff period. Since import prices are exclusive of tariffs, tariffs are not the direct explanation for this difference.

Figure 5: Mean prices by period and year



Our observations consist of all transactions between importers and exporters during the 2003-2009 period. We use the index pair (i,j) for an importer i-exporter j relationship. For the transactions performed in each relationship, we identify the year, t, and tariff regime, N (non-tariff) or T (tariff). In some of the relationships, several transactions take place within the same time period ((t,N) or (t,T)). We use k as a count-index for these transactions. $P_{i,j}^{N}(k,t)$ is then the price a Norwegian importer i obtains from a foreign exporter j in his k'th transaction in the non-tariff period of year t. In (1), we have specified the variables that are used to explain the import price of apples in the non-tariff period.

$$(1)\qquad \ln P_{i,j}^{N}(k,t) = \beta_0 + \beta_1 \ln\left(Dist_j\right) + \beta_2 \ln\left(GDP_j(t)\right) + \beta_3 Border_j + \beta_4 ln(Imp\ share_i(t)) + \beta_5 \ln(Imp\ per\ employee_i(t)) + \beta_6 ECP_{i,j}(k,t) + \beta_7 VCP_{i,j}(k,t) + \beta_8 EU_j + \varepsilon_{i,j}(k,t).$$

The three first variables are in line with a standard gravity approach.

(i) We include the geographical distance between the capital of Norway (Oslo) and the capital of the country (*j*) where the apples are grown, $Dist_j$. This variable reflects transportation cost, but also familiarity with the trading country.

(ii) In addition, we include GDP-per capita for country *j*, GDP_j, for the following reason: An increase in the national income in the country of origin (country *j*) means an increase in demand for fruit in that country, and thus, an increase in the domestic price, and therefore the price they sell apples for to firms in other countries (Atici and Guloglu, 2006).

(iii) We include a common border dummy in our model, $Border_j$, to control for a possible "neighbor effect." This variable takes the value 1 if country *j* borders Norway and 0 otherwise.

Next we include two firm-specific variables.

(i) We expect that firm size matters. We use a firm's share of total import as a measure of its size ($Imp\ share_i$).

(ii) As we argued in the introduction, we also expect the firm's degree of specialization to matter. We measure the degree of specialization as the volume of apples imported per employed in firm *i* ($Imp\ per\ employee_i$).

We also take into consideration the currency that has been used in the transaction. There are three alternatives for currency choice: The currency of the importer (Norwegian krone), the currency of the exporter or a currency from a third country (vehicle currency). This choice is modelled by two dummy variables, *ECP* and *VCP*.

(i) *ECP* (Exporter Currency Pricing) takes on the value 1 if the trade is invoiced in the exporter's home currency, and 0 otherwise. As long as firms are risk-averse, it is in their interest that the transaction is settled in their national currency. Therefore, foreign exporters that are able to obtain a trade invoiced in their own currency are expected to pay a premium in the form of a lower price.

(ii) *VCP* (Vehicle Currency Pricing) takes on the value 1 if the trading partners choose to make use of a vehicle currency in the transaction, and 0 otherwise. In this case, both trading partners are exposed to exchange rate risk.

Lastly, the EU-dummy, EU_j, takes on the value of one if the imported apples having been harvested in an EU-country, and zero otherwise.

As we emphasized in Section 2.2, the price formation of apples differs between the trade regimes. In the tariff period, the price of the apples is stabilized by the Norwegian authorities. That means that exporters of apples into Norway not only face competition from the Norwegian producers, but they also see a regulated price. When we explain the import prices in the tariff period, $P_{i,j}^{T}$, we, therefore, include the Norwegian target price of apples, *Target,* as an explanatory variable. Furthermore, the GDP from the various countries, which we took as a proxy for the apple price of the exporting countries in the tariff-free case, are taken away, i.e. we assume that the exporting firms do pricing to the market in the tariff period.[19] We then expect β_2 to be positive. However, the interesting question is how close this coefficient is to 1. A β_2 equal to 1, means that a one percent increase in the target price is completely copied into the import price. Besides the target price, we expect the import prices in the tariff period to be affected by the same set of variables as in (1).

$$(2) \quad \ln P_{i,j}^{T}(k,t) = \beta_0 + \beta_1 \ln(Dist_j) + \beta_2 \ln(Target(t)) + \beta_3 Border_j + \beta_4 \ln(Imp\ share_i(t)) + \beta_5 \ln(Imp\ per\ employee_i(t)) + \beta_6 ECP_{i,j}(k,t) + \beta_7 VCP_{i,j}(k,t) + \beta_8 EU_j + \varepsilon_{i,j}(k,t).$$

Table 7 reports summary statistics for the variables of interest.[20]

Table 7: Summary statistics, overall

Variable	Mean	SD	Min	Max
Import price ($P_{i,j}$)	9.46	9.36	1.18	272,7
- No tariff ($P_{i,j}^{N}$)	8.76	7.91	1.18	272,7
- Tariff ($P_{i,j}^{T}$)	10.28	10.74	2.06	199,7
Distance (km)	4832	5228	417	17991
GDP (billions)	1419	1565	5	13144
Import share	0.3	0.26	0.000007	1
Import share per employee (tons)	6.67	12.7	0.000	135
Target price	10.40	1.14	9	12.5

[19] Results when we include GDP from the various countries are offered in Appendix A.5
[20] For statistics on firm information see Tables 3-5, choice of currency see Table 2 and share of trade to the EU Figure 3.

For statistics on the currency used in the transactions (*ECP* and *VCP*), we refer to Table 2. Furthermore, the share of trade to the EU is indicated in Figure 3.

In Table 8, we report the results. For both periods, we first report the results for the full sample.[21] Then we show results in a sample where only import prices below 20 NOK/kg are included. The estimation in the non-tariff period is done by including year dummies. Since the target price varies between, but is fixed within, years, this variable serves as a year dummy variable in the tariff period estimation.

In Table 8 we have grouped the various variables in three sections: Firms specific, market specific and gravity related variables.

[21] To divide the sample into a tariff and non-tariff period can be problematic, because the firms may act strategically between the periods. For example, in order to avoid tariffs firms may increase their import of apples in the end of April just before the tariff period starts. In Section 6 of the Appendix we show a graph picturing the imports two weeks before and two weeks after the tariff period. We see that the sales are about the same in the weeks we look at. Our conclusion is then that there is absence of this kind of strategic behavior in our data set.

Table 8: Main results

	No-tariff period		***Tariff period***	
ln Unit value	*OLS,all values*	*OLS, values < 20 NOK/kg*	*OLS, all values*	*OLS,values<20 NOK/kg*
Firm specific variables:				
ln Imp share	*-0.013***	*-0.013***	*-0.036**	*-0.015***
	(0.006)	*(0.006)*	*(0.019)*	*(0.006)*
ln Imp per employee	*-0.043****	*-0.038****	*-0.055***	*-0.037****
	(0.011)	*(0.010)*	*(0.022)*	*(0.013)*
ECP	*-0.137****	*-0.136****	*-0.187****	*-0.129****
	(0.041)	*(0.041)*	*(0.069)*	*(0.040)*
VCP	*0.091**	*0.079*	*-0.028*	*0.033*
	(0.050)	*(0.050)*	*(0.120)*	*(0.095)*
Market specific variables:				
ln GDP	*0.043****	*0.046****	-	-
	(0.015)	*(0.015)*	-	-
ln Target price	-	-	*0.714****	*0.729****
	-	-	*(0.168)*	*(0.122)*
Gravity related variables:				
ln *Dist*	*0.178****	*0.184****	*0.197****	*0.223****
	(0.032)	*(0.032)*	*(0.051)*	*(0.041)*
Border	*1.938****	*0.228*	*1.813****	*0.077*
	(0.074)	*(0.184)*	*(0.178)*	*(0.111)*
EU	*0.473****	*0.477****	*0.416****	*0.456****
	(0.043)	*(0.043)*	*(0.103)*	*(0.090)*
Constant	*-0.878***	*-1.030****	*-1.308**	*-1.639****
	(0.381)	*(0.350)*	*(0.709)*	*(0.513)*
Observations	*18,516*	*18,057*	*16,037*	*15,238*
R-squared	*0.575*	*0.345*	*0.582*	*0.220*
Year dummies	*Yes*	*Yes*	*No*	*No*

Robust standard errors in parentheses clustered on (firm, origin)
**** p<0.01, ** p<0.05, * p<0.1*

We see that increased import shares result in significantly lower import prices. We find this to be the case, both for the complete, as well as the restricted sample set in both regimes. So there seems to be an economy of scale effect in our data set. But we also find a specialization effect; i.e. increased import per employee leads to a decrease in the import price. This effect is more pronounced than the economy of scale effect, in the sense that it is more significant. We see that the specialization effect is independent of the trade regime, and also the size of the sample.

As for the currency effects, we see a clear risk premium. If exporters are allowed to have the sale contracts settled in their home currency, they have to pay a discount in the form of a lower price. We see that this effect is highly significant: 13.7 % lower import price in the tariff free period, while the import price is lowered by 18.3 % in the tariff period. Lastly, the effect of using a vehicle currency is insignificant, as expected.

The next two variables, *GDP* and *Target*, reflect market structure. The *GDP* variable is included in the non-tariff period. This variable function as a measure of the price of apples in the exporting country, and we see that this variable is highly significant. The interpretation is then that in the non-tariff period, the pricing of imported apples is cost based.[22] Interestingly, in the tariff period, the Norwegian target price is also highly significant. The coefficient attached to this variable is 0.714. That means that we have close to a complete copying of the Norwegian price. So, it seems that the pricing policy of exporters of apples into Norway in the tariff period is characterized by pricing to the market.

We have also included three control variables. The first of these is distance to the country of origin. This is highly significant in both periods, a result that is in accordance with what is found in the referred literature. The border effect needs a comment. In both periods, the border effect is highly significant. However, when prices above NOK 20 are excluded, the border effect disappears. The explanation for this is that the largest import prices originate from Sweden, as we have shown in Table A.3 in the Appendix. Observe also that the EU dummy is positive and highly significant. This is particularly true in the tariff-free period. This can be caused by many factors. It may reflect quality. Some of the EU-countries are known to have high quality apple producers. As a last point let us mention that we also have controlled for possible effects from direct trade from the country of origin vs. the shipment going by a second country before reaching Norway. But taking this into account had no significant impact on the results.

[22] In Section 5 of the Appendix we report the results when GDP for the various foreign countries is included. We see that GDP in this case is insignificant, as it should be.

6. Conclusion

As reviewed by Bernard et al. (2007), in the last decades we have seen an increasing interest in firms engaged in international trade. This paper focus on trading firms engaged in imports, in particular the price they are able to obtain on the goods they import. We have used highly disaggregated Norwegian customs data to investigate if firm specific factors explain differences in import prices between firms, and we find this to be the case. First, the nature of the firm matters. The larger and the more specialized a firm is, the lower is the firm's import price. Second, the way a firm operates matter. In this respect we have examined the firm's decision as to which currency to use. And here we find a clear and significant currency effect. If an importing firm manages to trade in Norwegian kroner, that comes with a cost in the form of a higher import price.

From the descriptive statistics, we find it striking that the import price varies markedly between firms. This gives profit possibilities for firms. As pointed out above, one of our findings is that the specialized firms are able to obtain lower import prices than other firms. These firms also have more unstable trading relationships than is the case for other firms. Their trade behaviors then conform to profit seeking firms using a hit-and-run strategy.

We have stressed that the Norwegian market is regulated half of the year. During the Norwegian harvesting season there is a (high) tariff on apples. In addition, the authorities operate with a target price. It seems that the competition in the market differs between the tariff and non-tariff period. In the non-tariff period it seems as if exporters set prices based on costs. However, in the tariff period it seems that the exporters choose to price to the market. But even if the pricing strategy changes, our econometric results tell us that the firm specific effects seem to be unaffected. They seem to be almost identical in the two pricing strategy cases.

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Appendix

1. Administrative tariff reductions

Table A.1: Administrative tariff reductions for apples. 2003-2009

Start	End	Tariff
01.05.2003	18.05.2003	0.00
01.05.2004	10.05.2004	0.00
01.05.2005	14.05.2005	0.00
20.11.2005	30.11.2005	2.95
01.05.2006	14.05.2006	0.00
01.05.2007	16.05.2007	0.00
11.11.2007	30.11.2007	0.25
01.05.2008	12.05.2008	0.00
01.05.2009	16.05.2009	0.00
29.11.2009	30.11.2009	0.25

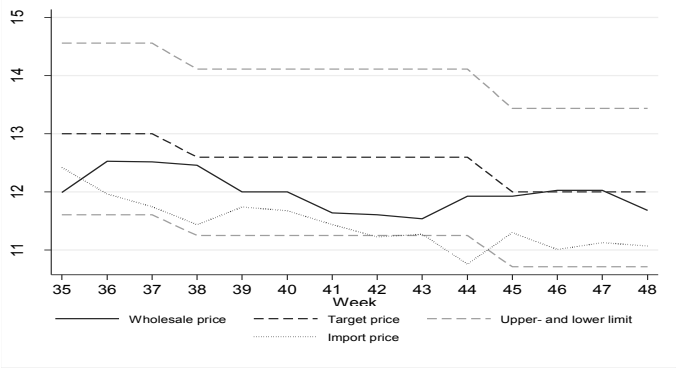
(Source: NAA)

2. Price regulation in the tariff period

In Figure A.1, we illustrate the various apple prices for the Norwegian 2009 season. The prices are given on a weekly basis, where week numbers are posted along the horizontal axis. The three dotted lines give the target price, including the +/- 12 % band width. The dark solid line gives the wholesale price, and we see that this price lies inside the band and fairly close to the target price for the whole period. We have also computed the average import price from the information in our data set. To this computed price we have added the tariff, drawn into the figure as the light marked solid line. With one exception (week 35), we see that the wholesale price for Norwegian apples lies above the import price.[23]

[23] In order to make a just comparison between the import price (including tariff) and the wholesale price, a transportation cost from the harbor to the wholesaler should be added, which we have not.

Figure A.1: Target price, wholesale price and import price inclusive of tariff. 2009

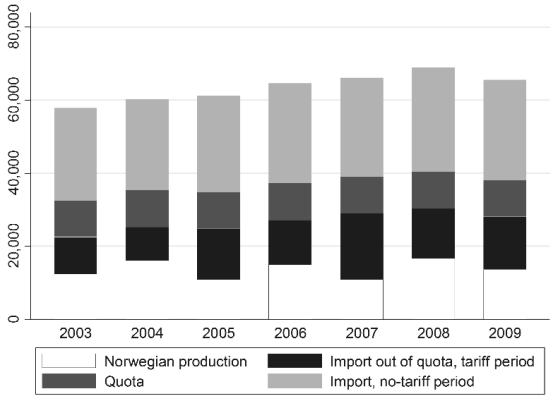


(Source: Statistics Norway and authors own calculations)

3. Norwegian production and import of apples

Figure A.2 illustrates the size of the Norwegian production compared to the import of apples. The Norwegian production is marked as the white part of the columns. It accounts for 21 % of the supply of apples.[24] Observe that the import of apples in the tariff period (May 1st-November 30th) is larger than the Norwegian production. In the figure, we have also marked the size of the auctions, which takes 43 % of the imports.

Figure A.2: Norwegian production and total import in tons. Tariff and tariff-free period. 2003-2009



(Source: Statistics Norway and NAA)

[24] The supply of apples is defined as Norwegian production plus imports. According to Norges Frukt- og Grønnsaksgrossisters Forbund, in 2011 Norwegian apples took 10 % of the apple consumption. That means that a substantial share of the Norwegian apple production goes to processing.

4. The import price of apples in the data set

Table A.2: Unit value by country of origin. 2003-2009

No-tariff period				Tariff period			
Country of origin	**Mean unit value**	**St.dev, unit value**	**Share of total volume (%)**	**Country of origin**	**Mean unit value**	**Std.dev, unit value**	**Share of total volume (%)**
Sweden	51.8	29.24	0.1	Sweden	54.65	25.72	0.1
UK	33.71	12.79	0.02	Finland	53.43	18.2	0.0002
Egypt	25.82	5.79	0.0003	UK	40.73	9.96	0.005
Iran	16.97	2.8	0.0002	India	21.13	6.65	0.002
Israel	15.92	.	0.0003	Denmark	15.83	4.21	0.02
Denmark	11.79	4.02	0.004	Egypt	15.61	3.81	0.005
Turkey	10.99	1.42	0.01	New Zealand	10.84	3.4	10.1
New Zealand	10.05	2.66	0.4	Peru	10.75	.	0.004
South Africa	8.9	2.97	0.3	Morocco	9.35	4.93	0.02
Thailand	8.64	.	0.0005	Chile	9.18	3.38	11.4
France	8.62	3.47	7.9	Netherlands	8.52	3.78	1.5
Italy	8.61	2.66	46.6	China	8.46	2.46	0.5
Netherlands	8.22	4.73	1.3	Italy	8.41	2.88	26
Chile	8.03	2.8	2.9	Switzerland	8.24	2.56	0.1
Brazil	7.92	1.69	0.9	Spain	8.22	3.06	0.3
Spain	7.69	2.47	0.3	South Africa	8.18	1.81	10.0
Argentina	7.49	3.52	13.8	Brazil	7.9	2.88	1.6
USA	7.48	1.48	4.3	Turkey	7.87	3.46	0.01
Uruguay	7.24	1.34	0.1	France	7.66	3.08	13.8
China	7.23	1.82	7.9	Argentina	7.48	3.67	19.6
Austria	7.16	1.12	2.7	USA	7.29	0.77	0.1
Bosnia	6.83	3.09	0.01	Saudi-Arabia	7.26	0.37	0.05
Switzerland	6.69	0.92	0.1	Austria	7.2	1.49	1.3
Belgium	6.64	2.89	1.7	Iran	7.18	.	0.006
Germany	6.36	2.81	2.6	Belgium	6.97	4.21	0.9
Portugal	6.06	0.98	0.01	Portugal	6.91	0.33	0.002
Hungary	5.64	1.13	0.1	Germany	6.78	2.65	1.0
Morocco	5.07	.	0.001	Uruguay	6.4	1.82	0.1
Poland	4.72	2.12	5.7	Hungary	6.21	1.41	0.2
Greece	4.58	1.68	0.01	Chezch Rep.	5.08	.	0.0004
				Poland	4.97	2.44	1.5
				Macedonia	3.86	2.25	0.01

(Source: Statistics Norway and authors own calculations)

5. Results when GDP are included in the regression for the tariff period

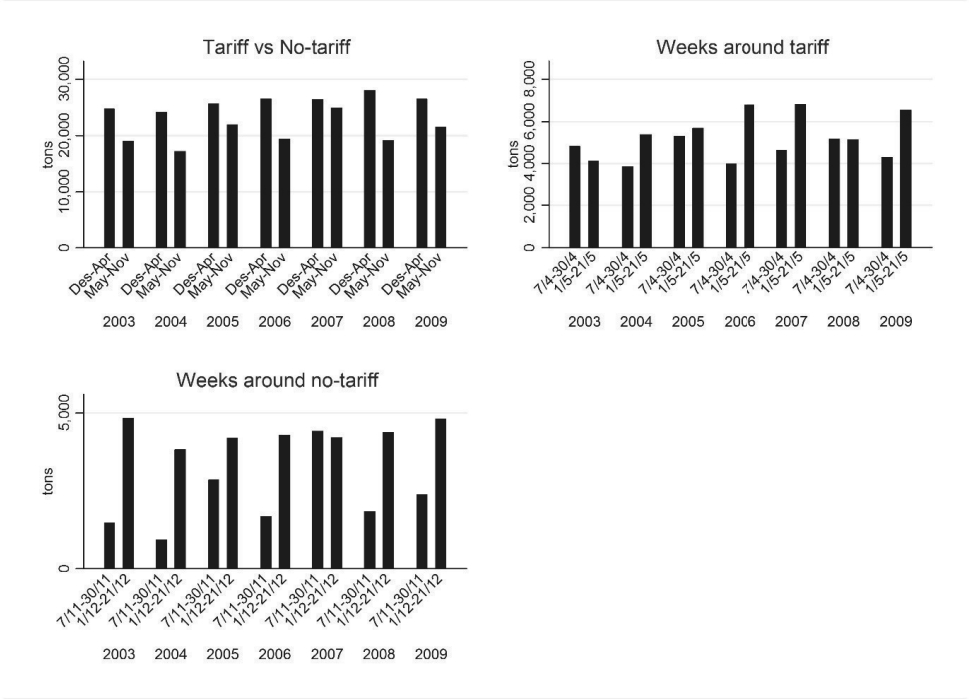
Table A.3: Main results. GDP included in both periods

ln Unit value	***No-tariff period***		***Tariff period***	
	OLS,all values	*OLS, values < 20 NOK/kg*	*OLS, all values*	*OLS,values<20 NOK/kg*
Firm specific variables:				
ln Imp share	*-0.013***	*-0.013***	*-0.038***	*-0.017***
	(0.006)	*(0.006)*	*(0.019)*	*(0.007)*
ln Imp per employee	*-0.043****	*-0.038****	*-0.054***	*-0.036****
	(0.011)	*(0.010)*	*(0.022)*	*(0.012)*
ECP	*-0.137****	*-0.136****	*-0.203****	*-0.145****
	(0.041)	*(0.041)*	*(0.070)*	*(0.041)*
VCP	*0.091**	*0.079*	*-0.030*	*0.031*
	(0.050)	*(0.050)*	*(0.117)*	*(0.091)*
Market specific variables:				
ln GDP	*0.043****	*0.046****	*-0.036*	*-0.037*
	(0.015)	*(0.015)*	*(0.027)*	*(0.025)*
ln Target price	*-*	*-*	*0.721****	*0.737****
	-	*-*	*(0.170)*	*(0.122)*
Gravity related variables:				
ln *Dist*	*0.178****	*0.184****	*0.189****	*0.215****
	(0.032)	*(0.032)*	*(0.048)*	*(0.038)*
Border	*1.938****	*0.228*	*1.749****	*0.010*
	(0.074)	*(0.184)*	*(0.167)*	*(0.109)*
EU	*0.473****	*0.477****	*0.480****	*0.522****
	(0.043)	*(0.043)*	*(0.114)*	*(0.105)*
Constant	*-0.878***	*-1.030****	*-0.323*	*-0.614*
	(0.381)	*(0.350)*	*(0.780)*	*(0.630)*
Observations	*18,516*	*18,057*	*16,037*	*15,238*
R-squared	*0.575*	*0.345*	*0.583*	*0.226*
Year dummies	*Yes*	*Yes*	*No*	*No*

Robust standard errors in parentheses clustered on (firm, origin)
*** p<0.01, ** p<0.05, * p<0.1

6. Buying decisions in connection with going from one tariff regime to another?

Figure A.3: Imports of apples in the weeks before, and after, a change in tariff regime



(Source: Statistic Norway)