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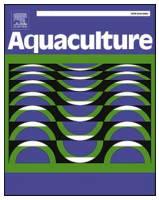

Intermediaries in Norwegian salmon exports

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ABSTRACT

Production of a number of important aquaculture species is highly export oriented, and intermediaries play an important role in the supply chains facilitating the trade. This paper examines the role of intermediaries (e.g. trading companies) in Norwegian salmon exports. Using customs data for the period 2016–2019, we identify two groups of firms in Norwegian salmon exports according to their main economic activity: producers that also export their salmon and independent intermediaries. We show that although both groups of firms have established a global trade network, several interesting differences exists between the two groups. A relatively small number of producers take a significantly higher share of overall exports than a large number of intermediaries, as there is a large number of smaller companies in the second group. On average, producers supply more distant markets with larger volumes than intermediaries. Market concentration measures indicate that a high share of the exports is concentrated among the top exporters in both groups of firms. Interestingly, intermediaries are in many markets able to charge a price premium for several salmon products relatively to the producers.

1. Introduction

A substantial and increasing share of international exports is facilitated by intermediaries, such as trading companies, merchant wholesalers and custom brokers (Virtanen et al., 2022a; Medin, 2021; Akerman, 2018; Fujii et al., 2017).[1] This is also true for trade in aquaculture products in general with salmon as an important example (Gizaw et al., 2021). As the use of intermediaries in seafood trade increases, this raises important questions with respect to the role such firms have in the supply chain of seafood, the food category with the highest global trade share (Deb et al., 2022; Anderson et al., 2018; Fernández-Polanco and Llorente, 2019; Fernández-Polanco et al., 2021; Hobbs et al., 2023). While the roles of intermediaries have been investigated for some terrestrial food products (Gaigné et al., 2018; Lehtinen et al., 2016), the role has received limited attention in the literature on seafood markets and trade.[2]

Norway is the world's largest producer of salmon, and most of the production is exported by a large number of companies (Straume et al., 2020). These companies differ significantly in terms of size, markets served, and the stability of trade relationships (Oglend and Asche, 2022; Straume, 2017; Asche et al., 2021; Svanidze et al., 2023). In this paper we investigate the role of intermediaries (traders) in contrast to producers, where producers are vertically integrated firms that both produce and export salmon. The paper focuses on the four largest salmon products: fresh whole, fresh fillets, frozen whole and frozen fillets which makes up over 97% of the exports. First, we show that both groups of firms supply a global market.[3] Second, we identify interesting differences in product-specific shipping distance and specialization, as well as for market concentration and market-specific unit values between producers and traders.

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[1] USDA (2023) defines intermediaries (merchant wholesalers) as "… primarily engaged in buying groceries and related products from manufacturers or processors, and reselling these products to retailers, institutions, and other businesses", this is a definition that can be applied to how trading companies operate within Norwegian salmon aquaculture industry.

[2] One partial exception is Johansen et al. (2019), who investigated the seafood industry's direct and indirect effects on Norway's economy from 2004 to 2017 and show that intermediaries are an important part of the aquaculture supply chain. However, they do not go into any details with respect to the characteristics of the intermediaries.

[3] There exists a global market for salmon (Landazuri-Tveteraas et al., 2021: Salazar and Dresdner, 2021; Roll et al., 2022), as well as for many other seafood species (Anderson et al., 2018; Fernández-Polanco et al., 2023; Salazar and Dresdner, 2023).

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Control over the production process and associated innovations has made the aquaculture industry highly successful (Anderson, 2002; Asche, 2008; Bergesen and Tveterås, 2019; Garlock et al., 2020; Cojocaru et al., 2022; Afewerki et al., 2023). Increased control with the production process also facilitates innovations throughout the supply chain, aiming to improve logistics (Kvaløy and Tveteras, 2008; Asche et al., 2018; Asche et al., 2021) and product development (Asche et al., 2018; Brækkan et al., 2018; Landazuri-Tveteraas et al., 2018; Oglend and Straume, 2020; Cojocaru et al., 2021; Iversen and Hydle, 2023; Onozaka et al., 2023).[4] Increased control leads to more margins, and a producer (exporter) can optimize along each of them (Asche and Smith, 2018). Markets targeted, transaction modes, agglomeration, and organizational structure as examples of such finer margins the supply chain (Larsen and Asche, 2011; Straume, 2014; Gaasland et al., 2020; Oglend and Asche, 2022).[5]

Salmon is the most advanced aquaculture species in many dimensions, and therefore making it a hub for innovation within the industry (Smith et al., 2010; Asche and Smith, 2018). Globally, salmon is now the species with the second-highest export value after shrimp, and Norway is the largest producer of farmed salmon with a production share of over 50% (Iversen et al., 2020). During the last two decades, the size of the largest firms has increased significantly (Pandey et al., 2023), and a number of companies are also integrating vertically towards the market. Many of these large producers, though not all, operate their own harvesting plants and manage their own exports, and some even operate secondary processing facilities downstream in the supply chain.

Intermediaries often possess knowledge and access to local business relationships (Virtanen et al., 2022b), suggesting that using intermediaries can reduce various costs such as setting up distribution networks. Intermediaries might be especially important for small and medium-sized firms to be able to participate in international trade (Abel-Koch, 2013). Hence, one will expect intermediaries to be more important for smaller firms and in distant trade. However, the degree to which economies of scale affect intermediaries and their extent of specialization in specific markets remain unclear.

In the next section we discuss the existing knowledge on the role of intermediaries in international trade before presenting the data in Section 3. Section 4 provides a discussion of products, shipping distance and specialization, while the investigation of market concentration and unit values is carried out in Section 5. Finally, Section 6 concludes.

2. The role of intermediaries

Since the seminal work of Bernard and Jensen (2004) and Bernard et al. (2007), it is well-known that exporting firms have different characteristics than non-exporters; for example they are larger and more productive. A few large firms often dominate exports, and these are generally the most productive firms that offer the highest quality to the most remote buyers (Bonfiglioli et al., 2019; Freund and Pierola, 2015). This is also true for seafood trade. Straume et al. (2020) show that the ten largest exporters account for more than 50% of overall exports and supplies the highest number of destination markets for Norwegian salmon.

Recent theoretical models in international trade building on the seminal work of Melitz (2003) have set out to explain the presence of intermediaries in export using the idea of an intermediation technology (Crozet et al., 2013; Ahn et al., 2011; Antras and Costinot, 2011). The basic idea is that producers can avoid high fixed costs incurred for penetrating new or difficult markets by using intermediaries. Intermediaries will buy products domestically and distribute them across different destination markets. As they do not produce the goods themselves, they are able to buy more different goods and spread the fixed market entry cost over multiple products (economics of scope) and large volumes (economics of scale). For producers, it becomes profitable to sell to the intermediaries and indirectly make use of the intermediaries' distribution channels rather than investing in the costs needed to establish their own distribution channels. An interesting finding from these papers is that intermediaries are most used when exporting to more distant markets with a lower profitability. The intermediaries are less productive than producers, smaller in terms of employees and trade in products of lower quality than producers (Abel-Koch, 2013; Crozet et al., 2013). Ahn et al. (2011) also show that firms are more likely to become direct exporters after having used intermediaries when they first target foreign markets.

According to USDA, merchant wholesalers accounted for 55% of grocery wholesale in the US in 2017. Better access to firm-level data, including customs data, has made it possible to disentangle intermediaries from direct exporters to investigate the importance of such firms in international trade. In the broader context of US trade, Bernard et al. (2007) show that about 15% of exports are accounted for by wholesale and retail firms. Bernard et al. (2015) find that approx. 10% of Italian trade involves intermediaries. For Sweden intermediaries (including retailers) account for roughly 15% of total export according to Akerman (2018). Chen and Li (2014) demonstrate that intermediaries play important roles in China's international trade, accounting for about 44% of exports in 2006. Both Chen and Li (2014) and Bernard et al. (2015) also emphasizes that intermediaries are more frequently involved in trade in homogeneous products than in differentiated products, as more complex products may require more specific specialized knowledge, increasing the likelihood of direct export. Bernard and Moxnes (2018) argue that the existing literature on intermediaries lack substantial evidence on the firm-to-firm networks for intermediaries, also highlighting this an important topic for future research.

3. Data and descriptive statistics

The data used in this paper is customs data at the transaction level provided by the Norwegian customs authorities. The data contain all transactions involving the four main products in Norwegian salmon aquaculture exports over the period 2016–2019.[6] Each transaction contains information on the ID of the exporter, NACE-code denoting the exporter's main economic activity, the product traded at the HS8-digit level, the destination country, and weight and value of the transaction.[7] In total 197 firms export a product of salmon to 139 different destination countries over the period. Using the NACE-code for the firms' main economic activity, we divide the exporters into two groups: producers and intermediaries. A unique feature of the dataset is that the ID of the exporting firm is not anonymized, as is the most usual in customs data, enabling us to also manually verify the accurate classification of all firms within their respective group. We classify 19 firms as producers and 178 firms as intermediaries. We commence our analysis by showing the trade networks for producers and intermediaries in

[4] It is interesting to note how the Norwegian aquaculture industry can adapt to supply chains with a high trade frequency to maintain product quality (Asche et al., 2021; Svanidze et al., 2023), while one of the most important products for the most valuable species in the fishing industry is whole frozen cod that is exported to China for secondary processing (Asche et al., 2022).

[5] While there are fewer margins to optimize over, this is potentially important factors also in simpler aquaculture supply chains (Botta et al., 2023; Pettersen et al., 2023) and for wild fish (Wolff and Asche, 2022; Bronnmann et al., 2023; Sogn-Grundvåg and Zhang, 2023a, 2023b).

[6] Fresh whole (03021411), fresh fillet (03044100), frozen fillet (03048100) and frozen whole (03031311).

[7] Weight is in kilo, value in NOK. During the period covered by the data set the exchange rate of NOK/USD varied between 8.50 and 10. See Straume et al. (2020a) for a thorough discussion on transaction-level export data for Norwegian salmon export.

Figs. 1 and 2.

Each node (dot) in the network represents trade value to the destination market. The larger the node, the higher value of salmon products are exported to the destination country. Figs. 1 and 2 clearly indicate that both producers and intermediaries serve a global market. Overall the producers trade in 109 different markets, while intermediaries serves 120 markets. For both groups, the most valuable destinations are European markets, but they also serve the US, Asian and African markets, with the Asian markets being particularly important for producers. Though both producers and intermediaries export to African countries, none of these countries rank among the most valuable destinations. The networks for Norwegian salmon exports are in line with what was shown by Gephart and Pace (2015), who study the structure and evolution of the global seafood trade network and argue that trade in seafood has become increasingly global over time. We find both producers and intermediaries among the top 10 Norwegian salmon aquaculture companies.

We restrict our analysis to the 24 most valuable markets,[8] which account for approx. 93% of all export value for the four products of interest. Within these 24 largest destination markets, the producers take 65% of the total export value of the four salmon products, leaving the remaining 35% of the value for the intermediaries. Table 1 presents destination country-specific market shares, along with the number of producers and intermediaries serving each market.

Overall Poland is the largest destination country for salmon products during the period 2016–2019 with a market share of 14%, followed by France and Denmark.[9] We see that Denmark is the destination targeted by the most exporters, approx. 85% of the producers and 42% of the intermediaries. In contrast, the Czech Republic represents the destination market with the lowest number of active exporters in the period of interest, but also Poland is served by a relatively low share of both producers and intermediaries despite it being the largest destination market. There is considerable variation in the number of firms serving the top destinations. For instance, about 30% as many firms export to Denmark as to France. Moreover, numerous firms have established relations with customers in less prominent markets, approx. 25% of exporters serve China, a destination with an overall market share slightly over 1%.

4. Products, shipping distance and market specialization

The four major salmon aquaculture products exported from Norway, ranked by value, are fresh whole (80%), fresh fillets (12%), frozen fillets (6%) and frozen whole (2%). Though it is evident from Fig. 1 that both producers and intermediaries supply salmon products on a global scale, these two groups may have different average unit values, volumes, number of markets, and market shares within various products and markets. This is investigated in Table 2 below.

Producers have the greatest overall market share for all products except for frozen whole. The most substantial difference in market share occurs in the export of fresh fillets, followed by fresh whole. This is natural as scale and frequency are important factors in the trade with fresh products like salmon (Asche et al., 2021). Except for fresh whole, there are some (minor) differences in average unit value for the two groups of firms. While producers on average have the highest average unit values for trade in frozen products, intermediaries on average get a small premium on export of fresh fillets. Given that producers have the largest market share for three out of four products, it comes as no surprise that these firms also ship larger volumes for these products than the intermediaries. Finally, we observe that there are no systematic differences between producers and intermediaries when it comes to the number of products and destination markets they target. In Table 3, we provide some measures of how far the two groups of firms ships their products. We calculate the shipping distance as the sum of market shares multiplied by the geographical distance from Norway to the destination market.[10]

We find the largest differences in shipping distance for the two most valuable products, fresh whole and fresh fillets. For both products, the distance measure for intermediaries is less than half that of producers. This indicates that intermediaries, on average, target geographical close markets to a higher degree than producers. Long distance trade of fresh products might require a higher degree of coordination of harvest and shipment that favors producing firms. For export of salmon, Straume (2017) demonstrates that increased geographical distance and low unit values are associated with shorter duration in trade relationships, while the largest exporters are most robust to failures. Oglend et al. (2023) argues that failures in trade relationships also are associated with large relationship specific price deviations from a given reference price. This also suggests that large producers through own distribution channels might be better prepared for maintaining trade relationships over time.

The trade literature reports mixed results when it comes to the relationship between geographical distance and the importance of intermediaries. While Akerman (2018) reports that intermediaries become more important as markets becomes more distant, Bernard et al. (2015) argue that increased distance has a general negative effect on both producers and intermediaries, and that there is no significant difference between the two types of firms. Lehtinen et al. (2016) studies food export from Finland to China and Germany and argues that intermediaries become more important as the geographical distance to the destination market increases. With increased geographical distance, cultural distance also tends to increase implying larger fixed costs to enter the markets. For example, to penetrate the Chinese market it is a necessity for the exporter to have a familiarity with the local culture and language.

We also investigate the prevalence of market specialization in the two groups of firms. Most producers are large companies and export all four products globally. The group of intermediaries are significantly more heterogeneous, with several firms being specialized in certain products and/or destination markets. The two most specialized intermediaries ship approx. 100% of their export value to a single market. These two firms do not supply the same market and are specialized in different products. Both supplies their chosen market by a significant share of the total export from Norway to the destination. Both firms also have a strong connection to just one buyer in their chosen destination market. Also in general, more firms specialize their exports towards a single market for the more processed product forms. For example, for frozen whole and frozen fillets, we find four or more specialized intermediaries. Not surprisingly, there are more specialized trade activity towards more distant geographical markets, especially in these two products. It is of interest to note that some of these specialized intermediaries are privately owned firms, while others are owned by different producing companies that chooses to cooperate in export activities through a trading company. Gaigné et al. (2018) argue that vertical ownership (the manufacturer acquiring equity shares in intermediaries) is prevalent in the food industry and may create an export premium. Following Gaigné and Gouel (2022), some intermediaries will be able to reduce market-specific risk by acquiring large product portfolios (economics of scope). Some of the intermediaries in Norwegian salmon aquaculture trades in a large variety of seafood products, while

[8] If we had included more markets these would have had markedly lower overall market shares than the ones included in Table 1.

[9] The roles of Poland and Denmark illustrate how imports for processing and re-exports can be important also in supply chains for fresh seafood. There are of course a number of reasons for re-exports, with lower labor costs and higher effective tariffs for more processed products among the most important (Asche et al., 2022; Svanidze et al., 2023).

[10] Data for geographical distance is taken from the CEPII-database (www.cepii.fr).

Fig. 1. Trade network, producers.

Fig. 2. Trade network, intermediaries.

Table 1
24 largest destination markets, market share and total number of firms over the period 2016–2019.

Destination	Overall mkt. share	# producers	# intermediaries
1. Poland	0.140	10	49
2. France	0.113	11	39
3. Denmark	0.084	16	74
4. USA	0.069	13	44
5. Spain	0.066	8	43
6. UK	0.065	11	41
7. The Netherlands	0.060	12	43
8. Italy	0.053	12	33
9. Sweden	0.048	9	45
10. Germany	0.046	11	51
11. Japan	0.042	11	26
12. Lithuania	0.035	10	29
13. Korea	0.028	9	29
14. Finland	0.026	11	27
15. Israel	0.017	9	21
16. Vietnam	0.015	12	23
17. Hong Kong	0.015	11	37
18. Thailand	0.013	11	20
19. Belgium	0.013	8	19
20. Portugal	0.012	7	12
21. China	0.011	10	36
22. Ukraine	0.010	9	21
23. Singapore	0.009	11	24
24. Czech Republic	0.009	4	4

others can be specialized in one product of salmon, such as fresh whole or fresh fillets.

5. Market concentration

The Herfindahl-Hirschman index (HHI) is a common measure of market concentration and frequently used in analyzing various aspects of firm or market size in the Norwegian aquaculture industry (Straume et al., 2022; Pandey et al., 2023) as well as more generally (Garlock et al., 2022, 2023; Love et al., 2022a, 2022b). The HHI is calculated as the sum of squared market shares:

$$HHI = \sum_{i=1}^{n} s_i^2 \tag{1}$$

where s_i is the market share of company i and n is the number of exporters trading in each product. A HHI close to 0 indicates perfect competition, while a HHI that equals 1 will imply that there is only one firm in the market.[11] Markets with few firms and large variations in market shares will have a high degree of concentration. Following Pandey et al. (2023), building on the index-values used by the US Department of Justice, a market with HHI below 0.15 are considered unconcentrated, between 0.15 and 0.25 is moderately concentrated, and

[11] See Pandey et al. (2023) for a discussion on economic explanations for increased firm concentration.

Table 2
Average unit value, volume, and market share. Product-level, 2016–2019.

	Market share		Average unit value (NOK/kg)		Average volume (tons)		# markets	
	Prod.	*Int.*	*Prod.*	*Int.*	*Prod.*	*Int.*	*Prod.*	*Int.*
Fresh whole	0.651	0.349	60.03	60.76	523,945	284,311	24	24
Fresh fillets	0.730	0.270	93.85	95.26	56,709	20,825	24	22
Frozen fillets	0.585	0.415	105.77	100.13	20,227	15,204	23	22
Frozen whole	0.486	0.514	59.32	57.71	3633	3991	18	21

Table 3
Average shipping distance in km. Product-level, 2016–2019.

	Producers				Intermediaries			
Year	*Fresh whole*	*Fresh fillets*	*Frozen fillets*	*Frozen whole*	*Fresh whole*	*Fresh fillets*	*Frozen fillets*	*Frozen whole*
2016	59,402	64,220	40,682	27,389	28,060	23,241	45,662	56,215
2017	60,656	61,087	47,681	42,664	26,805	26,375	38,663	39,790
2018	63,834	64,001	53,919	37,408	23,627	23,460	32,426	47,057
2019	60,674	67,231	39,990	32,090	26,787	20,231	46,354	52,375

a market with HHI above 0.25 is highly concentrated.[12]

Table 4 investigates differences in market concentration between producers and intermediaries at the product level. In the largest product category, fresh whole, we find the highest HHI-index for producers. The numbers indicate that the market for fresh whole is moderately concentrated for producers, while unconcentrated for intermediaries. Regarding the other three products, the HHI numbers indicate a moderate to high market concentration for producers. While the market for fresh fillets is highly concentrated for intermediaries, they operate in an overall unconcentrated market when exporting the most processed products (frozen fillets and frozen whole). The fact that we find the highest HHI for processed products indicates specialization in some firms, for producers we see that this is most important for fresh fillets. The importance of the top exporters is well-known both for export in general (Freund and Pierola, 2015) and for Norwegian salmon export (Straume et al., 2022).

In Tables 5 and 6, we calculate corresponding concentration numbers for the specific destination markets[13] for the two most valuable products, fresh whole, and fresh fillets respectively. Corresponding tables for frozen whole and frozen fillets are provided in the appendix.

Several interesting observations emerge for trade in fresh whole salmon in Table 5. Among producers, the least concentrated market is Denmark with a HHI of 0.119, followed by Thailand, Germany, and China. The most concentrated markets are three relatively small markets - the Czech Republic, Portugal, and Belgium. But also the three largest markets; France, Poland, and Spain has a relatively high HHIs. As seen in Table 5, these markets are served by relatively many producers, indicating that the high HHI might stem from a high variation in firm-specific market shares. Most markets have a HHI higher than 0.25 and are classified as concentrated markets indicating a significant degree of market specific specialization among Norwegian exporters. For intermediaries several other patterns emerge. Again Denmark, together with Korea, is the most unconcentrated market. The most concentrated markets are Singapore, Israel, and Japan. Also for traders Portugal and the Czech Republic have high HHI values. The CR_3index illustrates that the top exporters also take the largest share of export value in the least concentrated markets.

Table 4
Market concentration – products.

	Producers	Intermediaries
	HHI	HHI
Fresh whole	0.160	0.122
Fresh fillets	0.279	0.298
Frozen fillets	0.277	0.114
Frozen whole	0.168	0.114

Both producers and intermediaries obtain their highest average unit values when targeting the Korean market, with a unit value disparity of 3.50 NOK/kg.[14] In general intermediaries obtains a price premium in more markets than producers. However, the largest price premium is in favor of the producers in the Ukraine, reaching 6.15 NOK/kg. Producers also secure a marginally higher average unit value in Poland, which is the overall most valuable destination market.

The largest destination markets for fresh fillets among producers are Japan, while it is USA for traders. Both markets are more distant than the top markets for fresh whole. For producers, all markets are classified as concentrated markets according to the calculated HHI numbers.[15] The most concentrated markets are the Czech Republic, Belgium and Portugal, while Hong Kong, Germany and Japan are the least concentrated. For the latter three we see from the CR_3 that the three largest firms take the whole market. The least concentrated market for intermediaries in fresh fillets is Sweden, followed by Germany and Hong Kong. Also for intermediaries we see that the top exporters are the only active traders in several markets. Producers obtain the highest average unit value for fresh fillets in the USA, followed by Korea and Portugal. For traders, the highest paying markets are the geographically closer markets Finland and France. We observe a very large price premium in favor of the intermediaries in both Finland (approx. 43 NOK/kg) and France (approx. 37 NOK/kg), a potential signal of quality differences or a high willingness to pay for certain brands in these markets.

6. Concluding remarks

This paper presents the first evidence of the role of intermediaries in Norwegian salmon exports. We have presented a range of descriptive evidence on different characteristics between producers and intermediaries in the period 2016–2019. Our results indicate that though

[12] There exists a number of other concentration measures, and while they have slightly different emphasizes, they then to be highly correlated (Pavic et al., 2016).

[13] The total number of markets may deviate from 24, since not all group of firms necessarily export to all the 24 largest overall markets in each product.

[14] Southeast Asian markets are often reported to have a preference for larger fish, and larger fish typically has a higher unit price (Asche and Guttormsen, 2001). This is a feature that is common in the seafood market (Smith et al., 2017; Wolff and Asche, 2022).

[15] Hong Kong is on the limit with a HHI of 0.248.

Table 5
HHI – markets. Ranked by total export value. Fresh whole.

Intermediaries							
Market	Exp. share	Avg. unit value	HHI	Market	Exp. share	Avg. unit value	HHI
France	0.139	58.756	0.275	Poland	0.223	57.006	0.313
Poland	0.127	57.402	0.359	Denmark	0.119	58.826	0.132
Spain	0.098	60.261	0.363	The Netherlands	0.096	60.707	0.200
Denmark	0.086	56.702	0.119	UK	0.072	60.563	0.340
UK	0.076	57.393	0.191	Italy	0.071	63.551	0.154
Italy	0.061	61.935	0.173	France	0.070	61.989	0.204
The Netherlands	0.060	60.862	0.157	Germany	0.053	61.837	0.201
Lithuania	0.047	56.524	0.261	Spain	0.039	62.426	0.329
Germany	0.042	60.168	0.152	Korea	0.034	74.115	0.134
Finland	0.032	57.129	0.190	Lithuania	0.034	57.807	0.278
Japan	0.029	66.126	0.190	Sweden	0.033	61.727	0.432
USA	0.027	66.918	0.313	Finland	0.025	55.518	0.197
Sweden	0.023	60.284	0.325	Portugal	0.020	64.632	0.462
Korea	0.022	70.606	0.219	USA	0.016	68.697	0.202
Hong Kong	0.021	67.199	0.251	Vietnam	0.016	71.822	0.316
Vietnam	0.019	69.989	0.349	China	0.015	68.940	0.325
Czech Rep.	0.016	59.750	0.877	Japan	0.011	66.741	0.483
Thailand	0.015	65.399	0.140	Hong Kong	0.010	68.727	0.225
China	0.014	67.215	0.162	Thailand	0.010	65.150	0.186
Ukraine	0.012	59.732	0.231	Ukraine	0.010	53.581	0.210
Portugal	0.012	62.864	0.455	Belgium	0.009	63.297	0.469
Singapore	0.011	64.591	0.335	Israel	0.008	66.249	0.492
Israel	0.009	67.652	0.311	Singapore	0.007	65.214	0.528
Belgium	0.005	61.790	0.414	Czech Rep.	0.001	63.155	0.460

Table 6
HHI – markets. Ranked by total export value. Fresh fillets.

Producers				Intermediaries			
Market	Mkt. share	Avg. unit value	HHI	Market	Mkt. share	Avg. unit value	HHI
Japan	0.235	94.082	0.321	USA	0.650	94.319	0.649
France	0.169	86.906	0.467	Sweden	0.099	89.815	0.193
USA	0.119	118.496	0.502	Japan	0.049	97.076	0.546
Poland	0.083	77.500	0.845	UK	0.039	87.953	0.573
Belgium	0.083	90.081	0.935	France	0.033	124.424	0.350
Sweden	0.082	92.767	0.543	Denmark	0.030	109.770	0.355
Korea	0.062	109.544	0.467	Germany	0.028	99.575	0.210
Israel	0.039	102.006	0.372	Poland	0.017	82.472	0.414
Denmark	0.026	94.003	0.360	Israel	0.014	103.129	0.449
UK	0.021	99.185	0.398	Korea	0.012	117.232	0.641
Spain	0.018	95.538	0.503	Italy	0.006	105.154	0.533
Finland	0.017	84.227	0.501	Singapore	0.006	101.833	0.427
Singapore	0.015	90.422	0.425	The Netherlands	0.005	84.103	0.444
Germany	0.007	94.195	0.265	Spain	0.004	105.503	0.358
The Netherlands	0.007	85.381	0.334	Thailand	0.003	117.169	0.720
Thailand	0.005	95.693	0.420	Belgium	0.003	90.623	0.812
Czech Republic	0.004	86.630	0.992	Hong Kong	0.001	127.486	0.217
Vietnam	0.002	86.908	0.618	Ukraine	0.001	97.891	0.829
Lithuania	0.002	101.992	0.886	Portugal	0.001	80.876	0.654
Portugal	0.001	109.346	0.931	Finland	0.001	129.765	0.403
Italy	0.001	84.089	0.318	China	0.000	113.273	0.465
Ukraine	0.000	92.831	0.846	Czech Republic	0.000	101.321	1.000
Hong Kong	0.000	104.934	0.248	Lithuania	0.000	88.890	0.854
China	0.000	90.714	0.637	Vietnam	0.000	101.580	0.378

intermediaries' value share in exports are relatively high for most salmon products, producers are leading in most dimensions. The producers are relatively few in number but have the largest overall market shares for all salmon products, indicating that several very large firms are present in this group. Though the intermediaries are obviously a more heterogeneous group than the producers, e.g. in terms of market specialization, the trade network of the latter is the most global in the sense of supplying average higher trade values to more distant markets. Moreover, they provide flexibility making it difficult for any buyer to lock in exporters.

On average, producers ship products twice as far as intermediaries do. This finding contradicts Akerman (2018) argument that intermediaries are most important in trade to the most distant markets. Producers of salmon may have well developed control over their own distribution channels as many of them are very large and productive firms. When it comes to product- and market-specific unit values, intermediaries seem to be able to charge a price premium. Some possible explanations for this could be better marketing/branding, or market-specific knowledge when it comes to targeting the market segments with the highest willingness to pay.

The significant heterogeneity of the salmon exporters is an important factor in explaining why the industry seem so well adapted to cope with internal environmental shocks (Asche et al., 2017), as well as external shocks such as Covid-19 (Straume et al., 2022; Yang et al., 2022; Anderson et al., 2023; Aarstad et al., 2023).

The main challenge for exporters of food products is to find partners

and customers in foreign markets (Lehtinen et al., 2016). Differences in business culture and challenges due to different languages, business regulations, and more can create difficulties for firms to penetrate new markets. By using small intermediaries, less productive, or newly established firms in the aquaculture industry may be able to learn their true potential in the export industry, and potentially "greasing the wheel" with respect to investing in their own distribution channels and going into direct export in the future.

CRediT authorship contribution statement

Hans-Martin Straume: Conceptualization, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Frank Asche:** Conceptualization, Investigation, Validation, Writing – original draft, Writing – review & editing. **Atle Oglend:** Conceptualization, Investigation, Validation, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare no conflict of interests related to this article.

Data availability

The data that has been used is confidential.

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Appendix A

Table A1
HHI – markets. Ranked by total export value. Frozen fillets.

Producers				Intermediaries			
Market	Mkt. share	Avg. unit value	HHI	Market	Mkt. share	Avg. unit value	HHI
Sweden	0.321	106.355	0.447	USA	0.410	121.631	0.233
USA	0.225	126.395	0.724	Sweden	0.182	98.758	0.200
Germany	0.163	110.782	0.705	Israel	0.108	89.770	0.360
France	0.090	106.979	0.580	Germany	0.078	84.076	0.257
Israel	0.051	88.508	0.240	France	0.039	91.095	0.374
Spain	0.049	131.226	0.552	Poland	0.029	59.781	0.144
UK	0.014	101.612	0.939	Denmark	0.029	59.031	0.093
Lithuania	0.013	67.092	0.649	Italy	0.027	123.307	0.531
Vietnam	0.013	48.750	0.349	Japan	0.026	105.341	0.528
Denmark	0.009	85.126	0.399	Spain	0.021	98.101	0.320
Belgium	0.008	83.453	0.519	UK	0.016	74.440	0.223
The Netherlands	0.008	110.418	0.573	Hong Kong	0.009	125.597	0.472
Japan	0.007	57.529	0.376	Belgium	0.009	137.752	0.722
Hong Kong	0.007	128.551	0.942	The Netherlands	0.003	93.359	0.157
Portugal	0.006	151.257	1.000	Portugal	0.003	114.626	0.556
Poland	0.004	36.412	0.338	Korea	0.002	106.654	0.268
Finland	0.004	81.744	0.516	Ukraine	0.002	48.380	0.605
Thailand	0.004	89.362	0.495	Finland	0.002	84.331	0.349
Ukraine	0.004	35.480	0.899	Lithuania	0.002	48.314	0.644
Italy	0.002	113.504	0.405	Thailand	0.001	96.918	0.275
China	0.001	129.805	0.677	Singapore	0.001	94.662	0.353
Singapore	0.000	86.812	0.926	China	0.000	90.644	0.304
Korea	0.000	63.815	0.504	Vietnam	0.000	33.397	0.501

Table A2
HHI – markets. Ranked by total export value. Frozen whole.

Producers				Intermediaries			
Market	Mkt. share	Avg. unit value	HHI	Market	Mkt. share	Avg. unit value	HHI
Israel	0.288	57.472	0.187	Thailand	0.185	61.548	0.231
Thailand	0.264	62.785	0.244	Israel	0.183	58.348	0.277
Poland	0.081	55.739	0.302	Poland	0.141	50.477	0.173
Singapore	0.075	60.248	0.788	USA	0.096	67.186	0.664
Korea	0.049	62.224	0.605	Hong Kong	0.072	63.229	0.158
Denmark	0.048	43.684	0.520	Korea	0.060	65.462	0.508
Japan	0.047	64.336	0.500	Denmark	0.046	49.094	0.128
Lithuania	0.033	65.958	0.266	Spain	0.042	50.836	0.576
HONG KONG	0.033	64.987	0.225	Singapore	0.030	59.009	0.358
Germany	0.020	80.481	0.987	Lithuania	0.028	57.627	0.324
Ukraine	0.013	51.326	0.269	Germany	0.024	58.522	0.325
USA	0.012	70.356	0.693	Ukraine	0.017	40.578	0.189
Vietnam	0.012	54.953	0.626	China	0.016	48.551	0.407
Sweden	0.008	42.683	0.520	France	0.015	61.828	0.342
The Netherlands	0.007	69.172	0.245	UK	0.012	59.723	0.467
France	0.004	99.705	0.603	Sweden	0.009	47.991	0.175
China	0.001	67.329	0.998	Italy	0.006	104.329	0.399

(continued on next page)

Table A2 (*continued*)

Producers				Intermediaries			
Market	Mkt. share	Avg. unit value	HHI	Market	Mkt. share	Avg. unit value	HHI
Spain	0.001	51.226	0.846	Vietnam	0.006	59.426	0.504
Finland	0.001	57.792	1.000	Japan	0.004	71.299	0.387
UK	0.001	73.166	1.000	Finland	0.003	38.866	1.000
Belgium	0.001	47.243	1.000	The Netherlands	0.002	70.514	0.189
Italy	0.000	80.156	0.504	Portugal	0.001	43.636	0.544
Portugal	0.000	80.000	1.000	Belgium	0.001	134.703	0.986

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