



The structure of Norwegian seafood trade

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ABSTRACT

While seafood is a highly traded commodity, lack of data has largely prevented examination of the firms and industries that are conducting the actual transactions. In this paper we use highly disaggregated data to provide an overview of the seafood exports from Norway, the world's 2nd largest seafood exporting country, and a country where fisheries as well as aquaculture are important industries. The industry has a global reach with Norwegian seafood reaching 172 different countries in the period 2016–2020. While there are as many as 437 different exporting firms, this is relatively few firms compared to the 11,024 different buyers that import Norwegian seafood. There is significant heterogeneity in the export sector from very small firms handling only a few products to very large firms handling a large variety of products. The average firm is quite specialized and serves only 9 markets. However, there are also a handful of large exporters who ship products from all three main sectors in the Norwegian seafood industry to a large number of markets. The 10% largest companies make up 39% of the total export value and provide significant synergies between the aquaculture, pelagic and whitefish sectors.

1. Introduction

As much as 38% of the global seafood production is traded internationally [27] and 78% of the production is exposed to trade competition [64]. This makes seafood the food category with the highest trade share [2] and has generated significant interest in various facets of the seafood trade, including the structure of trade networks [33,43], who benefits from the trade [3,13], the impact of shocks [25,35,40], what products are being traded [12] and particular features of specific countries such as import dependence [30,34] and re-exports [8,63]. A common feature of these studies is that they are conducted using data at the country level. While countries are important in international trade because their governments can influence trade patterns with measures such as tariffs and non-tariff trade barriers, it is firms, and not countries, that trade.¹

In recent years, access to highly disaggregated trade data has allowed researchers to examine the structure of international trade relationships at the firm level. A rapidly growing literature provides insights that seem to hold for most industries in most countries. Even within narrowly defined industries, there are a large number of firms that trade, but the characteristics of the firms vary substantially. In particular, a few large firms tend to be very important for the total trade value [19,28]. Studies of networks between exporters and importers have revealed a highly skewed distribution of the number of customers between firms. The largest exporters of a product to a destination typically have many buyers, but a few large ones are particularly important in that they take a significant share of the exported quantity [15]. Trade is also highly dynamic as most trade relationships are short-lived. However, a few trade relationships are longer-lasting and more important for the total

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¹ Non-tariff trade barriers come in a number of forms such as phytosanitary measures [22] and exclusion of products with “unacceptable” production practices [26], and at times private industry practices such as a requirement of eco-labels are regarded as a non-tariff trade barrier despite not being imposed by a government [47,53].

trade value. The largest and most productive exporters grow faster and offer better wages and more stable jobs [16]. They also ship higher quality products to more distant and difficult markets [11]. Hence, the existence of larger exporters is important for the producers they serve as they add capacity and resilience to the system.

Recently, these approaches are being applied to specific issues in select seafood sectors. Straume et al. [61] give an overview of insights from disaggregated data on Norwegian salmon exports, while Yang et al. [66] investigate the duration of Chinese shrimp imports. However, there are no attempts to characterize a country's seafood export industry and explore potential differences between species groups. This is important because the structure of trade may influence the resilience and competitiveness of the seafood industry. In many countries, fisheries and aquaculture policies are implemented to serve the coastal communities that make a living off these production activities [1,4,31,36,38,44,65]. While the main interventions are perceived to be through improved fisheries management or aquaculture policies, trade is an important part of the system as it influences prices obtained, as well as who will be the consumers of the seafood [5,12,13,24,41].

In this paper we utilize data at the transaction level for all Norwegian seafood exports during the period 2016–2020. This data is used to describe the structure of Norwegian seafood exports with a focus on firms and the markets they serve. Norway should provide a good case for investigating seafood trade at the firm level as it is the world's second-largest seafood exporting country [27], its seafood production sector has significant harvest and aquaculture components [60], where some but not all are certified with ecolabels [20] and the country has a number of vulnerable fisheries dependent communities [37]. However, it will of course only be a start as the socio-economic and demographics of the seafood sector vary significantly around the world [38].

This paper is organized as follows: in Section 2 we describe the Norwegian seafood and the data in Section 2, and discusses general trends in the Norwegian seafood trade in Section 3. In Sections 4 and 5 we take a closer look at the firms and market concentration in the product groups, and for the largest export products. Section 6 discusses product bundling and Section 7 offers some concluding remarks.

2. The Norwegian seafood sector

The Norwegian seafood sector has three main components – the whitefish sector, the pelagic sector and the aquaculture sector.² Traditionally, the whitefish sector has been the most important with respect to landings value. The cod fisheries are most important, and with haddock and saithe are other important species [50]. In 2020 total landings of whitefish was 852 thousand metric tons (mt) with a value of 14,496 mill NOK, making up 15% of the seafood exports by value. As the fleet primarily consist of smaller vessels located in northern Norway, the whitefish sector is often regarded as the most important sector from a fisheries policy perspective [18,23,59]. Whitefish is exported in a number of product forms, and this is in part due to the fact that the small-scale fleet and the incentives in the management system that creates a highly seasonal fishery with significant quality challenges [17, 57,58].

The pelagic sector tends to be the largest sector by quantity although with large between years variation. However, as the pelagic species fetch relative low unit prices, the pelagic sector tends to be less important than the whitefish by value. In 2020, total landings were 1616 thousand metric tons (mt) with a value of 10,686 mill NOK, making up 11% of the seafood exports by value. The main species harvested were mackerel and herring [56].

The aquaculture sector is a relatively recent sector as production

reached significant quantities first in the 1980 s. The main species is Atlantic salmon which makes up 94% of aquaculture production. The remaining 6% is primarily trout, although there is also produced small quantities of a handful of other species [39,49]. In 2020 total production was 1488 thousand metric tons (mt) with a value of 68,695 mill NOK, or 72% of the seafood exports by value. With the high export value, the aquaculture sector is also the most diverse of the sectors with significant heterogeneity in terms of the types of markets being served [46].

As Norway is a relatively small country with about 5 million inhabitants, the seafood sector is export oriented and about 95% of the seafood produced is exported [60]. An important feature of the Norwegian fisheries management system is that each vessel has to be owned by an active fisher, and no fisher can own a majority share in more than one vessel, although a significant exception exists for the whitefish trawler fleet [59]. Consequently, there is little vertical integration between the fleet and the processing and export sectors. This is different for aquaculture where most of the large salmon companies are operating as their own exporters, while most mid-sized and smaller firms and some of the larger ones use independent exporters. This can in part be understood as a function of the fixed costs involved in exporting activities.

3. Norwegian seafood exports: General trends

Our analysis will be conducted using customs data provided by the Norwegian Customs Authority for the period 2016–2020. The data set contains all export declarations for the 25 most valuable seafood products during this period. These 25 products make up 97% of Norwegian seafood exports. Each custom declaration contains the date for the shipment, an identifier for the exporting firm as well as the importing firm in the destination country, the product traded at the most detailed HS8-level, the destination country, the value and weight of the shipment, transport mode, contract-form and invoicing currency.³ In total, the data set contains 1125,030 shipments by 437 different exporting firms to 11,024 different buyers in 172 different destination markets.

Table 1 shows the average annual export value of the three sectors and each sector's share of annual export value, export quantity and number of shipments. As expected, the export shares largely reflect the share of production by each sector. The aquaculture sector has a higher share of shipments than its share of exports, suggesting smaller and more regular shipments than the other two sectors. This is largely due to most salmon exports being fresh and freighted by truck to the EU [10]. For the two harvest-based sectors, most products are conserved, and shipments are mostly shipped by boat where larger shipments give lower transportation costs due to economies of scale [14,60].

The left-hand panels of In Figs. 1–3's show the three sectors' monthly export value and quantity. The right-hand panels shows the monthly number of exporters, destination markets (countries) and importers. For aquaculture (Fig. 1), there is a clear positive trend in export value and quantity, reflecting that aquaculture production has increased with 12%

Table 1
Annual export value and shares of export value and shipments, main product groups. 2016–2020.

Sector	Average annual export value (bill. NOK)	Share of export value	Share of shipments
Aquaculture	69.15	0.77	0.82
Pelagic	5.58	0.07	0.04
Whitefish	14.45	0.16	0.14

² The three subsectors we investigate make up 92% of the first-hand production value of seafood reported by the Norwegian Directorate of Fisheries. The rest is accounted for by smaller products such as crabs, mussels and algae.

³ The "Harmonized System" (HS) is an international product nomenclature developed by the World Customs Organization and is the basis for most countries customs tariffs.

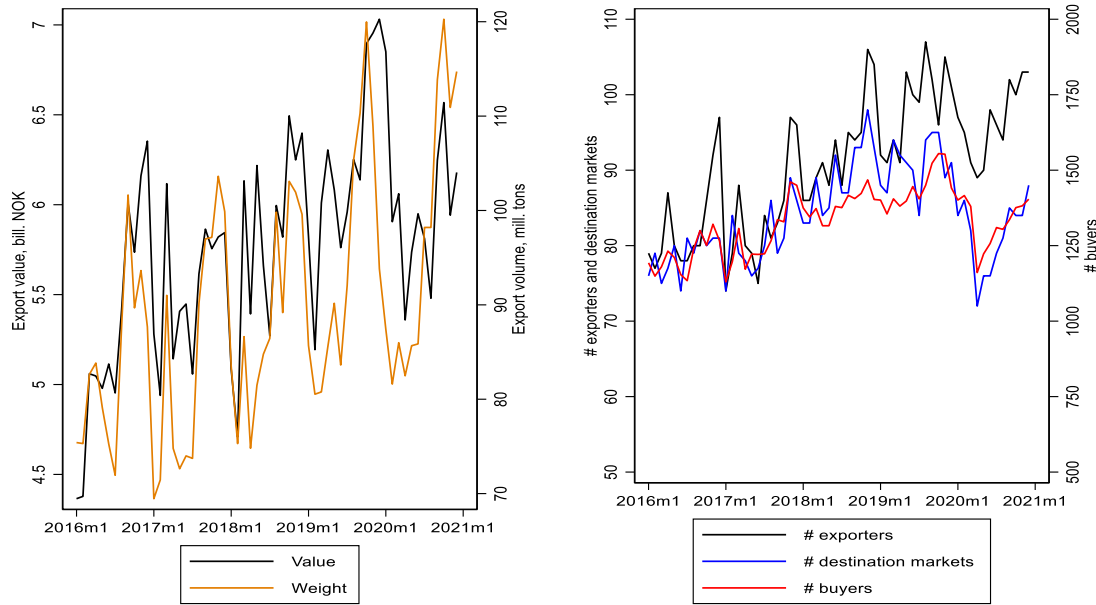


Fig. 1. Exports of aquaculture products, 2016–2020.

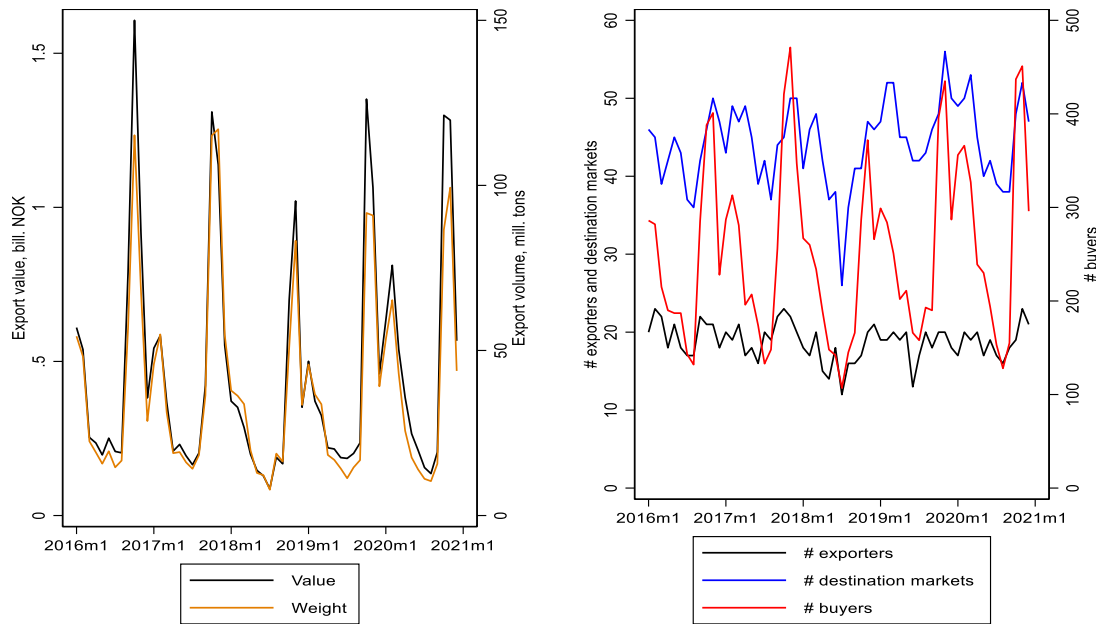


Fig. 2. Exports of pelagic products, 2016–2020.

during the period, largely due to the industry being immensely profitable [55,68]. The figure also shows that there is some seasonality in aquaculture as both demand and production have seasonal components [46].

The number of exporters also has a clear positive trend, suggesting that new companies are at least partly responsible for the export growth. It is also interesting to note the November peak in the number of exporters, which suggests that some exporters are only active when there is peak demand before Christmas. Until 2020, there is also a positive trend in the number of destination markets and importers. This trend has a similar, but less pronounced, seasonality than quantity. In 2020 there is a sharp decline in the number of destination markets and importers, indicating a clear Covid-19 impact. While there is at best a moderate drop in the number of exporters, there is no impact on aggregate export values and quantities. This supports the conclusion of Straume et al. [62] that the aggregate impact of Covid-19 on the Norwegian aquaculture

sector was moderate and largely consisted of firms shifting exports from some markets to others.⁴ However, it does suggest that the impact was stronger in some markets and for some importers, and that market exit played a role in the initial period of the pandemic. In particular, the number of destination markets was reduced from a peak of 98 in November 2018–72 in April 2020, or nearly a one third decline. Moreover, while the recovery was rapid, neither the number of destination markets nor the number of buyers were back to the pre-pandemic level by the end of 2020.

Figs. 2 and 3 show that the development has been very different for the two harvest-based sectors. There are no clear trends with a possible exception of the weakly increasing export value for whitefish due to

⁴ The moderate effect of Covid has also been observed in other aquaculture sectors [45,67].

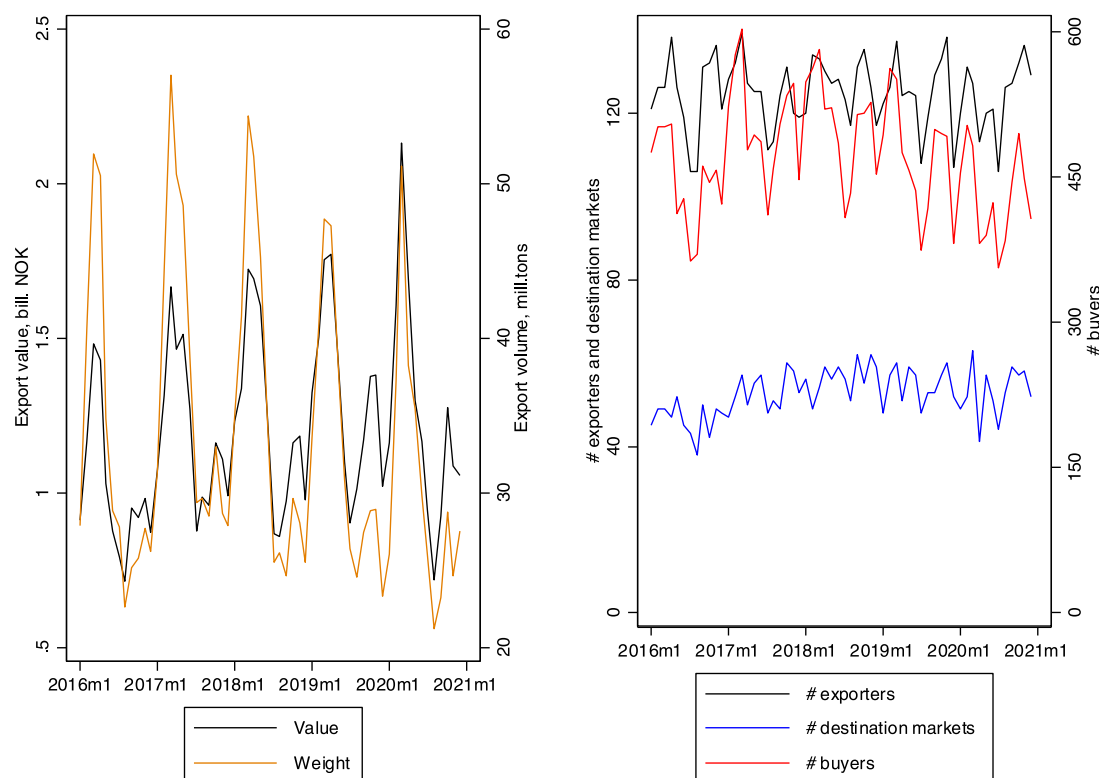


Fig. 3. Exports of whitefish products, 2016–2020.

increased prices. This is not unexpected given that all the main fisheries are quota regulated [59], and landings vary around a stable mean [23, 56]. The fisheries are highly seasonal, and the export quantities and values largely follow these seasonal patterns.⁵ However, it is notable how seasonality is somewhat moderated for the number of buyers, and it is quite weak or non-existent for the number of exporters and destination markets. It is also notable that there is no visible impact of Covid-19 in any of the series, suggesting that the limited impact of Covid-19 on the trawler fleet reported by Asche et al. [6] holds for the Norwegian fisheries more generally.

Table 2 shows the 25 most important seafood products in Norwegian seafood exports, ranked by average annual export value during the period 2016–2020, as well as annual average export value, quantity, unit price and main sector.⁶ Given the dominance of aquaculture in overall export value it is not surprising that the most important product is a salmon product, whole fresh salmon. It is still notable how important whole fresh salmon is, as it with an export value of 52.6 billion NOK makes up 34% of total export value. The export value of the second-largest product, fresh salmon fillets, is by comparison only 8.01 billion NOK or 5.2% of total export value. It is also notable that among the top five products there is also one product from the pelagic sector (frozen mackerel) and one from the whitefish sector (frozen cod).

4. Norwegian seafood exports: Market concentration

In this section we investigate how concentrated seafood exports are with respect to destination markets and among exporters. We use two

⁵ This is in line with what is observed in other countries [42], and suggest that to the extent that trade is used to smooth consumption, it is to a large extent due to seasons with different peaks.

⁶ We have also looked at the median values of export value and quantity per exporter. We do not report these numbers as they are close to the averages, indicating relatively symmetric distributions.

measures of market concentration. These are respectively a Herfindahl-Hirschman Index (*HHI*) and a Concentration Ratio (*CR*). These are common measures of market concentration and have been used for a variety of purposes such as investigating ownership concentration [48], quota concentration [21] and species concentration in respectively seafood consumption [41] and production [32]. The main use of the *HHI* is in anti-trust cases where a market is regarded as concentrated if the *HHI* is higher than 0.25.

The *HHI* is computed as the sum of squared market shares S_i , i.e., $HHI = \sum_i S_i^2$. The index takes values between 0 and 1, where it is close to zero if there is little concentration and close to one when there is a high degree of concentration. We provide two *HHI* measures; a *HHI* for concentration of destination markets where a few markets dominate export if the *HHI* is high, and a *HHI* for the concentration of exporters where a few exporters dominate export if the *HHI* is high. The CR_j is computed as the sum of market shares S_i for the j largest firms, i.e., $CR_j = \sum_j S_i$, and we provide it for the five largest exporters, i.e. CR_5 .

The total number of exporters by category, the number of destination markets and buyers and their associated *HHIs* and the CR_5 for the largest exporters are shown for the three main sectors in Table 3. Somewhat surprisingly, the largest number of exporters are associated with whitefish. Hence, this is not only the sector with the smallest and most numerous vessels and landing locations, but also the largest number of exporters, underlining the sector's importance in coastal communities. Still, the aquaculture sector exports to more markets with 147, although the whitefish sector is also quite global and served 135 markets over the five-year period. The pelagic sector has significantly fewer exporters and markets. There are many more buyers of aquaculture products, but the most striking insight here is the very large number of buyers being served relatively to the number of exporters. The *HHIs* for destination markets are all quite low, reflecting the global demand for Norwegian seafood and thereby no strong dependence on any specific market. Whitefish is, however, more dependent than the other sectors on some main markets. This will become more pronounced when we look at the specific products in Table 5 below. The pelagic sector is much more

Table 2
Descriptive statistics. 25 largest export products. Annual averages 2016–2020.

	Sector	Export value (bill. NOK)	Export value per exp. (mill. NOK)	Export volume (metric tons)	Export volume per exp. (metric tons)	Unit value (NOK/kg)
Salmon, fresh	Aquaculture	52.6	571.8	883,969	9617.6	59.50
Salmon, fresh fillet	Aquaculture	8.01	117.8	84,193	1242.9	95.14
Salmon, frozen fillet	Aquaculture	4.52	64.5	43,607	623.4	103.65
Mackerel, frozen fillet (<600 g)	Pelagic	3.60	118.0	255,122	8494.9	14.11
Cod, frozen	Whitefish	3.24	55.9	108,965	1859.2	29.73
Cod, dried salted	Whitefish	2.52	45.0	35,054	623.3	71.89
Trout, fresh whole	Aquaculture	2.05	45.7	36,844	816.7	55.64
Cod, fresh whole	Whitefish	1.58	22.6	48,652	689.4	32.48
Haddock, frozen	Whitefish	1.28	31.5	56,933	1369.0	22.48
Saithe, dried	Whitefish	1.15	47.2	37,299	1537.8	30.83
Cod, wet salted	Whitefish	1.07	21.8	20,646	423.6	51.83
Salmon, frozen whole	Aquaculture	1.04	17.4	17,635	294.0	58.97
Herring, butterflies	Pelagic	0.83	51.0	66,751	4140.0	12.43
Herring, NVG	Pelagic	0.80	36.7	115,617	5318.7	6.92
Cod, frozen blocks	Whitefish	0.68	28.7	16,354	623.4	41.58
Greenland halibut, frozen	Whitefish	0.68	14.3	15,253	343.5	44.58
Cod, frozen fillets	Whitefish	0.58	12.9	7531	166.5	77.02
Cod, dried	Whitefish	0.57	14.4	3121	79.1	182.63
Saithe, frozen	Whitefish	0.42	9.8	34,388	802.0	12.21
Trout, frozen whole	Aquaculture	0.40	14.4	7440	260.8	53.76
Cod, fresh fillet	Whitefish	0.37	19.3	4384	110.3	84.40
Herring, skinless fillet	Whitefish	0.35	41.2	22,679	2698.6	15.43
Trout, fresh fillet	Aquaculture	0.32	13.0	3299	132.7	97.00
Haddock, fresh	Whitefish	0.31	5.5	2097	305.3	147.83
Salmon, smoked	Aquaculture	0.30	4.5	16,975	30.9	17.67

Table 3
Descriptive statistics and market concentration. Main product groups. 2016–2020.

Sectors	# exporters	# markets	# buyers	HHI market	HHI exporter	CI_5
Aquaculture	266	147	6739	0.06	0.08	0.54
Pelagic	67	96	2435	0.07	0.22	0.74
Whitefish	319	135	3675	0.10	0.03	0.30

Note: since some exporters are active in more than one product group the number of exporters here add up to a larger number than the 437 exporters in the dataset.

concentrated than the two other sectors with a *HHI* of 0.22 and a CI_5 of 0.74, indicating the existence of a few very large exporters. The *HHI* and CI_5 are smallest for whitefish, highlighting the importance of many small firms and the lack of dominant players.

Networks can be a useful approach to describe patterns in large data sets and have been used e.g. to describe global seafood trade [33]. Fig. 4 shows graphs for directed networks for all transactions in the three sectors conducted in 2019. Each line (edge) represents a trade relationship between an exporter and importer. The edges are weighted by trade value, meaning that the thickest lines represent the most valuable trade relationships. The size of the nodes (black dots) is weighted by the number of connections so that the largest nodes have the most export connections (buyers in different destination markets).

One can clearly see that the three figures have different patterns. For the aquaculture network, the largest exporters tend to have unique set of buyers represented by the umbrella-shaped clouds. Some of the most valuable trade relationships are found between exporters with many connections and some of their unique buyers, but there are also cases with valuable relations between exporters with few connections and unique buyers. The pattern with many unique buyers is observed only for a few firms in the pelagic groups and for no firms in the whitefish group. In the pelagic group we see that the firm with the most unique buyers also has some very thick edges both to firms that are unique buyers and to buyers that the exporter shares with other Norwegian exporters. For the whitefish group we see that there are a few exporters that have many buyers, but these large buyers do not seem to be unique to the large exporters. There is no clear pattern for the most valuable

trade relations (thickest edges). Hence, the aquaculture sector appears to be quite distinct in its main operational mode relatively to the harvest-based sectors.

5. Norwegian seafood exports: Firms and products

Table 4 reports average firm size, average number of destination markets and buyers for the three main sectors. Not surprisingly, exporters of aquaculture products are far larger than the average size of exporters of pelagic and whitefish products. We see that the average number of markets served are approximately the same for exporters of aquaculture products and pelagic products, while lower for exporters of whitefish. It is of interest that the average firm only serves a handful of markets but has a significant number of buyers within these markets, and that whitefish exporters have a lower average number of buyers. This suggests a relative high degree of market specialization for most exporters given the large number of markets served by each of the sectors (Table 3). There are a number of potential reasons for the specialization, such as destination-specific investments as well as cultural competence [60].

The total number of exporters by product, the number of destination markets and buyers and their associated *HHIs* and the CR_5 for the largest exporters are shown in Table 5. There are no surprises in the number of exporters for the various products, but it is noticeable that there are many exporters even for narrowly defined products. There are many exporters of all salmon products even for the smaller ones like smoked salmon, suggesting that many salmon exporters ship more than one product. There is a large number of exporters for cod products, but fewer for other whitefish products such as various product forms based on haddock and saithe. Similarly, there are relatively few exporters of most pelagic products. For all products there are many buyers. These findings illustrate the importance of firms in for the trade patterns of seafood, and how it is the large number of exporters and importers that create global markets.⁷

⁷ Anderson et al. [2] show how there are global market for most groups of seafood species. Some recent examples of market integration studies are [9,51, 52,54].

Table 5
Descriptive statistics for market and firm concentration. Product-level. 2016–2020.

Product name	# exporters	# markets	# buyers	HHI market	HHI exporter	CI ₅
Salmon, fresh farmed	152	119	4730	0.07	0.08	0.56
Salmon, fresh fillet	124	124	1582	0.13	0.16	0.81
Salmon, frozen fillet	122	94	1489	0.15	0.08	0.57
Mackerel, frozen fillet (<600 g)	58	79	1747	0.11	0.20	0.77
Cod, frozen	55	120	663	0.19	0.09	0.52
Cod, dried salted	96	60	592	0.48	0.12	0.67
Trout, fresh whole	82	68	1182	0.10	0.21	0.80
Cod, fresh whole	124	47	821	0.37	0.07	0.49
Haddock, frozen	78	44	443	0.28	0.07	0.46
Saithe, dried	47	46	465	0.19	0.12	0.69
Cod, wet salted	83	27	232	0.64	0.05	0.39
Salmon, frozen whole	109	83	860	0.08	0.07	0.50
Herring, butterfiles	28	39	580	0.19	0.27	0.85
Herring, NVG	34	71	1022	0.13	0.25	0.75
Cod, frozen blocks	56	44	287	0.38	0.33	0.88
Greenland halibut, frozen	84	44	551	0.27	0.08	0.55
Cod, frozen fillets	111	56	472	0.17	0.18	0.78
Cod, dried	66	59	383	0.57	0.06	0.43
Saithe, frozen	75	49	533	0.22	0.06	0.42
Trout, frozen whole	55	49	310	0.13	0.18	0.78
Cod, fresh fillet	87	38	368	0.60	0.30	0.89
Herring, skinless fillet	16	30	238	0.35	0.39	0.95
Trout, fresh fillet	52	44	323	0.27	0.27	0.90
Haddock, fresh	99	33	479	0.38	0.08	0.55
Salmon, smoked	134	98	872	0.12	0.16	0.82

Table 4
Annual average firm size, number of markets, and buyers. Main product groups. 2016–2020.

Sector	Average firm size (mill. NOK)	Average # markets per firm	Average # buyers per firm
Aquaculture	456	9	40
Pelagic	157	10	43
Whitefish	69	5	13

When it comes to destination markets, several of the salmon products goes to over 100 different markets suggesting truly global supply chains, and the *HHIs* are also low indicating no dominating markets. This is markedly different for whitefish, and particularly dried and salted products. Wet salted cod only goes to 27 markets, and a *HHI* of 0.64 suggest that a few markets dominate. All the *HHIs* of over 0.5 for destination markets are associated with cod, and fresh cod and fresh cod fillets are in this category. For the fresh products, it is because it is mostly northern European markets that are being served, and it suggests less developed logistics than for fresh salmon. For the dried and salted products, the main markets are in southern Europe as well as Brazil. However, given that there are a number of buyers in these markets, the dependence on a few markets does not appear to be a concern from a competition perspective. Dependence on a few markets could potentially make exporters vulnerable to market specific shocks but given that Norwegian seafood trade was robust to Covid-19 [7], it is hard to imagine market shocks that could strongly influence export-flows. For pelagic products, the relatively few and large exporters do not translate into fewer market opportunities as a large number of markets are being served with little evidence of concentration.

The *HHIs* and *CI₅* at the exporter level show that for some products, exports are highly concentrated. For skinless herring fillets the *HHI* is 0.39 and the *CI₅* is 0.95. For several of the other pelagic products these measures are also high, indicating a high degree of concentration. Moreover, as the exporters are the same for many of these processed pelagic products, this appears to be a highly specialized industry. However, there are also highly specialized products in the other sectors. For fresh trout fillets the *HHI* is 0.27 and the *CI₅* is 0.90. Perhaps most surprisingly, frozen and fresh cod products also have quite high *HHIs* and *CI₅*, indicating that there are some larger firms also in the whitefish sector that appear to specialize on a few product forms.

6. Norwegian exports: Bundling of products

A stylized fact about trade in general is that larger firms trade a higher number of products. Aquaculture and fisheries are generally considered as separate sectors and to some degree as competing seafood

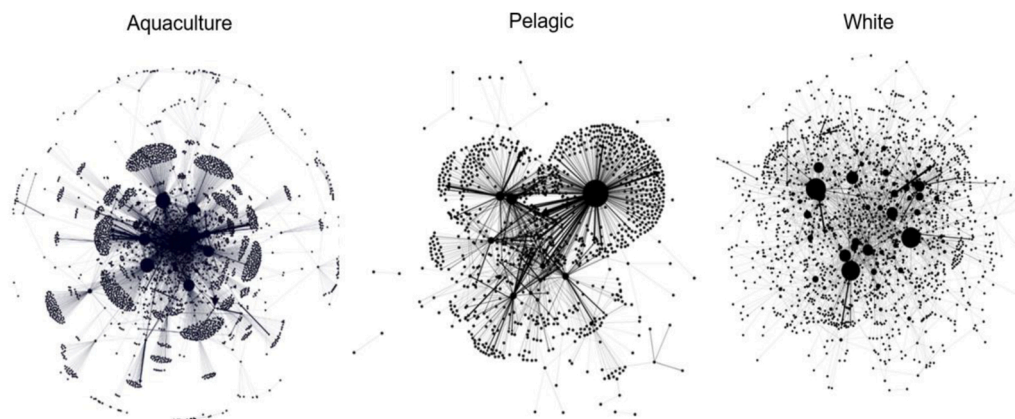


Fig. 4. Trade networks for the three major seafood sectors in 2019.

Table 6
Descriptive statistics. Bundling product groups by exporting firms. 2016–2020.

# Product groups	# exporters	Share of export value	Share of export volume	Share of shipments
1	263	0.35	0.30	0.32
2	133	0.27	0.29	0.24
3	41	0.38	0.41	0.44

Table 7
Descriptive statistics. Bundling product groups by importing firms. 2016–2020.

# Product groups	# buyers	Share of export value	Share of export volume	Share of shipments
1	9385	0.51	0.51	0.50
2	1453	0.41	0.39	0.40
3	186	0.08	0.10	0.10

production activities. An important policy question is whether this also translates to the marketing activity of seafood. Could there be important synergies in the exports between the three main sectors that connect them, i.e. do aquaculture exports facilitate the exports of wild fish or vice versa? Gaasland et al. [29] indicate that there are industry clusters in terms of salmon exports, but this is a feature that has not received any attention beyond salmon. Furthermore, since exporting activities generally involves fixed costs, this facilitates the formation of independent and specialized exporters that can serve several producers and product forms.

In Table 6, the number of exporters shipping products from one sector, two sectors and three sectors, respectively, are shown together with their share of total exports by value, quantity, and number of shipments. Out of the 437 exporters that are active during the period, 60% trades in products from only one of the main product groups, 30% trade in two of the product groups and 10% trade in all three product groups. However, firms that trade in all three product groups are large firms as they make up 38% of the total export value, and 41% of the volume of exports. They also trade more frequently than the other 90% of the firms, indicated by a shipment share of 44%. The results show that the marketing of seafood is far more integrated than the production side.

A striking feature of the group of firms that trade in all three product groups is that they account for a relatively large share of export value within all three groups. These firms account for 38% of the value in aquaculture, 64% in pelagic products and 25% in whitefish. For firms that trade in two out of the three product groups the value shares are 23% for aquaculture, 33% for pelagic and 41% for whitefish. This indicates that most of these combinations include the two wild fish sectors, while the link to aquaculture is weaker.

Corresponding numbers for importers of Norwegian seafood is reported in Table 7. Here one can see that only 1.7% of the 11,024 active buyers import products from all three major product groups. These firms are large since they import 8% of the export value, but they are still not very important for the over-all exports. A large majority of the buyers, approximately 85%, only buy products from one of the three product groups. The importers that buy products from two of the three product groups are important though as they take 41% of the total export value.

7. Concluding remarks

While seafood is highly traded, lack of data has prevented investigation of the firms and industries that are conducting the actual transactions. We use highly disaggregated data to provide an overview of Norwegian seafood exporters. There is substantial heterogeneity among exporting firms, varying from very small firms handling only a few products to very large firms trading many product forms to a larger number of markets. The industry has a global reach with three products being exported to more than one hundred countries. In total Norwegian seafood is exported to 172 different countries. There are 437 different

exporting firms, but this is small number compared to the 11,024 different buyers that import Norwegian seafood.

The average exporting firm is quite specialized and serves only 9 markets, but there are also a handful of large exporters who ship products from all three main sectors in the Norwegian seafood industry. These account for 10% of exporting companies and as much as 38% of the export value. While this indicates significant capacity to shift products between markets, it is notable that among firms that ship products from two categories, aquaculture products are the ones that most often are left out. Hence, the synergies seem to be stronger for the two harvest-based sectors.

Important differences exist between sectors. Large companies are most important in the pelagic sector where a few firms make up most of the exports. The whitefish sector is the least concentrated export sector consisting of many small firms. While this seems to fit a sector that is highly important in supporting coastal communities, it is most likely also a challenge for the sector as there are few, if any, companies with the characteristics of a high-capacity exporter. Whitefish is also dependent on fewer markets, but as there are many importers this does not provide a challenge with respect to competition. Still, the fact that Covid-19 has not created major challenges for any of the sectors or products indicates that all sectors are highly flexible and resilient.

An interesting question for future research is to what extent the multi-product exporters facilitate trade growth in different product forms using their existing trade networks. It is well known that geography plays an important role in trade growth [60], i.e. entry into a specific market is more likely if the exporter already trades with a neighboring country. It seems likely that such effects might also translate to the product form space.

CRedit authorship contribution statement

Hans-Martin Straume: Conceptualization, Data collection, Investigation, Software and Visualization, Formal analysis, Writing – original draft, Writing – review & editing. **Frank Asche:** Conceptualization, Investigation, Validation, Writing – original draft, Writing – review & editing. **Atle Oglend:** Conceptualization, Data collection, Validation, Writing – original draft, Writing – review & editing. **Ivar Gaasland:** Data collection, Formal analysis, Validation, Writing – original draft, Writing – review & editing. **Ingrid K. Pettersen:** Conceptualization, Validation, Writing – original draft, Writing – review & editing. **Geir Sogn-Grundvåg:** Conceptualization, Validation, Writing – original draft, Writing – review & editing.

Data Availability

The data that has been used is confidential.

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