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by

Alena Lappo

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ANALYSIS OF
COST OF PRODUCTION
IN NORTH ATLANTIC FISHERIES*

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Abstract

The purpose of this report is to analyse the cost of production in North Atlantic pelagic fisheries – Atlantic mackerel, Atlantic herring and blue whiting. The analysis is undertaken for various fleets from Norway, the United Kingdom (Scotland) and Iceland with data covering the period 2007-11. The results show substantial differences in value creation and cost of production. Moreover, it is shown that a reallocation of quota shares could enhance the total value of the fisheries in question.

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1. INTRODUCTION

The purpose of this report is to analyse the cost of production in North Atlantic pelagic fisheries – in particular for Atlantic mackerel, Atlantic herring and blue whiting. The analysis is undertaken for three countries:

1. The United Kingdom (Scotland): pelagic trawler fleet.
2. Norway: purse seine fleet and pelagic trawler fleet.
3. Iceland: combined purse seine and pelagic freezer trawler fleet.

For the United Kingdom the analysis covers the period 2007-2010, for Norway 2008-11 and for Iceland it is for 2007-11, and investigates how cost of production depends on several variables, such as total quantity landed, quantity per vessel, fuel price, vessel type and crew size and crew size. In addition, a comparative analysis across the three countries and the different vessel groups is undertaken.

This report is organised as follows. Section 2 gives background information on pelagic fisheries in the North Atlantic. Section 3 provides a description of UK pelagic trawlers fleet and its cost analysis. Section number 4 provides an overview of Norwegian purse seiner and pelagic trawlers fleets as well as analyses of their costs whereas the Icelandic fleet is analysed in section 5. Then, the section 6 provides a comparative analysis across fleets and countries.

2. PELAGIC FISHERIES IN THE NORTH ATLANTIC

The North Atlantic is home to some of the richest fishing grounds in the world. Historically, blue whiting and Norwegian spring spawning herring have been the largest stocks but the fishery for mackerel is also very important. These stocks are all straddling, i.e., they are harvested both in coastal states Exclusive Economic Zones (EEZs) and in a high seas area called the "Banana Hole" (Bjørndal, 2009).

The fishery for Norwegian spring spawning herring is managed by a cooperative agreement among all coastal states involved (Bjørndal and Munro, 2012). For mackerel, there is currently no international agreement, and the fishery is unsustainable which is also true for blue whiting (Bjørndal and Ekerhovd, 2013).

Table 2.1 gives total allowable catches (TACs) for these three species for the period 2007-11.

The TAC for herring varied between 1.28-1.642 million tonnes between 2007-2010; it was reduced to 988,000 tonnes in 2011. For blue whiting there has been a dramatic reduction in the TAC from 1.847 million tonnes in 2007 to 40,000 tonnes in

2011. This is due to a substantial reduction in stock size over time (Bjørndal and Ekerhovd, 2013). For mackerel, on the other hand, the TAC has increased from 502,000 tonnes in 2007 to 959,000 tonnes in 2011. It must be noted that, while total catch of herring in most years is less than or equal to the TAC, the reverse is the situation for mackerel and blue whiting, with catches exceeding TACs.

Table 2.1. Total Allowable Catches of Norwegian Spring Spawning Herring, Blue Whiting and Mackerel 2007-2011 ('000 Tonnes).

Year	Norwegian Spring Spawning Herring	Blue Whiting	Mackerel in Northeast Atlantic
2007	1,280	1,847	502
2008	1.518	1,250	458
2009	1,642	606	605
2010	1,483	548	885
2011	988	40	959

Source: ICES Advice 2011, Book 9.

Several countries participate in these fisheries, with Norway, Iceland and the United Kingdom (Scotland) the most important ones. The overall TAC is distributed among the countries participating in the fishery, so that each country has a national TAC. As noted, there are currently no international agreements for mackerel and blue whiting. As a consequence, countries set unilateral TACs.

Regulations vary from country to country. In terms of quotas, UK pelagic vessels operate within the confines of the fixed quota allocation (FQA) system. Vessels are members of Producer Organisations (PO), and they will either operate as a pool or have individual quotas (IQs). Either way each pelagic vessel will have a specific number of FQA units for each species in each area, and the membership conditions of the PO will determine whether those FQA units are pooled together (and shared equally amongst member vessels) or whether each vessel only fishes against their own FQA holdings (some time it is a combination of the two).

In Norway, various vessel groups participate in these fisheries with purse seine and pelagic trawlers being the most important ones. These fleets are regulated with individual vessel quotas (IVQs). In Iceland, purse seiners and pelagic freezer trawlers participate in these fisheries. They are all in an individual transferable quota (ITQ) system.

As will be demonstrated below, fuel costs represent a substantial share of variable costs. Moreover, there has been substantial variation in the fuel price over time. Figure 2.1 gives the fuel index for 2000-11[1].

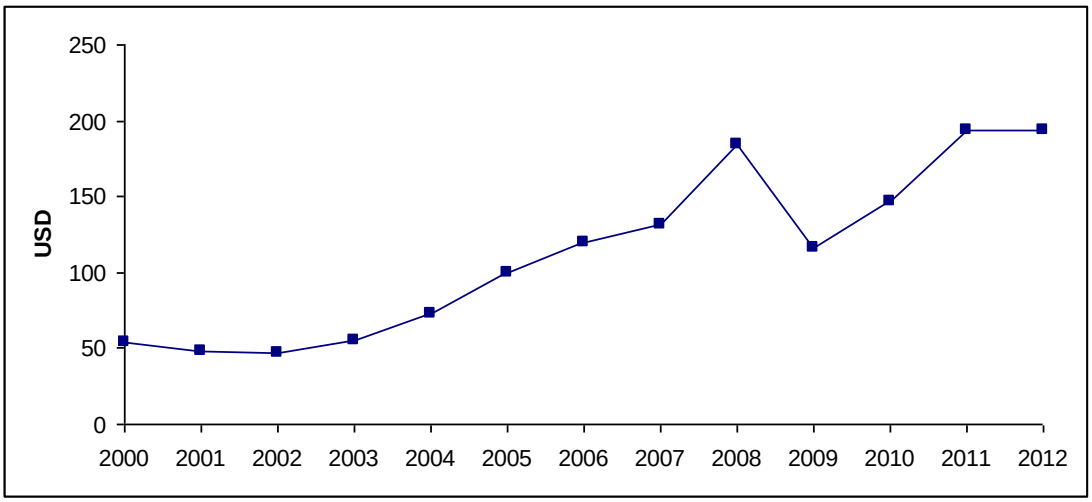

Figure 2.1. Commodity Fuel Index - Includes Crude Oil (Petroleum), Natural Gas, And Coal Price Indices for The World (USB). 2005 = 100.
Source: Appendix, table A1.

The price was fairly constant during 2000-03, but then nearly doubled from 2003 to 2005. It subsequently increased by more than 80% by 2008, before dropping considerably in 2009. Since then it increased at levelled off in 2011-12, 94% higher than in 2005.

3. UK PELAGIC TRAWLER FLEET

3.1 Overview over fisheries and fleet for the period of 2007-2011[2]

In the UK, pelagic trawlers over 40 m harvest most of the UK Atlantic herring, Atlantic mackerel and blue whiting quotas. These vessels are predominantly based in Shetland and the North East of Scotland.

Table 3.1 provides catch statistics for 2007-2011. Total landings vary considerably from 311,362 tonnes in 2007 down to 282-283,000 tonnes in 2008-2009, then up to 291,722 tonnes in 2010 and again down to 279,856 tonnes in 2011.

Although the vessels harvest many different species, the most important are Atlantic herring, Atlantic mackerel and blue whiting representing between 80-90 % of landings in 2007-11 (table 3.1). From the point of view of quantity and value, Atlantic mackerel is the most important. Atlantic mackerel and herring are mainly used for

human consumption, whereas blue whiting is used for reduction into fish meal and oil. It is important to note that all three species represent targeted fisheries so they do not overlap in the catches. Moreover, the three fisheries take place in different seasons of the year.

Table 3.1. Volume of landings

Volume of landings (kg)	2007	2008	2009	2010	2011
Atlantic herring	90,585,121	66,763,352	66,342,828	66,349,581	60,802,150
Atlantic mackerel	132,303,849	126,875,813	170,945,516	159,021,020	180,346,735
Blue whiting	56,465,614	38,150,474	6,349,451	7,970,917	1,358,170
Total A. herring, A. mackerel, blue whiti	**279,354,583**	**231,789,639**	**243,637,795**	**233,341,518**	**242,507,055**
Total other species	32,007,475	51,897,597	38,754,269	58,380,579	37,348,693
Gran total(tonnes)	**311,362**	**283,687**	**282,392**	**291,722**	**279,856**

In all the years Atlantic mackerel was the most important species. The catch of Atlantic mackerel increases over time from 47% of the total in 2007 to 74% in 2011. Relatively, the catches of Atlantic herring decline slightly over time from 32% in 2007 to 25% in 2011. The total landings of blue whiting, in contrast, plummeted from 20% in 2007 down to 1% in 2011. This shows that catch composition experienced significant changes over time.

The number of active vessels remained fairly constant over time (table 3.2). There were 31 vessels in 2007-2009, up from 28 in 2006. In 2010 the fleet increased to 34 and eventually decreased to 32 vessels in 2011. The average fleet age is also fluctuating somewhat, ranging from 10 years in 2008 to 13 in 2011, so the fleet is fairly modern. However, it is noticeable that the average vessel age increases with the fleet size. This might suggest that the added or replaced pelagic trawlers were not newly build.

In general, average registered vessel tonnage increased over time being, from 1,716 Gross Tonnes (GT) in 2007 to 2,091 GT in 2010. The average fuel consumption was 1,716 thousand litres in 2007, that is, 46 thousand more than in 2008. Data for 2009-2011 is not available.

The average number of days at sea was 85 in 2007. For the next three years it was between 71-74, falling to 62 in 2011. That might be explained by overall decrease in total catches from 2007 to 2011.

On average the crew size accounted for 12 people in 2007, 9 in 2008, 15 in 2009 and 14 in 2010. The full-time equivalent for these years was 7, 4, 7 and 5 respectively.

Table 3.2. Fleet statistics

Fleet statistics	2007	2008	2009	2010	2011
Number of vessels (units)	32	31	31	34	32
Avg. Landings per vessel (tonnes)	9,730	9,151	9,109	8,580	8,745
Avg. vessel age (years)	12	10	11	12	13
Avg. weight (Gross Tonnes)	1,716	1,934	1,953	2,091	1,993
Avg. fuel consumption ('000 litres)	1,716	1,670	N/A	N/A	N/A
Avg. employement (people)	12	9	15	14	-
Avr. FTE - full-time equivalent	7	4	7	5	-
Avg. time at sea (days)	85	72	71	74	62

Average value has increased considerably from € 612/tonne in 2007 to € 1007/tonne in 2011, an increase of 64%. Most of the increase took place in 2011. The value went up by 30% (from €424 per tonne to €551 per tonne) for Atlantic herring and by 34% (from € 970 per tonne to € 1,300 per tonne) for Atlantic mackerel. The average value per tonne of blue whiting experienced a dramatic increase of 195%, from € 174/tonne in 2007 to € 513/tonne in 2011 (table 3.3).

Table 3.3. Average value per tonne

Average value per tonne (Euro)	2007	2008	2009	2010	2011
Atlantic herring	**424**	**347**	**382**	**390**	**551**
Atlantic makerel	**970**	**1,004**	**997**	**975**	**1,300**
Blue whiting	**174**	**171**	**200**	**241**	**513**
Average value per tonne all species	**612**	**585**	**737**	**700**	**1,007**

3.2 Cost analysis for the period of 2007-2010

Average vessel revenue, costs and profits for 2007-2010 are displayed in table 3.4. These data represents averages for total landings. Fishing income[3] was listed at € 5,957 million in 2007, €5,356 million in 2008, € 6,712 million in 2009, € 6,009 million in 2010 with landings of 9,730 tonnes, 9,151 tonnes, 9,109 tonnes and 8,580 tonnes, respectively.

Among costs, fuel and other operating costs[4] are the most significant in 2007 and 2008 representing 42% and 41%, respectively, of the total costs while crew wages were 27% and 28%, respectively. In 2009 and 2010 the fuel expenses decreased to 29% and 16% while the crew wages went up to 31% and 27%, respectively, of total costs. The decrease in fuel costs in 2009-2010 might be explained by the lower catches and days at sea comparing to 2007-2008.

Table 3.4. Income, costs and profits per vessel 2007-10.

Vessel statistics	2007	2008	2009	2010
Volume of landings (tonnes)	9,730	9,151	9,109	8,580
Value from landings (Euros)	5,956,938	5,355,837	6,712,311	6,009,256
Total Income (Euros)	5,956,938	4,970,140	6,712,311	6,009,256
Crew wage	(1,438,501)	(1,118,275)	(1,499,180)	(1,491,107)
Fuel and other operating costs	(2,243,718)	(1,646,043)	(1,392,657)	(878,118)
Insurance, repairs and maintenance	(833,639)	(513,610)	(1,270,202)	(2,256,976)
Total Operating costs	(4,515,858)	(3,277,928)	(4,162,039)	(4,626,201)
Opprtunity cost of capital	(830,602)	(34,945)	(43,941)	(2,571)
Annual depreciation costs		(671,446)	(636,499)	(862,876)
Total Capital costs	**(830,602)**	**(706,391)**	**(680,440)**	**(865,446)**
Total Costs (Euros)	**(5,346,460)**	**(3,984,319)**	**(4,842,479)**	**(5,491,647)**
Profit (Euros)	**610,478**	**985,821**	**1,869,831**	**517,609**

Total capital costs[5] on average represent 16% of the total costs and vary only slightly in 2007-2010. Total costs reached the highest level of € 5,491,647 in 2010 when the smallest amount of fish was caught, 8,580 tonnes. This can be explained by higher insurance, repairs and maintenance and higher depreciation per vessel than in other years.

Profits after variable and fixed costs were € 610,478 in 2007, € 985,821 in 2008, € 1,869,831 in 2009 and € 517,609 in 2010. Average profit per tonne varies from € 63 in 2007 to € 109 in 2010 (table 3.4). However, it must be pointed out that the improved average profitability per tonne in 2009 and 2010 should be attributed to the change in the fish composition (the highest catches of Atlantic mackerel that have been registered) and an increase in price over time.

It is noticeable that throughout the period under consideration the average cost per tonne is higher than the average value for Atlantic herring and blue whiting while lower than that for Atlantic mackerel. This shows that the profitability of the vessels very much depends on the mackerel fishery. The fisheries for herring and blue whiting can be considered marginal in the sense that they will be undertaken as long as revenues cover variable costs. However, these fisheries do not contribute (much) towards covering fixed costs.

Opportunity costs

The actual costs paid by a business may be different from opportunity costs. A prime example of that are interest and depreciation payments. If the purchase of a piece of

machinery is fully funded by equity, the firm will incur no interest payments. In reality there will, however, be an economic cost, as this capital will have an opportunity cost. In this section, we will use opportunity costs for labour and capital, while we assume that market prices for other inputs such as fuel also represent their opportunity costs.

For capital, we would ideally like the opportunity cost of boat and gear for every year under consideration. This information is not available. For 2006, however, we have insurance value for boat and gear at £ 12,630,800 (Anderson *et al.*, 2008). We will assume this is the value also for 2007.

Furthermore, we will assume boat and gear are depreciated over a 15 year time period. While this may appear a bit short for the vessel, it may be long for gear. Thus on average it may be appropriate. Furthermore, we assume the scrap value after 15 years is zero. Finally, we assume a 5% real interest rate and depreciation according to the annuity method. This gives an annuity factor of 0.09634. Thus, for 2007, interest and depreciation will be £ 1,216,851 or € 1,778,306 when converted into Euros[6] (table 3.5).

The insurance value, or other measures of the opportunity cost of capital, is not available for other years. For this reason, we use the 2007 estimate and adjust with inflation for the years 2008-10[7].

For labour, we use an opportunity cost of £ 63,000 or € 92,068 per man-year in 2007. This is representative of what is paid in the supply sector, which is likely to represent alternative employment opportunities for fishermen on pelagic trawlers. We adjust with inflation for the years 2008-10[8].

As for the number of man-years, we use full time equivalents, namely seven, four, seven and five, respectively, for years 2008-10 (table 3.2).

Profit estimation for 2007-10, based on these assumptions, is presented in table 3.5.

Table 3.5. Profit estimation based on opportunity cost 2007-10.

Vessel statistics	2007	2008	2009	2010
Total Income (Euros)	5,956,938	4,970,140	6,712,311	6,009,256
Crew wage	(619,385)	(427,691)	(651,903)	(559,172)
Fuel and other operating costs	(2,243,718)	(1,646,043)	(736,945)	(878,118)
Insurance repair and maintenance	(833,639)	(513,610)	(1,270,202)	(2,256,976)
Interest and depreciation on capital	(1,805,806)	(1,870,815)	(1,910,543)	(1,975,552)
Total Costs (Euros)	**(5,502,548)**	**(4,458,160)**	**(4,569,593)**	**(5,669,818)**
Profit (Euros)	**454,390**	**511,980**	**2,142,717**	**339,438**
Avg cost of production per tonne (Euros)	**(566)**	**(487)**	**(502)**	**(661)**

When comparing to table 3.4, it is noticeable that wage costs are substantially reduced. Capital costs, on the other hand, are higher. For three out of four years (2007, 2008 and 2010) total costs increase so that profits decline, while the opposite is true for 2009.

Average cost is reduced from 566 Euro/tonne in 2007 to 487 Euro/tonne in 2008. It subsequently increases, with a particularly strong increase in 2010 to 661 Euro/tonne which is likely to have been caused by an increase in insurance, repair and maintenance.

4. NORWEGIAN FLEETS[9]

For Norway, two fleets will be considered, namely purse seiners and pelagic trawlers. Total catches of purse seiners are generally four times those of trawlers.

4.1 Purse seine fleet

4.1.1 Overview over fisheries and fleet for 2008-2011

The most important species for purse seiners in terms of quantity and value are Atlantic herring, Atlantic mackerel, capelin and blue whiting. Table 4.1 provides catch statistics for 2008-2011. Total volume of landings was fairly constant during the 2008-10 period, however, it decreases considerably in 2011 to 844,593 tonnes, representing a reduction of 23% compared to 2008 (table 4.1).

Table 4.1. Volume of landings

Volume of landings (tonnes)	2008	2009	2010	2011
Atlantic herring	565,163	551,692	478,704	338,798
Atlantic mackerel	83,210	86,128	167,341	145,909
Capelin	40,355	166,134	204,924	282,731
Blue whiting	362,828	181,178	165,010	11,119
Total main species	**1,051,556**	**985,132**	**1,015,979**	**778,557**
Total other species	48,312	91,706	45,449	66,036
Gran total(tonnes)	**1,099,868**	**1,076,838**	**1,061,428**	**844,593**

The number of active vessels has been stable over time, varying between 78-80 (table 4.2). The average fleet age varies from 15 years in 2008 to 17 in 2011, so the fleet is fairly modern. Average registered vessel tonnage increased slightly over time, being 1,570 Gross Tonnes (GT) in 2008 and 1,584 GT in 2010. The average number of days at sea increased from 189 in 2008 to 194 in 2009, then decreased to 181 in 2010 and 157 in 2011. Average landings per vessel were fairly constant for 2008 – 2011, however, went down considerably in 2011 in line with the reduction in total landings.

Table 4.2. Fleet statistics

Fleet statistics	2008	2009	2010	2011
Number of vessels in population (units)	80	79	78	80
Avg. Landings per vessel (tonnes)	13,748	13,631	13,608	10,557
Avg. vessel age (years)	15	16	17	17
Avg. weight (GT- Gross Tonnes)	1,570	1,576	1,577	1,584
Avg. time at sea (days)	189	194	181	157

Atlantic herring represents the biggest portion of all fish caught. However, the volume decreases over time from 565,163 tonnes (51% of total catches) in 2008 to 338,798 tonnes (40% of total catches) in 2011. Two factors influenced this trend: overall drop in catches during the period and change in the fish composition. Thus, the volume and proportion of capelin rises significantly in 2008-2011 from 40,355 tonnes (4% of total catches) to 282,731 tonnes (33% of total catches). The importance of Atlantic mackerel increases as well as its landings – from 83,210 tonnes (8% of the total catches) in 2008 to 145,909 tonnes (17% of the total catches) in 2011. The catches of blue whiting, in contrast, decrease dramatically over time. In 2008 it represented 33% (362,828 tonnes) of all the fish caught, and only 2% (19,352 tonnes) in 2011.

Table 4.3. Average value per tonne.

Average value per tonne (NOK)	2008	2009	2010	2011
Atlantic herring	**3,131**	**2,834**	**3,522**	**5,841**
Atlantic mackerel	**11,483**	**8,243**	**8,055**	**12,977**
Capelin	**2,423**	**1,756**	**1,954**	**2,213**
Blue whiting	**1,020**	**1,431**	**1,869**	**4,082**
Average value per tonne all species	3,048	2,917	3,652	5,696

Average value per tonne was fairly constant in 2008 – 09, then rose 25 % from 2009 – 10, and then rose considerably to NOK 5,696 in 2011, an increase of 56 %. The average value of Atlantic herring went up by 87%. The values for Atlantic mackerel and capelin fluctuate over time, but less significantly. Similar to the UK catch statistics, blue whiting experienced the most noticeable change in the average value per tonne. The figure rose by 300% from NOK 1,020 per tonne in 2008 to NOK 4,082 per tonne in 2011 (table 4.3).

4.1.2 Cost analysis 2008-2011

Average vessel revenue and cost data for 2008-20011 are displayed in table 4.4. These data represents averages for total landings. The profit and loss analysis, however, is done on a sample of boats out of total population. The number of sample boats for each year can be found in table 4.5.

Table 4.4. Income, costs and profits per vessel 2008-11.

Vessel statistics	2008	2009	2010	2011
Total income (NOK)	**43,627,194**	**41,297,293**	**50,902,396**	**61,219,755**
Special tax	(1,243,820)	(1,181,561)	(1,601,367)	(1,834,678)
Crew wage	(12,352,341)	(12,097,643)	(14,358,387)	(16,844,230)
Fuel and lubrication oil	(5,289,984.7)	(4,052,704)	(4,706,212)	(4,633,112)
Insurance, repairs and maintenance	(6,515,306)	(6,024,453)	(6,591,104)	(6,967,725)
Other variable costs	(2,913,145)	(3,135,363)	(3,898,944)	(3,859,907)
Total Operating costs	**(28,314,597)**	**(26,491,724)**	**(31,156,014)**	**(34,139,652)**
Interest	(2,604,902.8)	(4,181,146)	(3,344,684)	(4,813,875)
Depreciation on vessel	(4,483,719.1)	(4,634,964)	(4,012,581)	(4,219,244)
Total Capital costs	**(7,088,622)**	**(8,816,110)**	**(7,357,265)**	**(9,033,119)**
Total Costs (NOK)	**(35,403,219)**	**(35,307,834)**	**(38,513,279)**	**(43,172,771)**
Profit (NOK)	**8,223,975**	**5,989,459**	**12,389,117**	**18,046,984**

Income from landings[10] went up over time from NOK 43,627,194 in 2008 to NOK 61,219,755 in 2011.

Among operating costs, crew wages[11], insurance repairs and maintenance[12], fuel and lubrication oil are the most significant. Expense on crew was 44% in 2008 and 49% in 2011. Insurance, repair and maintenance represented 23% in 2008 and 20% in 2011. Fuel expenses decreased over time, being 19% of the total operating costs in 2008, down to 14% in 2011.

Special tax is defined as payment to the social security system. As such it is a cost rather than a tax and included in cost of production.

The total capital costs - interest and depreciation on vessel - fluctuate from 19% to 25 % of the total costs over the period.

Depreciation on fishing licenses and permits is not included as a cost of production. Fishing licenses and permits represent capitalised resource rent. For this reason depreciation is not included as part of cost of production.

In general, total costs increase on yearly basis, mainly due to increased expense on crew wages and interest costs.

Bottom line profits were NOK 8,223,975 in 2008, up to NOK 18,046,984 in 2011 (+119% across the years). It is worth noticing that in spite of decreased volume in 2011, the profits increased due to a significant increase in average price per tonne that compensated for the volume reduction.

As shown in table 4.5, average profit per tonne, at NOK 598 in 2008, increased considerably to NOK 1,709 per tonne in 2011 (+186%). As the total volume of catches went down over the period, the steep rise in average profit from 2009

onwards is attributable to the increasing average income outperforming increasing average costs.

Table 4.5. Average results.

Average results (NOK)	2008	2009	2010	2011
Number of vessels in the sample	70	65	66	65
Average income per tonne	3,173	3,030	3,741	5,799
Average cost per tonne	(2,575)	(2,590)	(2,830)	(4,089)
Average profit per tonne	598	439	910	1,709

Opportunity cost

Next, we want to correct for opportunity costs. For 2007, this is set at NOK 700,000 per man year. Also for Norway, the supply industry is considered the alternative employment opportunity for fishermen. For later years, the wage cost is adjusted by wage cost index for the private sector (appendix, table A3). We use the number of man-years as reported by the vessels.

Interest and depreciation of capital is estimated on the basis of the asset values of vessel and gear which we assume represent the opportunity cost of capital[13]. As for the UK, a 5% interest rate is assumed with depreciation over 15 years according to the annuity method.

Table 4.6. Profit estimation based on opportunity cost 2008 -2011

Vessel statistics	2008	2009	2010	2011
Volume of landings (tonnes)	13,748	13,631	13,608	10,557
Total Income (NOK)	43,627,194	41,297,293	50,902,396	61,219,755
Special tax	(1,243,820)	(1,181,561)	(1,601,367)	(1,834,678)
Crew wage	(11,727,380)	(11,880,960)	(12,429,690)	(12,276,110)
Fuel and other operating costs	(5,289,985)	(4,052,704)	(4,706,212)	(4,633,112)
Insurance repair and maintenance	(6,515,306)	(6,024,453)	(6,591,104)	(6,967,725)
Interest and depreciation on capital	(6,431,648)	(6,413,172)	(6,042,145)	(6,372,018)
Total Costs (NOK)	(31,208,139)	(29,552,850)	(31,370,518)	(32,083,643)
Profit (NOK)	12,419,056	11,744,443	19,531,878	29,136,112
Avg cost of production per tonne (NOK)	(2,270)	(2,168)	(2,305)	(3,039)

When comparing with table 4.4, we notice a reduction in wage costs, particularly for 2011 as well as in capital costs. Profits are higher for all years.

Average cost of production is quite stable for 2008-10, however, it increased substantially in 2011 to 3,039/tonne.

4.2 Pelagic Trawlers fleet

4.2.1 Overview over fisheries and fleet for 2008-2011

Pelagic trawlers catch various types of fish among them Atlantic herring, Norway pout, sandeel, capelin, blue whiting and Atlantic mackerel. Table 4.7 provides catch statistics for 2008-2011. Total volume of landings follows an irregular path: 231,576 tonnes in 2008, almost constant at the same level in 2009, then steeply increased to 271,519 in 2010, and eventually down to 184,264 tonnes in 2011. Noticeably, there is a substantial difference in the composition of catch across the period.

Table 4.7. Volume of landings

Volume of landings (tonne)	2008	2009	2010	2011
Atlantic herring	104,779	105,261	83,118	57,104
Norway pout	6,173	35,628	57,897	2,716
Sandeels	53,184	17,336	50,692	67,586
Capelin	0	26,127	29,930	29,518
Atlantic mackerel	3,312	1,676	6,668	12,952
Blue whiting	54,706	38,262	27,170	7,204
Total main species	**224,162**	**224,290**	**255,475**	**177,080**
Total other species	7,414	10,898	16,044	7,184
Gran total(tonnes)	**231,576**	**235,188**	**271,519**	**184,264**

The fleet counted 25 vessels in 2008, 24 vessels in 2009-2010 and 27 vessels in 2011 (table 4.8). The average fleet age varies. It was 22 years in 2008, 23 in 2009 and 24 in 2010. The average age comes down to 17 years in 2011, which suggests that new vessels were added to the fleet this year.

Table 4.8. Fleet statistics

Fleet statistics	2008	2009	2010	2011
Number of vessels in population (units)	25	24	24	27
Avg. Landings per vessel (tonnes)	9,263	9,800	11,313	6,825
Avg. vessel age (years)	22	23	24	17
Avg. weight (GT- Gross Tonnes)	747	731	790	798
Avg. time at sea (days)	246	214	207	189

The average vessel tonnage fluctuates over time: 747 Gross Tonnes (GT) in 2008, 731 GT in 2009, 790 GT in 2010 and 798 GT in 2011. The increase in the average vessel tonnage in 2009 and 2010 might reflect the larger size of newly added or replaced vessels in the fleet.

It is noticeable that the average number of days spent at sea decreased from 246 days in 2008 to 189 days in 2011, despite the increasing average number of boats. Similarly, the average volume of landings is decreasing over the same period

The most important species caught in all the years were Atlantic herring and sandeel.

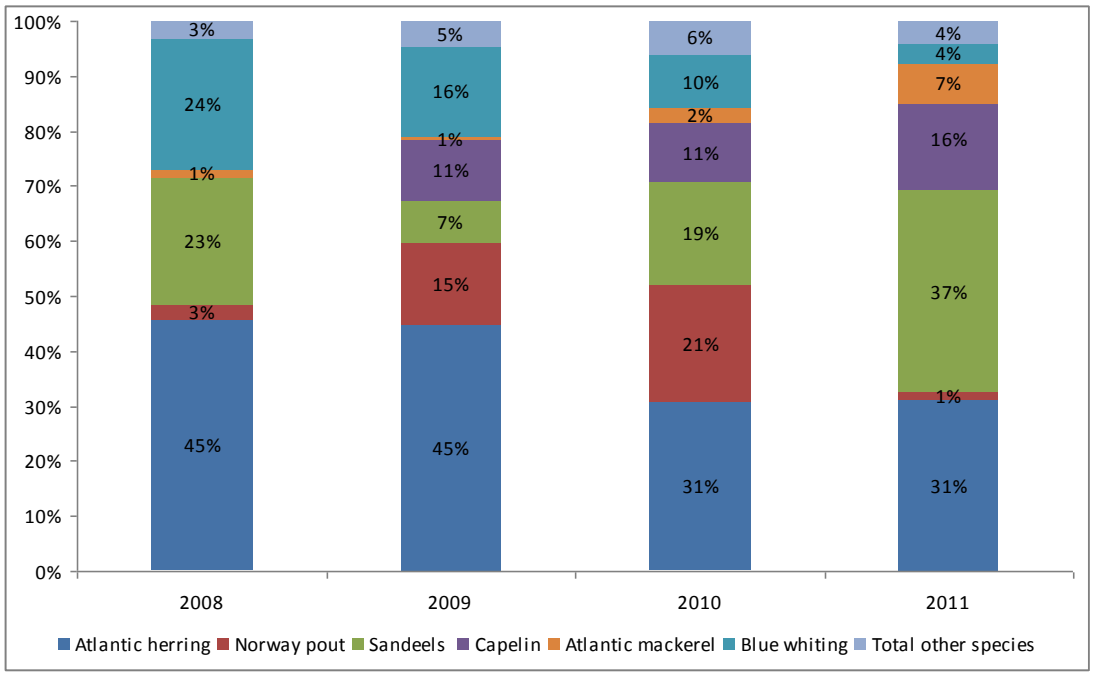

Figure 4.1. Volume distribution.

The catches of Atlantic herring decreased gradually over time, representing 45% of total fish caught in 2008-2009 and 31% in 2010-2011 (figure 4.1). The volume of sandeel also fluctuates considerably over time: 23% of total catches in 2008, 7% in 2009, 19% in 2010 and 37% in 2011.

Capelin was not harvested in 2008, but contributed 11% to total catches in 2009-2010 and 16% in 2011.

The share of mackerel in total catches varies from 1% in 2008-09 to 2% in 2009 and 7% in 2011. The catches of blue whiting steeply declined from 24% in 2008 to just 4% in 2011.

Average value per tonne increased continuously during the period, being NOK 1,914 in 2008 and NOK 3,639 in 2011. The average value of blue whiting and Atlantic herring went up by 132% and 114% respectively across the four-year period. The values of Atlantic mackerel, Norway pout, sandeel and capelin increased on average by 52% across the same period (table 4.9).

Table 4.9. Average value per tonne

Average value per tonne (NOK)	2008	2009	2010	2011
Atlantic herring	2,451	2,357	2,814	5,234
Norway pout	1,127	1,387	1,817	1,651
Sandeels	1,165	1,476	1,918	1,799
Capelin	-	1,418	1,961	2,144
Atlantic mackerel	6,769	6,735	8,191	10,571
Blue whiting	978	1,275	1,897	2,272
Average value per tonne all species	**1,914**	**1,928**	**2,414**	**3,639**

4.2.2 Cost analysis 2008-2011

Table 4.10 displays average vessel revenue and cost data for 2008-2011. These data represent averages for total landings. The profit and loss analysis is done on a sample of boats out of total population. The number of sample boats for each year can be found in table 4.10.

Table 4.10. Income, costs and profits per vessel 2008-11.

Vessel statistics	2008	2009	2010	2011
Total income (NOK)	**18,159,796**	**19,402,183**	**27,171,993**	**24,909,291**
Special tax	(529,386)	(571,759)	(736,313)	(750,414)
Crew wage	(5,172,968)	(6,205,106)	(7,956,287)	(6,966,328)
Fuel and lubrication oil	(3,530,914)	(2,480,042)	(3,432,130)	(3,173,735)
Insurance, repairs and maintenance	(3,100,744)	(3,174,087)	(4,753,906)	(3,863,431)
Other variable costs	(767,766)	(1,091,166)	(1,295,168)	(1,076,626)
Total Operating costs	**(13,101,779)**	**(13,522,160)**	**(18,173,804)**	**(15,830,534)**
Interest	(3,475,761)	(3,170,587)	(3,306,559)	(2,818,229)
Depreciation on vessel	(1,727,791)	(1,770,851)	(2,035,576)	(1,994,364)
Total Capital costs	**(5,203,552)**	**(4,941,438)**	**(5,342,135)**	**(4,812,593)**
Total Costs (NOK)	**(18,305,331)**	**(18,463,598)**	**(23,515,939)**	**(20,643,127)**
Profit (NOK)	**(145,535)**	**938,585**	**3,656,054**	**4,266,164**

Income from landings[14] increased from NOK 18,159,796 in 2008 to NOK 27,171,993 in 2010, then went down to NOK 24,909,291 in 2011. However, cost efficiency improved across the period, so that the bottom line trend is improving: a loss of NOK 145,535 was recorded in 2008, whereas profits of NOK 938,585, NOK 3,656,054 and NOK 4,266,164 were realised, respectively, in 2009, 2010 and 2011. Consequently, the profit margin follows the same trend.

With regards to operating costs, the reduction of "days at sea" is reflected in a lower value of fuel expenses as percentage of total cost, when moving from 2008 (19%) to 2011 (15%). Within non-operating costs, interest costs as percentage of total cost also decreased, being 19% in 2008 and 14% in 2011.

Table 4.11. Average results.

Average results (NOK)	2008	2009	2010	2011
Number of vessels in the sample	25	24	24	27
Average income per tonne	1,960	1,980	2,402	3,650
Average cost per tonne	(1,976)	(1,884)	(2,079)	(3,025)
Average profit per tonne	**(16)**	**96**	**323**	**625**

With a similar logic, average income and profit per tonne increased across the period, from an average loss of NOK 16 per tonne in 2008, to an average profit of NOK 625 per tonne in 2011 (table 4.11).

Opportunity costs

Table 4.12 gives profit estimates, based on opportunity costs, using the same assumptions and procedures as for purse seiners.

Table 4.12. Profit estimation based on opportunity cost 2008-2011.

Vessel statistics	2008	2009	2010	2011
Volume of landings (tonnes)	9,263	9,800	11,313	6,825
Total Income (NOK)	18,159,796	19,402,183	27,171,993	24,909,291
Special tax	(529,386)	(571,759)	(736,313)	(750,414)
Crew wage	(5,981,850)	(6,168,960)	(7,917,000)	(6,591,200)
Fuel and other operating costs	(3,530,914)	(2,480,042)	(3,432,130)	(3,173,735)
Insurance repair and maintenance	(3,100,744)	(3,174,087)	(4,753,906)	(3,863,431)
Interest and depreciation on capital	(3,417,415)	(3,143,099)	(4,765,419)	(2,710,666)
Total Costs (NOK)	(16,560,309)	(15,537,947)	(21,604,768)	(17,089,446)
Profit (NOK)	**1,599,486**	**3,864,236**	**5,567,225**	**7,819,845**
Avg cost of production per tonne (NOK)	(1,788)	(1,586)	(1,910)	(2,504)

When comparing these results to table 4.10, there is little difference for crew wage, while capital costs decrease. As a consequence, total costs decrease for all years with a concomitant increase in annual profits.

Average cost per tonne declines from 2008 to 2009, but is subsequently on the increasing, reaching NOK 2,504/tonne in 2011.

4.3 Comparison of two Norwegian fleets

On average purse seiner fleet is three times as big as pelagic trawlers one and accounts for around 80% of all the total catches of Norwegian fleets in 2008-11. A purse seiner's average landings are on average 30 % higher than that of pelagic

trawlers. On the other hand, pelagic trawlers spent an average 20%-30% more days at sea than purse seiner fleet.

The average revenue per tonne and average profit per tonne of purse seiners is also significantly higher than that of pelagic trawlers. The difference in average profitability can be explained by diverse fish composition. For both fleets Atlantic herring is the biggest revenue contributor, but purse seiners has higher quota of Atlantic mackerel in their catches which average value per tonne is higher than that of sandeel caught by pelagic trawlers.

5. ICELANDIC FLEET

Data are available for the Icelandic pelagic fleet for 2007-11. All values have been converted into Norwegian kroner NOK (see appendix, table A5 for exchange rates).

Landings are given in table 5.1. There was a substantial decline from 642,700 tonnes in 2007 to a bottom level of 403,400 tonnes in 2010, increasing to 466,800 tonnes in 2011. There have been substantial changes in species composition over time. Capeling catches declined from 243,100 tonnes in 2007 to only 11,800 tonnes in 2009, recovering to 259,800 tonnes in 2011. Catches of blue whiting declined from 165,000 tonnes in 2007 to only 3,400 tonnes in 2011. Herring catches declined in 2010 and 2011. Mackerel catches, on the other hand, increased due to the changed migration pattern for this species (Bjørndal and Ekerhovd, 2013).

Table 5.1. Volume of Landings 2007-11. 000 Tonnes.

Volume of landings (tonnes)	2007	2008	2009	2010	2011
Herring	209,8	231,2	223,5	171,5	123,5
Mackerel	24,6	74,0	84,0	69,4	73,0
Blue Whiting	165,0	96,0	81,3	53,4	3,4
Capelin	243,1	103,8	11,8	89,8	259,8
Total other species	0,3	0,2	37,4	19,3	7,1
Gran total	642,7	505,2	438,0	403,4	466,8

Of 20 vessels in operation in 2011, 12 were purse seiners and eight were pelagic freezer trawlers[15] (table 5.2). Over the period in question, the size of vessels, measured in gross tonnage, length and kW, has not changed very much. It is noticable that the average building year of vessels has remained contant (1979) since 2008, i.e., the fleet has been aging.

Table 5.2. Fleet Statistics 2007-2011.

Fleet statistics	2007	2008	2009	2010	2011
Number of vessels (units)	25	19	21	20	20
Average gross tonnage (GT)	1 286	1 380	1 387	1 316	1 316
Average vessel length (m)	58	59	61	58	58
Average vessel kW	3 106	3 468	3 543	3 325	3
Average building year of vessels	1 976	1 979	1 978	1 979	1 979
Insurance value (million NOK)	988	694	705	918	892

Average value per tonne is given in table 5.3. The overall average has increased from NOK 1,209/tonne in 2007 to NOK 1,836/tonne in 2011, an increase of 50%. This increase is primarily due to a very large increase in the herring price, from NOK 742/tonne in 2007 to NOK 2,036/tonne in 2011. In addition, mackerel, the most valueable species and entering the statistics in the last three years, almost doubled in price from 2009 – 2011.

Table 5.3. Average Value NOK/tonne 2007-11.

Average value per tonne (NOK)	2007	2008	2009	2010	2011
Herring	742	1 625	1 414	1 605	2 036
Mackerel	N/A	N/A	1 405	1 877	2 762
Blue Whiting	1 114	887	882	1 368	1 226
Capelin	1 281	1 025	1 554	1 964	1 460
Average value per tonne all species	1 209	1 382	1 276	1 718	1 836

n.a. = not available.

Table 5.4 gives annual operating accounts for the *entire* pelagic fleet for 2007-11. Total income declined from NOK 777 million in 2007 to NOK 559 million in 2009, then increasing to NOK 857 million in 2011. These changes can be explained by developments in total landings, landings composition and prices, as given above.

Table 5.4. Profit estimation based on opportunity cost 2007-11. Mill NOK.

Vessel statistics	2007	2008	2009	2010	2011
Volume of landings (tonnes)	643	505	438	403	467
Total Income (million NOK)	777	698	559	693	857
Fishing gear	(67)	(34)	(32)	(24)	(37)
Other costs	(86)	(59)	(55)	(63)	(66)
Maintenance and repair	(67)	(39)	(41)	(44)	(52)
Insurance	(8)	(10)	(13)	(13)	(12)
Interest and depreciation on capital	(110)	(83)	(84)	(110)	(106)
Total costs	(743)	(558)	(510)	(591)	(702)
Profit	34	140	49	102	155
Average cost NOK/tonne	(1.156)	(1.105)	(1.164)	(1.465)	(1.504)

Definitions:
Total income = export products + fresh fish for processing (other income excluded).
Labour costs = fishermen‘s shares + other wages + labour related costs.
Other costs = transportation + salaries + overhead + sales + landing + other.

Imputed costs on capital is based on the insurance value of vessels, assuming a 6% interest rate and depreciation over 12 years. This gives an annuity factor of 0.11928. For the UK and Norwegian fleets, opportunity cost was estimated assuming a 5% interest rate and depreciation over 15 years which gives an annuity factor of 0.09634. Thus imputed cost of capital is relatively higher for Icelandic than for UK and Norwegian vessels.

Total profit shows great variability over time, however, profit increased in the last three years from NOK 49 million in 2007 to NOK 155 million in 2011.

Average cost per tonne is quite stable and in the range 1,100-1,160/tonne between 2007-09, however, cost then increased quite substantially and was recorded at NOK 1,504/tonne in 2011. When we compare with average value per tonne, it is noticeable that mackerel is the most profitable fishery followed by herring.

6. COMPARATIVE ANALYSIS ACROSS COUNTRIES

In contrast to the UK pelagic fleet, Norwegian fleets are comprised of both pelagic trawlers and purse seiners, and are considerably bigger in terms of number of vessels and catches. For Iceland, a combined fleet of purse seiners and pelagic trawlers has been included.

In the period 2008-2011, the total days spent at sea are greater for Norway (table 6.1). On average, Norwegian purse seiners spent 180 days at sea and Norwegian pelagic trawlers spent 214 days, whereas UK pelagic trawlers spent 70 days at sea. For Iceland, information on days at sea is not available.

The total number of vessels fleet fluctuates from 31 to 34 in the UK and from 102 to 107 in Norway while it has decreased from 25 to 20 in Iceland. The total volume of landings of Norwegian fleets is on average 75% higher than that of UK fleet across the years (1,331,444 tonnes versus 283,687 tonnes in 2008 and 1,028,857 tonnes versus 279,856 tonnes in 2011). For Iceland, total landings varied between 403-643,000 tonnes per year[16], i.e., more than for UK and Norwegian pelagic trawlers but less than for the Norwegian purse seine fleet.

It is interesting to highlight the declining trend, both for UK and Norway, in days spent at sea and, as a consequence, in total landings. For UK, we observe a -1.4% in landing volumes in 2011, compared to 2008. The decline is much more noticeable for Norway: -20.4% for pelagic trawlers and -23.2% for purse seine over the same period.

However, in absolute terms, the Norwegian fleet is more numerous, the value number of days at sea is greater and catch quantities are much higher that for the UK.

Table 6.1 Landings, days at sea and average landings per vessel

Vessel statistics		2007	2008	2009	2010	2011
Days at sea	UK Pelagic trawlers	85	72	71	74	62
	Norway Pelagic trawlers	n/a	246	214	207	189
	Norway Purse seine	n/a	189	194	181	157
	Iceland	n/a	n/a	n/a	n/a	n/a
Number of vessels	UK Pelagic trawlers	32	31	31	34	32
	Norway Pelagic trawlers	n/a	25	24	24	27
	Norway Purse seine	n/a	80	79	78	80
	Iceland	25	19	21	20	20
Total landings (tonnes)	UK Pelagic trawlers	311,362	283,687	282,392	291,722	279,856
	Norway Pelagic trawlers	n/a	231,576	235,188	271,519	184,264
	Norway Purse seine	n/a	1,099,868	1,076,838	1,061,428	844,593
	Iceland	642,700	505,200	438,000	403,400	466,800
Avr. Landings per vessel (tonnes/vessel)	UK Pelagic trawlers	9,730	9,151	9,109	8,580	8,746
	Norway Pelagic trawlers	n/a	9,263	9,800	11,313	6,825
	Norway Purse seine	n/a	13,748	13,631	13,608	10,557
	Iceland	25,708	26,589	20,857	20,170	23,340

Moving from operations to economic information, table 6.2 offers a comparative cost/profit analysis. With volumes much higher for the Norwegian fleets than the UK's, total revenues and total costs are also greater for Norway. Total revenues for the UK are higher than for Iceland even if landings are lower.

However, it appears that revenue optimisation is more favourable for the UK: for instance, in 2011, the average revenue per tonne was 7,582 NOK for UK Pelagic trawlers, and only 3,650 and 5,799 for Norwegian pelagic trawlers and purse seine, respectively and only NOK 1.835/tonne for Iceland. On the other hand, costs are lower in Norway: the average cost per tonne is lowest for Iceland, with UK pelagic trawlers having highest average cost per tonne.

Next, it is possible to compare average net profit per tonne. Values are generally greater for the UK – although a high degree of fluctuation is noticeable. In the case of Norway, profits are lower but there is a continuously increasing trend for pelagic trawlers and a tremendous improvement in 2011 for purse seiners after a couple of challenging years. For Iceland average net profit per tonne is lower than for the UK and the Norwegian purse seine fleet, except for 2010, when Iceland has higher net profit per tonne than both the Norwegian fleets.

Table 6.2 Revenue and costs 2007-2011.

Revenue and costs		2007	2008	2009	2010	2011
Value of landings (1000 NOK)	UK Pelagic trawlers	1,528,787	1,269,572	1,773,754	1,695,940	2,197,467
	Norway Pelagic trawlers	n/a	453,995	465,652	652,128	672,551
	Norway Purse seine	n/a	3,490,176	3,262,486	3,359,558	4,897,580
	Iceland	777,000	698,000	559,000	693,000	857,000
Total costs (1000 NOK)	UK Pelagic trawlers	(1,372,115)	(1,017,754)	(1,312,021)	(1,441,360)	n/a
	Norway Pelagic trawlers	n/a	(457,633)	(443,126)	(564,383)	(557,364)
	Norway Purse seine	n/a	(2,832,258)	(2,789,319)	(3,004,036)	(3,453,822)
	Iceland	(743,000)	(558,000)	(510,000)	(551,000)	(702,000)
Average revenue per tonne (NOK)	UK Pelagic trawlers	4,910	4,475	6,281	5,814	7,852
	Norway Pelagic trawlers	n/a	1,960	1,980	2,402	3,650
	Norway Purse seine	n/a	3,173	3,030	3,165	5,799
	Iceland	1,209	1,382	1,276	1,718	1,836
Average cost per tonne (NOK)	UK Pelagic trawlers	(4,407)	(3,588)	(4,646)	(4,941)	n/a
	Norway Pelagic trawlers	n/a	(1,976)	(1,884)	(2,079)	(3,025)
	Norway Purse seine	n/a	(2,575)	(2,590)	(2,830)	(4,089)
	Iceland	(1,156)	(1,105)	(1,164)	(1,366)	(1,504)
Average net profit per tonne (NOK)	UK Pelagic trawlers	503	888	1,635	873	n/a
	Norway Pelagic trawlers	n/a	(16)	96	323	625
	Norway Purse seine	n/a	598	439	335	1,709
	Iceland	53	277	112	352	332

Table 6.3 shows a comparative analysis of operating and total cost per day at sea for Norway and the UK. Iceland is not included, as information on days at sea is not available. Norwegian pelagic trawlers have the lowest costs, whereas UK pelagic trawlers have highest costs with Norwegian purse seiners in the middle. It is noticeable that the total costs per vessel increase respectively with the decrease in the number of days at sea. There is a similar relationship between operating (variable costs) and the number of days for Norwegian pelagic trawler and purse seine fleets.

Table 6.3. Operating and Total Costs per Day at Sea for Norway and the UK. '000NOK/tonne.

Cost per day at sea		2007	2008	2009	2010	2011
Operating cost per vessel per day at sea (1000 NOK)	UK Pelagic trawlers	(426)	(375)	(512)	(501)	n/a
	Norway Pelagic trawlers	n/a	(53)	(63)	(88)	(84)
	Norway Purse seine	n/a	(150)	(137)	(172)	(217)
Total costs per vessel per day at sea (1000 NOK)	UK Pelagic trawlers	(504)	(456)	(596)	(594)	n/a
	Norway Pelagic trawlers	n/a	(74)	(86)	(114)	(109)
	Norway Purse seine	n/a	(187)	(182)	(213)	(275)

Profitability per tonne

As discussed above, the different fleets harvest several species. In this paper we have paid particular attention to herring, mackerel and blue whiting, which not only are among the most important fisheries in the North Atlantic in terms of quantity as well as value, but they are also harvested by all fleets under investigation.

What is important to bear in mind is that not only do the fleets have different cost structures, the price for a given species may also vary with fleet. This is related to fish quality which may vary with fleet and country. We now turn our attention to this issue.

Average price (value) per tonne herring per fleet and year is given in table 6.4. Some very interesting observations can be made. In particular, it is noticeable that the Norwegian fleets fetch much higher prices for their product than the UK fleet and even more so than the Icelandic fleet. In 2008, the Norwegian purse seine fleet fetched a price that is almost twice that of the Icelandic fleet; by 2011, the Norwegian purse seine fleet fetched a price that is almost three times that of the Icelandic.

It can also be noticed that relative price increases are much higher for Norway than for Iceland. From 2010 to 2011, the Norwegian purse seine price increased from NOK 3,522 to NOK 5,841/tonne, an increase of 66%. In the same period, the Icelandic prices increased by only 27%.

Table 6.4. Average Price (Value) of Herring per fleet and Country 2007-11. NOK/tone.

Country	2007	2008	2009	2010	2011
United Kingdom	3400	2859	3339	3124	3901
Norway PS	N/A	3 131	2 834	3 522	5 841
NorwayPT	N/A	2 451	2 357	2 814	5 234
Iceland	742	1 625	1 414	1 605	2 036

The same kind of pattern can largely be observed for mackerel (table 6.5). In 2011, the Norwegian purse seine price for mackerel of NOK 12,977/tonne is 4.7 times that of the Icelandic (NOK 2,762/tonne) which is a huge difference.

Table 6.5. Average Price (Value) of Mackerel per fleet and Country 2007-11. NOK/tonne.

Country	2007	2008	2009	2010	2011
United Kingdom	7781	8273	8714	7809	9202
Norway PS	N/A	11 483	8 243	8 055	12 977
NorwayPT	N/A	6 769	6 735	8 191	10 571
Iceland	N/A	N/A	1 405	1 877	2 762

As for blue whiting (table 6.6), the situation is different. For this species, UK fishermen fetch the highest price all years except 2011.

Table 6.6. Average Price (Value) of Blue Whiting per fleet and country 2007-11. NOK/tonne.

Country	2007	2008	2009	2010	2011
United Kingdom	1 396	1 407	1 749	1 932	3 630
Norway PS	N/A	1 020	1 431	1 869	4 082
NorwayPT	N/A	978	1 275	1 897	2 272
Iceland	1 114	887	882	1 368	1 226

These results are very interesting. It is very noticeable that the prices (values) are so different for the same species. This indicates important differences in quality as well as usage for herring, mackerel and blue whiting. Moreover, it is noteworthy that in recent years, prices for all species have increased. While this may appear to be as expected for blue whiting and herring, where quantities have declined, it is somewhat surprising for mackerel, where quantities have actually increased. Closer investigation of these issue remains an interesting question for further research.

Above, we analysed cost of production per tonne based on opportunity cost. The results are summarised in table 6.7.

Table 6.7. Average Cost per Tonne per Fleet and Country Based on Opportunity Cost. NOK/tonne.

Country	2007	2008	2009	2010	2011
United Kingdom	4,507	3,980	4,344	5,255	N/A
Norway PS	N/A	2,270	2,168	2,305	3,039
NorwayPT	N/A	1,788	1,568	1,910	2,504
Iceland	1,156	1,105	1,164	1,465	1,504

The results about the cost structure are very clear: the UK fleet has the highest cost per tonne, followed by Norwegian purse seiners, Norwegian pelagic trawlers and the Icelandic fleet.

When we compare prices and costs, it is noticeable that for Norway and the UK, the mackerel fishery is most profitable and blue whiting least profitable. For Iceland, herring was most profitable up to 2009, while mackerel has been most profitable in 2010-11. Moreover, relative and absolute differences in profitability between the different species are less than for Norway and the UK.

What is noticeable here is that Norwegian fishermen not only fetch the highest prices but also have the lowest cost per tonne harvested. TACs are distributed to the different countries as percentage shares which are usually constant over time (Bjørndal and Munro, 2012). The results here indicate that the value shares are very different from the quantity shares. More than that, quantity shares could be rearranged

in a way that would enhance total value from the fishery in a way that could make all countries better off.

7. SUMMARY

The purpose of this paper was to analyse cost of production and profitability for fishing fleets from Norway, the UK and Iceland in three pelagic fisheries in the North Atlantic. The analysis has come up with very interesting results. *A priori* one would have expected prices fetched in the different countries for the same species would be fairly similar. This is not so, as price differentials are quite substantial. Cost differences are also substantial. Perhaps this is less surprising, as different fleets with different operating and technological characteristics are considered.

Differences in prices for the same species must be due to differences in quality and usage. Analysis of these differences as well as price-quantity relationships would represent an interesting topic for further research.

The results also have very important policy implications. As explained by Bjørndal and Munro (2012) and Bjørndal and Ekerhovd (2013), the "zonal principle" is important for sharing of quotas among countries sharing a fish stock. This principle is purely based on quantities, not values. The results in this paper show that value shares are very different from quantity shares. An implication of that is that a reallocation of the TAC could increase the total return from the fishery in a way that, in principle, could make all better off. This would also be an interesting topic for further analysis.

APPENDIX

Table A1. Commodity Fuel Index - Includes Crude Oil (Petroleum), Natural Gas, And Coal Price Indices for The World

Year	USD
2000	53.69
2001	48.01
2002	47.19
2003	55.23
2004	72.414
2005	100
2006	119.23
2007	131.69
2008	184.47
2009	116.49
2010	146.73
2011	193.57
2012	193.75

Source: http://www.economywatch.com/economic-statistics/price-index-indicators/Commodity_Fuel_Index/

Table A2. The United Kingdom Consumer Price Index 2007-2011.

Year	CPI	CPI base year 2007
2007	104.7	100
2008	108.5	103.6
2009	110.8	105.8
2010	114.5	109.4
2011	119.6	114.2

Consumer Price Index- <http://www3.hants.gov.uk/finance/retailpricesindexandconsumerpriceindex.htm > (accessed 05/04/2013).

Table A3. Wage Cost Index for Norway 2007-11.

Year	Wage cost index
2007	100
2008	105.5
2009	108.8
2010	113.1
2011	117.7

Source: https://www.ssb.no/statistikkbanken/selecttable/hovedtabellHjem.asp?KortNavnWeb=lonnansatt&CMSSubjectArea=arbeid-og-lonn&checked=true

Table A4. Exchange Rates

Year		Currency	
	1 Pound=xxx Euro	1 EUR=xxx NOK	1 ISK=xxx NOK
2007	1.46	8.02	10.904
2008	1.26	8.24	15.219
2009	1.22	8.74	19.63
2010	1.66	8.01	20.569
2011	1.15	8.07	20.638

Source: Bloomberg.

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ENDNOTES

[1] This index includes crude oil, natural gas and coal, however, it should be representative for fuel prices paid by fishing vessels.
[2] All cost, revenue and fleet data have been provided by the Joint Research Centre. Revenues and costs are in Euros.
[3] This represents "total value of landings". This value, in contrast to "total income from landings", allows analysing the composition of fish landings –that would not be possible if using "total income from landings".
[4] Other operating costs includes commissions, harbour dues, subscriptions and levies, shore labour, boxes, crew travel, food stores.
[5] This combines opportunity cost of capital and annual depreciation cost.
[6] Source – Bloomberg; 2007 year average £ 1= € 1.4614.
[7] This has been done using the Consumer Price Index (appendix, table A1).
[8] This has been done using the Consumer Price Index (appendix, table A1).
[9]All data in this section are from the Directorate of Fisheries, Norway (www.fiskeridirektoratet.no).
[10] This represents income from landings of "sample boats" for which data are available (see table 4.5).
[11] Includes labour wages, food expense to crew, social expense, contribution to pension scheme.
[12] Includes maintenance on vessel, maintenance on gear, insurance on vessel, other insurance.
[13] There is data on the book value of fishing licenses and permits. As noted, this is capitalised resource rent and not consider part of cost of production.
[14] Represents income from landings.
[15] Information about the split between purse seiners and pelagic freezer trawlers for other years is not available.
[16] For Iceland, landings are for the fleet under consideration. We do not know quantity landed of pelagic species by other Icelandic vessels.

The purpose of this report is to analyse the cost of production in North Atlantic pelagic fisheries – Atlantic mackerel, Atlantic herring and blue whiting. The analysis is undertaken for various fleets from Norway, the United Kingdom (Scotland) and Iceland with data covering the period 2007-11. The results show substantial differences in value creation and cost of production. Moreover, it is shown that a reallocation of quota shares could enhance the total value of the fisheries in question.

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