SEAFISH

SEAFISH ECONOMIC ANALYSIS

Size-price dependency in the market for whitefish

Size-price dependency in the market for whitefish

1. Summary

Seafish analysed data on sales of cod and haddock at Peterhead auction between 2006 and 2015 to estimate how much fish size influenced price at auction. Further analysis was done to estimate how much a lower average size of landed fish could impact fishing revenues. The study found strong evidence of size-dependent pricing for both species and estimated that if catching selectivity is not increased, fishermen operating whitefish vessels could earn as much as £21,000[1] less in gross annual fishing income from cod and haddock landings, compared to pre-landing obligation fishing revenues.

The study suggests that if selectivity is improved, fishermen could achieve a higher overall value for their landings than if they land the same proportion of small fish that they were catching before the landing obligation was implemented.

2. Introduction and Background

Once the landing obligation is fully in place and fishermen are no longer allowed to discard small or undersize fish, the average size of landed fish is expected to decrease, at least in the short term, until skippers modify their fishing tactics and patterns. Because fish price is generally higher for larger size grades of fish, if the average size of fish landed by the UK whitefish fleet shifts down, the overall value of landings would be expected to be lower than if there was no decrease in average size.

Seafish estimated the impact of fish size on auction price and used these results to illustrate how a downward shift in the average size composition of landings could impact the revenues of UK whitefish vessels.

3. Methods

Following established methodology[2], Seafish used a hedonic price model to isolate different fish attributes, including fish size grade, to estimate the degree to which each individual factor influenced the price of cod and haddock at auction.

The data included information about all sales of cod and haddock at Peterhead auction from 2006 to 2015, including vessel identification, buyer name, port of landing, date of landing[3], and the fish species, size grade, presentation and freshness, for each sale. The analysis was restricted to landings from vessels that frequently sold via the auction, or those that supplied cod or haddock to Peterhead auction every year during the 10-year analysis period, over a minimum of 100 landings.

The results from the hedonic analysis were used in a scenario analysis to estimate the total revenue that could be associated with different possible landing size compositions under the landing obligation.

---

[1] All monetary figures in the text are rounded to the nearest thousand.

[2] McConnell, K.E. & Strand, I.E., 2000. Hedonic Prices for Fish: Tuna Prices in Hawaii. American Journal of Agricultural Economics, 82(1), pp.133–144. ; Guillen, J. & Maynou, F., 2015. Characterisation of fish species based on ex-vessel prices and its management implications: An application to the Spanish Mediterranean. Fisheries Research, 167, pp.22–29.

[3] As date of sale information was not provided in the dataset and the auction only operates from Monday to Friday, all Saturday and Sunday landings were treated as being sold at the auction on Monday and all other sales were treated as if they occurred on the date of landing.

The key research questions this study aimed to address were:

- *How much does fish size influence fish price per kg at auction?*
- *If the average size of landed fish decreases because of the landing obligation, how might fishing revenues be affected compared to if average size does not decrease?*

3.1 Hedonic Analysis

The general form for the hedonic model is:

$$ln\mathrm{P}_{it} = f\left(a_1, ..., a_n\right) \tag{1}$$

where *lnP* is the natural logarithm of the price per kilogram of fish sold (£/kg), *i* indexes the observation, *t* is time and $a_1, ..., a_n$ represents the set of unique fish attributes for each lot of fish sold, including fish size grade.

The results of the hedonic model were interpreted as percentage price deviations from the baseline category of size-1, largest fish, controlling for presentation, freshness, port of landing and vessel, as well as month, year and day-of-the-week of sale. Prices were adjusted for inflation using the HM Treasury GDP deflator to reflect 2015 pound equivalence. The adjusted parameter estimates for the size grade variables from the hedonic analysis are shown in Tables 1 and 2.

Table 1. Hedonic model adjusted parameter estimates for different size grades of cod.

Variable	Coefficient	Std. Error	*t*-Statistic[4]
Size-2	0.034	0.007	4.73*
Size-3	-0.051	0.007	-6.69*
Size-4	-0.171	0.008	-19.80*
Size-5	-0.347	0.008	-35.43*

* statistically significant at the 5% level

Table 2. Hedonic model adjusted parameter estimates for different size grades of haddock.

Variable	Coefficient	Std. Error	*t*-Statistic
Size-2	-0.025	0.011	-2.30*
Size-3	-0.184	0.011	-15.78*
Size-4	-0.376	0.010	-36.81*

* statistically significant at the 5% level

The hedonic analysis of Peterhead auction data showed strong evidence of size-dependent pricing for both cod at haddock at the market. The results revealed that from 2006 to 2015, on average, the price of the smallest cod at Peterhead auction was 35% less than the price of the largest size grade and the average price for the smallest size grade of haddock was 46% less than the price of the largest, over the 10-year analysis period. Average price estimates for each size grade of cod and haddock were calculated using the parameter estimates from the hedonic model and are shown in Table 3.

---

[4] The t-statistic is the result of a t-test, which is used to test whether the means of two populations are statistically different from one another. For this analysis, the t-test was used to assess whether the prices of size-2, size-3, size-4 and size-5 fish were statistically different from the price of size-1 fish, on average.

Table 3. Average price estimates for each size grade of cod and haddock if size-1 fish were sold for £2 per kg.

Fish Size Grade	Cod Price (£/kg)	Haddock Price (£/kg)
Size-1	£ 2.00	£ 2.00
Size-2	£ 2.06	£ 1.95
Size-3	£ 1.90	£ 1.63
Size-4	£ 1.66	£ 1.25
Size-5	£ 1.31	N/A

3.2 Scenario Analysis

In the scenario analysis, price and landing size composition data of cod and haddock sold between 2013 and 2015 at Peterhead auction were used to represent North Sea and west of Scotland cod and haddock landed and sold in the UK by UK fishermen. Using the Peterhead dataset, the annual fishing revenues for fishermen aboard a hypothetical, typical whitefish vessel in the over 24m fleet segment targeting cod and haddock in the North Sea and west of Scotland[5] were estimated to be £859,000 before the landing obligation.

Four 'landing obligation' scenarios were then explored. Estimated annual revenues from the landing size compositions of each landing obligation scenario were compared to illustrate how altered landing size compositions and size-dependent pricing might influence the value of landings under the landing obligation.

For each of the landing obligation scenarios, it is assumed that the hypothetical fishermen comply fully with the landing obligation and their vessel does not "choke" (run out of quota) on any stock. It is assumed that, before the landing obligation, one-third of cod and haddock discards were the smallest fish size grade (due to high grading) and two-thirds were below minimum landing size and were discarded due to regulations. It is assumed that in the first year after the landing obligation is in place there is no significant change in average market prices compared to 2015.

In Scenario A, the fishermen do not change their fishing tactics in any way and continue to catch the same ratio of size-5 cod, size-4 haddock and undersize (below MCRS[6]) fish as they did before the landing obligation. Accordingly, the vessel's quotas are used with an increased share of the smallest size category and below MCRS fish, thus reducing the shares of larger fish that are landed, see Figures 1, 2, 3. Under scenario A, in which the fishermen do not change the catch size composition, the fishermen are estimated to lose £21,000 annually, or 2.5% of fishing revenues from North Sea cod, North Sea haddock and west of Scotland haddock, compared to the pre-landing obligation value.

---

[5] In 2015 there was no quota allocation or uptake of west of Scotland cod to the UK fishing fleet. The total stock quota allocation to the vessel in the scenario analysis was calculated based on the UK's 2015 national quota use statistics dataset. Available from: https://www.gov.uk/government/statistical-data-sets/quota-use-statistics#section-2. These figures are assumed to account for international quota swaps. The average annual landings for North Sea cod, North Sea haddock and west of Scotland haddock for the hypothetical vessel in the scenario analysis were 141,629 kg, 338,189 kg, and 42,831 kg respectively, after accounting for quota uplift of 11% for North Sea cod, 14.5% for North Sea haddock and 9.8% for west of Scotland haddock.

[6] Minimum Conservation Reference Size

In Scenarios B, C and D the fishermen are able to improve fishing selectivity and avoid 25%, 50% , and 75% of previously discarded small and below MCRS fish[7], redistributing the landing size compositions accordingly, see Figures 1, 2, 3.
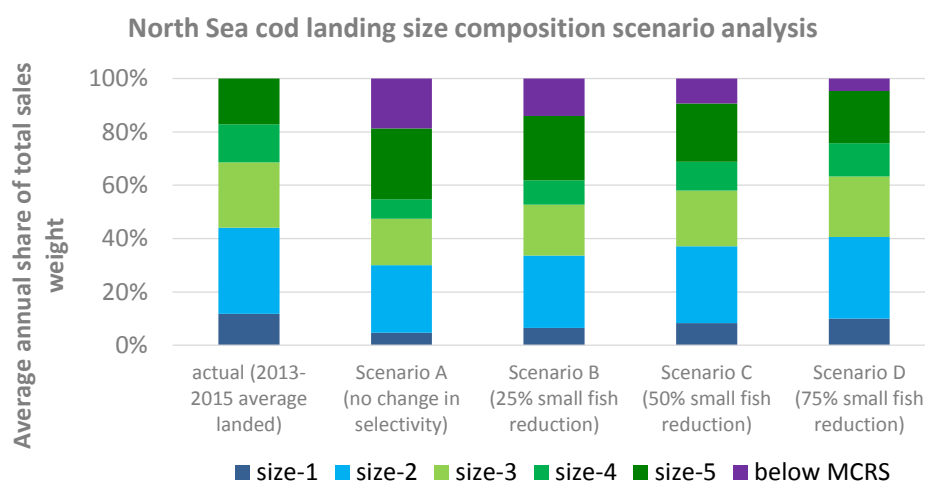
North Sea cod landing size composition scenario analysis

Figure 1. Estimated landing size compositions for North Sea cod under each scenario.

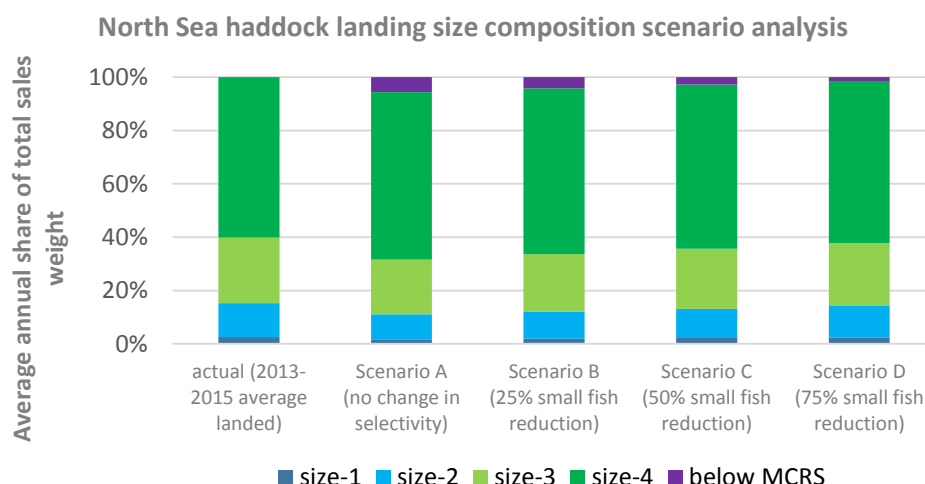North Sea haddock landing size composition scenario analysis

Figure 2. Estimated landing size compositions for North Sea haddock under each scenario.

---

[7] The discard estimates were provided by the 2017 Seafish bioeconomic modelling report. For North Sea cod, the discard ratio was 27.9% for Scottish TR1 vessels and for North Sea haddock and west of Scotland haddock the discard ratios were 8.3% and 6.0% respectively. Available from:
http://www.seafish.org/media/Publications/Seafish_Bioeconomic_Methodology_Report_FINAL.pdf
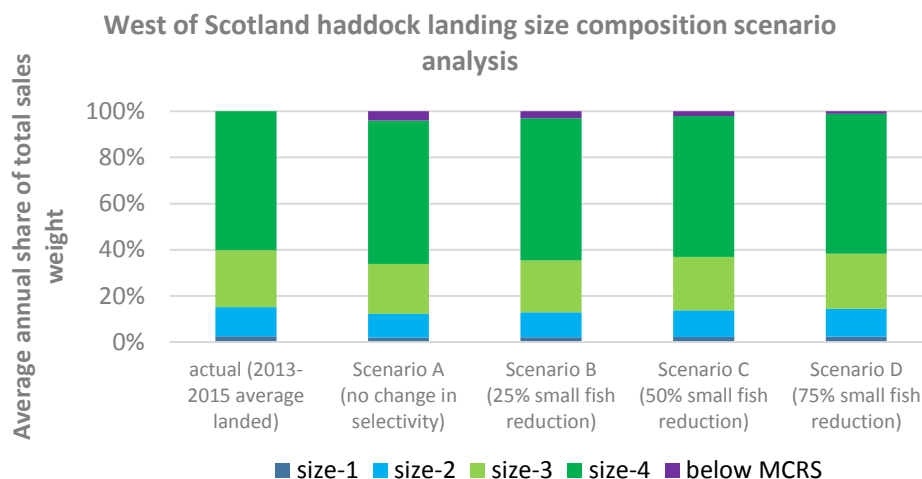
West of Scotland haddock landing size composition scenario analysis

Figure 3. Estimated landing size compositions for west of Scotland haddock under each scenario.

4. Findings

Improving fishing selectivity could help UK fishermen earn higher annual fishing revenues from cod and haddock landings under the landing obligation than if they do not increase selectivity. The analysis estimated additional annual fishing revenues of £27,000, £59,000 and £92,000 for Scenarios B, C and D respectively for a typical whitefish vessel compared to baseline Scenario A, see Table 4.

Table 4. Estimated annual revenue from cod and haddock landings under each scenario.

Scenario	Estimated Annual Revenue (£)*	Absolute Change from Baseline (£)*	Percentage Change from Baseline (%)
Scenario A (no change in selectivity)	838,000		
Scenario B (25% small fish reduction)	865,000	+27,000	3.2
Scenario C (50% small fish reduction)	897,000	+59,000	7.0
Scenario D (75% small fish reduction)	930,000	+92,000	10.9

figures rounded to the nearest thousand

5. Conclusions

The results of the hedonic analysis show evidence of size-dependent pricing in the UK's largest whitefish market. Based on the hedonic analysis results, the scenario analysis illustrates possible financial outcomes that fishermen operating a UK whitefish vessel in the over 24m fleet could experience under the landing obligation, depending on the level of fishing selectivity and catch of smaller fish.

If selectivity is not improved, fishermen are likely to catch the same proportion of small and undersize fish and, because of the landing obligation, land more small and undersize fish. As smaller fish generally achieve lower prices per kg at auction, if fishermen land more small and undersize fish, they are likely to earn less revenue after the landing obligation is fully in place.

Fishermen may be able to increase revenues by improving fishing selectivity through gear changes and tactical decisions about when, where and how to fish. If fishermen effectively alter fishing tactics and reduce catches of smaller, less valuable fish, a typical whitefish vessel in the over 24m fleet may be able to increase cod and haddock revenues by as much as £92,000 annually, compared to landing with no change in catch size compositions after the landing obligation is fully in place.