

The Value of Fish Quality¹

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Abstract. This paper aims to reveal consumers' preferences for quality graded fish products based upon existing data on first-hand sales in Denmark. The data represents the value of fish for consumption as a non-differentiated private good.

The objective is to measure the welfare gains to society of an increase in "quality" for major fish species. The demand for Quality Extra and quality A-fish is estimated using an Inverse Almost Ideal Demand System (IAIDS-model) as the functional form of demand on first-hand sales data following the European Union established trade norms for quality-grading and size-categories. Secondly the possibility of estimating changes in consumer surplus as the welfare gained by society of a general increase in quality of landed fish is discussed. However, the estimates on consumer surplus are not yet completed.

The model adopted is a pricing model for the implicit price of the characteristic "quality" which necessarily is part of the product i.e. fish for consumption. Today the Danish market for fish does not explicitly state the "quality" of fish in the consumers market. This is generally a credence parameter. There are no objective verifiable standards available to the consumer and this is an element of trust in the word of the fish retailer.

This paper shows the first results of adopting a revealed preference model for indirect benefit estimation on existing quality differentiated fish at first-hand sales. We explicitly discuss the assumptions of "weak complementarity" and "derived demand" necessary to run the model.

Key words: fish quality, revealed preference, consumers' preference, derived demand, IAIDS-model.

INTRODUCTION

This paper aims to reveal whether consumers are willing to pay a premium for or buy larger quantities of fish products differentiated by labelling on the grounds that the fish are of a higher quality or comes from a sustainably managed fishery?

As stated in Jaffry *et al* (2000); the focus of fisheries management has lain with supply-side measures and attempts to use these measures to promote responsible and sustainable fisheries management. Over the last few years, however, there has been a growing recognition that traditional 'command and control' techniques in fisheries management are insufficient on their own to adequately address many of the management challenges facing fisheries management, particularly over-exploitation (Hanna 1992, Homans and Wilen 1992, Wessels and Anderson 1992, Johnston 1995). This recognition has spurred interest in the potential of product labelling, as a means of generating market-driven incentives in support of fisheries management objectives. Traditionally there has been little differentiation in seafood products, such that consumers have been largely unable to exercise choice as to the location and state of the fishery their

seafood came from and how it was caught. By introducing 'eco'-type labelling the intention is to facilitate this consumer choice and by employing an environmental vector in the consumers' demand function provide an incentive and reward structure for fisheries adopting 'sustainable', 'responsible' or 'ecologically' sound management practices.

The MISSFISH project is surveying consumers' response to quality and "management regime" (eco-) labelling of fish using both stated and revealed preferences in Denmark and United Kingdom. The preliminary findings from the Conjoint and Contingent Valuation Surveys have been presented earlier (Jaffry *et al.* 2000, Wattage *et al.* 1999) and the final results are expected later this year.

This paper shows the first results of adopting a revealed preference model for indirect benefit estimation on existing quality-differentiated fish at first-hand sales. Our objectives are to reveal the change in consumer surplus (welfare measure of quality) for the two different quality-grades (Quality Extra and A-fish).

A successful introduction of labelling for quality rests with the simple fact; whether this property is included in

the utility-function of consumers or not. It is furthermore discussed whether this adopted approach is theoretically consistent with economic theory and when applied to available market data, whether a functional form revealing the consumers demand for quality may be elicited.

Earlier results by Poulsen and Juhl (1999) point to the fact that consumer preferences include a perception of freshness.

Poulsen and Juhl (1999) use in-home tests to identify Danish consumer perceptions of and preferences for quality of fresh plaice and fresh cod. The tests were carried out by giving fresh and optimally treated fish as gifts to chosen consumers and ask these consumers to complete questionnaires about their consumption of the fish. The fish were labelled with different combinations of catch area, name of fishing vessel and catch date (and thereby age), thereby creating an opportunity to assess consumer demand for seafood labelling.

The results indicate that information about catch data, and thereby age, influence consumer perception of and preference for fresh plaice and fresh cod. As expected, increasing age leads to lower assessment of quality, as consumers who were informed about catch date purchase less relatively old fish (6-12 days) than consumers who were not informed. The result have to be seen in the light of results obtained in Larsen *et al* (1999), where it by use of quality index method tests (QIM-tests) is concluded that no quality differences can be found for fresh plaice and fresh cod younger than twelve days. These results lead to mainly two conclusions. Firstly, a label with catch date will lead consumers not to purchase fish, although the purchase could have created a good experience. Secondly, consumer perceptions and preferences are to a higher extent determined by expectations than by actual experiences. Results in relation to catch area and name of fishing vessel are found to of limited importance (Poulsen and Juhl, (1999)).

The hypothesis examined here is that a possibility of determining the consumers preference for quality exists based upon information for the related private good – fish for consumption – in a consumer market, where there is no accurate and reliable measure of quality and quality therefore is a non-marketed good (credence parameter).

1. THEORY

1.1 Revealed preferences

Revealed preferences cover semantically the indirect benefits derived from actual observations of behaviour in the market. Revealed preference theory has been de-

veloped to determine values for the environment using observed behaviour on usage of the environment, i.e. demand for recreational use of the environment.

Revealed preference methods include the travel cost models (TCM), random utility models of recreational use (RUM, Train, 1998 – random-parameter logit models of anglers choice of fishing sites) and hedonic pricing models (HPM). The TCM estimates the recreational value of a recreational site (fishing-site (review, Fisher and Ditton, 1993, McKean *et al*, 1996)), forest area or the like) by analysing the travel expenditure of visitors to the site, while the HPM often uses variations in house prices to estimate the value of local environmental quality, as traffic noise, air-pollution (Brucato, 1990) or demand for public safety (Clark and Cosgrove, 1990).

More general review of revealed preference methods for valuing recreation and the environment is found in Herziges and Kling, (ed.), (1999), Bateman (1993), and true to the theoretical starting point in the theory of public goods Basu (1980) published his book, “Revealed preference of government, with a closer scrutiny of government rationality”.

Bockstael and McConnell (1999) discuss the behavioural basis of non-market valuation in models that implicitly treat environmental quality as a choice variable. The authors underline the inherent difficulties of estimating the behavioural models as functions of an “environmental good”, because sufficient observations on combinations of varying the same “environmental good”, associated prices and behaviour must be available to estimate some relevant demand function (p.15).

1.2 Demand theory

If q denominates the “quality” and we adopt the Freeman (1993) classification of utility approach for these characteristics, the following links to the consumers’ utility function may be demonstrated:

Quality (q) can produce utility indirectly as a factor input in the production of a marketed good that yields utility.

As we are focusing this paper on the establishment of the welfare gains for quality, this indirect utility is consistent with this first Freeman classification, if higher quality gives a better percentage yield in the production process offers further choices on use of the product, and gives a longer life to the product (durability). However quality is in this respect not an indirect benefit, but a direct benefit known by the purchaser of fish at first-hand sales and paid for as part of the explicit parameters describing the product (species, size, weight, quality and other properties deemed important for the fish monger).

Quality (q) can be an input in the household production of utility-yielding commodities. This second Freemann classification does not constitute any problem, as the quality parameter does influence the input of fish for production of meals in the household.

Quality (q) can produce utility directly by being an argument in an individual's utility function. This is apparently true for the quality of fish (or the perception of the quality of fish).

The techniques available for estimation of indirect benefits can be viewed from these three distinct possible perceptions of how quality enters into the choices made by consumers when purchasing fish. Recalling the objective of determining consumers' preferences for quality through consumers' factual choice of the private commodity - fish - the characteristic quality is assumed to be a quality embodied in the fish. This means that the first Freemann classification is dealing with the interaction between fishermen and fishmongers/fish-processing industry, the second Freemann classification considers primarily the quality (q) as an input. However the third Freemann classification where different quantities of q may be purchased through choosing different combinations of goods, appears more appropriate. The 3rd approach may be chosen for the future analysis to make the study consistent with the results expected from the CVM and CJA. This implies that this approach may theoretically be used to measure the implicit price of quality (q), and lead to revealing the demand for quality (q) and the consequent welfare gains of changes in fish quality (Consumers Surplus).

The interaction between the consumer good (fish) and the quality of the fish can be characterised as weak complementarity, implying that higher quality enhances the enjoyment individuals derive from consuming fish and if quality enhances consumers demand will increase, ceteris paribus (i.e. price). The "enjoyment" of quality (q) in this context requires that you actually buy fish (The problem of not adhering to weak complementarity may arise if for example you view a "management regime" as a "defensive measure" and not as a positive attribute to the marketed good (the fish), and if consumers avoid buying fish for this reason, then we have a situation where our choice of methodology does not hold as $\delta x/\delta q < 0$).

The assumptions included are:

- Weak complementarity between fish for consumption (x) and the quality (q). This is true where fish are not consumed, and increases or decreases in quality do not need be compensated. "Belief" is used advisedly for this problem, because preferences that conform to weak complementarity are inherently untestable (Bockstael and McConnell (1999)).
- The good must be a non-essential good; it must be one for which there is a finite compensation for its elimination. If this is not the case, then there exists no Hicksian choke price and there is therefore no way to drive the demand for quality (q) to zero and still maintain the original level of utility (Bockstael and McConnell (1999)).

The welfare measure under these assumptions may be viewed as in Figure 1 (Freemann 1993, p. 106).

Figure 1. The welfare measure for an increase in q when q and x₁ are weak compliments

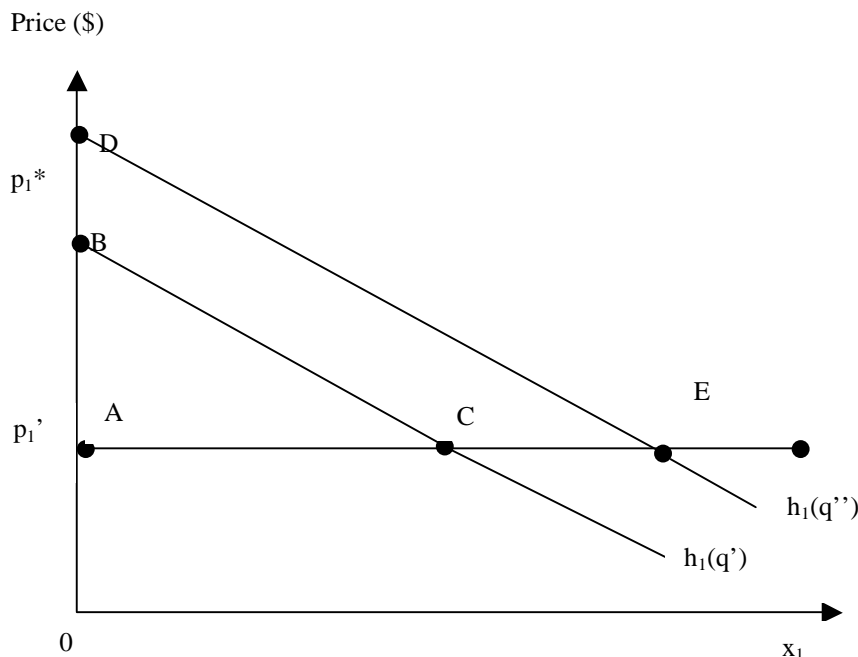


Figure 1 shows that the benefit of a change in q (quality) is the area BCED between the compensated demand curve of $h_1(q')$ and the compensated demand curve of $h_1(q'')$, where the later includes the assumed improvement of quality. One can therefore express the compensating variation of a discrete change in the environmental good (i.e. fish quality) either in an explicit form or - as we have chosen - in an implicit form. Bockstael and McConnell (1999) argue that the problem is not in stating this Hicksian measure of welfare but in finding some observable manifestation of it. The area BCDE may also be viewed as the difference in consumer surplus between demand for fish of higher quality as compared to fish of a lower quality, where consumer surplus is defined as the difference between consumers willingness to pay and what they actually pay in the market place.

1.3 The IAIDS model

The Inverse Almost Ideal Demand System (IAIDS) of Eales and Unnevehr (1994) is selected in this paper as the specification for the demand system. The inverse version is selected, as seafood is a good, which is storable only to a limited extent and given that supplies are determined by bio-economy, weather and fishery regulations, no matter what the prices are, implying that prices must adjust to the landed quantities. The AIDS functional form is selected as it is built on a well-defined preference structure, where consistent aggregation from micro level to the market level can be made and tested for the cost minimising consumer (Eales and Unnevehr (1994)). The IAIDS model is given by:

$$w_i = \alpha_o + \alpha_s \ln(Q) + \sum_j \alpha_{ij} \ln(q_j) \quad (1)$$

Where: $w_i = \frac{P_i q_i}{\sum_j P_j q_j}$ = Market share of good i .

$$\ln(Q) = \alpha_o + \sum_j \alpha_j \ln q_j + 0.5 \sum_i \sum_j \alpha_{ij} \ln q_i \ln q_j$$

q_j = Quantity of good j .

α_o = Intercept.

α_s = Coefficient of scale effect.

α_{ij} = Coefficient of quantity effect.

In the IAIDS model the sensitivities are measured by flexibilities, which are given by:

Uncompensated price flexibility

$$y \quad f_{ij} = \frac{\alpha_{ij}}{w_i} + \alpha_s \frac{w_j}{w_i} - \delta_{ij} \quad (2)$$

Compensated price flexibility

$$f_{ij}^* = f_{ij} - w_j f_s \quad (3)$$

Scale flexibility:

$$f_s = \frac{\alpha_s}{w_i} - 1 \quad (4)$$

Where $\delta_{ij} = 1$ if $i=j$ and zero otherwise.

Flexibilities are the inverse equivalent of elasticities in ordinary demand models and are defined as:

Price flexibility ($= f_{ij}, f_{ij}^*$): percentage change in price of a good, as demand increases by one percent. Own price flexibility describes the percentage change in price of a good, where the demand for exactly that good increases by one percent. Provided that the flexibility is greater than -1 , the price is inflexible. If the flexibility is less than -1 , the price is flexible. The cross price flexibility is defined as the percentage change in price of a good, where the demand for another good increases by one percent. Provided that the cross price flexibility is negative the goods are substitutes, and if it is positive the goods are complements. The smaller cross price flexibility the more the goods are perfect substitutes, and the greater cross price flexibility the more the goods are perfect complements. Two types of price flexibilities exist. The normal, uncompensated price flexibility contains both the direct quantity induced price effect, and the indirect quantity induced price effect, caused through changes in total expenditure. The compensated price flexibility only contains the quantity induced price effect.

Scale flexibility ($= f_s$): percentage change in the normalised price (price divided by quantity) of a good, whose buyers' aggregate consumption of goods increases by one percent. Provided that the flexibility is greater than -1 the good is a luxury, and provided that it is less than -1 the good is a necessity.

1.4 Derived demand

The only quality stratified time series data available for fish in Denmark is the first-hand sales of fish landed in Danish Ports by both Danish and foreign fishermen. We assume that the first-hand sales of fish is a derived demand of the final consumers and therefore can be used as a proxy to differentiate consumer demand for the different quality grades of fish.

The price formation under perfect competition is theoretical requiring a marginal cost pricing in the short run. This price system is seldom used in practice, as industries more often use a mark-up for profits on the calculated average cost of production - or they produce on contract

at a pre-negotiated contract price (private label production /brand name production) where the upper limit for the first-hand purchase price of fish for the processing firm is indirectly set to accommodate the acceptable mark-up profits. In both cases the processing companies may adopt a mark-up pricing system. Isaksen (1999) argues...when the price is set, the firm can meet the demand through varying the level of production. In the short run both price and maximum production are given, but in the longer run both will vary. The price will then be directly proportional to the excess demand in the market, and the mark-up can be regarded as a function of the price elasticity.

If mark-up is engaged as a price setting mechanism in the industry it follows that consumer demand for fish is directly influencing the first-hand sales price (ab fishermen), which then covers the notion that first-hand sales prices accurately represent derived demand. It follows that consumers demand therefore is the primary demand. Likewise for the supply, primary supply is what the fishermen offer the buyers, while derived supply is what the retailers offer for sale. Isaksen (1999) uses the following graphic presentation of the theoretical framework for mark-up between producer and retailer:

Figure 2. Mark-up, primary and derived supply and demand (Isaksen, 1999)

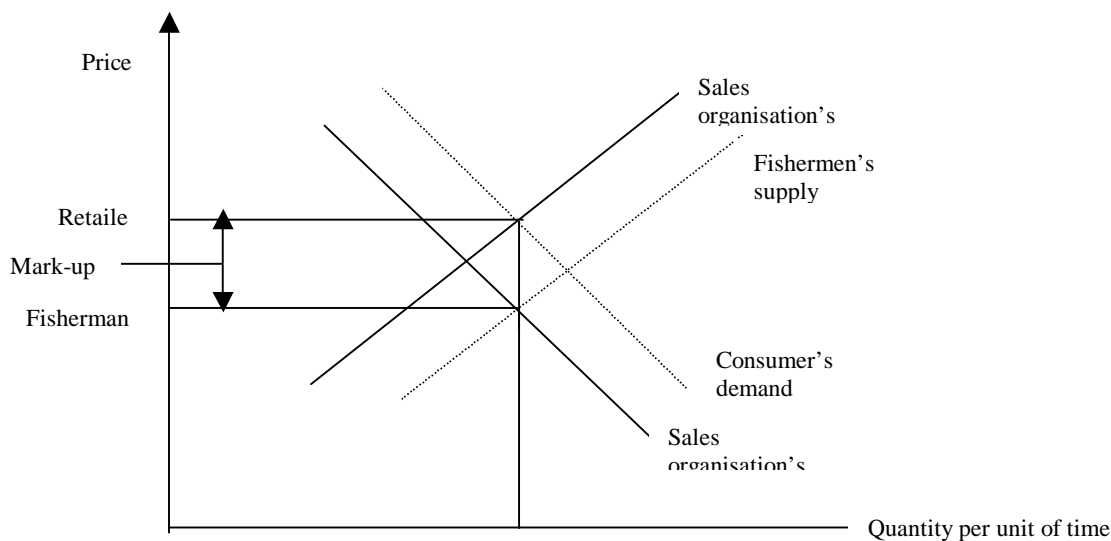


Figure 2 is static; however, the mark-up may change over time. Moreover, the mark-up may be a constant or a percentage increase in price over and above the average production costs.

Consistent quality differentiated data are not available on consumer market prices for the fish products we selected (see table 1 below) in different quality categories. On the other hand data for the “observable manifestation of quality differences” that illustrate quality differences are based on first-hand sales. The assumption is that it is highly probable that pricing of first-hand sales is an accurate representation of derived consumer demand.

The mark-up is essential to our model, as consumer willingness to pay for higher quality, as revealed by the derived demand in the first-hand market between fishermen and fish traders/processing firms, is dependant on

the mark-up used through the processing and trade system.

2. DATA

The products analysed were selected to make comparisons between expected results from the conjoint analysis, the contingent valuation survey and the revealed preference analysis possible. The species chosen represent the most common species landed in Denmark and the analogous consumer products selected represent the products with the highest market penetration. To accomplish the possibility of data aggregation and more direct comparisons between for example the landed fish and the later product, combined products are avoided. These choices also help avoiding zero answers in the Conjoint and CVM analysis. The products selected are shown in table 1 for the full survey.

Table 1. Fish species and products used in the full survey

Conjoint Analysis		Contingent Valuation Survey		Revealed Preferences	
Denmark	United Kingdom	Denmark	United Kingdom	Denmark	United Kingdom
Fresh cod fillets	Fresh cod fillets	Fresh cod fillets	Fresh cod fillets	Cod	Cod
Frozen breaded plaice	Frozen fish fingers	Frozen breaded plaice	Frozen fish fingers	Plaice	
Canned mackerel in tomato	Canned tuna	Canned mackerel in tomato	Canned tuna	Mackerel	Tuna
Frozen shrimp	Frozen prawns	Frozen shrimp	Frozen prawns	Shrimp	Prawns
Fresh salmon steaks	Fresh salmon steaks	Fresh salmon steaks	Fresh salmon steaks	Salmon	Salmon
Smoked salmon	Smoked haddock	Smoked salmon	Smoked haddock		Haddock

In the table (Table 1), the products analysed in this paper are given in Italics, i.e. cod, plaice, mackerel, shrimp and salmon in Denmark are selected.

Data, which differentiate markets of seafood products in relation to quality, are available in the first-hand sales, from the Danish Directorate of Fisheries and includes size and quality graded seafood species in volume and value for each landing lot for the period 1993 to 1998 (both years included). The data follows the trade norms for marine fish species KN-code 302, which is standardised in accordance with Council Regulation (EC) No 2406/96 of 26 November 1996 laying down common marketing standards for certain fishery products and sorted into Quality Extra, A-quality, B-quality and Not admitted. The quality differentiation is defined for freshness and includes the colour of the skin and skin mucus, the look of the eye, gills and peritoneum (in gutted fish), the smell of gills and abdominal cavities and the consistency of the flesh. The data includes landings in Denmark by both Danish and foreign fishermen, but not over-land imports, which for some species may be important.

The data have been aggregated to monthly time series for cod, salmon, plaice, mackerel and shrimp in volume, value and average price for quality and size categories. Moreover, the average prices have been corrected for the general price development, using the consumer price index. Finally, as this study focus only on the relationship between different qualities and not on the relationship between different size categories, the price differences caused by different sizes are removed from the data. This is done by calculating the prices (weighted average prices of average size equivalents), using equation 5.

$$P_{it} = \sum_k p_{kit} \left(\frac{p_k^o}{p^o} \right) \left(\frac{q_{kit}}{\sum_k q_{kit}} \right) \quad (5)$$

Where: k =Size categories.
 i, j =Quality standards.

p_{it} = Weighted average price in period t of quality standard i .

p_{kit} = Average price in period t of quality standard i in size category k .

p_k^o = Average price for all periods of size category k .

p^o = Average price for all periods and for all categories.

$\sum_k q_{kit}$ = Quantity in time period t for quality standard i in all k size categories.

Equation 1 shows that the price in period t measures the price of the average size equivalents, giving a price premium to the small fish and a price discount to the large fish. Summary statistics of the data set is presented in table 1 as monthly average.

TABLE 2. DATA SUMMARY STATISTICS, MONTHLY AVERAGE

	Quantity/kg	Price ¹ /Dkr.
Cod:	7,340,000	10.26
Grade E	4,358,000	10.56
Grade A	2,019,000	9.93
Plaice:	2,169,000	12.08
Grade E	548,000	13.44
Grade A	1,363,000	13.05
Mackerel:	4,471,000	3.44
Grade E	1,617,000	3.48
Grade A	2,233,000	3.31
Shrimps:	774,000	16.87
Grade E	133	36.62
Grade A	61	29.76
Salmon:	60,000	20.30
Grade E	15,800	20.20
Grade A	2,900	15.76

Note 1: Measured in yearly prices as weighted average price of average size equivalents in 1998 price level.

Source: Danish Directorate of Fisheries according to appendix 1.

Table 2 shows average monthly landings and average prices of average size equivalents in 1993 price level. Quality graded landings cover 87%, 88%, 86%, <0.1% and 31% of total landings for cod, plaice, mackerel, shrimps and salmon, respectively. Due to the small share of shrimps graded, this species is not subject to further analysis. Furthermore, it appears that the average prices of Quality Extra are higher than the average price of A-quality in all five cases as expected. The price difference is largest for salmon (28%) and shrimps (23%) and relatively small for mackerel (5.1%), plaice (3.0%) and cod (0.3%). This is in accordance with a priori expectation, as salmon and shrimps are expected to be luxury goods.

3. RESULTS

For cod, plaice, mackerel and salmon in Quality Extra and A-quality, IAIDS 2-goods models are estimated according to equation 1 with 2 periods lag and with three dummy variables accounting for seasonality³. Thereby, it is assumed that the prices of the single grades of the single species are only affected by the exogenous variables in equation 1, ceteris paribus. The best models are sought using single equation estimation (OLS). The ln(Q) quantity index is unknown, as it can only be calculated on the basis of parameters estimated in equation 1, and as these parameters can only be estimated given a known

ln(Q), an approximation may be chosen. Eales and Unnevehr (1994) and Jaffry *et al* (1999) suggest the use of the Stone price index in the ordinary AIDS, according to Deaton and Muellbauer (1980). The justification for the use of the Stone price index is that prices moves together over time. This is not the case for quantities, however, as empirical evidence are not known from other studies, the Stone quantity index is used in the estimation, as in the form in equation 6.

$$\ln(Q_s) = \sum_i w_i^o \ln \left(\frac{q_i}{q_i^o} \right) \quad (6)$$

Where:

$\ln(Q_s)$ = Stones quantity index (Laspeyres form).

w_i^o = Market share of good i in a base period.

q_i^o = Quantity of good i in a base period.

The base period is chosen as the mean of all periods and as all variables are known, the models are estimated. Due to insignificance and negativity of all the intercepts⁴, the regressions are performed as origo-regression, where R² does not allow for the mean, indicating that R² should be interpreted cautiously. Estimation results are given table 3.

Table 3. OLS Parameter estimates¹

	Scale effects α_s	Quantity effects								Average market shares	R ²	DW
		Cod		Plaice		Mackerel		Salmon				
		α_e	α_a	α_e	α_a	α_e	α_a	α_e	α_a			
<u>Cod</u>												
Grade E	-0.023 (-0.005)	0.191 (0.005)	-0.190 (0.005)							0.696	(0.99)	1.69
Grade A	-0.031 (0.004)	-0.169 (0.004)	0.198 (0.005)							0.304	(0.99)	1.68
<u>Plaice</u>												
Grade E	-0.017 (0.005)			0.212 (0.005)	-0.185 (0.005)					0.293	(0.99)	2.20
Grade A	-0.023 (0.006)			-0.200 (0.005)	0.213 (0.006)					0.707	(0.99)	2.20
<u>Mackerel</u>												
Grade E	-0.038 (0.005)					0.108 (0.006)	-0.070 (0.006)			0.432	(0.95)	1.96
Grade A	-0.041 (0.004)					-0.086 (0.006)	0.120 (0.006)			0.568	(0.97)	1.76
<u>Salmon</u>												
Grade E	-0.054 (0.011)							0.090 (0.010)	-0.080 (0.008)	0.877	(0.97)	1.78
Grade A	-0.057 (0.011)							-0.093 (0.010)	0.083 (0.008)	0.123	(0.92)	1.87

Note 1: The values in the parentheses are the standard errors. If parameters are fat, they are estimated significantly on a 5% level.

Table 3 shows that the R^2 seems reasonable and that autocorrelation is absent in all cases. Moreover, it appears that the models estimated for cod and plaice are better than for mackerel and salmon. The reasons are probably that cod and plaice are more important species in Denmark than salmon, as salmon is landed in small quantities only at the island Bornholm most often without

grading. Finally, all parameters for the quantity and scale effects are estimated significantly on a 5% level.

Given the parameter estimates and market shares in table 3, the uncompensated price and scale flexibilities are presented on average using equation 2 and 4.

Table 4. Uncompensated price and scale flexibilities

	Scale flexibilities	Price flexibilities							
		Cod		Plaice		Mackerel		Salmon	
		E	A	E	A	E	A	E	A
<u>Cod:</u>									
Grade E	-1.03	-0.75	-0.28						
Grade A	-1.10	-0.63	-0.38						
<u>Plaice:</u>									
Grade E	-1.06			-0.29	-0.67				
Grade A	-1.03			-0.29	-0.72				
<u>Mackerel:</u>									
Grade E	-1.09					-0.79	-0.21		
Grade A	-1.07					-0.18	-0.83		
<u>Salmon:</u>									
Grade E	-1.06							-0.95	-0.10
Grade A	-1.46							-1.17	-0.38

Table 4 shows, that all the price flexibilities have the expected negative signs. The price flexibilities are generally numerically larger than results obtained from other estimations of inverse demand models at seafood markets, according to Nielsen (1999). These other estimations includes also one known study of inverse demand in Denmark, the Jørgensen *et al* (1991) study, where the price flexibility of cod is estimated to -0.14 . However, the results are in line with the Jaffry *et al* (1999) study, which estimate an IAIDS for fish species in Spain and obtain results, which are also larger than other estimations of inverse seafood demand in Spain, according to for example Millán (1998). The difference is explained by partly the use of different functional forms (the IAIDS and the Rotterdam form) and partly the time periods used.

Moreover, it appears from the table that for cod and salmon, own price flexibilities are larger for the Quality Extra than for A-quality. Cross price flexibilities are less than the own price flexibilities for plaice and mackerel as expected, however, this is not the case for A-quality cod and salmon. The reason for this is probably that A-quality forms part of joint markets with Quality Extra of cod and salmon as the main products.

Scale flexibilities have all the expected signs and centres around -1 as expected. For plaice and mackerel the scale flexibilities are numerically larger for Quality Extra than for A-quality as expected, indicating that plaice and mackerel of Quality Extra are luxury goods to a larger extent than plaice and mackerel of A-quality. For cod and salmon the opposite result are obtained. The reason for the results can be, that prices of each species in both quality grades are formed on joint markets.

These results are obtained given that interaction between price and quantity of the single grades of the single species does not exist, that is, simultaneity is assumed absent. As some interactions are expected, this is not realistic, implying that simultaneity biases probably are present. Therefore, the results are only preliminary and will be replaced by results obtained by simultaneous regression or co-integration at a later stage.

Moreover, the results are obtained given the *ceteris paribus* assumption. That is, given that prices are only affected by quantity of own grade, quantity of cross grade and by the Stone quantity index, thereby leaving all other potential affecting variables unchanged. This assumption

is not realistic, as seafood markets according to for example Gordon and Hannesson (1996), Asche and Hannesson (1997) and Clay and Fofana (1999) generally is found connected, both between species and countries. Thereby, catches and production of several species in several countries will affect prices of Quality Extra and A-quality of the four analysed species. Nonetheless, it is expected that the models can give some indications of the relationships between Quality Extra and A-quality fish and thereby of the value of the quality of fish.

4. VALUE OF FISH QUALITY

Unfortunately it has not been possible to present the estimations of welfare gains due to the difference in quality from A-fish to Quality Extra as described in Figure 1. Our working hypothesis was to establish the consumer surplus for a hypothetical market of Quality Extra and the consumer surplus for a hypothetical market of A-fish.

Estimating the value of fish quality was planned in two steps. The first step was to estimate the demand functions for the two different quality grades, Quality Extra and A-quality using the IAIDS, as it's functional form. This has been accomplished. Second step was planned to include the difference in consumer surplus between the two estimated demand curves for each species. This step has not been accomplished yet. Application of IAIDS models to consumer market analysis for fish is a very recent development (1994 and later) and as no examples of IAIDS models in the literature has been used for a similar second step purpose no methodological comparisons have been possible. The plan is to continue the work to solve the problems, which has arisen.

5. DISCUSSION

The overall objective for the total survey is to establish consumer preference for quality and eco-labelling of fish. In this paper the revealed preference methodology is used. The objective is to estimate the value of quality to the consumers as revealed in the first-hand sales of fish. The results are important to decisions on whether or not a public scheme introducing certification standards and subsequent certified labels on fish quality and eco-labelling for sustainable management regime should be implemented. If the consumers prefer higher quality and a sustainable management regime and are willing to pay for these properties, this may in the longer run aid the traditional management tools engaged. On the other hand a rational economic choice of policy should include reflections on whether the gross welfare gains to consumers exceed the increased costs of production and public costs incurred running the labelling scheme or not.

The value of quality is assumed revealed as quality enters the demand through purchasing of fish for consumption. Quality is assumed entering the private consumer good (fish) as a property with weak complementarity. Second fish are assumed to be a non-essential good. Both assumptions seem appropriate.

A direct analogy between the consumer goods market and first-hand sales of fish in Denmark imply a consistent mark-up pricing in all subsequent trade of the fish from first-hand sales through to the consumer. This is a strong assumption, as other decision parameters influence the price decision of processing firms and traders. First, most of the fish landed in Denmark are exported. The derived demand does therefore mirror the foreign consumers and not necessarily the domestic consumers getting asked in the Conjoint and Contingent Valuation surveys. Second the size categories are known to be more important to the price formation than quality grading (See Annex 1) implying that either the consumers prefer larger fish or larger sizes give better percentage utilisation in the processing or are easier processed in the firms due to technical constraints. These questions need further investigation.

6. REFERENCES

- Asche** F. & Hannesson R. (1997), Market integration between Whitefish and Salmon in France, SNF Working Paper A40/97.
- Basu**, Kaushik (1980) Revealed preference of government. Cambridge: Cambridge University Press.
- Bateman**, Ian (1993) Evaluation of the environment: a survey of revealed preference techniques, working paper 6, Centre for Social and Economic Research on the Global Environment.
- Brucato Jr.**, Peter F., James C. Murdoch and Mark A. Thayer (1990) Urban air quality improvements: a comparison of aggregate health and welfare benefits to hedonic price differentials, *Journal of Environmental Management* **30**, 265-279.
- Bockstael**, N.E., and Kenneth E McConnell, The Behavioral Basis of Non-Market Valuation (1999) in Valuing Recreation and the Environment, Revealed Preference Methods in Theory and Practice (Ed. Joseph A. Herriges and Catherine L. Kling), Edward Elgar, UK.
- Clark**, David E. and James C. Cosgrove (1990) Hedonic prices, identification, and the demand for public safety, *Journal of Regional Science* **30** (1), 105-121.
- Clay** P. & Fofana A. (1999), Delineation of the UK Seafood Markets, Paper presented at the XIth EAFE Conference April 1999 in Dublin.
- Deaton** A. and Muellbauer J. (1980), An Almost Ideal Demand System, *American Economic Review*, volume 70, 312-26.

- Eales**, J.S., and L. Unnevehr, The inverse almost ideal demand system, *European Economic Review* 38 (1994) 101-115. North-Holland.
- Fisher**, Mark R. and Robert B. Ditton (1993) A social and economic characterization of the U.S. Gulf of Mexico recreational shark fishery, *Marine Fisheries Review* 55 (3), 21-27.
- Freeman III**, A. Myrick (1993) The measurement of environmental and resource values – theory and methods. Washington: Resources for the Future.
- Gordon** D.V. & Hannesson R. (1996), On Prices of Fresh and Frozen Cod Fish in European and U.S. Markets, *Marine Resource Economics*, volume 11, pp. 223-238.
- Hanley**, Nick, Jason Shogren and Ben White (1997) *Environmental Economics in theory and practice*. London: MacMillan.
- Hanna**, S. S. 1992. Interactions between shellfish and groundfish fisheries on the west coast: implications for system management. *Journal of Shellfish Research*. 11(1): 133-141.
- Herriges** J. A. and C. L. Kling (1999), *Valuing Recreation and the Environment, Revealed Preference Methods in Theory and Practice* (Ed), Edward Elgar, UK.
- Homan**, F. R. and Wilen, J. E. 1992. Marketing losses in regulated open access fisheries. unpublished manuscript, University of California, Davis.
- Isaksen**, John Roald, Cod Prices for Fishermen and Consumers, *økonomisk Fiskeriforskning*, Volume 9:1, 1999.
- Jaffry**, S., H. Pickering, P. Wattage, D. Whitmarsh, J. Frere E. Roth, M. Nielsen (2000), The Role of Conjoint Analysis in the Evaluation of Fish Product Markets, EAFE-conference, Esbjerg, Denmark.
- Jaffry**, S., G. Taylor, S.Pascoe, An inverse demand system for fish species in Spain, Paper presented at XI'th conference of the European Association of Fisheries Economists (EAFE), Dublin, Ireland, 7-9 April 1999.
- Johnston**, R. S. 1995. Developments in seafood markets and market research. in D. S. Liao (ed) *International Cooperation for Fisheries and Aquaculture Development: proceedings of the 7th biennial conference of the International Institute of Fisheries Economics and Trade*, Taipei, Taiwan R.O.C. July 18-21 1994. National Taiwan Ocean University. pp.17-30.
- Jørgensen** H.P, Rodgers, P. E., Smit J. and Valatin G. (1991), *The Economic Impact of Fisheries Management in the North Sea: Whiting and Saithe in the Scottish Market*, Report for EC Fisheries Directorate, SFIA, Edinburgh.
- Larsen**, E., G. Hyldig and M. Frederiksen (1999), Fresh fish: quality in retail trade (in Danish), project summary from Danish Institute for Fisheries Research, Department of Seafood Research.
- McKean**, John R., Richard G. Walsh and Donn M. Johnson (1996) Closely related good prices in the travel cost model, *Amer. J. Agr. Econ.* 78, 640-646.
- Millán** J.A, (1998), An Econometric Model of Spanish Fisheries, paper presented to IIFET 9th Conference.
- Nielsen**, M., EU Seafood Markets-Integration and Demand, SJFI-Working Paper no 13/1999, Danish Ministry of Food, Agriculture and Fishery.
- Perman**, Roger, Yue Ma, James McGilvray and Michael Common (1999) *Natural resource & Environmental Economics*. Dorset: Dorset Presss.
- Poulsen** C. S. and Juhl H. J. (1999), Fresh fish: quality in retail trade, design, implementation and results (in Danish), Report from the Centre for Market Surveillance, Research and Strategy for the Food Sector at Aarhus School of Business to the Danish Fish Marketing Board.
- Rådets forordning (EØF)** Nr. 3759/92 af 17.december 1992 om den fælles markedsordning for fiskerivarer og akvakulturprodukter. (Council Regulation (EC) No 3759/92 of 17 December 1992 on the common organization of the market in fishery and aquaculture products).
- Rådets forordning (EØF)** Nr.2406/96 af 26.november 1996 om den fælles handelsnormer for visse fiskerivarer. (Council Regulation (EC) No 2406/96 of 26 November 1996 laying down common marketing standards for certain fishery products).
- Train**, Kenneth E. (1998) Recreation demand models with taste differences over people, *Land Economics* 74 (2), 230-239.
- Wattage**, P., H. Pickering, S. Jaffry, D. Whitmarsh, J. Frere, E.Roth, M. Nielsen, (1999) Management Regime Differentiated Seafood: Consumers' Willingness to pay, Paper presented at XI'th conference of the European Association of Fisheries Economists (EAFE), Dublin, Ireland, 7-9 April 1999.
- Wessels**, C. R. and Anderson, J. L. 1992. Innovations and progress in seafood demand and market analysis. *Marine Resource Economics* 7(4): 209-228.

ENDNOTES

¹ This paper represents part of the project “Market Driven Incentives for sustainable Fisheries Management” (MISSFISH) - **FAIR CT98 4255**. One of the project objectives is to test and compare consumers responsiveness to “quality” differentiated seafood products adapting both revealed and stated preference methodologies.

² Hicksian demand, where a price exists (choke price) such that the compensated demand is equal to zero or phrased differently. There is some level of expenditure on other goods that will sustain utility even when you do not purchase any fish at all.

³ Therefore, it is not actually equation 1, which is estimated, but equation 1 added with three dummy variables ($D2$, $D3$ and $D4$). The regression equation is: $w_i = \alpha_o + \alpha_s \ln(Q) + \sum_j \alpha_{ij} \ln(q_j) + \beta_2 D2 + \beta_3 D3 + \beta_4 D4$, where $D2=1$ if observation are in the 2nd quarter of the year and otherwise zero, $D3=1$ if observation are in the 3rd quarter of the year and otherwise zero and $D4=1$ if observation are in the 4th quarter of the year and otherwise zero. Moreover, two types of trend variables (1,2,3,4,5 and $\ln 1, \ln 2, \ln 4, \ln 8, \ln 16$ ) were sought added to the regression equation in order to include structural changes in consumer preferences, as described in Deaton and Muellbauer (1980). However, none of these trend variables were found significant and they did not change the results considerable.

⁴ Eales and Unnevehr (1994) were also unsuccessful in estimating the intercepts.