Calculations of Danish prices of unprocessed seafood

Nielsen, Max

Publication date:
2000

Document version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Nielsen, M. (2000). *Calculations of Danish prices of unprocessed seafood*. Statens Jordbrugs- og Fiskeriøkonomiske Institut. SJFI Working Paper, No. 9/2000

Ministeriet for Fødevarer, Landbrug og Fiskeri
Statens Jordbrugs- og
Fiskeriøkonomiske Institut

Calculations of Danish prices of unprocessed seafood

Max Nielsen

SJFI – Working Paper no. 9/2000

Calculations of Danish prices of unprocessed seafood[1]

Max Nielsen

Danish Institute of Agricultural and Fisheries Economics

E-Mail: max@sjfi.dk

October 2000

Abstract:

This paper is part of an initiative aiming at assessing the short-term economic outlook for the Danish fisheries sector. The outcome is an annually published report. The purpose of this paper is to outline a method which can be used for calculating the prices Danish fishermen can obtain for their catches in the coming year. Prices are calculated in a model where changes in future supply ceteris paribus explain changes in future prices at the ex-vessel level. Supply is calculated partly on the basis of known TAC decisions for the coming year and partly on the basis of biological advice and utilisation of quotas in former years. Where TACs do not exist or are unknown, extrapolations are made on basis of the historical trends in supply.

Denmark forms a part of integrated international seafood markets, as large quantities of raw fish are imported for processing and as large quantities are exported. As a consequence, significant price calculations can only be made on an international scale. Therefore, price trends for groups of species are calculated for an area covering both the whole EU and significant countries exporting to the EU, based on existing knowledge of price flexibilities. Groups of species are chosen on the basis of the existing knowledge of market integration between species, assuming that the prices of species within groups are perfectly integrated and that the prices between groups are not integrated.

The choice of price flexibilities and the presence of aggregation errors are explicitly addressed and the introduction of market shares is suggested as a solution. Based on the outlined method and given the assumptions, roundfish and flatfish prices are calculated to increase by 50% and 20%, due to shortage of supply. Prices of freshwater fish are expected to decrease by around 15%, due to continuous increases in farm production, and prices of pelagic fish and fish for reduction are calculated to remain stable or decrease slightly. As a result, prices of total seafood for human consumption are calculated to increase by around 5%.

Keywords: Seafood, Supply, Prices, Flexibilities, EU, Denmark.

---

[1] This is a revised version of “Forecast of Danish ex-vessel seafood prices” presented at the XIIth EAFE Conference in Esbjerg, 13-15 April 2000. The paper is a contribution to an annual report of the short-term economic outlook for the Danish fisheries sector.

Contents:

1. Introduction

This paper is part of an initiative aiming at assessing the economic outlook for the Danish fisheries sector in the short term. The outcome is an annually published report. The purpose is to outline and use a method to calculate trade patterns and the prices Danish fishermen could obtain for their catches in 2000, given a supply determined by Total Allowable Catches (TAC).

The calculations are built on the understanding that the Danish seafood markets forms part of an internationally integrated seafood market, implying that assessments need international coverage. Therefore, trends in supply are assessed in both the whole EU and in the main non-EU countries exporting to the EU.

Supply on unprocessed seafood is calculated on the basis of historical catch levels for the years 1996-99, combined with biological stock assessments and a priori known TAC levels for 2000 decided by the EU Council of Ministers. Where appropriate, bilateral trade agreements between the EU and trade partners are also taken into account. Later, the estimates of supply serve as a base for prediction of trends in prices in 2000, given existing knowledge of demand, market structure and market integration.

The paper is divided into six sections. In Section Two and Three, the theoretical base and the methodology are outlined. The data is described in Section Four. In section Five, results are described separately for the markets for codfish, flatfish, pelagic fish, freshwater fish, crustaceans, bivalves, seafood for human consumption and fish for reduction. Conclusions are drawn in Section Six.

2. Theory

In Neo-classical theory, price formation for a normal good is considered as a process where demand and supply coincide, thereby determining the equilibrium and market clearing price. In this process, production quantity and price are determined interactively. However, it only applies for a normal good where the production quantity is influenced by the changing price. On ex-vessel seafood markets, production quantity is not expected to be greatly affected by changing prices, partly as it is supposedly determined by exogenous factors such as the bio-economy, weather and fisheries regulation, and partly since seafood has to satisfy the basic human need for food. Therefore, a different market clearing process is assumed to take place on ex-vessel seafood markets, where quantity to be produced is determined in a first step and that quantity determines price in the second step.

Thus, ex-vessel seafood prices are calculated in this paper using existing estimated inverse demand models with exogenous supply, where changes in quantities explain changes in prices. These inverse demand models can be written in a generalised functional form according to Equation 1.

(1) $$p_i = f(m, q_i, q_j)$$

Where: p_i = Price on good *i*.
m = Income.
q_i = Quantity of good *i*.
q_j = Quantity of other goods *j*.

From the equation it appears that the price of good *i* on the left hand side of the equation is a function of income, quantity of good *i* and a vector of the quantity of other goods *j*.

In this paper, however, income and quantity of good *j* are assumed away and thus the only remaining explanatory variable is own-quantity. This implies that price changes are explained only by changes in quantities, and not by changing income or changing quantities of other goods. Thus, substitution between goods is assumed not to exist. However, as goods are placed in aggregated groups of species, substitution is only assumed non-existent between groups of species. Within each group, perfect substitution is assumed between the single species.

Using this model, the central behavioural parameter is the price flexibility, which describes the effect changing quantities have on prices. Provided that Equation 1 is represented in the functional form in Equation 2, it can be shown that the price flexibility (f_p) is found as the first derivative of f in relation to quantity, shown as Equation 3.

(2) $$P_i = c * q_i^{f_p}$$

(3) $$\frac{\partial \ln(P_i)}{\partial \ln(q_i)} = f_p$$

where c represents a factor, which describe shifts of the demand curve and where Equation 3 represents the price flexibility, due to the logarithms in both numerator and denominator.

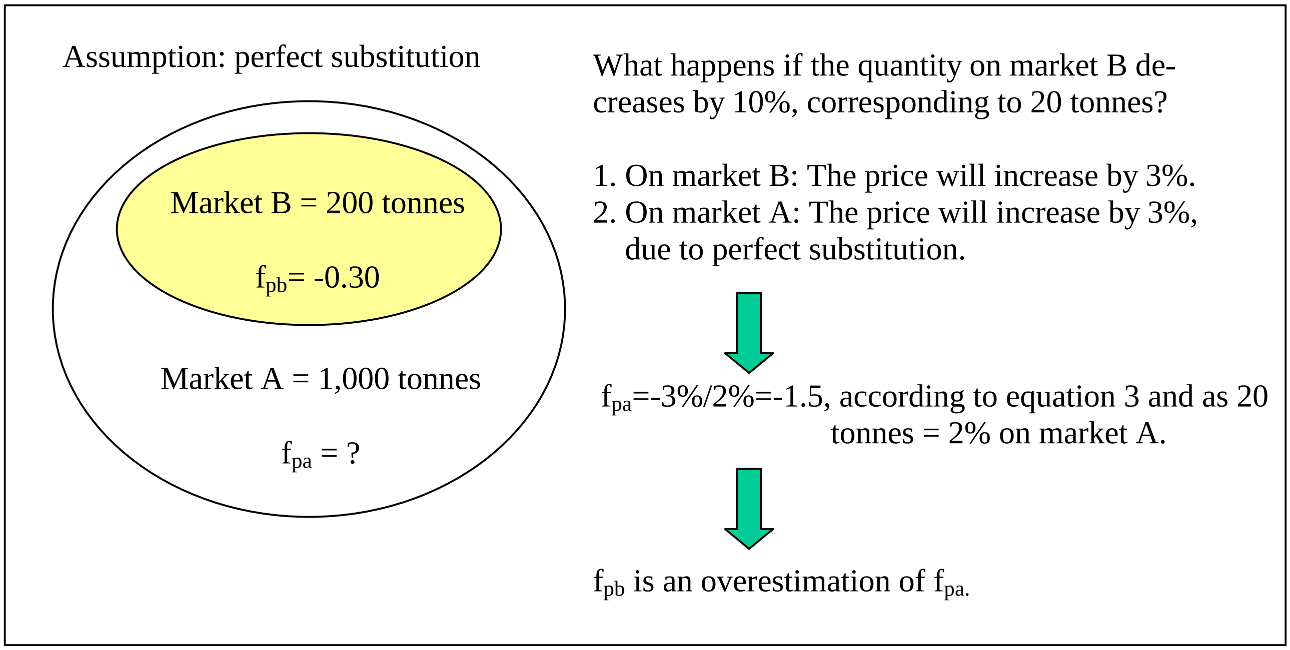
The price flexibility is defined as the percentage change in the price of a good brought about by a one percent increase in demand for that good. Provided that the flexibility lies between 0 and –1, the price is inflexible. If the flexibility lies between –1 and $-\infty$, the price is flexible. Two 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. However, in this paper there is no distinction between the two, due to the limited number of estimations and the heterogeneous nature of these estimations.

Ex-vessel seafood price calculations are based on estimations obtained from the international seafood demand literature, summarised in Nielsen (1999), and therefore further estimations are not carried out in this paper[2]. In the literature, inverse demand models are estimated in several functional forms, including linear, logarithmic, Rotterdam, Almost Ideal Demand System and generalised forms. Unfortunately, results obtained using these different types of functional forms affect results. However, in this paper no attempt has been made to correct them, as this would be unwarrantedly complex given the other assumptions.

As trends in supply are analysed for groups of species in an area covering both the whole EU and significant countries exporting to the EU, the price flexibilities should ideally be chosen from among those surveys estimated on the same aggregation level. However, according to Nielsen (1999), 69 out of 75 known price flexibilities are estimated for single species in separate EU countries. Thus, application of known detailed estimated price flexibilities will underestimate the effect of changing quantity on aggregated and internationally integrated markets, as the effect on external prices is not taken into account. The issue can be illustrated by an example, shown in Figure 1.

[2] Where price flexibilities are not known, inverted price elasticities estimated in ordinary demand models are used as a substitute, as price flexibilities are the equivalent of inverted price elasticities in theory. However, although inverted price elasticities overestimate price flexibilities in practical estimations, according to Houck (1965), this issue is not addressed further. The reason is that it is reasonable to assume that quantities are exogenous and price flexibilities are thereby preferred over price elasticities.

FIGURE 1: **Comparison of price flexibilities on integrated markets – an example.**



In the figure an example is shown where a price flexibility of –0.3, meaning that a 10% decrease in the quantity of a good causes a price increase of 3%, is estimated for a small part of a larger market. The small part of the market represents 200 tonnes and the total market 1,000 tonnes. The effect of the decrease of 10% in the quantity, corresponding to 20 tonnes is 3% on the small market prices. Assuming that the good on the small market is a perfect substitute for the good on the total market, the price increase on the total market is 3%. The decrease in the quantity on 20 tonnes on the total market of 1,000 tonnes corresponds to a decrease on the total market of 2%. Thus, the price flexibility for the total market is - 3%/2% = - 1,5. A decrease in the quantity of 10% implies an increase in the price of 15%. Hence, price flexibilities estimated for small shares of larger perfectly integrated markets underestimate price flexibilities for the larger markets. The reason is that if markets are perfectly integrated, possible increases in supply on the small market will be exported to other parts of the larger market and thereby the effect on prices will be the same for the whole market. In other words, supply changes will cause a ripple effect, where prices will change on all parts of the large market.

Moreover, Salvanes and DeVorets (1997) show this by estimating ordinary demand models on four different levels of aggregation for meat and fish in Canada. Their results show that the own-price elasticity at the aggregated level is reduced if substitution among subgroups is present.

Calculating prices for species that form part of international and inter-species integrated markets, by use of existing estimations, may take this issue into account. Assuming perfect substitution and given knowledge of market size and share of an integrated market, the price flexibility for the aggregated market can be calculated directly using Equation 4.

$$(4) \qquad \partial P_i = f_p \frac{\partial q_i}{w_i}$$

Where: ∂P_i = The change in price of good i, caused by the change in the quantity of good i.

∂q_i = The change in the quantity of good i.

w = Market share of good i.

Thus, price changes can be calculated as the price flexibilities multiplied the change in quantity and divided by the market shares.

3. Method

Calculations of prices for 2000 at the first level of seafood markets in Denmark is carried out for groups of species in five steps using Equation 4.

First, forecast supply of fisheries and aquaculture products for 2000 is derived on the basis of trends in actual levels from 1996 to 1999.

EU supply of unprocessed seafood is defined as EU catches from wild fisheries, production from aquaculture in the EU and imports of wild and farmed fish and fish products from non-EU countries. Unprocessed seafood is defined as fresh and frozen whole fish, crustaceans and bivalves, including gutted fish with and without head. Fish fillets, canned and prepared seafood are considered processed and is not included in the definition[3].
Exports are not subtracted from supply, as they are presumed to affect prices inside the EU.

[3] Imports are measured as imported weight, that is, it can be live weight, weight with or without head, cleaned or uncleaned weight etc. Therefore, imported and live weight are not directly comparable. However, as imports consist of unprocessed products only (whole fish and gutted fish with or without head, not fish fillets), the difference between imported and live weight is relatively small and, therefore, the issue is omitted here. For example, gutted cod with head and gutted cod without head make up 85% and 63% respectively of a live cod. As a consequence, it is implicitly assumed that the share of fish imported as live weight doesn’t change.

The level of supply is the average of the years 1996-97 for fisheries and aquaculture in the EU and the average of the years 1996-98 for imports.

The trends in supply takes into account developments in catching and aquaculture both for supplies originating from the EU and for imports. Where catch is unknown it is assumed unchanged from the year before if the fishery makes up less than 20% of total catch in the supplier group or if the change in landings between the two former years is less than 15%. If either share or change is significant ad-hoc considerations are made.

The main fisheries and aquaculture products are identified using a criterion of importance, by selecting the most important species and trade partners in the years 1996-97 in a process with the following steps:

1. Seafood species caught and raised in the EU are identified and placed in 7 groups.
2. The top countries supplying the EU from outside are identified so that 75% of imports from non-EU countries are covered.
3. The most important species are selected on the basis of total catches in the years 1996-97, using two criteria: 1) catches have to cover 75% of catches in the group of species in the EU and 2) catches have to cover 75% of catches in the group of species in the EU and the main non-EU countries, exporting to the EU.
4. Catches for single countries in single areas are selected to cover 75% of the total catch of each species.

Secondly, EU supply in 2000 is calculated on the basis of supply in the years 1996-99 using two scenarios, according to Table 1.

TABLE 1: **Low-supply and high-supply scenarios for the EU supply of seafood in 2000**

	TAC's present and known	----------- TAC's not present or unknown ----------- Increasing catches	Decreasing catches
Scenario 1 – low-supply	Unchanged percentage quota utilisation.	Unchanged at the 1999 level.	Unchanged trend in supplies.
Scenario 2 – high-supply	Perfect quota utilisation.	Unchanged trend in supplies.	Unchanged at the 1999 level.

The two scenarios are used to calculate the most optimistic and the most pessimistic supply situations that can be expected. Where TACs are known and present, these values are used.

However, this is only the case for the EU. Where TACs are not present or unknown, estimations are made on the basis of historical supplies.

Thirdly, average price flexibilities and their associated average market shares are identified for groups of species on the basis of existing studies set out in Nielsen (1999), assuming that markets consist of the whole EU and the main non-EU countries exporting to the EU and with supplies as in the years 1996-97. Only price flexibilities estimated for a significant part of the market are included in the calculations. A significant part is defined as more than 5% of total supply in the years 1996-97.

Fourthly, trends in prices at the first level of seafood markets in the EU are identified on the basis of those in supply in the whole EU using Equation 4 given average price flexibilities and average market shares. As the model is built to measure the effect of marginal changes, it is not capable of measuring the effect of large changes, which affect market structures. Therefore, price calculations are only made if supply changes by less than 20%.

In calculating the price trends, a *ceteris paribus* assumption is made and the other primary assumptions may be summarised as follows:

- Demand and market structure are unchanged.
- Income changes do not affect prices.
- Perfect substitution is present between species within each group[4].
- Substitution is absent between groups.
- Perfect substitution is present between EU fish products and those of the main countries exporting to the EU.
- Substitution is absent between EU fish products and those of other countries (the main countries exporting to the EU excluded), implying that EU seafood prices are unaffected by the situation in Japan and the USA, for example.

---

[4] However, there is a problem with this assumption, as it is assumed that a decline in the supply of cod on one tonne, for example, will be compensated for by an increase in whiting on one tonne. This might not be true. The problem can be dealt with by assuming that each group is a parcel of fixed proportions of the constituent species, however, with one tonne of cod being the same as two tonnes of whiting if the price on cod is twice the price of whiting. Several indices including Paasche and Laspeyres indices can be used to make the assumption more reliable. Squires (1988) refer to the problem as the Index Number Problem. The problem is omitted in this paper, but will be described in details in a future paper.

Fifthly, prices in 2000 at the first level of seafood markets in Denmark are estimated on the basis of the estimated price trends in the whole EU in 2000 and on the basis of the Danish price levels in the year 1999.

4. Data

Supply of unprocessed seafood in the EU originates from marine fisheries, fish farms or from imports. Data on marine fisheries is available from the EUROSTAT New Cronos Database for all countries worldwide for the years 1996-97. However, this data is more aggregated for some countries than others. Data on production on fish farms is also available from the database for all countries worldwide for the same years. The database includes 294 different species caught in the EU in the years 1996-97 and 169 of these are in this paper placed in 7 groups of species: roundfish, flatfish, pelagic fish, freshwater fish, crustaceans, bivalves and fish for reduction. The remaining 135 species, that cover 7% of total catches, are excluded from the analysis. Species included in the 7 groups are shown in Appendix 1. Catches from the North and Central East Atlantic Ocean, as well as catches from the Mediterranean Sea, are included in the analysis. Inventories of unprocessed frozen seafood are not included, as they are expected to be small, due to their relatively short keeping quality in cold-storage plants.

Data on the EU imports from non-EU countries is available from the EUROSTAT Comext Database for the years 1996-98. It is available on a detailed level (8-diget codes) with trade partners identified. Total EU imports from non-EU countries is separated into near and distant imports, where near imports is defined as imports from trade partners with whom the EU has made an agreement on fisheries or seafood trade[5]. Distant imports explain the remaining imports. Of imports of 231 codes of unprocessed seafood, 214 in total are allocated to the same 7 groups of species as the catches. The codes included in the groups are also shown in Appendix 1.

EU supply of seafood for 2000 is calculated on the basis of the TACs in 2000. An overview of the TACs from the Worldfish Report (1999) is used. Moreover, catches and production on fish farms worldwide are calculated using information obtained from the FAO Globefish

[5] According to Hatcher (1997) and Vestergaard and Frost (1998) these countries or areas are: the Canaries Island, Ceuta and Melilla, Iceland, Norway, Switzerland, the Faroe Islands, Malta, Turkey, Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovakia, Romania, Russia, Morocco, Tunisia, Egypt, Mauritania, Cap Verde Island, Senegal, Gambia, Guinea Bissau, Guinea, the Ivory Coast, Equatorial Guinea, Sao Tome, Angola, the Seychelles, Madagascar, Mauritius, Canada, Greenland and Argentina.

Databank. Finally, supply is calculated using ad-hoc national sources of fisheries and aquaculture data.

Prices on the ex-vessel market in Denmark are from the Danish Directorate of Fisheries. Annual average prices of the main species in the species groups caught in Denmark are used.

5. Results[6]

5.1 Supply and trade

Roundfish

The EU roundfish market is supplied by the catches of EU fishermen as well as by significant imports. Annual catches of 28 roundfish species in the EU were 792,000 tonnes live weight in the years 1996-97, with cod being the most important species covering 38% of total catches, and with cod, haddock, hake, whiting and saithe covering more than 75% between them. The cod fishery in the North Sea is the single most important; however, the haddock fishery in the North Sea and the hake fishery in EU waters also contribute significantly to EU supply.

Annual imports of unprocessed roundfish were 325,000 tonnes imported weight in the years 1996-98. Of these, 72% originated in countries with which the EU has made bilateral agreements on fisheries or seafood trade. The most important part is cod originating from the North Atlantic Ocean, including from the Barents Sea caught by Norway and Russia, and cod originating from Icelandic fisheries. However, imports of hake from Argentina also form a significant share. The remaining imports originate from various countries worldwide, with Cape hake caught by Namibia and South Africa in the South East Atlantic Ocean being the most important. Imports are concentrated on a few supplier countries, with Norway covering 25% of total EU imports of roundfish and the five largest supplier countries covering 71%.

Annual EU exports of unprocessed roundfish were 15,000 tonnes live weight in the years 1996-98, corresponding to 5% of imports. Therefore, EU exports of unprocessed roundfish are small compared to imports.

---

[6] This section is based on detailed calculations available on request from the Danish Institute of Agricultural and Fisheries Economics (SJFI).

Thus, the EU market for unprocessed roundfish was in the years 1996-97 supplied by EU fishermen, imports of roundfish from Norway, Iceland and Russia and imports of hake from Argentina, Namibia and South Africa. Therefore, developments in future supply heavily depends on the expected future catch levels in these countries.

Based on the criteria of importance, set out in Section 3, cod, haddock, hake, whiting and saithe are the leading roundfish species among fisheries in the EU and the top 6 countries exporting to the EU. The trend in supply from those fisheries and trends in near and distant imports are shown in Table 2 for the years 1996-2000.

TABLE 2: **Estimated supply of unprocessed roundfish in the EU in the years 1996-2000 (000 tonnes).**

	Supply				Supply 2000			
					Scenario 1		Scenario 2	
Suppliers:	1996	1997	1998	1999	Level	%	Level	%
Own	792	724	649	599	499	-16.7	595	-0.7
Near imports	233	230	206	177	156	-11.6	178	0.3
Distant imports	92	88	88	88	88	0.0	88	0.0
Total	1,117	1,042	943	863	743	-13.9	860	-0.3

Source: Calculations based on EUROSTAT New Cronos Database, EUROSTAT COMEXT Database, Worldfish Reports and EU Commission Landing statistics for species subject to quotas in EU.

Given the assumptions, it appears, that supply of roundfish in 2000 is expected to decrease 13.9% in the low-supply scenario and with 0.3% in the high-supply scenario.

The low-supply scenario seems more realistic than the high-supply scenario owing to the poor condition of several of the most important stocks. The cod spawning stock in the North Sea is outside safe biological limits, causing ICES (1999) to recommend a 40% decrease in catches from the 1998 level in 2000. The EU followed this advice and reduced the TAC by around 40% to 73,000 tonnes. The northern hake stock is also outside safe biological limit and has a recommended decrease of 40% to 20,000 tonnes. The EU TAC was reduced by 24% to 42,000 tonnes.

The cod stock in the northern part of the Atlantic Ocean, including the Barents Sea, is outside safe biological limits. ICES (1999) recommends on this basis a 77% decrease in the fishery in relation to the 1999 TAC, to 110,000 tonnes in 2000. This advice was partly followed by Norway, where the TAC was reduced by 90,000 tonnes. In the unregulated part of the Barents Sea the poor condition of the stock is also expected to decrease catches in 2000.

Finally, the biomass of the hake stock in Argentina is according to Fis-Net (1999) below the limit. As a consequence, the situation of the 2000 fishery is uncertain, but it is expected to be similar to or worser than the poor fishery of 1999. Due to the worsened condition of these stocks, decreasing catch rates and TACs are expected to reduce catches of roundfish in 2000. Therefore, catches are expected to decrease by around 13.9%, as is calculated in the low-supply scenario.

The species included in the roundfish group are chosen on the understanding that roundfish markets are integrated in the EU (Asche and Hannesson 1997b). Therefore, misleading choice of species is not expected to affect results considerably. However, results could be affected by a structural change in the EU roundfish market, as Globefish (2000) reports that a strange situation occurred in the second quarter of both 1999 and 2000. In the beginning of the year quotas were small, supply limited and prices high. Then a sudden oversupply of Alaska Pollack occurred and prices dropped sharply. This situation is not incorporated in the calculated prices for 2000, as the trend in supplies are identified in the main countries exporting roundfish to the EU in the years 1996-98, not in 1999 and 2000. As a consequence, the calculated roundfish prices may be overestimated.

Flatfish

The EU flatfish market is supplied by the catches of EU fishermen as well as by imports. Annual catches of 33 flatfish species in the EU were 351,000 tonnes live weight in the years 1996-97, with plaice being the most important species at 29% of total catch and with plaice, monkfish, sole, skates, megrim, flatfish and lemon sole covering more than 75%. The most important fishery is the plaice fishery in the North Sea and the monkfish fishery in the waters surrounding the British Isles.

Annual average imports of unprocessed flatfish were 56,000 tonnes imported weight in the years 1996-98. Of these, 69% originate in countries with which the EU has made bilateral agreements on fisheries or seafood trade. The most important part of these is Greenland halibut, originating from the North Atlantic Ocean and caught by Iceland, Greenland, the Faroe Islands and Norway. Flatfish is also imported from Morocco in significant quantities. The remaining imports originate from various countries worldwide, with American anglers and flatfish caught by US fishermen and flatfish from Namibia being the most important.

Imports are concentrated on relatively few supplier countries, with Norway covering 17% of total EU imports of flatfish and the top five supplier countries covering 60%. Moreover, catches in countries exporting to the EU and from within the EU cover several species, 8 being necessary to meet 75% of total catches in the EU and the top seven countries exporting to the EU.

Annual EU exports of unprocessed flatfish were 20,000 tonnes live weight in the years 1996-98, corresponding to 36% of imports.

EU fishermen and imports supplied the total EU market for unprocessed flatfish in the years 1996-97. The top seven countries exporting to the EU supplied 75% of imports. Based on the criteria of importance, the EU and the top 7 countries exporting to the EU are selected as the leading supplier countries and plaice, Greenland halibut, monkfish, flatfish, skates, sole, American anglers, dab, megrim and lemon sole as the leading species. The trend in supply in the EU from those fisheries and trends in supply in near and distant countries exporting to the EU are shown in Table 3 for 1996-2000.

TABLE 3: **Estimated supply of unprocessed flatfish in the EU in the years 1996-2000 (000 tonnes).**

	Supply				Supply 2000			
					Scenario 1		Scenario 2	
Suppliers:	1996	1997	1998	1999	Level	%	Level	%
Own	351	353	316	310	286	-7.6	396	27.8
Near imports	39	37	29	31	24	-22.4	40	28.3
Distant imports	17	13	13	13	11	-16.3	13	3.0
Total	407	402	358	354	321	-9.3	449	26.9

Source: Calculations based on EUROSTAT New Cronos Database, EUROSTAT COMEXT Database, Worldfish Reports and EU Commission Landing statistics for species subject to quotas in EU.

Given the assumptions, it appears that changes in supply of flatfish in 2000 are expected to decrease by 9.3% in the low-supply scenario and to increase by 26.9% in the high-supply scenario. The realism of the two scenarios can only be assessed with caution, as some stocks are in poor condition and others are subject to increased fishing. However, the high-supply scenario is considered unrealistic as it assumes that 100% of the important North Sea plaice quota is utilised in 2000 while only 75% was used in 1999. Moreover, it is unrealistic to expect that the positive trend from 1998-99 in the Greenland halibut fishery in Norway, with the catch almost doubling, will continue in 2000. Therefore, catches are expected to remain stable or fall slightly.

The species included in the flatfish group are not expected to form one integrated market in the whole EU, as considerable differences can be present between cheap species (for example plaice and dab) and the more expensive (among them sole and Greenland halibut). Moreover, it is expected that landings in the Netherlands determine the prices of the main Danish flatfish species, plaice and sole. Supply of other flatfish species in the EU is not expected to have considerable effect on the plaice and sole prices, as these prices probably are formed on separate markets.

Pelagic fish

The EU pelagic fish market is supplied by the catches of EU fishermen as well as by imports. Annual catches of 36 pelagic fish species in the EU were 2,039,000 tonnes live weight in the years 1996-97, with herring being the most important species, covering 34% of total catches and with herring, pilchard, mackerel, sardinella and anchovy covering more than 75%[7]. The most important fishery is the herring fishery in the Northeast Atlantic Ocean including the North Sea.

Annual imports of unprocessed pelagic fish were 112,000 tonnes imported weight in the years 1996-98. Of these, 29% originates in countries with which the EU has made bilateral agreements on fisheries or seafood trade. Annual EU exports of unprocessed pelagic fish were 579,000 tonnes in the years 1996-98. Therefore, EU is a large net-exporter of unprocessed pelagic fish.

The total EU market for unprocessed pelagic fish in the years 1996-97 was supplied by EU fishermen and imports, with 75% of imports being supplied by the top 15 countries exporting to the EU. Based on the criteria of importance, the EU and the top 15 countries exporting to the EU are selected as the principal suppliers, and herring, pilchard, Atlantic and chub mackerel, sardinella and anchovy, the main species. The trend in supply in the EU from those fisheries and the trend in supply in near and distant countries exporting to the EU are shown in Table 4 for the years 1996-2000.

[7] Herring and pilchard are used both for human consumption and reduction, as, for example, the use of herring for reduction is permitted in Norway. However, as the main use of the species is for human consumption, it is assumed that the only use is for human consumption.

TABLE 4 **Estimated supply of unprocessed pelagic fish in the EU in the years 1996-2000 (000 tonnes).**

	Supply				Supply 2000			
					Scenario 1		Scenario 2	
Suppliers:	1996	1997	1998	1999	Level	%	Level	%
Own	2,039	2,057	2,180	1,979	1,989	0.5	2,337	18.1
Near imports	33	41	43	40	40	0.0	44	10.1
Distant imports	79	58	58	58	45	-23.2	84	45.0
Total	2,151	2,156	2,281	2,077	2,074	0.0	2,465	18.7

Source: Calculations based on EUROSTAT New Cronos Database, EUROSTAT COMEXT Database, Worldfish Reports and EU Commission Landing statistics for species subject to quotas in EU.

Given the assumptions, it appears that supply of pelagic fish in 2000 is expected to remain unchanged in the low-supply scenario and to increase 18.7% in the high-supply scenario[8]. The low-supply scenario is considered more realistic than the high-supply scenario, as catches are not expected to increase considerably, owing to the presence of under-utilised TACs in the North East Atlantic and North Sea herring fishery in 1999.

The species included in the pelagic fish group are not expected to form one integrated market in the whole EU, as there are expected to be separate markets for small pelagic fish (herring, mackerel, pilchard and sardinella) and the larger pelagic fish (primarily tuna). Moreover, the EU market for small pelagic fish can possibly be separated into a northern part consisting of herring and mackerel and a southern part consisting of pilchard and sardinella. The presence of this situation decreases the reliability of results.

Freshwater fish[9]

The EU freshwater fish market is supplied by aquaculture production in the EU, catches by EU fishermen and by significant imports. Annual supply of 18 freshwater fish species

[8] These results are only valid for small pelagics, as all the selected species are all small pelagics. Therefore, given that substitution is not present between small pelagics and large pelagics (tuna species), the results cannot be used as a basis for calculating supply and prices for large pelagics. However, as this paper focuses on the Danish fishing industry and as large pelagics are not caught in Danish waters, the results are considered to be reliable.

[9] Some of the most important species in the freshwater fish group (including salmon, trout and eel) are not really freshwater fish, as they live most of their lives in saltwater. The group includes the main species produced in marine aquaculture and freshwater ponds. Despite “diadromous fish” being a more precise name for this group of species, the more common name “freshwater fish” is used, as all the species, if not living in freshwater, returns to freshwater to spawn.

raised or caught in the EU was 601,000 tonnes live weight in the years 1996-97, with rainbow trout being the most important species covering 39% of total catches and with rainbow trout, salmon and 4 other species covering more than 75%. The most important supply sources are rainbow trout, raised on farms in EU countries, and salmon grown in the UK (Scotland).

Annual imports of unprocessed freshwater fish averaged 255,000 tonnes imported weight in the years 1996-97. Of these, 88% originated in countries with which the EU has made bilateral agreements on fisheries or seafood trade. The most important part of these is salmon raised in Norway. Imports are very concentrated as Norway covers 78% of total EU import of freshwater fish and with the top five supplier countries covering 91%. Moreover, total catches in countries exporting to the EU and within the EU cover few species; only 3 species are necessary to meet 75% of total supply in the EU and Norway.

Annual EU exports of unprocessed freshwater fish were 18,000 tonnes live weight in the years 1996-97, corresponding to 7% of imports. Therefore, EU exports of unprocessed freshwater fish are very small compared to imports.

Thus, the EU market for unprocessed freshwater fish in the years 1996-97 was supplied by EU farms and imports from Norway. Therefore, trends in future supply depends heavily on the expected future production levels in these countries.

The criteria of importance select salmon, rainbow trout, freshwater fish, sea bass, carp and surmullet as the supply-leading freshwater fish species in the EU and Norway. Trends in supply in the EU and Norway are shown in Table 5 for the years 1996-2000.

TABLE 5 **Estimated supply of unprocessed freshwater fish in the EU in the years 1996-2000 (000 tonnes)**.

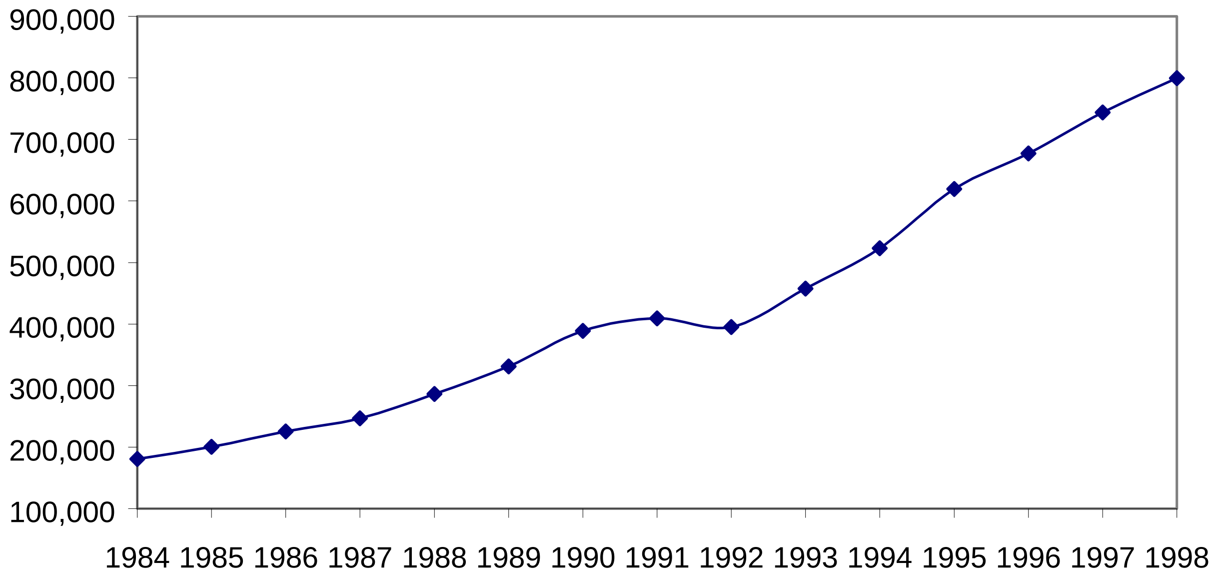
	Supply				Supply 2000			
					Scenario 1		Scenario 2	
Suppliers:	1996	1997	1998	1999	Level	%	Level	%
Own	601	638	673	700	700	0.0	730	4.3
Near imports	225	256	272	313	313	0.0	361	15.2
Distant imports	30	30	30	30	30	0.0	30	0.0
Total	856	924	975	1,043	1,043	0.0	1,121	7.5

Source: Calculations based on EUROSTAT New Cronos Database, EUROSTAT COMEXT Database, Worldfish Reports and EU Commission Landing statistics for species subject to quotas in EU.

Given the assumptions, supply of freshwater fish in 2000 is expected to remain unchanged in the low-supply scenario and to increase 7.5% in the high-supply scenario. The high-supply scenario is considered more realistic than the low-supply scenario, as the continuous increase in production of salmon primarily in Norway, but also in Scotland, is expected to continue. However, if the market is saturated the increase in production could stagnate.

Whether the market is saturated or not can be assessed in a chart of a time series of supply of freshwater fish, as shown in Figure 2.

FIGURE 2: **EU supply (catch and production in aquaculture) of freshwater fish in 1984-98, selected by the criteria of importance**



From the figure it appears that supply of freshwater fish has increased all years since 1984, except for 1992. Moreover, it appears that supply has increased considerably each year since 1993. Therefore, it does not seem likely that the increase in supply will fade out or that supply will even decrease. As a consequence the market is not assessed to be saturated.

Salmon dominates the freshwater fish group and as it is traded on a global market (DeVoretz and Salvanes 1993) misleading choice of species is not thought to affect results considerably.

Crustaceans etc.

The EU market for crustaceans, including cuttlefish, is supplied by the catches of EU fishermen as well as by significant imports. Annual catches of 40 crustacean species in the EU were 366,000 tonnes live weight in the years 1996-97, with lobster being the most important species covering 16% of total catches and with lobster, octopus, shrimp, crabs and 5 other species covering more than 75%. The most important fishery is the lobster fishery in the waters surrounding the British Isles and the Spanish and Portuguese octopus fisheries in the Central-east Atlantic Ocean.

Annual imports of unprocessed crustacean were 279,000 tonnes imported weight in the years 1996-98. Of these, 30% originated in countries with which the EU has made bilateral agreements on fisheries or seafood trade. The most important part of these is cold-water shrimp from Greenland and Canada and squid from Argentina. The remaining imports originate from various countries worldwide, both from fisheries and farms. Important supply sources include raised tiger prawn from Thailand, Indonesia and India and some caught or raised crustacean species from China. Imports are spread over several supplier countries, with the top 5 supplier countries covering only 40% of total EU imports of unprocessed crustacean. Moreover, catches in countries exporting to the EU and within the EU cover several species; 8 species being necessary to meet 75% of total catches in the EU and the top 19 importer countries.

Annual EU exports of unprocessed crustaceans amounted 55,000 tonnes live weight in the years 1996-98, corresponding to 20% of imports.

Thus, the EU market for unprocessed crustaceans in the years 1996-97 was supplied by EU fishermen and imports, with 75% of imports coming from the top 19 supplier countries. Therefore, trends in future supply heavily depends on the expected future catch levels worldwide as well as on expected future production in aquaculture worldwide.

The criteria of importance select marine crustaceans, decepods, tiger prawn, cold-water shrimp, craps, lobster, cuttlefish, squid and octopus as the leading crustacean species among species in the EU and the top 19 countries exporting to the EU. The trend in supply within the EU from those fisheries and the trends in near and distant imports are shown in Table 6 for the years 1996-2000.

TABLE 6 **Estimated supply of unprocessed crustaceans in the EU in the years 1996-2000 (000 tonnes).**

	Supply				Supply 2000			
					Scenario 1		Scenario 2	
Suppliers:	1996	1997	1998	1999	Level	%	Level	%
Own	365	418	403	406	396	-2.3	484	19.2
Near imports	82	109	81	85	81	-4.9	97	14.2
Distant imports	197	212	214	211	205	-3.0	240	13.5
Total	644	740	697	702	682	-2.8	821	16.9

Source: Calculations based on EUROSTAT New Cronos Database, EUROSTAT COMEXT Database, Worldfish Reports and EU Commission Landing statistics for species subject to quotas in EU.

Given the assumptions, it appears that supply of crustaceans in 2000 is expected to decrease by 2.8% in the low-supply scenario and to increase 16.9% in the high-supply scenario. The realism of the two scenarios can only be assessed with caution, as supply depends on the worldwide state of the fishing and aquaculture industries on which information is lacking. Therefore, based on the mean trend in Scenarios 1 and 2, supply may be expected to increase slightly.

The crustacean group is not expected to form one integrated market, as the group is very heterogeneous. The most important parts of this market are shrimp, lobster, crab and cuttlefish markets. The presence of these smaller markets decreases the reliability of results.

Bivalves[10]

The EU bivalve market is supplied by aquaculture production within the EU, catches by EU fishermen and by significant imports. Annual supply of 18 bivalve species in the EU was 1,019,000 tonnes live weight in the years 1996-97, with blue mussel being the most important species covering 49% of total supply and with blue mussel, Mediterranean mussel and oyster covering more than 75%. The most important supply sources are blue mussel raised in various EU countries, including Spain, the Netherlands and France.

Annual imports of unprocessed bivalves were 324,000 tonnes imported weight in the years 1996-98. Of these, 44% originated in countries with which the EU has made bilateral agreements on fisheries or seafood trade. The most important part of these originates from

[10] Although clams may not be bivalves, they are included in this group of species, as it is the species of closest resemblance.

Morocco. The remaining imports come from various countries worldwide, with scallops from China being an important species.

Imports are relatively widely sourced from various countries, with Morocco covering 17% of total EU imports of bivalves and the top five supplier countries covering only 48%. Moreover, total catches in countries exporting to the EU and within the EU cover few species, with only 3 species necessary to meet 75% of total supply in the EU and the top 13 supplier countries.

Annual EU exports of unprocessed bivalves were 29,000 tonnes exported weight in the years 1996-98, corresponding to 9% of imports. Therefore, EU exports of unprocessed bivalves are small compared to imports.

Thus, the EU market for unprocessed bivalves in the years 1996-97 was supplied by EU fishermen and imports, with 75% of imports being supplied by the top 13 countries exporting to the EU. Therefore, trends in future supply heavily depend on the expected future catch and production levels in these countries. The criteria of importance select blue mussel, Mediterranean mussel, oysters, clams and marine molluscs as the leading bivalve species among fisheries in the EU and the top 13 supplier countries. The trend in supply in the EU from those fisheries and the trends in near and distant import are shown in Table 7 for 1996-2000.

TABLE 7 **Estimated supply of unprocessed bivalves in the EU in the years 1996-2000 (000 tonnes).**

	Supply				Supply 2000			
					Scenario 1		Scenario 2	
Suppliers:	1996	1997	1998	1999	Level	%	Level	%
Own	1,019	1,056	1,290	1,267	1,247	-1.6	1,599	26.1
Near imports	150	150	150	150	150	0.0	150	0.0
Distant imports	191	213	213	213	208	-2.1	252	18.5
Total	1,360	1,418	1,653	1,630	1,605	-1.5	2,001	22.7

Source: Calculations based on EUROSTAT New Cronos Database, EUROSTAT COMEXT Database, Worldfish Reports and EU Commission Landing statistics for species subject to quotas in EU.

Given the assumptions, supply of bivalves in 2000 is expected to decrease by 1.5% in the low-supply scenario and to increase 22.7% in the high-supply scenario. The realism of the two scenarios can only be assessed with caution, as information on the trends in the EU supply originating worldwide is limited. Therefore, based on the mean trend in Scenario 1 and 2, supply is expected to increase. This seems reasonable, due to the continuous increase in the production of bivalves in EU aquaculture.

The species included in the bivalve group are chosen from among relatively homogeneous species. Therefore, misleading choice of species is not thought likely to affect results considerably.

Seafood for human consumption

The EU seafood market is supplied by the catches of EU fishermen and production of EU fish farmers, as well as by significant imports. Annual supply of 173[11] seafood species in the EU was 5,167,000 tonnes live weight in the years 1996-97, with pelagic fish being the most important group covering 39% of total supply and with pelagic fish, bivalves, roundfish and freshwater fish covering more than 75%.

Annual imports of unprocessed seafood amounted to 1,773,000 tonnes imported weight in the years 1996-98. Of these, 49% originates in countries with which the EU has made bilateral agreements on fisheries or seafood trade. The top five countries exporting to the EU are Norway, Morocco, Argentina, Canada and the Faroe Islands. The remaining imports originates from various countries worldwide, with Thailand, the US, Ecuador, India and Senegal being the top five countries exporting to the EU. Imports are sourced from a range of supplier countries, with Norway covering 18% of total EU imports of seafood and the top five supplier countries covering only 37%. However, despite this, supplies of individual species are often concentrated on relatively few countries.

Annual EU exports of unprocessed seafood averaged 692,000 tonnes live weight in the years 1996-98, corresponding to 44% of imports. However, whereas imports are spread across all 6 groups of species for human consumption, exports are largely limited to pelagic fish.

Thus, the EU market for unprocessed seafood in the years 1996-97 was supplied by EU fishermen, fish farmers and imports, with 75% of imports being supplied by the top 24 importer countries. Therefore, trends in future supply heavily depend on the expected future catch and production levels in these countries.

---

[11] Excluding 123 species not placed in any of the six groups of fish used for human consumption and 10 species placed in the fish for reduction group.

Based on the results shown in Table 2 to 7, the trend in supply of the selected species in the EU and the trends in near and distant imports are shown in Table 8 for 1996-2000.

TABLE 8 **Estimated supply of unprocessed seafood for human consumption in the EU in the years 1996-2000 (000 tonnes).**

	Supply				Supply 2000			
					Scenario 1		Scenario 2	
Suppliers:	1996	1997	1998	1999	Level	%	Level	%
Own	5,167	5,246	5,511	5,261	5,117	-2.7	6,141	16.7
Near imports	762	823	781	796	757	-4.3	870	9.3
Distant imports	606	614	616	613	587	-4.2	700	14.2
Total	6,535	6,583	6,908	6,670	6,461	-3.1	7,711	15.6

Source: Calculations based on EUROSTAT New Cronos Database, EUROSTAT COMEXT Database, Worldfish Reports and EU Commission Landing statistics for species subject to quotas in EU.

Given the assumptions, it appears that seafood supply in 2000 is expected to decrease by 3.1% in the low-supply scenario and to increase 15.6% in the high-supply scenario. The low-supply scenario seems more realistic than the high-supply scenario, as it was chosen as the most realistic scenario in the case of roundfish, flatfish and pelagic fish, though partly offset by the opposite assessment for freshwater fish. The realism of the scenarios for crustaceans and bivalves cannot be judged owing to lack of information. Therefore, the total EU supply of seafood for human consumption is expected to remain stable around the 1999 level or decrease slightly, though with significant changes in supply both in some groups of species and in several individual species.

Fish for reduction

The EU fish for reduction market is supplied by the catches of EU fishermen as well as by imports. Annual catches of 6 species in the EU were 2,044,000 tonnes live weight in the years 1996-97, with sandeel being the most important species covering 39% of total catches and with sandeel, horse mackerel and sprat covering more than 75%[12]. The Danish fishery is the most important.

Annual imports of fish for reduction amounted to 82,000 tonnes imported weight in the years 1996-98. Therefore, the EU imports of fish for reduction are relatively insignificant.

[12] Horse mackerel and blue whiting are used both for reduction and human consumption, as blue whiting, for example, is used for production of surimi. However, as the main use of the species is for reduction, it is assumed that the only use is for reduction.

Annual EU exports of unprocessed fish for reduction were 278,000 tonnes exported weight in the years 1996-98 making the EU a large net-exporter of fish for reduction[13].

Thus, the EU market for unprocessed fish for reduction in the years 1996-97 was supplied largely by EU fishermen. Therefore, trends in future supply heavily depends on expected future catch levels in the EU. The criteria of importance select capelin, sandeel, blue whiting, sprat and horse mackerel as the leading species among fisheries in the EU. The trend in supply in the EU from those fisheries and the trends in near and distant imports are shown in Table 9 for the years 1996-2000.

TABLE 9 **Estimated supply of fish for reduction in the EU in the years 1996-2000 (000 tonnes).**

	Supply				Supply 2000			
					Scenario 1		Scenario 2	
Suppliers:	1996	1997	1998	1999	Level	%	Level	%
Own	2,044	2,193	1,897	1,916	2,096	9.4	2,786	45.4
Near imports	49	59	55	51	41	-18.8	53	4.1
Distant imports	33	33	33	33	33	0.0	33	0.0
Total	2,186	2,285	1,985	2,000	2,170	8.5	2,872	43.6

Source: Calculations based on EUROSTAT New Cronos Database, EUROSTAT COMEXT Database, Worldfish Reports and EU Commission Landing statistics for species subject to quotas in EU.

Given the assumptions, it appears that supply of fish for reduction in 2000 will increase by 8.5% in the low-supply scenario and increase 43.6% in the high-supply scenario. The low-supply scenario seems more realistic than the high-supply scenario, as the utilisation of the main Danish quotas of sand eel and sprat cannot be expected to increase to 100% in the short-term, with utilisation of 53% and 83% in the year 1999, respectively.

The species included in the fish for reduction group have been chosen to cover the species mainly used for fishmeal and fish-oil production. These species are easily identified and misleading choice of species is not considered likely to affect results considerably. However, as discussed below, the availability of fish for reduction from Chile and Peru does appear to affect results, as does the global supply of soyabean.

[13] These figures are obtained from the foreign trade statistics; however, in some countries some fish for consumption are registered in the same product groups as fish for reduction. The import and export figures of fish for reduction therefore includes an unknown amount of fish for consumption.

5.2 Prices

Using the method outlined in Sections 2 and 3 and the expected total EU supply, estimated above, prices of unprocessed seafood are calculated on the basis of selected price flexibilities and market shares using the Danish price level of unprocessed seafood.

Flexibilities and market shares

Price flexibilities are not estimated but selected on the basis of the results in existing seafood demand literature, and set out in Appendix 2. The estimated price flexibilities in this literature have a heterogeneous nature. They have been derived from both inverse and ordinary[14] demand models estimated in several different functional forms using data on different market levels, periods, product forms, aggregation levels and at different times[15]. Consequently, the price flexibilities used are chosen on the basis of ad-hoc considerations, though from the existing information. They and their share of the total market are shown in Table 10, together with detailed considerations of choice.

---

[14] More precisely, price elasticities, not flexibilities, are estimated in ordinary demand models. However, the price elasticity is normally the inverse of the price flexibility.

[15] A problem arises from the use of price flexibilities, that of simultaneity bias (identifying whether changes in the observations are the results of shift in or along the demand or supply curves). Most papers assume perfect elasticity of supply in estimating the inverse demand functions, corresponding to that prices are determined by the quantity demanded, given an exogenous quantity of supply. This assumption is not considered to affect results considerable, as seafood is a scarce resource with a market clearing process which can be explained in such a model, as described in Section 2.

TABLE 10: **Price flexibilities and market shares.**

Product:	Price flexibility	Market share /%	Consideration
Roundfish	–0.25	7.4	The average of 53 known estimations is –0.38 and the average of 40 of these all estimated using inverse demand models is –0.25. Moreover, the average of 22 of these estimations all estimated for the ex-vessel market level is –0.23. Of these estimations 10 cover more than 5% of the total market of 1,117,000 tonnes in the years 1996-97 (see Table 2), and the weighted average of these estimations is –0.25.
Flatfish	–0.20	8.6	The average of 12 known estimations all for the ex-vessel market using inverse demand models is –0.26. Of these 2 cover more than 5% of the total market of 407,000 tonnes in the years 1996-97 (see Table 3), and the weighted average of these estimations is –0.20.
Pelagic fish	–0.33	12.7	The average of 10 known estimations is –0.35 and the weighted average of 5 of these all estimated for the ex-vessel market level and covering more than 5% of the total market of 1,600,000 tonnes in the years 1996-97 (see Table 4), is –0.28.
Freshwater fish	–0.42	20.6	The average of 22 known estimations is –0.70 and the weighted average of 5 of these estimated on the most highly aggregated data (for Norwegian exports of salmon to the whole EU) and covering more than 5% of the total market of 856,000 tonnes in the years 1996-97 (see Table 5), is –0.42.
Crustaceans	–0.44	11.9	The average of 17 known estimations is –0.63 and the average of 7 of these all estimated for the ex-vessel market using inverse demand models is –0.47. The weighted average of 3 of these covering more than 5% of the total market of 644,000 tonnes in the years 1996-97 (see Table 6), is –0.44.
Bivalves	–0.49	11.3	The weighted average of 3 known estimations all covering more than 5% of the total market of 1,360,000 tonnes in the years 1996-97 (see Table 7), is -0.49.
Total seafood for human consumption	–0.74	52.9	The average of 25 known estimations (all ordinary demand models) is –1.16 and the average of 20 of these all with a time period of one year is –0,74. Moreover, the most highly aggregated estimation for intra- and extra-EU imports of seafood is –0.74.
Fish for reduction	–0.08	45.9	No estimations are known, however, -0.08 is selected (see Appendix 2).

Source: Appendix 2.

Given the assumptions, it appears that the largest price flexibility is chosen for total seafood for human consumption, which seems reasonable due to the high aggregation level. The price flexibilities for the single groups of seafood for human consumption are smaller, with those for flatfish, roundfish and pelagic fish in the lower range (-0.33; -0.20) and those for bivalves, crustaceans and freshwater fish in the upper range (-0.49; -0.42). The larger price flexibilities for freshwater fish, crustaceans and bivalves can probably be explained by, that these groups of species face fewer substitutes than the other groups, owing to their more specialised and exotic nature. The price flexibility for fish for reduction is close to zero (-0.08), which seems reasonable as the supply of other protein sources internationally (fish for reduction from Chile and Peru and American soyabeans) are expected to determine a world market price for protein influencing that of fish for reduction.

Trends

Based on the trend in total EU supplies and on price levels in Denmark in the years 1996-99, the Danish prices of unprocessed seafood in 2000 are calculated using Equation 4, given the price flexibilities and market shares in Table 10. The trend in the prices is shown in Table 11 for 1996-2000.

TABLE 11 **Prices of unprocessed seafood in Denmark 1996-2000, EURO/kg.**

					2000[2]			
					Scenario 1		Scenario 2[3]	
Species:	1996	1997	1998	1999	Level	%	Level	%
Roundfish	1.17	1.31	1.89	1.89	2.78	47.0	1.90	1.0
Flatfish	2.14	2.14	2.15	2.27	2.76	21.6	.	.
Pelagic fish	0.18	0.20	0.21	0.18	0.18	- 0.0	0.09	-48.6
Freshwater fish[1]	3.38	3.27	3.27	3.23	3.23	0.0	2.74	-15.3
Crustaceans	3.31	2.81	3.42	5.19	5.73	10.4	1.95	-62.5
Bivalves	0.09	0.09	0.10	0.12	0.13	6.5	.	.
Total seafood for human consumption	0.92	1.08	1.10	1.18	1.23	4.3	0.92	-21.8
Fish for reduction	0.08	0.11	0.14	0.09	0.09	- 1.5	.	.

Note 1: Price level of Danish imports of unprocessed salmon from Norway.
2: Prices are shown at 1999 price level and prices and price changes in the most realistic scenario are in bold.
3: Missing values (= ".") indicate that reliable price calculations cannot be made, as the method is only capable of calculating effects of marginal changes and as supplies change by more than 20%.
Source: Calculations based on price data from the Danish Directorate of Fisheries.

Given the assumptions, price calculations of unprocessed seafood in Denmark in 2000 appear. For Scenario 2 for some groups of species calculations are not made, as the method used is only reliable for marginal changes in supplies and as supplies in these cases are expected to change considerably. Calculations of prices and price changes in the most realistic scenarios are in bold and it appears that the low-supply scenario (Scenario 1) is the more realistic situation for roundfish, flatfish, pelagic fish, total seafood for human consumption and for fish for reduction. The high-supply scenario (Scenario 2) is the more realistic situation for freshwater fish. For crustaceans and bivalves neither of the scenarios are considered to be realistic, as information on the actual situation on these markets in the years 1998-99 is too limited.

The calculations indicate an increase in prices for roundfish, flatfish and total seafood for human consumption. Roundfish prices are expected to increase by 47.0%[16], which is

[16] All price trends estimated in the paper are in real terms. That is, the trend in fixed prices measuring purchasing power.

explained by the shortage of supply among all the traditional sources. Flatfish prices are expected to increase by 21.6% and prices of total seafood for human consumption are expected to increase more moderately by 4.3%, although with significant differences between the groups of species. Prices of pelagic fish and fish for reduction are estimated to remain almost stable. Prices of freshwater fish will decrease by 15.3% because of an expected continuous increase in production of salmon primarily in Norway, but also in Scotland.

These results are obtained on the basis of several assumptions, set out in Section 3, which may not necessarily hold. Firstly, changing demand can affect prices through changing income, population, age composition and eating habits. Moreover, changing market structure can affect prices, through for example concentration. However, as the analysis only covers one year, the demand and the market structure is not expected to change considerably and the results may therefore be expected to be fairly robust.

Secondly, changing incomes can affect prices. However, since income (measured as total consumption in the EU) is expected to increase by only 3.0% in 2000, according to OECD (1999), and as seafood forms a very limited part of consumers budget, this effect is considered to be relatively unimportant.

Thirdly, the assumption that the species within the groups are perfect substitutes and thus form part of the same integrated market is not necessarily true. However, substitution is expected to be present between most species within each group and, as shown by Asche and Hannesson (1997a) among others, the roundfish market, for example, is closely integrated in the EU.

Fourthly, the assumption that substitution between groups is absent is not reliable. Although substitution between seafood and other food products, according to Burton and Young (1992), Guillotreau (1998) and Myrland *et al* (1998), is found to be weak, substitution between groups of species for human consumption is not. Substitution is found to be present to some extent between all groups of species. Substitution is expected to be relatively large between the traditional wild caught species in the codfish, flatfish and pelagic fish groups. Freshwater fish is not a substitute for roundfish, as Asche and Hannesson (1997a) found that salmon and roundfish markets are not integrated. However, Clay and Fofana (1999) found that salmon is a weak substitute for shrimps. Crustaceans and bivalves are expected to be substitutable for each other and for the four groups of fish for human consumption to a lesser extent, due to the special and exotic nature of these species.

Given that some substitutability is present between the groups of species for human consumption, the price changes will be, to that extent, overestimated. The larger the substitutability, the more the price changes are overestimated. Similarly, price changes are probably slightly overestimated for roundfish and flatfish.

Fifthly, the assumption that perfect substitution is present between the EU countries and the main countries exporting to the EU seems relatively reliable, due to the fact that the main part of the supply is traded across borders.

Sixthly, the assumption that substitution is absent between the EU and other countries (the main countries exporting to the EU excluded) may be unreliable due to the continuing globalisation of seafood trade. For roundfish, Gordon and Hannesson (1996) found that frozen cod is a substitute in Europe and America, but reject that fresh cod is. For freshwater fish, DeVoretz and Salvanes (1993) concluded that salmon is substitutable globally. This is also considered to be the case for crustaceans, due to the global nature of markets for both tiger prawns and cold-water shrimps. Information on substitution of flatfish, pelagic fish and bivalves globally is limited, however, since these species are traditionally caught and consumed locally. This could indicate, that these groups of species are weaker substitutes globally than the others. Fish for reduction is also expected to be substitutable globally, as a world market price is expected to exist for protein sources used for animal feed. Given that substitution is present globally for groups of species, the price changes will be overestimated. The larger the substitutability, the larger are the over-estimations of the price changes.

Finally, the calculations are made given the *ceteris paribus* assumption, which may not necessarily hold. For example, given that substitution is present globally, the validity of the calculations is weak, due to the ripple effect of price changes. For fish for reduction, the price in the EU is expected to be determined by the main protein supply sources, which is fish for reduction from Peru and Chile and soymeal produced by soyabeans, as Asche and Tveteraas (2000) found that the global markets for fishmeal and soyameal are integrated. Catches of small pelagic fish from Peru and Chile, primarily used for reduction, in 1997 were 12 million tonnes or 4 times the catch in the EU. The main species were jack mackerel (a horse mackerel species) and anchovies. In 1998 catches dropped considerably, due to the El Niño weather phenomenon but in the first half of 1999 catches increased again. This increase is expected to continue, due to the recovery of the fishing industries. However, as catches of jack mackerel are expected to decrease, due to a ban imposed on fishing for them caused by the state of the stock, the total catch level is only expected to increase slightly or remain stable, according to Fis-Net (2000). The international market price of soyabeans declined in the years 1997-99. However, according to Oil World (2000) the trend has been reversed in the first three months of 2000, as prices have increased by around 20%; a trend, which is expected to reverse again, due to an increase in world soyabean production of 8% in the 2000-01 season compared to 1999-2000, according to USDA (2000). Therefore, a small price decrease is expected, partly caused by slight increases in catches of fish for reduction in Chile and Peru not offset by substitution from soyabean to fish meal, as the soyabean price is also expected to decrease.

As a consequence of all these assumptions, the method seems to have some weaknesses. However, these weaknesses have probably had little effect on the reliability of the results.

6. Conclusion

Danish prices of unprocessed seafood for 2000 were calculated on the basis of expected developments in the supply of unprocessed seafood in the whole EU, presuming that prices are determined by supplies, given price flexibilities (and thereby demand) selected from the international seafood demand literature.

Market shares were introduced as a solution to the problem of applying estimates of price flexibilities to small parts of larger integrated markets, as their direct use would underestimate the effect that changing quantities have on prices, if the whole integrated market was considered.

Prices are expected to increase for roundfish, flatfish and total seafood for human consumption. Roundfish prices were expected to increase by 50%, which was explained by the shortage of supply among all the traditional sources. Flatfish prices were expected to increase by 20% and prices of total seafood for human consumption was expected to increase more moderately by around 5%, although, with significant differences between the groups of species. Prices of pelagic fish and fish for reduction appears likely to remain stable or decrease slightly. Prices of freshwater fish will decrease by around 15%, because of continuing increases in production of salmon in Norway and Scotland.

These results were obtained on the basis of the outlined method and the outlined assumptions, implying that interpretation of the calculated figures should be made with caution before use for forecasting.

References

Asche F. & Hannesson R. (1997a), Market integration between Whitefish and Salmon in France, SNF Working Paper A40/97.

Asche F. & Hannesson R. (1997b), On the Global Integration of the Markets for Whitefish, SNF Report 98/97.

Asche F., Salvanes K.G. & Steen F. (1994), Market Delineation and Demand Structure, SNF Working Paper A106/94.

Asche F. & Tveteraas S. (2000), On the relationship between aquaculture and reduction fisheries, paper presented at the X'th IIFET Conference in Corvallis, Oregon.

Barten A. P. & Bettendorf L.J. (1989), Price formation of fish – an application of an Inverse Demand System, European Economic Review, volume 33, pp. 1509-1525, North-Holland.

Burton M. (1992), The Demand for Wet Fish in Great Britain, Marine Resource Economics, volume 7, pp. 57-66.

Burton M. & Young T. (1992), The structure of changing tastes for meat and fish in Great Britain, European Review of Agricultural Economics, volume 19, pp. 165-80.

Clay P. & Fofana A. (1999), Delineation of the UK Seafood Markets, Paper presented at the XIth EAFE Conference April 1999 in Dublin.

DeVoretz D. & Salvanes K. G. (1988), Demand for Norwegian Farmed Salmon: A Market Penetration Model, , Proceeding of the 4th Conference of the International Institute of Fisheries Economics and Trade.

DeVoretz D. and Salvanes K. G. (1993), Market Structure for Farmed Salmon, American Journal of Agricultural Economics, volume 75 (February 1993), pp. 227-233.

Fis-net (1999), Argentina: Hubbsi hake on the verge of extinction, article of 4 October obtained from FAO GLOBEFISH Databank.

Fis-net (2000), Chile: Sardine compensates for lack of jack mackerel, article of 31 January obtained from FAO GLOBEFISH Databank.

Gibbs J., Shaw S. A. and Gabbott M. (1997), An analysis of price formation in the Dutch Mussel Industry, Proceedings from EAFE V 1993.

Globefish (2000), Globefish Highlights – A quarterly update based on the Globefish Databank, no. 2, 15 June, FAO.

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.

Guillotreau P. et. al. (1998), Foreign Trade and Seafood Prices: Implications for the CFP, Final Report, July 1998, Report from LEN-CORREIL at University of Brest, CEMARE at University of Portsmouth, University of Valencia and SNF in Bergen.

Guillotreau P., Peridy N. and Bernard P. (1998), Trade Barriers and the European Imports of Seafood Products: a quantitative assessment, Paper presented to IIFET 9th Conference.

Harmsma H. (1988), Survey of the Market for Mussels and Mussels Products, LEI-DLO, Fisheries Division, Publication no. 5.78, Hague.

Hatcher A. C. (1997), The EUropean Community's tariff regime for fish imports 1988-94, Centre for the Economics and Management of Aquatic Resources, Report no. 46, University of Porthmouth.

Hermann M. & Lin B.H. (1988), The Demand and Supply of Norwegian Atlantic Salmon in the United States and European Community, Proceeding of the 4th Conference of the International Institute of Fisheries Economics and Trade.

Houck J. P. (1965), The Relationship of Direct Price Flexibilities to Direct Price Elasticities, Journal of Farm Economics, Volume 47, no. 3, pp. 789-792.

ICES (1999), Extract of the report of the Advisory Committee on Fishery Management on stocks in the Northeast Atlantic Ocean, October 1999.

Ioannidis C. & Whitmarsh D. (1987), Price formation in fisheries, Marine Policy, pp. 143-145.

Ioannidis C. and Matthews K. (1995), Determination of Fresh Cod and Haddock Margins in the UK, 1988-1992, Seafish Report 3007, SFIA, Edinburgh.

Jørgensen H.P, Rodgers P. E. & Smit J. (1989), The economic impact of fisheries management in the North Sea: Cod & Haddock in the Scottish Market.

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.

Jørgensen H.P. (1988), Baltic Sea Cod Price Responsiveness, , Proceeding of the 4th Conference of the International Institute of Fisheries Economics and Trade.

Millán J.A, (1998), An Econometric Model of Spanish Fisheries, paper presented to IIFET 9th Conference.

Millán J.A, and Aldaz N. (1998), An Analysis of Demand for Fresh and Frozen Fish Species in Spain, paper presented to IIFET 9th Conference.

Myrland, Trondsen, Johnston and Lund (1998), Determinants of Seafood Consumption in Norway: Lifestyle, revealed preferences and barriers to consumption, Paper presented at the 9th IIFET Conference.

Nielsen M. (1999), EU Seafood Markets – Integration and Demand, working paper from SJFI.

OECD (1999), Economic Outlook, December 1999.

Oil World (2000), International market prices for soyabean meal (monthly averages), 44%, any origin, CIF Rotterdam Hamburg, Jan 1981- Mar 2000, article of 10 March obtained from FAO GLOBEFISH Databank.

Salvanes K. G. and Devorets D. (1997), Household Demand for Fish and Meat Products: Separability and Demographic Effects, Marine Resource Economics, volume 12, pp. 37-55.

SFIA & DIFER (1986), Bio-economic evaluation of the Norway Pout Box, EU financed project.

United States Department of Agriculture (2000), World Agricultural Production, Circular Series WAP 07-00, July 2000.

Vestergaard, N. and H. Frost (1998) Tariff problems in the Fishing Industry, Note for the Danish Ministry of Food, Agriculture and Fisheries, South Jutland University Centre, Danish Institute of Fisheries Economics Research.

Worldfish Report (1999), Fisheries Council agrees large TAC cuts for 2000, article of 21 December.

APPENDIX 1: **Definition of groups of species and selected fisheries**

Group:	Species		
	Caught and farmed in the EU[1]	Unprocessed import to the EU[2]	Selected fisheries[3]
Roundfish	cod atlantic cod, had haddock, hke european hake, whg whiting, pok saithe, red atlantic redfishes, lin ling, hkm senegalese hake, bib pouting, rng roundnose grenadier, pol pollack, gro groundfishes nei, gux gurnards + searobins nei, bli blue ling, dpx demersal percomorphs nei, lnz lings nei, gur red gurnard, reb beaked redfish, reg golden redfish, caa atlantic wolfish, hkx hakes nei, usk tusk, blu bluefish, fve european whitefish, pod poor cod, gug grey gurnard, gun piper gurnard and cat wolffishes nei.	03025010, 03025090, 03026200, 03026300, 03026931, 03026933, 03026935, 03026941, 03026945, 0302695166, 03026967, 03026968, 03026986, 03036011, 03036019, 03036090, 03037200, 03037300, 03037811, 03037812, 03037813, 03037819, 03037890, 03037935, 03037937, 03037941, 03037945, 03037951, 03037955 and 03037985.	Cod atlantic cod (Denmark/NEA, Iceland/NE Norway/NEA and Russia/NEA), had haddock (Norway/NEA, Russia/NEA and UK/NEA), hkc cape hakes (Namibia/SEA and South Africa/SEA), hke European hake (Spain/NEA-CEA-MED, France/NEA and Italy/MED), hkp argentina hake (Argentina/SWA), pok saithe (Iceland/NEA and Norway/NEA) and whg whiting (France/NEA and UK/NEA).
Flatfish	ple european plaice, mon angler, sol common sole, ska skates, meg megrim, flx flatfishes nei, lem lemon sole, anf anglerfishes nei, dab common dab, fle european flounder, wit witch flounder, tur turbot, lez megrims nei, ghl greenland halibut, mnz monkfishes nei, rjn cuckoo ray, srx skates and rays + nei, bll brill, rjc thornback ray, sox soles nei, scf turbots nei, rjm spotted ray, gpd dusky grouper, cet wedge sole, mgr meagre, hal atlantic halibut, rjo longnosed skate, rjb blue skate, sos sand sole, pla american. plaice, bum atlantic blue marlin, rjf shagreen ray and lef lefteye flounders.	03022110, 03022130, 03022190, 03022200, 03022300, 03022910, 03022990, 03026981, 03033110, 03033130, 03033190, 03033200, 03033300, 03033910, 03033920, 03033930, 03033980 and 03037981.	Ang American angler (USA/NWA), dab common dab (Denmark/NEA, Iceland/NEA and UK/NEA), flx flatfishes nei (Spain/NEA and USA/NEP/, ghl greeenland halibut (Greenland/NWA, Iceland/NEA and Norway/NEA, lem lemon sole (Denmark/NEA, France/NEA, Iceland/NEA and UK/NEA), meg megrim (France/NEA, Ireland/NEA and UK/NEA), mon angler (France/NEA and UK/NEA), ple European plaice (Denmark/NEA, Iceland/NEA, Netherlands/NEA and UK/NEA), ska skates (Spain/NEA, France/NEA, UK/NEA and USA/NWA) and sol common sole (Belgium/NEA, France/NEA, Italy/MED, Netherlands/NEA and UK/NEA).
Pelagic fish[4]	her Atlantic herring, pil European pilchard, mas Chub mackerel, mac Atlantic mackerel, saa Round sardinella, yft Yellowfin tuna, skj Skipjack tuna, ane European anchovy, bet Bigeye tuna, six Sardinellas nei, bft Northern bluefin tuna, sbx Porgies + seabreams+ etc, pel Pelagic fishes nei, swo Swordfish, frz Frigate and bullet tuna, max Mackerels nei, tux Tuna-like fishes nei, ppx Pelagic percomorphs nei, maz 'Scomber' mackerels nei, col Sardinia coral, arg Argentines, sae Madeiran sardinella, bon Atlantic bonito, sbr Red (=Blackspot) seabream, lta Little tunny (=Atlantic black skipjack), sbg Gilthead seabream, srg Sargo breams + nei, sbp Pargo breams + nei, gar Garfish, rpg Red porgy(=Common seabr), sba Axillary seabream, brb Black seabream, sbs Saddled seabream, swa White seabream, mkx Mackerel-like fishes nei and shr Sharpsnout seabream	03023110, 03023190, 03023210, 03023290, 03023310, 03023390, 03023911, 03023919, 03023991, 03023999, 03024005, 03024010, 03024098, 03026110, 03026130, 03026405, 03026410, 03026498, 03026921, 03026925, 03026955, 03026975, 03026987, 03026995, 03034111, 03034113, 03034119, 03034212, 03034218, 03034232, 03034238, 03034252, 03034258, 03034290, 03034311, 03034319, 03034390, 03034921, 03034923, 03034929, 03034941, 03034943, 03034949, 03034990, 03035005, 03035010, 03035098, 03037110, 03037130, 03037410, 03037411, 03037420, 03037490, 03037921, 03037923, 03037929, 03037931, 03037965, 03037975 and 03037987.	ane European anchovy (Spain and Italy/MED and Morocco and Ghana/CEA), her Atlantic herring (Denmark, Norway, Russia, Sweden and United Kingdom/NEA), mac Atlantic mackerel (Denmark, Ireland, Norway, RUSSIA and United Kingdom/NEA), mas Chub mackerel (Ecuador/SEP, South Korea and Taiwan/NWP), pil European pilchard (Spain and Morocco/CEA and Portugal/NEA) and saa Round sardinella (Ghana/CEA and Venezuela/CWA).

APPENDIX 1: **Definition of groups of species and selected fisheries, continued**

Group:	Species		
	Caught and farmed in the EU[1]	Unprocessed import to the EU[2]	Selected fisheries[3]
Freshwater fish	rainbow trout, sal atlantic salmon, frf freshwater fishes nei, bss seabass, fcp common carp, mux surmullets, fpe european perch, ele european eel, coe european conger, fpi northern pike, muf flathead grey mullet, clu clupeoids nei, mul mullets nei, trs sea trout, frx roaches, sme european smelt, fcy carp - cyprinids nei, fbm freshwater bream, pln pollan, slx salmonoids nei, fpp pike-perch, mur red mullet, bse seabasses, tro trouts nei, lum lumpfish, fbu , urbot, bsx groupers+ seabasses nei, shz shads nei, atb big-scale sand smelt, svf brook trout, sil silversides, svc silver carp, shd allis and twaid shads, fgx freshwater gobies, fcg grass carp, dia diadromous fishes nei, bic bighead carp, elp eelpout and stb striped bass.	03019110, 03019190, 03019200, 03019300, 03019911, 03019919, 03021110, 03021190, 03021200, 03021900, 03026600, 03026911, 03026919, 03026969, 03026994, 03031000, 03032110, 03032190, 03032200, 03032900, 03037600, 03037700, 03037911 and 03037919.	Bss seabass (Greece/FARM and Italy/FARM-MED), fcp common carp (Germany/FARM and France/FARM), frf freshwater fishes nei (Germany/INL, France/INL and Greece/INL), mux surmullets (Spain/MED and Italy/MED), sal atlantic salmon (Norway/FARM and UK/FARM) and trr rainbow trout (Germany/FARM, Denmark/FARM, Spain/FARM, France/FARM, Italy/FARM and Norway/FARM).
Crustaceans	nep norway lobster, occ common octopus, csh common shrimp, cre edible crab, ctl cuttlefishes+ bobtail, oct octopuses, sqc common squids, dps deepwater rose shrimp, pra northern prawn, cru marine crustaceans nei, ctc common cuttlefish, dcp natantian decapods nei, cra marine crabs nei, scr spinous spider crab, sqe european flying squid, mts mantis squillid, squ squids nei + oliginidae+ ommastrephi, rcw red swamp crawfish, lbe european lobster, ari aristeid shrimps, ocm horned and musky octopus, tgs caramote prawn, sqi shortfin (northern)squid, crg green crab, pen penaeus shrimps nei, cpr common prawn, sop southern pink shrimp, ssh scarlet shrimp, slo common spiny lobster, crw palinurid spiny lobster, cep cephalopods nei, pal palaemonid, shrimps, crs swimcrabs, kup kuruma prawn, prf giant river prawn, crd danube crayfish, fcx freshwater crustaceans, pan pink shrimps, ocz octopuses and git giant tiger prawn.	03061110, 03061190, 03061210, 03061290, 03061310, 03061330, 03061340, 03061350, 03061380, 03061410, 03061430, 03061490, 03061910, 03061930, 03061990, 03062100, 03062210, 03062291, 03062299 and 03062331.	Cra marine crab nei (China//FARM and Vietnam/CWP), cre edible crab (Ireland/NEA and UK/NEA), cru marine crustaceans nei (China/NWP), csh common shrimp (Germany/NEA and Netherlands/NEA), ctl cuttlefishes+ bobtail (Thailand/CWP and Vietnam/CWP), dcp natanian decapods nei (Indonesia/CWP, India/WIO, Malaysia/CWP-WIO and Vietnam/CWP), dps deepwater rose shrimp (Spain/CEA and Italy/MED), git giant tiger prawn (Indonesia/FARM, India /FARM-WIO and Thailand/FARM), nep Norway lobster Ireland/NEA and UK/NEA), occ common octopus (Spain/CEA and Italy/MED), oct octopuses (Spain/NEA-MED, Portugal/NEA and Thailand/CWP-EIO), pen penaeus shrimps nei (Bangladesh/FARM and Thailand/CWP), pra northern prawn (Canada/NWA and Greenland/NWA), sqa argentine shortfin squid (Argentina/SWA) and sqc common squids (Indonesia/CWP and Thailand/CWP-EIO).
Bivalves	mus blue mussel, msm mediterranean mussel, oyg pacific cupped oyster, tps grooved carpetshell nei, coc common cockle, scx scallops nei, mol marine molluscs nei, sce common scallop, oyf european flat oyster, clx clams nei, qsc queen scallop, oyc cupped oysters nei, raz razor clams, msx sea mussels nei, oyp portuguese cupped oyster, clj japanese clam, clv venus clams and oyx flat oysters nei.	03071010, 03071090, 03072110, 03072910, 03073110, 03073190, 03074110, 03074191, 03074199, 03074901, 03074911, 03074918, 03074931, 03074933, 03074935, 03074938, 03074951, 03074959, 03075100, 03075910, 03076000, 03079100, 03079911, 03079913, 03079915, 03079918 and 03079990.	clj japanese clam (China/FARM), mol marine molluscs (China/FARM-NWP), msm Mediterranean mussel (Greece/MED and Italy/FARM-MED), blue mussel (Denmark/NEA, Spain/FARM, France/FARM and Netherlands/FARM) and oyg pacific cupped oyster (China/FARM).

APPENDIX 1: **Definition of groups of species and selected fisheries, continued**

Group:	Species		
	Caught and farmed in the EU[1]	Unprocessed import to the EU[2]	Selected fisheries[3]
Total seafood for human consumption	All species in the six groups.	All codes in the six groups.	All in group 1-6.
Fish for reduction[4]	cap Capelin, san Sandeels, whb Blue whiting, spr European sprat, hom Atlantic horse mackerel and nop Norway pout.	03026190, 03026191, 03026198, 03026985, 03026991, 03037190, 03037191, 03037198, 03037983, 03037991 and 05119190.	cap Capelin (Iceland /NEA), hom Atlantic horse mackerel (Denmark, Spain, Ireland, Netherlands and United Kingdom/NEA), san Sandeels (Denmark and Norway/NEA), spr European sprat (Denmark, Poland and Sweden/NEA) and whb Blue whiting (Norway and Russia/NEA).

Notes:

1: Based on the FAO classification of species used in the New Cronos Database. Species in the single groups are sorted in order of the highest catch and production levels in the years 1996-97.

2: Based on the codes in the Standard International Trade Classification (SITC).

3: Selected countries and fishing area are given in parenthesis. The meaning of the shortenings is: NEA=Northeast Atlantic Ocean, CEA=Central East Atlantic Ocean, SEA=Southeast Atlantic Ocean, MED=Mediterranean and Black Sea, NWA=Northwest Atlantic Ocean, SWA=Southwest Atlantic Ocean, NEP=Northeast Pacific Ocean, SEP=Southeast Pacific Ocean, NWP=Northwest Pacific Ocean, CWP=Central West Pacific Ocean, WIO=Western Indian Ocean, EIO=Eastern Indian Ocean, INL=Inland and FARM=raised on farms.

4: Some species, including herring, pilchard, horse mackerel and blue whiting, are used for both reduction and human consumption. In these cases the species are placed in either the human consumption groups or the fish for reduction group after their main use.

APPENDIX 2: **Price flexibilities and market shares**

Group of species:	Market	Source	Supply average 96-97/tonnes	Market share /%	Price flexibility
Roundfish:					
Cod	UK	Jørgensen et. al. (1989)	76,450	6.8	-0.29
Cod	UK	Jørgensen et. al. (1989)	76,450	6.8	-0.21
Cod	UK	Ioannidis & Whitmarsh (1987)	76,450	6.8	-0.27
Cod	UK	Ioannidis & Matthews (1995)	76,450	6.8	-0.15
Cod	Denmark	Jørgensen et. al. (1991)	85,600	7.7	-0.14
Cod	Denmark	Jørgensen (1988)	85,600	7.7	-0.11
Haddock	UK	Ioannidis & Whitmarsh (1987)	85,450	7.6	-0.38
Haddock	UK	SFIA & DIFER (1986)	85,450	7.6	-0.25
Haddock	UK	Ioannidis & Matthews (1995)	85,450	7.6	-0.27
Haddock	UK	Jørgensen et. al. (1989)	85,450	7.6	-0.45
Average				7.4	-0.25
Total supply	EU:Domestic+import		1,117,000		
Flatfish:					
Plaice	The Netherlands	Jørgensen et. al. (1991)	34,900	8.6	-0.27
Plaice	The Netherlands	Jørgensen et. al. (1991)	34,900	8.6	-0.12
Average				8.6	-0.20
Total supply	EU: Domestic+import		407,000		
Pelagic fish:					
Herring+mackerel	UK	Burton (1992)	260,100	16.2	-0.49
Herring+mackerel	UK	Burton (1992)	260,100	16.2	-0.40
Herring	UK	Ioannidis & Whitmarsh (1987)	112,900	7.0	-0.06
Mackerel	UK	Ioannidis & Whitmarsh (1987)	147,200	9.1	-0.13
Tuna	Spain	Millán (1998)	91,000	5.7	-0.30
Average				12.7	-0.33
Total supply	EU: Domestic+import		1,610,000		
Freshwater fish:					
Salmon from Norway	EU import	DeVoretz & Salvanes (1988)	178,000	20.8	-0.56
Salmon from Norway	EU fresh import	Asche et. al. (1997)	173,000	20.2	-0.27
Salmon from Norway	EU fresh import	Asche et. al. (1997)	173,000	20.2	-0.24
Salmon from Norway	EU farmed import	Herrmann & Lin (1988)	178,000	20.8	-0.55
Salmon from Norway	EU farmed import	DeVoretz & Salvanes (1993)	178,000	20.8	-0.47
Average				20.6	-0.42
Total supply	EU: Domestic+import		856,000		
Crustaceans:					
Crustaceans	Spain	Millán (1998)	102,600	15.9	-0.46
Octopus	Spain	Millán & Aldaz (1998)	51,000	7.9	-0.55
Octopus	Spain	Millán & Aldaz (1998)	51,000	7.9	-0.28
Average				11.9	-0.44
Total supply	EU: Domestic+import		644,000		

APPENDIX 2. **Price flexibilities and market shares, continued**

Bi-valves:					
Mollusc	Spain	Millán (1998)	204,300	15.0	-0.26
Mollusc	The Netherlands	Gibbs et. al. (1997)	103,900	7.6	-0.48
Mollusc	The Netherlands	Harmsma (1988)	103,900	7.6	-0.95
Average				11.3	-0.49
Total supply	EU: Domestic+import		1,360,000		
Total seafood for human consumption:					
Seafood	EU import from inside and outside EU	Guillotreau et. al. (1998)	3,166,850	52.9	-0.74
Total supply	EU: Domestic+import		5,984,000		
Fish for reduction:					
Fish for reduction	Denmark	*	1,300,000	45.9	-0.08
Total supply	EU: Domestic+import		2,832,000		

* This result is obtained from estimation of an inverse demand function for the Danish catches of fish for reduction on monthly data from November 1994 to October 1999, using a log-log model. The estimation result is:

$$\log(price) = 3.2 + 0.1 * D_{el\ln ino} - 0.08 * \log(catch)$$

with an explanatory power (R2) of 67% and with rejection of the hypothesis that the explanatory variables do not contribute to the explanation of price variations, either individually or together. A dummy variable representing the periods of the el Ninõ weather phenomenon in the Pacific Ocean was found significant. However, autocorrelation is present, as it was not possible to remove it without making the t-test of the explanatory variables insignificant. As the model is estimated in the log-log form, the price flexibility of –0.08 is given directly in the equation.

Working Papers

Statens Jordbrugs- og Fiskeriøkonomiske Institut

1/98	June 98	Christian F. Bach and Søren E. Frandsen	European Integration and the Common Agricultural Policy
2/98	June 98	Kim Martin Lind	An I(2) Analysis of a Factor Demand System Applied to Danish Pig Production
3/98	Juni 98	Boie S. Frederiksen og Anne H. Johannessen	Ledsageforanstaltningernes anvendelse – et studie af incitamentforhold
4/98	June 98	Lars-Bo Jacobsen	The Danish Contribution to the GTAP Database Methodological and Practical Issues
5/98	Juni 98	Ole Olsen, Svend Sørensen og Christian Tronier	Driftsgrensøkonomi for økologisk jordbrug 1996/97
6/98	Juli 98	Steffen Møllenberg og Henrik B. Pedersen	Grønne afgifter, energitilskud og gartnerierhvervets økonomi
7/98	August 98	Søren Svendsen	Regnskabsanalyse af 11 driftsfælleskaber om malkekvæg
8/98	September 98	Chantal Pohl Nielsen	The GTAP Database Content and Methodology
9/98	September 98	Chantal Pohl Nielsen	Economic structures and trade patterns of Denmark, the EU and the CEECs – Extracts from the GTAP database
10/98	Oktober 98	Michael H. J. Stæhr	Elasticities in the GTAP-Model
11/98	November 98	Hans G. Jensen, Søren E. Frandsen and Christian F. Bach	Agricultural and Economic-Wide Effects of European Enlargement: Modelling the Common Agricultural Policy

12/98	November 98	S.E. Frandsen, H.G. Jensen and D.M. Vanzetti	Expanding 'Fortress Europe' Implication of European enlargement for non-member regions
13/98	December 98	Jesper S. Schou	Undersøgelse af landbrugets pesticidanvendelse – Metode, data og resultater
1/99	Januar 99	Søren E. Frandsen og Hans G. Jensen	Kan velfærdsændringer i de generelle ligevægtsmodeller forklares? En dekomponering af den ækvivalerende variation
2/99	Februar 99	Knud Kristensen and Jørgen Dejgaard Jensen	Danish Farmers' Adjustment Capabilities: The Case of Fertiliser Regulation
3/99	Februar 99	Michael Parsby og Håkan Rosenqvist	Energiafgrødernes produktionsøkonomi - med særlig fokus på pil
4/99	Februar 99	Søren Svendsen	Teorigrundlag for undersøgelse af formaliserede samarbejder
5/99	Marts 99	Lars-Bo Jacobsen og Søren E. Frandsen	Analyse af de samfundsøkonomiske konsekvenser af en omlægning af dansk landbrug til økologisk produktion
6/99	Marts 99	Tove Christensen Jesper S. Schou	Oversigt over økonomiske analyser af landbrugets pesticidanvendelse
7/99	April 99	Chantal Pohl Nielsen	EU Enlargement and The Common Agricultural Policy: Modeling Issues
8/99	Juni 99	Nicolaj H. Nørgaard	Driftsøkonomisk betydning af salmonella hos svin
9/99	Juni 99	Kim Martin Lind	Long-run Behavior and Uncertainty in World Cereal Markets

10/99	Juli 99	Ole Olsen, Svend Sørensen og Christian Tronier	Driftsgrensøkonomi for økologisk jordbrug 1997/98
11/99	September 99	Jesper T. Graversen	Implementering af multi-site konceptet - en organisationsøkonomisk vurdering af incitamenter, muligheder og begrænsninger
12/99	September 99	Jesper Levring Andersen	A Review of the Basic Biological and Economic Approaches to Fishing Effort
13/99	September 99	Max Nielsen	EU Seafood Markets – Integration and Demand
14/99	September 99	Erik Lindebo	A Review of Fishing Capacity and Overcapacity
15/99	September 99	Hild Rygnestad	The Agenda 2000 policy reform for agriculture and rural development. Opportunities and limits for environmental protection
16/99	September 99	Niels Tvedegaard	Omlægning til økologisk svine- og planteproduktion - analyse af de økonomiske konsekvenser på udvalgte bedrifter
17/99	November 99	Knud Kristensen	A Consistent Estimate of Danish Agriculture's Production Function
18/99	December 99	Lars-Bo Jacobsen	Samfundsøkonomiske virkninger af kvælstofafgifter I landbruget
19/99	December 99	Erik Lindebo	Fishing Capacity and EU Fleet Adjustment
20/99	December 99	Nicolaj H. Nørgaard	Sammenhæng imellem drifts-økonomi og brysthindear hos svin
21/99	December 99	Hild Rygnestad og Jesper S. Schou	Miljøøkonomiske analyser: Kvælstofoverskud og datakrav

22/99	December 99	Jørgen Dejgaard Jensen, Knud Kristensen and Connie Nielsen	Estimating Behavioural Parameters for CGE-Models: Using Micro-Econometrically Estimated Flexible Functional Forms
23/99	December 99	Jesper S. Schou	Integrerede økonomi- og miljø-analyser for dansk landbrug Sammenfatning af arbejder i Ph.D afhandlingen
24/99	December 99	Jens Abildtrup	Status for miljøvenlige jordbrugsforanstaltninger, kortlægning af fremtidige analysebehov
1/00	Februar 2000	Tove Christensen & Hild Rygnestad	Environmental Cross Compliance: Topics for future research
2/00	Februar 2000	Niels Tvedegaard	Omlægning til økologisk planteavl – analyse af de økonomiske konse-kvenser på udvalgte planteavlsbe-drifter
3/00	May 2000	Chantal Pohl Nielsen and Kym Anderson	GMOs, Trade Policy, and Welfare in Rich and Poor Countries
4/00	June 2000	Hild Rygnestad	Integrating environmental economics and policy analyses in a geographical information system
5/00	July 2000	Arne Lauridsen, Ole Olsen og Svend Sørensen	Driftsgrensøkonomi for økologisk jordbrug 1998/99
6/00	July 2000	Henning Porskrog	Calculation SGM. How we do it in Denmark
7/00	Juli 2000	Steffen Møllenberg	Gartnerierhvervets produktivitets-udvikling – samt udviklingen i mængder og priser, herunder bytteforhold, mellem 1980 og 1998/99