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The Norwegian Market for Fish: The Distribution Channels and Demand Conditions

by

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Content

Chapter 1

Introduction

The present report analyses the consumer market for wild caught fish in Norway. In particular two issues are in focus. First the distribution chain and the interdependencies between prices on different distribution levels is studied. Then we try to quantify the consumer demand for fresh fish in Norway. In particular own-price elasticities and demographic effects are estimated and discussed. The information from the prices study and the demand analysis give us a picture also of the competition situation in this market. Even though our methodology does not allow us to distinguish between possible market power and competition, the results allow us to point to which product markets market power is more likely to occur. Finally we undertake an analysis of the interdependencies of prices on different distribution levels in France. The latter is done to be able to contrast the Norwegian distribution chain results.

In chapter 2 we try to determine to which extent producer and consumer markets in Norway for wild caught fish are integrated or not. Of particular interest is whether the Norwegian market is integrated along the distribution chain. Long-run interdependency in producer and consumer prices suggests integrated markets in Norway, and can be tested using cointegration techniques. Cointegration between prices implies stable long run relations and integrated markets. Cointegration techniques have been extensively used to test for market integration the last ten years. However, the technique has predominantly been used to distinguish between either regional markets or to quantify substituabillity between possible competing goods. More seldom these techniques have been used to look at markups in the distribution chains. Cointegration between producer and consumer prices suggests stable margins, and therefore in general competitive markets. Hence, when using cointegration techniques to analyse margins in the distribution chain we can learn something about the competition as well. In this chapter we will also analyse the margins between the producer- and the consumer level.

We focus on the most important wild fish product in terms of Norwegian consumption, cod, saithe, and prawns. For the cod specie we have data on three different product forms; “cod head on”, “cod head off” and fishfingers. For saithe we have data on the product form “saithe head off”.

In chapter 3 we analyse the consumer demand for several fish products in Norway. We analyse six species; cod, haddock, saithe, salmon, trout and shrimps. Both own price elasticities and demographic effects are considered.

Demand equations can give information on a number of interesting issues in the value chain. In particular, it is a common observation that prices are more volatile upstream then down stream. This is because it is highly unlikely that elasticities of price transmission, which measure the impact of a price change at a higher level in the value chain on a price at a lower level in the value chain, is larger then one (Gardner, 1975; Kinnucan and Forker, 1987; Wohlgenant 1990; Asche *et al*, 2002). Consumer demand will then put an upper bound on the price sensitivity of demand at any level in the chain. This will also put limits on the extent to which intermediary firms in the value chain can exploit market power at the different levels in the value chain. In this respect, the degree of substitution is also of interest as it gives information about to what extent the consumers can avoid price increases by changing consumer patterns.

Retail demand is often the most important point in any value chain, since every link in the chain is dependent on the consumers' demand. The intermediaries' demand for inputs is then derived from the consumer demand. Unfortunately, retail demand is also often a difficult part of the value chain to obtain information about since data is scarce. In particular there are no public bodies collecting systematic information with exception of the surveys that are used as input in the consumer price indices. However, while this gives reliable information on prices, information on quantities is more difficult to obtain. The only source of data is then consumer surveys, where a limited group of consumers report all their purchases. While these are often representative for common goods and groups of goods, there is often problems associated with many zero observations for goods that are not purchased with a high frequency (Heien and Wessells, 1989).

We use data from an annual consumer survey conducted by Norges Samfunsvitenskapelige Datatjeneste to obtain information on retail demand for the fish species they record; cod and haddock, saithe, salmon and trout and shrimp.

In chapter 4 we look closer at the value chain for fresh salmon into France. France is the largest and most diversified salmon market in Europe, with Norway as the main supplier followed by Scotland. There is no production of salmon in France. We undertake cointegration tests between the different distribution levels, and compare some descriptive statistics across these. This procedure makes it possible to make some simple comparisons with the Norwegian distribution chain for fish.

Our main results are summarized in chapter 5.

Chapter 2

A time series study of price development on wild caught fish species in the Norwegian distribution chain

2. 1. Introduction

In this chapter we try to determine to which extent producer and consumer markets in Norway for wild caught fish are integrated or not. Of particular interest is whether the Norwegian market is integrated along the distribution chain. Long-run interdependency in producer and consumer prices suggests integrated markets in Norway, and can be tested using cointegration techniques. Cointegration between prices implies stable long run relations and integrated markets. Cointegration techniques have been extensively used to test for market integration the last ten years. However, the technique has predominantly been used to distinguish between either regional markets or to quantify substituabillity between possible competing goods. More seldom this techniques have been used to look at markups in the distribution chains. Cointegration between producer and consumer prices suggests stable margins, and therefore in general competitive markets. Hence, when using cointegration techniques to analyse margins in the distribution chain we can learn something about the competition as well. In this chapter we will also analyse the margins between the producer- and the consumer level.

We focus on the most important wild fish product in terms of Norwegian consumption, cod, saithe, and prawns. For the cod specie we have data on three different product forms; “cod head on”, “cod head off” and fishfingers. For saithe we have data on the product form “saithe head off”.

The chapter start out with a presentation of the products and our dataset. Then in section 3 the theory of market delineation is summarised and in section 4 the cointegration techniques are described in detail. In section 5 the empirical results are presented and finally in section 6 we summarise our findings.

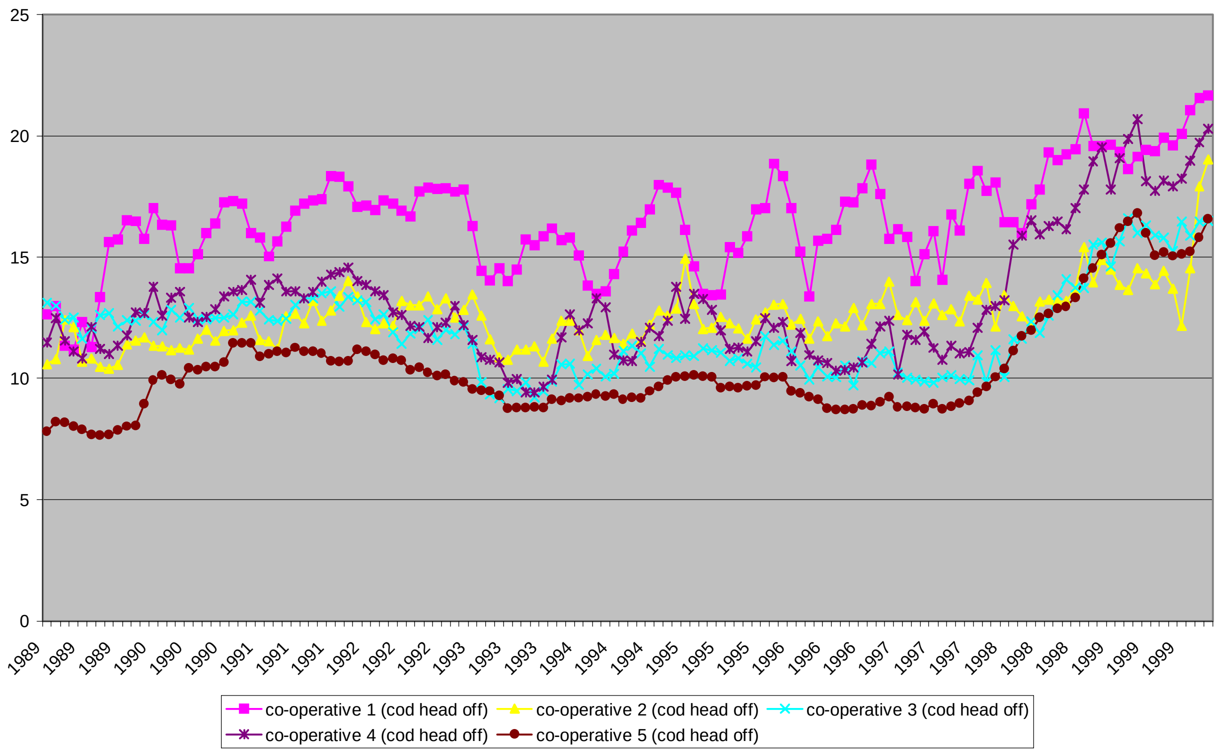
2.2 The products analysed

We analyse the Norwegian market for wild caught fish. We want to see to which extent the Norwegian market is integrated along the distribution chain. We will start out with the producer level to see whether producer prices across Norway are interdependent or not. Econometric long-run interdependency in producer prices suggests integrated producer markets in Norway. Then we analyse retailer prices to see to which extent also the consumer prices across regions differ or not. Finally, we will use the same econometric techniques to analyse also the development in the margin between the producer and consumer prices. We focus on the most important wild fish product in terms of Norwegian consumption, cod, saithe, and prawns.

We have data on monthly prices for the period January 1989 to December 1999. The producer prices are provided by the Norwegian Directorate of Fisheries (Fiskeridirektoratet) in Bergen, whereas the consumer prices are from the Norwegian Statistical Bureau (SSB). Producer prices are aggregated prices from five different co-operatives that handle all landings of wild fish in Norway. Starting in the south we have "*Skagerak*" that covers the eastern and southern part of Norway, "*Rogaland*" covers the areas up to the Bergen area where the co-operative "*West Norway*" is located. *"Sunnmøre/Romsdal"* is the next co-operative that covers the coastline up to Kristiansund, and *"Norges Råfiskelag"* covers the largest area, North Norway, starting with Nordmøre. The latter co-operative is also largest of the five in terms of volume of fish.

On the retailer level SSB has used the prices collected for the consumer price index to calculate prices for three different geographical regions for several fish products. The regions are Eastern Norway and Oslo (Region 1), the rest of southern Norway as far north as Trondheim including the west coast and Bergen (Region 2), and finally North Norway starting north of Trondheim (Region 3). In the present analysis we include five products; cod head on, cod head off, saithe head off, prawns and the processed product fish-fingers.[1]

Figure 2.2.1 Nominal price development "cod head on" from the five co-operatives the period 1989 to 1999



In Figure 2.2.1 we have shown the nominal price development for the producer prices on "cod head off" for the period 1989 to 1999. The long run trend seems to be quite similar across the

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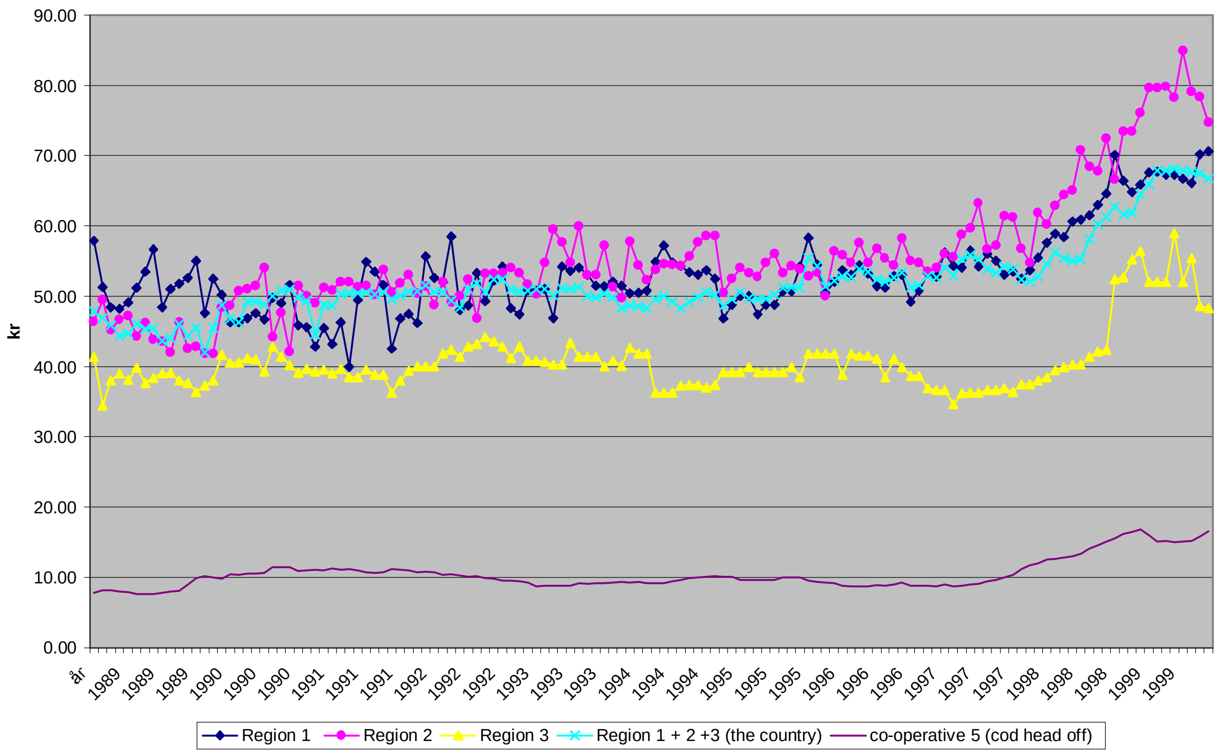
[1] In the consumer data "Cod head on" is cod including the head and the entrails, "cod head off" is cod above 1.5 kilo without head and entrails, "saithe head off" is large saithe above 1.5 kilo without head and entrails, "prawns" are prawns of quality 90-120 (per kilo), and "fish-fingers" are fish-fingers from cod 400 grams packages.

five cooperatives, but at the same time the data shows substantial short run dynamics. An interesting feature is that the prices from co-operative 5 (“Norges Råfiskelag”) has a smoother development then the other four price series. This is most likely due to the considerably larger volumes sold through this co-operative, averaging out the short run movements to a minimum.

Looking at the same product, but now at the consumer level we find a slightly different picture. This is ishown in Figure 2.2.2.

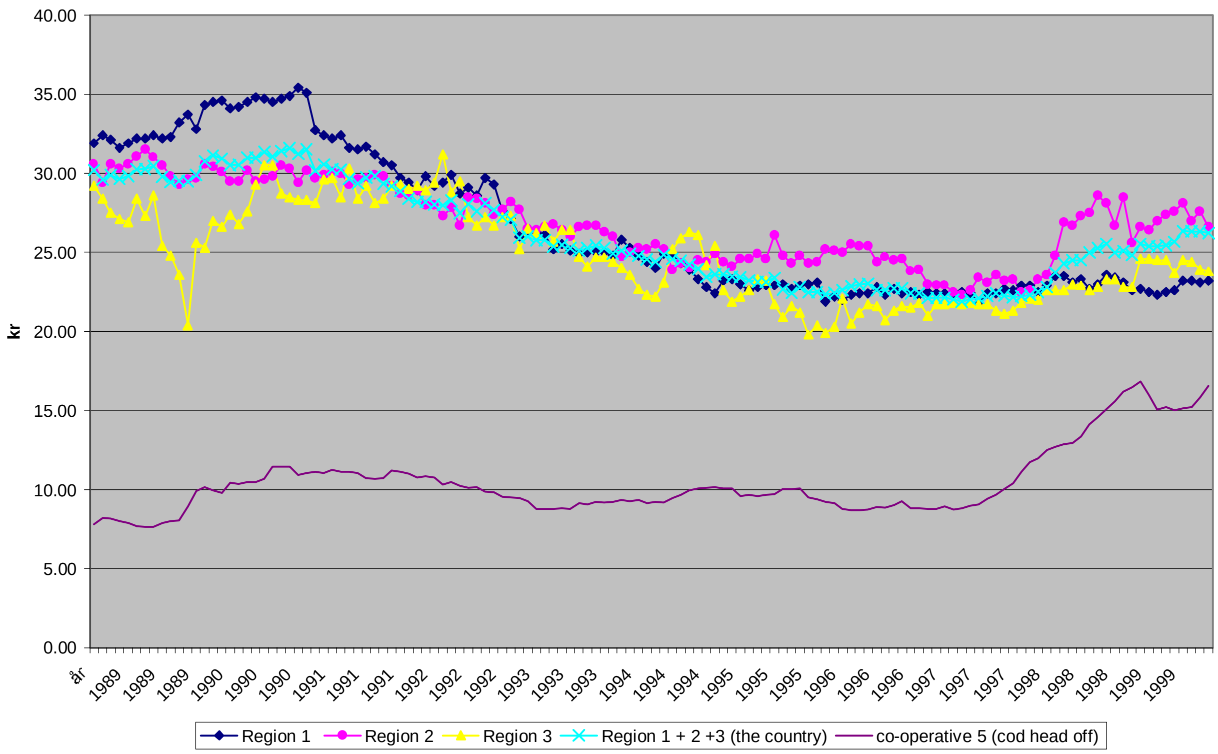
Figure 2.2.2 The nominal development in consumer- and producer prices on “cod head off” the period 1989 to 1999.



The price paths are now less equal. The two southern regions have a very similar development, but North Norway (region 3) has a lower level and a somewhat different trend in periods. The level can most easily be explained by the differences in transport costs. The average transport cost are higher in the south, due to longer distances between producers and the market. It is not as evident that the long run trend is equal across these series. Looking now at the producer price, represented by the largest co-operative (5 - Råfiskelaget), we see a margin in the range of NOK 30 to 40 over the period. The margin seems to be pretty stable, suggesting a fixed mark-up.

If we look at the more processed product, fish-fingers the impression of a fixed margin is less evident. This is shown in Figure 2.2.3.

Figure 2.2.3 The nominal development in consumer- and producer prices on "fish-fingers" the period 1989 to 1999.



Here the margin is decreasing, and the long-run trend differs across the consumer prices and the producer price. For most of the period the margin decrease due to reductions in the consumer prices, whereas the producer price is relatively stable. Hence, the decrease must be explained from changes within the downstream activities, within processing or the retailers. One possible explanation might be improved productivity in the processing industry. Another explanation is the development within the grocery chains, with a large increase in retailer concentration and reduced profit to the wholesalers.

On the other hand, the consumer prices is more equal across regions for fish-fingers. The latter mirrors a relatively integrated grocery sector within industrial homogenous products as fish-fingers.

2.3. Market delineation — Using time series methodology to test for market integration.

In this part we will try to use statistical time series methods to test for market integration in the Norwegian fish market. We will test for market integration both at the producer level and the consumer level. Finally we will use the same methodology to test the development in mark-up between these two distribution levels. A constant mark-up suggests constant economics of scale in the distribution system represented by the producer co-operatives on the lowest level of the distribution chain and the retailer prices on the highest level. This suggests a competitive distribution chain. Hence, rejection of the constant mark-up hypothesis suggests at least the possibility of market power in the distribution chain in the sense that reductions in producer prices only partly are passed through to the consumers. However, one should be careful to interpret such rejections as proof of market power all the time cost increases in the distribution chain, e.g., wage increases, might also lead to such rejections of constant mark-ups.

The literature on market delineation relies heavily on the interdependence of prices across markets and the arbitrage principle (Horowitz, 1981; Stigler & Sherwin, 1985; Slade, 1986; Higginson, *et al*, 1988; Benson & Faminow, 1990; Schrank & Roy, 1991; Weiner, 1991) . The first studies were basically investigating the correlation of prices between markets (Horowitz, 1981; Stigler & Sherwin, 1985). However, these models had several shortcomings.[2] Horowitz's adaptive lag-price model was an attempt to find a more sophisticated methodology. The next generation of models was based on Granger (1969) and Sim's (1972) work on causality, where one checks whether price determination in one region is exogenous to price formation in another (Slade, 1986; Uri & Rifkin, 1985; Higginson, *et al*., 1988; Benson & Faminow, 1990).

The models considered so far require stationary price series to capture the long-run properties of the variables appropriately. However, most time series are found to be non-stationary in their levels. Hence, stationarity is commonly achieved by first differencing the price series. Differencing is not a solution *per se* to the problem of nonstationarity and stability of the parameters of the model. Differencing eliminates all information about the long-run relationship, and restricts the model's ability to account for short-term dynamics (Hendry, 1986; Plosser & Schwert, 1978). Hence, Ardeni (1989) and Goodwin and Schroeder (1991) introduce cointegration tests to test for market boundaries. The idea of cointegration is that even if two or more variables in themselves are not stationary in the levels, linear combinations (so-called cointegration vectors) which are stationary may exist (Engle & Granger, 1987. When cointegration is verified, variables exhibit stable long-run relationship, which in this context implies that a spatial price parity equilibrium condition exists. The

[2] Common movements due to common cost and demand shocks could lead to high correlation coefficients and thus support one market erroneously. Further, correlation analysis cannot account for multi-period lagged responses to price shocks, i.e. if the response is delayed contemporaneous correlation may be small even when two series are perfectly correlated in the long run (Slade, 1986).

variables may drift apart from one another in the short-run due to random shocks, sticky prices, contracts etc., but in the long-run, economic equilibrium processes force the variables back to their long-run equilibrium paths (Engle & Granger, 1991). Hence, cointegration tests are superior when the investigated relationships are believed to be of long-run nature.

Ardeni (1989) and Goodwin & Schroeder (1991), utilise the Engle and Granger approach which is restricted to pairwise comparisons of prices. Hence, newer studies have used the multivariate model of Johansen (1988; 1991) and Johansen & Juselius (1990) that accounts for this problem by providing a matrix with all possible distinct cointegrating vectors based on all the variables (Bessler and Covey (1991); Gordon, Salvanes and Atkins, 1993; Beck, 1994; Benson *et. al.,* 1994; Sauer, 1994; Steen, 1995; Bose and McIlgrom, 1996; Schwarz and McIlgrom, 1996; Gordon and Hannesonn, 1996; Asche, Salvanes and Steen, 1997). Cointegration vectors could be thought of as representing constraints that an economic system imposes on the movements of the variables in the system in the long-run. In genral, the more cointegration vectors there are in a system, the more stable the system (Dickey *et al*, 1991). Johansen and Juselius provide test statistics allowing us to determine the number of significant cointegration vectors.

Variables could cointegrate even though one or more of them do not significantly contribute to the long-run relationship, i.e., the other variables in the system are the 'main contributors' to the significant cointegrating relation. For instance, price series which in general have independent processes could be weakly cointegrated if they are exposed to substantial common cost, or demand shocks, rather than the economic activities relevant to market delineation such as substitution and arbitrage. One way to deal with this problem is shown in Steen, 1995; Gordon and Hannesson, (1996); Asche, Salvanes and Steen, (1997). They suggest that one should impose null restrictions on the long-run parameters, socalled exclusion tests, using Johansen and Juselius proceduer to ensure robustness of the cointegration relations (Hamilton, 1994, pp. 648-50). Lately, Asche and Bremnes, (1997), has suggested another way of solving this. They argue that an alternative way to ensure that all products belong to the same market, is to require the existence of only one common stochastic trend; that is that all price series also cointegrate pairwise. Here we use the latter methodology. This is partly because when comparing the two approaches, one common trend vs. exclusion tests, we find that the common trend approach give more consistent results when used on the same dataset (Asche and Steen, 1998). This is particular clear in smaller samples since including one more price series in the johansen test increase the number of variables in the VAR model with proportionally more parameters than in a standard regression model.

We will employ the Johansen cointegration methodology for delineating markets. If arbitrage takes place, prices will move together in the long-run. Hence, when testing for cointegration one will expect these series to cointegrate. To conclude one integrated market e will require one common stochastic trend. This will be tested for using pairwise Johansen tests.

Hence when testing for integration at the different distribution levels we will undertake pairwise cointegration tests across different regions and also across different products. The constant mark-up hypothesis will be tested using pair-wise tests of co-operative prices and retail prices for each fish product.

2.4 Methodology: Integration and Cointegration

Consider two series of economic variables, x_t and y_t. Each series by itself is nonstationary and requires to be differenced once to produce a stationary series. However, a linear combination of the two series;

(1) $$y_t - \psi x_t = \varepsilon_t$$

may produce a residual series ε_t which is stationary. In this case, the series x_t and y_t are said to be cointegrated. Or more precisely, the series are said to be *cointegrated of order (1,1)* with the vector $[1, -\psi]$ called the *cointegration vector.* A straightforward generalisation for the case of *n* variables is the following. If $\boldsymbol{x_t}$ denotes an $n \times 1$ vector of series $x_{1t}, x_{2t}, \ldots, x_{nt}$ and each of them is *I(d)* and there exists an $n \times 1$ vector β such that $\mathbf{x_t}' \cdot \beta \sim I(d-b)$ (where $d \geq b \geq 0$), then $\mathbf{x_t}' \cdot \beta$ is cointegrated of order *d,b* (Engle & Granger, 1987) .

The relationship between Stigler's (1969) market definition and cointegration is evident. In Stigler's definition, a stable long-run relationship between prices implies that goods are in the same market. For nonstationary data series, cointegration is the only circumstance when these form a stable long-run relationship.

2.4.1 Testing for integration order

Before testing for cointegration one has to verify the variables' integration order. The most common test for integration is the test for a unit root developed by Dickey and Fuller (1979; 1981). The development in a series x_t is assumed to be described by an autoregressive process AR(1);

(2) $$x_t = \rho \cdot x_{t-1} + \varepsilon_t ,$$

where $\varepsilon_t \sim iid(0,\sigma)$. When $\rho = 1$, this process is nonstationary, i.e. it has a unit root. However, if $|\rho| < 1$, the series is stationary in the levels. Thus, the null hypothesis of a unit root tested for in the Dickey Fuller test is $\rho = 1$. To capture autocorrelated omitted variables (which would otherwise by default appear in the necessarily autocorrelated error term) it has been common practice to include lagged first differenced dependent variables on the RHS of (2);

(3) $$x_t = \rho \cdot x_{t-1} + \sum_{j=1}^{k} \gamma_j \Delta x_{t-j} + \varepsilon_t .$$

This test is commonly referred to as the Augmented Dickey-Fuller (ADF) test. Critical values for the test statistics may be found in Fuller (1976). The test is amenable to the case where the alternative includes a time trend and a constant term. However, the distribution of the critical values changes with the inclusion of such nuisance parameters. To determine the lag length, *k*, one starts with a sufficiently high *k*, and tests with decreasing *k*'s until the last lag is found significant (Schwert, 1989; Campbell & Perron, 1991).

2.4.2 The Multivariate Johansen Cointegration Methodology

Johansen (1988) shows how to find the number of cointegration vectors in a given set of variables. The methodology is later expanded to also account for factors such as deterministic seasonality and time trends (Johansen and Juselius, 1990 and Johansen, 1991). Even though the methodology is quite complex, the intuition behind it is more straightforward. To find the possible stationary linear combinations, the cointegration vectors, the data is divided into two groups, the variables in levels, and their first differences. Under the assumption of $I(1)$ processes, the differenced data are stationary. Using the technique of canonical correlation from the theory of multivariate analysis, the linear combinations of the data in levels which are highly correlated with the differences are found. If the correlation is sufficiently high, it follows that these linear combinations are stationary, and so are the cointegration vectors.

More formally, the vector of N variables $\mathbf{x}_t$ is assumed to be generated by an unrestricted vector autoregression (VAR) in the levels of the variables,

$$\mathbf{x}_t = \Pi_1 \mathbf{x}_{t-1} + \ldots + \Pi_k \mathbf{x}_{t-k} + \Phi D_t + \mu + \varepsilon_t, \tag{4}$$

where each of the Π_i is an $(N \times N)$ matrix of parameters, D_t are seasonal dummies orthogonal to the constant term μ and $\varepsilon_t \sim niid(0, \Omega)$. The VAR-system of equations in (4) written in error correction form (ECM) is

$$\Delta \mathbf{x}_t = \sum_{i=1}^{k-1} \Gamma_i \Delta \mathbf{x}_{t-i} + \Pi_K \mathbf{x}_{t-k} + \Phi D_t + \mu + \varepsilon_t \tag{5}$$

with $\Gamma_i = -I + \Pi_1 + \ldots + \Pi_i$, $i = 1, \ldots, k-1$. Hence, Π_K is the long-run 'level solution' to (4). If $\mathbf{x}_t$ is a vector of $I(1)$ variables, the left-hand side and the first $(k-1)$ elements of (5) are $I(0)$, and the last element of (5) is a linear combination of $I(1)$ variables. Given the assumption on the error term, this last element must clearly also be $I(0)$; $\Pi_K x_{t-k} \sim I(0)$, hence either $\mathbf{x}_t$ contains a number of cointegration vectors, or Π_K must be a matrix of zeros. The rank of Π_K, *r,* determines how many linear combinations of $\mathbf{x}_t$ are stationary. If *r*=*N*, the variables in levels are stationary; if *r*=0 so that Π_K=0, none of the linear combinations are stationary. When 0< *r*<*N* , *r* cointegration vectors, or *r* stationary linear combinations of $\mathbf{x}_t$ exist . In this case one can factorize Π_K ; $-\Pi_K = \alpha\beta'$, where both β and α are $(N \times r)$ matrices, and β contains the cointegration vectors (the error correcting mechanism in the system) and α the adjustment parameters.

Johansen and Juselius show that after undertaking appropriate factorizing and by solving an eigenvalue problem it is possible to test for the number of significant vectors using two different tests, the 'trace' test and the 'maximal eigenvalue' test. The trace test (η_r) is a likelihood ratio test for *at most r cointegrating vectors;* $\eta_r = -T\sum_{i=r+1}^{N} \ln\left(1-\hat{\lambda}_i\right)$ where T is number of observations and the $\hat{\lambda}_i$ are the eigenvalues that solve the eigenvalue problem. The maximal eigenvalue test (ξ_r), is a test of *the relevance of column r*+1 *in* β; $\xi_r = -T\ln\left(1-\hat{\lambda}_{r+1}\right)$.

As argued above we will use the "one common trend" approach first suggested in Asche and Bremnes (1997). They argue that it is not enough to have only one cointegration vector with more then two goods. The reason is that the law of one price (see Ardeni (1989) requires all the prices to have the same common stochastic trend. The only time this is true is when you in a system of *n* goods have *n*-1 cointegration vectors. This also implicates that all the *n* goods in the system should be pairwise cointegrated – and will therefore be tested for pairwise here.

2.5 Empirical analysis

Integration tests

First we have to verify the stochastic properties of the price series. This is done undertaking augmented Dickey Fuller tests (ADF) of the price series. In Table 2.5.1 the results for the producer prices are presented.

Table 2.5.1. Results from the augmented Dickey Fuller tests of the producer prices

Type of fish	Co-operatives		DF-test (trend included)	Number of lags
Cod head on	Skagerak	(1)	-1,0168	12
Cod head on	Rogaland	(2)	-1,2131	8
Cod head on	West-Norway	(3)	-1,2896	8
Cod head on	Sunnmøre/Romsdal	(4)	-0,77616	13
Cod head on	Råfisklaget	(5)	-1,1565	1
Cod head off	Skagerak	(1)	-1,2323	13
Cod head off	Rogaland	(2)	-0,93545	13
Cod head off	West-Norway	(3)	-0,61016	1
Cod head off	Sunnmøre/Romsdal	(4)	-1,7528	12
Cod head off	Råfisklaget	(5)	-2,2611	10
Saithe head on	Skagerak	(1)	-1,803	11
Saithe head on	Rogaland	(2)	-1,8779	12
Saithe head on	West-Norway	(3)	-1,445	8
Saithe head on	Sunnmøre/Romsdal	(4)	-2,1702	12
Saithe head on	Råfisklaget	(5)	-2,3335	12
Saithe head off	Skagerak	(1)	-2,6677	12
Saithe head off	Rogaland	(2)	-2,4386	8
Saithe head off	West-Norway	(3)	-0,87534	6
Saithe head off	Sunnmøre/Romsdal	(4)	-2,5745	13
Saithe head off	Råfisklaget	(5)	-2,159	9
Prawns	Skagerak	(1)	-1,5487	13
Prawns	Rogaland	(2)	-2,1344	12
Prawns	West-Norway	(3)	-2,4959	5
Prawns	Sunnmøre/Romsdal	(4)	-1,9356	11
Prawns	Råfisklaget	(5)	-2,3873	12

Test with trend */ significance level 5%, critical value 5%=-3,448, **/significance level 1%, critical value 1%=-4,038

Since the price series typically expose an upward nominal trend we have included a trend in the ADF tests. The lag length is determined by starting out with a reasonably long lag length, and then reducing the number of lags until the last lag is significant.

All 25 producer price series are found to be non-stationary at a 5% significance level. Now we turn to the retail level prices. The unit root test results are presented in Table 2.5.2.

Table 2.5.2. Results from the augmented Dickey Fuller tests of the retail prices.

Type of fish	Region (number)		DF-test (trend included)	Number of lags
Cod head on	Oslo	(1)	-3,6104*	1
Cod head on	South-West coast	(2)	-2,4962	3
Cod head on	North	(3)	-1,2459	2
Cod head on	Country		1,4624	10
Cod head off	Oslo	(1)	-1,5536	7
Cod head off	South-West coast	(2)	-1,1252	10
Cod head off	North	(3)	-3,0691	7
Cod head off	Country		-1,2996	2
Saithe head off	Oslo	(1)	-3,308	8
Saithe head off	South-West coast	(2)	-2,0222	10
Saithe head off	North	(3)	-2,0371	13
Saithe head off	Country		-0,25549	12
Cod, fishfingers	Oslo	(1)	-0,3881	12
Cod, fishfingers	South-West coast	(2)	-1,274	7
Cod, fishfingers	North	(3)	-2,0832	1
Cod, fishfingers	Country		-0,0827	5
Prawns	Oslo	(1)	-1,5982	8
Prawns	South-West coast	(2)	-1,6511	12
Prawns	North	(3)	-1,3568	2
Prawns	Country		-1,3901	10

Test with trend */ significance level 5%, critical value 5%=-3,448, **/significance level 1%, critical value 1%=-4,038

Also here we find the overall majority of the price series to be nonstationary. However, for “cod head on” in Oslo we find the price series to be stationarity.

Regional cointegration tests across product groups

Now we can turn to the cointegration tests. First we undertake bivariate Johansen tests of the producer prices. The results are presented in Table 2.5.3. Altogether 50 pairwise cointegration tests are undertaken. In 46 out of 50 cases cointegration is verified at a 5% significance level by both, or either the trace test or the maximum eigenvalue test. Of the remaining 4 cases 3 conclude cointegration on a 10% level. Hence, the producer prices are interdependent, and the market for cod, saithe and prawns are clearly integrated across Norway on the producer level. This implies that we cannot observe local markets within the different co-operatives. This is true regardless which product we look at. Hence, there is a national Norwegian market for all the species investigated.

Now we turn to the retail level. Here we undertake pairwise cointegration tests of the regional prices for cod, saithe, fishfingers and prawns. The results are presented in Table 2.5.4.

The results differ according to the different products. We perform 13 pairwise tests, whereof only 5 suggest cointegration at a 5% significance level, and 7 at a 10% level. Thus, the consumer prices are considerably less integrated, suggesting several local markets. However, and as will be shown below, since we are comparing only three regions the cointegration pattern sometimes reveal integrated markets even though some of the price interdependencies are more indirect for some of our products.

We have only two regions with saithe prices, the South-West coast (Region 2) and Oslo (Region 1). Here we find clear evidence of an integrated market. However, looking at cod the picture is less clear. Cod head off and fishfingers share the same pattern. The tests suggest cointegration between Oslo (R1) and the two other regions (R2 and R3) for both products.

Table 2.5.3 Bivariate cointegration results producer prices**.**

Cod head on

	Skagerak (1)	Rogaland (2)	West-Norway (3)	Sunnmøre/ Romsdal (4)	Råfisklaget (5)
Skagerak (1)	-	-	-	-	-
Rogaland (2)	18,03**/19,41**	-	-	-	-
West-Norway (3)	28,43**/30,62**	28,93**/29,83**	-	-	-
Sunnmøre/Romsdal (4)	24,56**/26,32**	12,78*/13,04	30,8**/32,4**	-	-
Råfisklaget (5)	16,25**/16,38**	7,622/7,764	23,09**/23,63**	31,12**/31,4**	-

Cod head off

	Skagerak (1)	Rogaland (2)	West-Norway (3)	Sunnmøre/ Romsdal (4)	Råfisklaget (5)
Skagerak (1)	-	-	-	-	-
Rogaland (2)	27,95**/32,63**	-	-	-	-
West-Norway (3)	19,66**/19,87**	13*/13,35*	-	-	-
Sunnmøre/Romsdal (4)	27,84**/28,01**	16,37**/16,5**	18,09**/18,28**	-	-
Råfisklaget (5)	23,2**/23,75**	14,84**/15,45**	17,64**/17,97**	25,48**/25,89**	-

Saithe head on

	Skagerak (1)	Rogaland (2)	West-Norway (3)	Sunnmøre/ Romsdal (4)	Råfisklaget (5)
Skagerak (1)	-	-	-	-	-
Rogaland (2)	17,74**/24,56**	-	-	-	-
West-Norway (3)	17,17**/22,67**	19,49**/24,48**	-	-	-
Sunnmøre/Romsdal (4)	19,59**/30,25**	22,73**/30,31**	31,33**/37,11**	-	-
Råfisklaget (5)	22,67**/24,79**	24,6**/26,86**	28,72**/30,58**	35,4**/65,71**	-

Saithe head off

	Skagerak (1)	Rogaland (2)	West-Norway (3)	Sunnmøre/ Romsdal (4)	Råfisklaget (5)
Skagerak (1)	-	-	-	-	-
Rogaland (2)	17,94**/29,82**	-	-	-	-
West-Norway (3)	13,48*/16,08**	29,39**/32,04**	-	-	-
Sunnmøre/Romsdal (4)	12,77*/19,21**	25,23**/31,16**	18,4**/20,8**	-	-
Råfisklaget (5)	12,71*/13,86*	31,55**/32,89**	16,63**/17,61**	17,85**/19,09**	-

Prawns

	Skagerak (1)	Rogaland (2)	West-Norway (3)	Sunnmøre/ Romsdal (4)	Råfisklaget (5)
Skagerak (1)	-	-	-	-	-
Rogaland (2)	20,52**/21,16**	-	-	-	-
West-Norway (3)	22,54**/23,97**	21,68**/22,34**	-	-	-
Sunnmøre/Romsdal (4)	33,31**/45,28**	27,06**/27,74**	29,21**/30,69**	-	-
Råfisklaget (5)	20,68**/28,99**	18,11**/18,66**	22,13**/23,95**	34,37**/43,1**	-

* significance level 10%, ** significance level 5%.

However, we cannot find cointegration between R2 and R3. This is interesting since in general by transitivity we would anticipate cointegration in all three cases when two of the three possibilities show cointegration. This is illustrated in Figure 2.5.1. The solid lines between R1 and R2 and R1 and R3 represent the cointegration relations. The stippled line between R2 and R3 shows the lack of cointegration for this price relation. Since R1 and R2 are

Table 2.5.4. Bivariate cointegration results on retail prices across regions**.**

Cod head on

	Oslo (region 1)	South-West coast (region 2)	North (region 3)
Oslo (region 1)	-	-	-
South-West coast (region 2)	21,44**/21,73**	-	-
North (region 3)	6,441/8,317	6,452/7,847	-

Cod head off

	Oslo (region 1)	South-West coast (region 2)	North (region 3)
Oslo (region 1)	-	-	-
South-West coast (region 2)	24,39**/24,45**	-	-
North (region 3)	15,09**/16,02**	8,5/8,876	-

Saithe head off

	Oslo (region 1)
South-West coast (region 2)	18,27**/22,27**

Prices from North (region 3) are missing

Fishfingers (cod)

	Oslo (region 1)	South-West coast (region 2)	North (region 3)
Oslo (region 1)	-	-	-
South-West coast (region 2)	15,07**/15,07*	-	-
North (region 3)	12,59*/12,83	6,925/7,695	-

Prawns

	Oslo (region 1)	South-West coast (region 2)	North (region 3)
Oslo (region 1)	-	-	-
South-West coast (region 2)	5,318/6,863	-	-
North (region 3)	5,27/6,664	13,83*/14,04*	-

* significance level 10%, ** significance level 5%.

Figure 2.5.1 Illustration of the cointegration pattern for cod head off and fishfingers

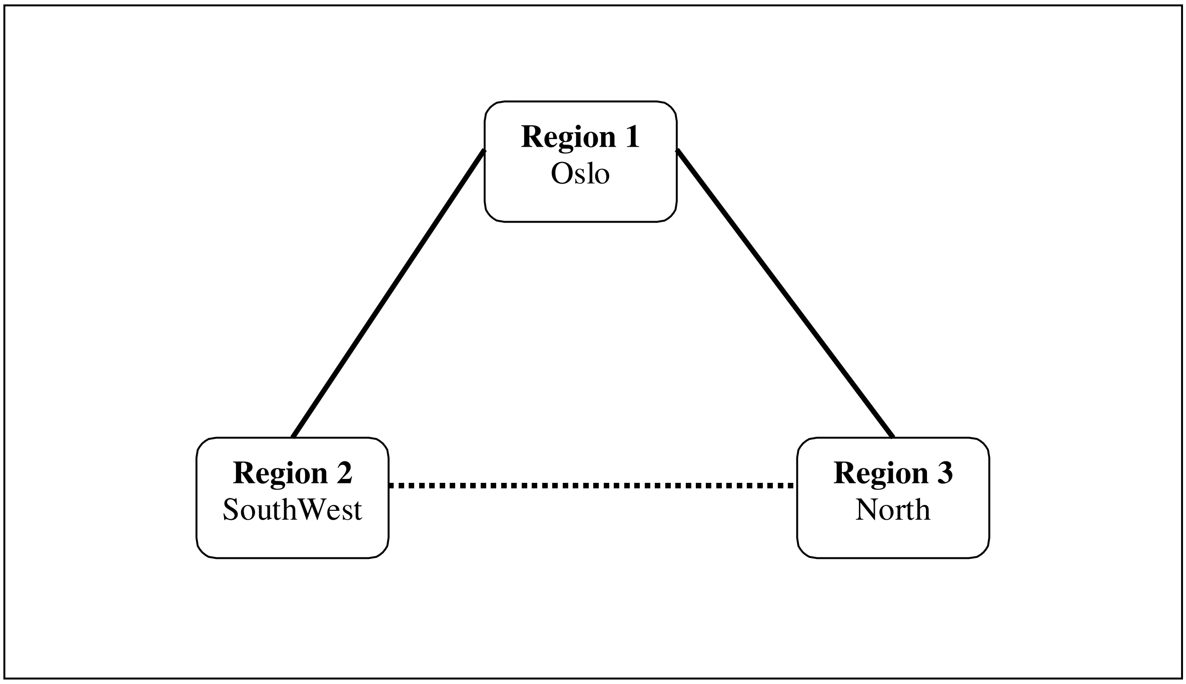
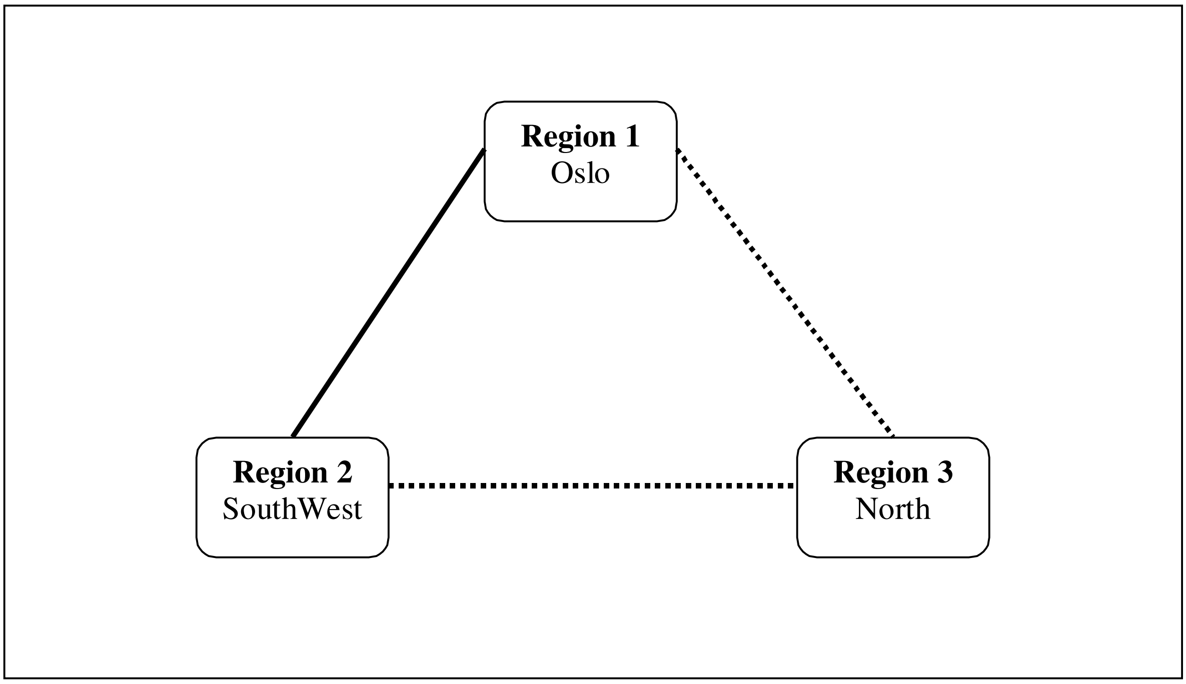


Figure 2.5.2 Illustration of the cointegration relation for cod head on



cointegrated, the R1 and R2 price series has a common stochastic trend. In the same fashion R1 and R3 should have the same stochastic trend. Hence, by transitivity also R2 and R3 should have the same stochastic trend.

This implies that the retail markets for cod head off and fishfingers should be considered as integrated. Looking at the third cod product; cod head on, the cointegration relations are shown in Figure 2.5.2. Here only one cointegration relation was found, the one between Oslo (R1) and the South-West coast (R2). Here the price series in the Northern market (R3) has not a common stochastic trend with R1 and R2. Hence, Northern Norway seems to constitute a separate local consumer market for "cod head on". One possible explanation is that this product is predominantly sold as a very fresh product, more so than cod head off and clearly also fishfingers.

Turning now to the last product, prawns, we also find local markets. Here the tests suggest that the Oslo region is a local market, whereas the rest of the country is an integrated market.

Summing up, we find some evidence of regional local markets on the consumer level across Norway, but on the producer level the market is clearly integrated across the country.

Cointegration tests across the distribution chain, producer vs. consumer prices

The last part of the analysis is to look at the long run properties of the margin between the producer and the consumer prices. This is done by undertaking cointegration tests between the producer and consumer prices. Since we found strong evidence of an integrated market on the producer level, it is sufficient to use one representative producer price. We use the producer price from the largest co-operative – Råfiskelaget, and compare this price to the prices in the

Table 2.5.5 Bivariate cointegration results between the producer prices (Råfiskelaget) and the consumer prices (R1-R3 and the country)

Cod head on

	Oslo (region 1)	South-West coast (region 2)	North (region 3)	Country
Råfisklaget (5)	2,752/4,104	6,646/6,967	10,83/14,83*	4,982/5,445

Cod head off

	Oslo (region 1)	South-West coast (region 2)	North (region 3)	Country
Råfisklaget (5)	14,03*/14,41*	9,113/9,527	17,01**/17,53**	13,65*/13,85*

Saithe head off

	Oslo (region 1)	South-West coast (region 2)	North (region 3)	Country
Råfisklaget (5)	26,4**/28,7**	9,057/10,46	†	15,15**/15,82**

Fishfingers @

	Oslo (region 1)	South-West coast (region 2)	North (region 3)	Country
Råfisklaget (5)	1,323/1,324	3,812/3,891	6,044/6,353	4,71/4,875

Prawns

	Oslo (region 1)	South-West coast (region 2)	North (region 3)	Country
Råfisklaget (5)	13,04*/13,89*	16,44**/16,51**	12,3*/17,04**	15,31**/15,31*

* significance level 10%, ** significance level 5%.
† Prices from North (region 3) are missing.
@ The producer price used here is cod head off

three different consumer regions (R1-R3) and to an aggregated consumer price for the whole country. The cointegration results are presented in Table 5.5.

Here we find cointegration at a 5% level only in 6 out of 19 cases, or 8 out of 19 on a 10% level. Also here the results differs according to products and regions. We have three important observations from these results:

1. For Prawns we find cointegration in all four possible cases, suggesting a stable mark up on prawns across the country.

2. The only case where cointegration is verified in the South-West region (R2) is for prawns, indicating a changing markup relationship between producer and consumer prices for cod and saithe in this region.
3. Within the product groups "cod head on" and fishfingers we can find basically no cointegration between any consumer prices and the producer price.

The third result is interesting. Looking at "cod head on", we found indication of local markets also when we analysed the consumer prices. Now we cannot establish stable long run markups for this product either. Hence, suggesting both local consumer markets and possibilities of market power in the distribution chain. To understand the fishfingers result better we have done an extended cointegration test for these products. Here we have included industrial wage as a predetermined variable to see whether the changing mark up could be due to cost changes. The results are presented in table 2.5.6.

Table 2.5.6. Bivariate cointegration results between the fishfingers' producer prices (Råfiskelaget) and the consumer prices (R1-R3 and the country), Wage included**.**

Fishfingers (cod)	Oslo (region 1)	South-West coast (region 2)	North (region 3)	Country
Råfisklaget (5)	2,002/2,664	1,412/1,514	7,372/7,377	1,755/1,926

* significance level 10%, ** significance level 5%.

Still no pair-wise cointegration is found. Thus, possible changes in wage cannot explain the changes in the markup between producer and consumer prices. Provided that the capital cost has been pretty stable during this period, the lack of stable markup for this product is noteworthy.

Looking at cod head off and saithe we find stable markups both in the Oslo region and in the North region.

2.6. Summarising the market integration results

We have analysed some of the most important Norwegian market segments for wild caught fish. We have tried to uncover to which extent the Norwegian market is integrated across regions and along the distribution chain. We started out with the producer level to see whether producer prices across Norway were interdependent or not. Then we analysed retailer prices to see to which extent also the consumer prices across regions differed or not. Finally, we used the same econometric techniques to analyse also the development in the margin between the producer and consumer prices. We focued on the most important wild fish product in terms of Norwegian consumption, cod, saithe, and prawns. We found five main results.

1. The producer level is clearly an integrated market. This holds for all the species analysed and across all five co-operatives.
2. The consumer prices is less integrated. We found local markets for “cod head on” and prawns, the other three groups, “cod head off”, fishfingers and saithe was integrated across the three Norwegian regions.
3. We find a stable long run mark up between producer prices and consumer prices for prawns across the country.
4. The South-West region (Region 2) is found to exhibit a changing markup relationship between producer and consumer prices for all three cod products and saithe.

5. Within the product groups “cod head on” and fishfingers we can find basically no cointegration between any consumer prices and the producer price, suggesting a changing mark up over time.

Hence, to the extent that there is room for independent pricing across Norway this is possible for cod head on and fishfingers. Note however, that this is a necessary condition for explotation of possible market power, but not a sufficient condition. For all the other products analysed – saithe, cod head off and prawns, both producer markets and consumer markets are integrated and the long run markup is stable over time suggesting a more competitive distribution chain.

Chapter 3

A demand study of the Norwegian fish market

3.1. Introduction

In this chapter we analyse the consumer demand for several fish products in Norway. We analyse six species; cod, haddock, saithe, salmon, trout and shrimps. Both own price elasticities and demographic effects are considered.

Demand equations can give information on a number of interesting issues in the value chain. In particular, it is a common observation that prices are more volatile upstream then down stream. This is because it is highly unlikely that elasticities of price transmission, which measure the impact of a price change at a higher level in the value chain on a price at a lower level in the value chain, is larger then one (Gardner, 1975; Kinnucan and Forker, 1987; Wohlgenant 1990; Asche *et al*, 2002). Consumer demand will then put an upper bound on the price sensitivity of demand at any level in the chain. This will also put limits on the extent to which intermediary firms in the value chain can exploit market power at the different levels in the value chain. In this respect, the degree of substitution is also of interest as it gives information about to what extent the consumers can avoid price increases by changing consumer patterns.

Retail demand is often the most important point in any value chain, since every link in the chain is dependent on the consumers' demand. The intermediaries' demand for inputs is then derived from the consumer demand. Unfortunately, retail demand is also often a difficult part of the value chain to obtain information about since data is scarce. In particular there is no public bodies collecting systematic information with exception of the surveys that are used as input in the consumer price indices. However, while this gives reliable information on prices, information on quantities are more difficult to obtain. The only source of data is then consumer surveys, where a limited group of consumers report all their purchases. While these are often representative for common goods and groups of goods, there is often problems associated with many zero observations for goods that are not purchased with a high frequency (Heien and Wessells, 1989).

In this chapter we will use data from an annual consumer survey conducted by Norges Samfunsvitenskapelige Datatjeneste to obtain information on retail demand for the fish species they record; cod and haddock, saithe, salmon and trout and shrimp. Unfortunately, our data contains a number of the problems one often encounters when using survey data, and in particular for salmon and trout and shrimp there are few observations. One can therefore question the reliability of our results. However, we still think they provide some valuable insights.

3.2. A brief review of the consumer theory

We will now briefly review the conditions on consumer demand implied by the consumer theory, i.e., the conditions that make demand functions theoretically consistent. The review is mostly based on Deaton and Muellbauer (1980a) and Cornes (1992). This is important since this also gives the different measures that we use to describe consumer demand.

There are four different representations of the consumer's preferences that are dual in the sense that they provide identical information about the consumer's preferences. These four representations are the utility function, the indirect utility function, the cost (or expenditure) function and the distance function. This gives rise to four different forms of demand functions; direct and inverse, compensated and uncompensated. There is a close relationship between the different approaches. In fact, if we know one representation, we will be able to derive all the others (Diewert, 1971; 1982; Deaton and Muellbauer, 1980b, ch. 2). This is the core of duality theory, as shown by Diewert (1971). Since it is mostly ordinary demand functions that are used in applied work, we will not consider inverse functions here.

Let $q=(q_1,...,q_n)>0$ be a bundle of goods with a corresponding vector of prices $p=(p_1,...,p_n)>0$. With a given budget, X, a consumer has a system of n ordinary uncompensated demand functions. The demanded function for each good is then;

(1) $q_i=g_i(p,X)$, for $i=1,...n$.

These demand functions are homogenous of degree zero in prices and expenditure. This homogeneity property implies that the consumer only considers real prices, as a doubling of all prices and the budget leaves the demanded quantities unaltered. In addition, the budget constraint must hold for the system of demand functions. That the budget constraint is met is known as the adding up condition.

The uncompensated demand functions do not allow us to separate the effects of changes in price and expenditure, thereby not allowing us to say anything about the direction of pure price responses. This is possible using compensated demand functions. These demand functions give us demanded quantity of a good given that the consumer is compensated so that his/hers utility level u is constant. The compensated demanded function for each good is;

(2) $q_i=h_i(p,u)$, for $i=1,...n$.

The pure effects of price changes may be summarised by the first derivatives of the system of demand equations, which is the second derivative of the underlying cost function, i.e., the Hessian matrix, S;

$$(3) \qquad S = \frac{\partial C^2(u,p)}{\partial p_i \partial p_j} = \begin{bmatrix} \frac{\partial h_1}{\partial p_1} & \cdots & \frac{\partial h_1}{\partial p_n} \\ \vdots & & \vdots \\ \frac{\partial h_n}{\partial p_1} & \cdots & \frac{\partial h_n}{\partial p_n} \end{bmatrix} = \begin{bmatrix} s_{11} & \cdots & s_{1n} \\ \vdots & & \vdots \\ s_{n1} & \cdots & s_{nn} \end{bmatrix}.$$

This matrix is also known as the substitution matrix or the Slutsky matrix. The concavity of the cost function implies that the Slutsky matrix is negative semidefinite and symmetric. The semidefiniteness follows from the homogeneity restriction and symmetry follows from Young's theorem. This is quite important, as it allows us to describe the compensated demand functions more accurately than the uncompensated demand functions. The negative semidefiniteness of the substitution matrix implies that the own-price effects are negative, i.e., the compensated demand curves are downward sloping, and Young's theorem implies that cross-price effects are symmetric. In addition, the adding up condition (the budget constraint) must hold, and homogeneity of degree one for the cost function implies that the compensated demand functions are homogenous of degree zero in prices.

The substitution matrix also plays an important part when relating changes in compensated demand to changes in uncompensated demand. When the consumer is at an optimum, compensated and uncompensated demand must be equal, $h(p,u)$=g(p,X). Differentiating this expression with respect to p holding u constant gives the Slutsky equation. Letting s_{ij} denote the ijth term in the substitution matrix and g_i the uncompensated demand function for the ith good, the Slutsky equation may be written as:

$$(4) \qquad s_{ij} = \frac{\partial g_i}{\partial p_j} + q_j \frac{\partial g_i}{\partial X}$$

The compensated effect of a change in the price of good j on the demand for good i can here be seen to be equal to the uncompensated effect plus the "compensation" given as the expenditure derivative, $\partial g_i / \partial X$, times the consumption of good j. Commodity j is said to be a net or Hicksian substitute (complement) for commodity i if s_{ij}>0 (<0) and a gross or Marshallian substitute (complement) if $\partial g_i / \partial p_j$>0 (<0). If the income effect $\partial g_i / \partial X$ is positive, good i is said to be normal, and if the income effect is negative, good i is said to be inferior. Note that the Marshallian own-price effect does not have to be negative. If the income effect is large enough and negative, the absolute value of the compensation may be larger than the absolute value of the Hicks substitution effect and give a positive Marshallian own-price effect. Such goods are known as Giffen goods, and are unlikely to occur in applied work.[3]

Throughout this section the effect of a change in one variable on another has been expressed as derivatives. However, a problem with using derivatives is that although they give the direction of change, the magnitude of the change is dependent on the unit of measurement. This makes them incomparable. It has therefore become common practice for economist to divide the derivative by the ratio of the levels of the two variables to obtain elasticities for ordinary demand functions and flexibilities for inverse demand functions. An elasticity has the same sign as the derivative, but is independent of unit of measurement as it gives the percentage change in one variable due to one percent change in the other variable. In the demand analysis, two types of elasticities are commonly used. These are

Uncompensated (price) elasticities: $\eta_{ij} = \dfrac{\partial g_i}{\partial p_j}\dfrac{p_j}{g_i}$

This elasticity gives the percentage change in the demanded quantity for good i due to a one percentage change in the price of good j. If i=j, the elasticity is often known as the demand

[3] However, examples where a good is reported to be a Giffen good do exist. See Johnston and Larson (1994) for a discussion of when Giffen goods may exist, and references to empirical studies where Giffen goods are reported. It should be noted that in most cases when Giffen goods are reported, even the authors note that econometric misspecification is a likely problem.

elasticity or the own-price elasticity for good *i*. If $i \neq j$, the elasticity is known as a cross-price elasticity.

Expenditure or income elasticity: $\eta_i = \frac{\partial g_i}{\partial X} \frac{X}{g_i}$

This elasticity measures the change in the demanded quantity for good *i* of a one percent change in expenditure/income. If the expenditure elasticity is positive we say that the good is a normal good, as consumption increases with increased expenditure, while if it is negative we say that the good is an inferior good. If the expenditure elasticity is larger then one, one often say that the good in question is a luxury good, as the budget share of the good increase with increased expenditure.

3. 3. Empirical specification

The theory only gives very general relationships between the variables of interest. To be able to use the theory to estimate the relationships of interest, one must specify functional forms. This is an important step in the analysis, since the choice of functional form impose additional restrictions the possible outcomes. We will here review the double log single equation specification that will be used in this analsysis.

Single equation specifications of demand equations has a history as long as applied work in economics. As the earliest empirical demand studies were mostly concerned with estimating elasticities, a specification linear in the natural logarithms of the variables, also known as the double log, was the most common specification. This specification is still the most commonly used single equation demand specification.

Letting q_{it} be the quantity consumed of good i at time t, p_{jt} the price of good j at time t and X_t the expenditure at time t, the equation to be estimated with the double log specification is

(5) $$\ln q_{it} = \alpha_i + \sum_j e_{ij} \ln p_{jt} + e_i \ln X_t$$

The advantage with this specification is that the estimated parameters can be interpreted as elasticities as $e_{ij} = \partial \ln q_{it} / \partial \ln p_{jt}$ (the cross price elasticity) and $e_i = \partial \ln q_{it} / \partial \ln X_t$ (the expenditure elasticity). The range of j varies, and typically includes commodities which are assumed to be closely associated with good i. A measure of expenditure X_t is typically, a (often highly aggregated) measure of the consumer's income or expenditure.

Two types of deterministic variables are also often considered in double log specifications; a trend and demographic dummies. A trend is a variable noting the time period (i.e. 1, 2, 3, 4, ...) and is included if there seems to be a increasing or decreasing trend in the (log) quantities. This can be interpreted as an exogenous shift in the consumer's taste. Demographic dummies represent characteristics that are thought to be important for demand patterns that are not reflected by the price variables. Examples of such factors are household size and age. With a trend variable, t, and a set of dummies S_m included, the double log can be written as

(6) $$\ln q_{it} = \alpha_i + b_i t + \sum_{m=2}^{M} \alpha_{im} S_m + \sum_j e_{ij} \ln p_{jt} + e_i \ln X_t$$

Whether a trend and/or seasonal dummies are included is of course an empirical question. In addition to these deterministic variables, structural shifts are also often taken account of with a dummy on the constant term. Whether this is necessary to consider is dependent on the market studied. If there have been any substantial changes in the market, e.g. changed regulations, one should consider whether there is a structural shift in the data.

3.4. Data

The data used her is from an annual consumer survey conducted by Norsk Samfunsvitenskapelig Datatjeneste (NSD). The survey contain information of food purchases as well as demographic information for slightly more then 1000 households each year. In the years 1987 to 1995 it contains information on five groups of seafood products, cod and haddock, saithe, salmon and trout and fresh fish. We also have data for 1996 and 1997, but the data categories for the seafood product change so that they are not compatible with the earlier years.

A general problem is that relatively few households consume seafood. An overview by product is given in Figure 3.4.1. We can see that only about 200 households or about 20% of the respondents consume either cod and haddock or shrimps and crustaceans. This is more then halved for saithe and salmon and trout, while very few reports that they consume other

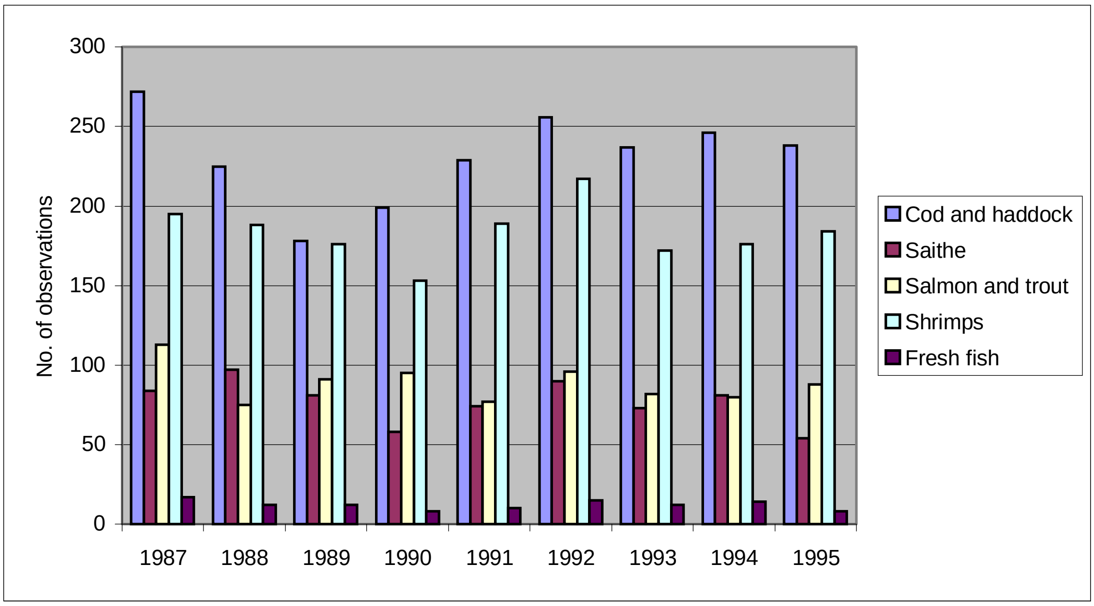


Figure 3.4.1. Number of observations for the different categories of seafood by year

fresh fish products. The situation is similar for 1996 and 1997. This does unfortunately put some limits on our work. First, it is not possible to estimate demand equations for other fresh fish. Moreover, with the limited data for 1996 and 1997, we find that we cannot estimate demand equations for these years. The data set that we are left with is then a panel for 1986 to 1995.

Virtually no household consume more than one type of seafood. This makes it impossible to investigate substitution relationships between different types of seafood. Since zero observation is present in large numbers for most goods, it also makes it difficult to estimate substitution relationships with respect to other goods. We therefore choose to estimate single demand equations for each seafood product containing only the price of the good and total food expenditure as explicit economic variables. Given that the observations is at the household level, and it is very unlikely that any single household can influence the prices, endogeneity of the price should not be an issue. It is common to use the consumer price index to represent the price of all other goods.[4] However, since the consumer price index has no variation for observations within the same year, we do not model it explicitly, but let it be represented in annual dummies together with other inter year variation.

As noted above the survey also contains demographic information for the different households. In our demand equations we will use information on family size, age of head of household, marriage status for head of household and community type. The different dummy variables are presented in Table 3.4.1, and in each category the dummy with the index 0 is used as the base period.

[4] See e.g. Varian (1992), p. 150.

Table 3.4.1. Demographic variables

Annual dummies:
- d1987= Year is 1987
- d1988= Year is 1988
- d1989= Year is 1989
- d1990= Year is 1990
- d1991= Year is 1991
- d1992= Year is 1992
- d1993= Year is 1993
- d1994= Year is 1994
- d1995= Year is 1995

Community type:
- bo0=Less the 2000 persons in the community
- bo1= Between 2000 –19999 persons in the community
- bo2= More then 20000 in the community

Number of persons in houshold:
- pers1= 1
- pers2= 2
- pers3= 3
- pers4= 4
- pers0= >4

Age groups: 0= (<,25), 1= (26, 35), 2= (36, 45), 3= (46, 55), 4= (56, 65), 5= (65,<);
Based on these age groups we get the following age dummies
- ald0= (<,25)
- ald1= (26,35)
- ald2= (36,45)
- ald3= (46,55)
- ald4= (56,65)
- ald5= (65,->)

Marriage status: 0= unmarried, 1= married

3.5 Empirical results

We then turn to the empirical results. The first good we look at is cod and haddock, which together can be labelled as high-valued whitefish. In Table 3.5.1, the results from the demand equation are reported. The explanatory power of our model is satisfactory given the cross sectional nature of our data, and the null hypothesis that the right hand side variables jointly are statistically insignificant is also clearly rejected. The annual dummies are all insignificant with exception of the dummy for 1995. This indicates that in general the combined effect changes in the surroundings, including the prices of other goods do not affect the demand for cod and haddock very much. The demographic variables also have little impact as they individually is statistically insignificant and in general the magnitudes are small. The most important variable is clearly price. The price elasticity is almost –2, and significantly different both from zero and –1. Hence, demand for cod and haddock seems to be relatively price elastic. The expenditure variable is positive but statistically insignificant. Hence, high-valued whitefish seems to be a normal good, but basically insensitive to changes in expenditure.

In Table 3.5.2, the results from the demand equation for saithe, which is also the most common species in the low-valued whitefish group in Norway, are reported. Also here the explanatory power of our model is satisfactory given the cross sectional nature of our data, and the null hypothesis that the right hand side variables jointly are statistically insignificant is also clearly rejected. The annual dummies are all insignificant as is the effect of most of the demographic variables. However, family size seems to be important, as one and two person households are less likely to demand saithe than larger families. Also here the most important variable is clearly price. The price elasticity is almost –1, but significantly different both from zero and –1. Hence, demand for saithe is price unelastic. The expenditure variable is positive but statistically insignificant. Hence, saithe seems to be a normal good, but basically insensitive to changes in expenditure.

Table 3.5.1. Parameter estimates, cod and haddock

Variable	Coefficient	St. Error
D1988	-0.140	0.137
D1989	-0.061	0.147
D1990	0.031	0.142
D1991	0.156	0.137
D1992	-0.255	0.134
D1993	-0.030	0.138
D1994	-0.187	0.144
D1995	-0.481	0.148
bo1	0.040	0.102
bo2	-0.002	0.045
pers1	-0.279	0.188
pers2	-0.001	0.065
pers3	0.007	0.042
pers4	-0.016	0.029
ald1	0.023	0.246
ald2	0.163	0.123
ald3	0.084	0.082
ald4	0.127	0.063
ald5	0.082	0.050
Married	0.022	0.096
Price	-1.925	0.066
Income	0.002	0.068
Constant	9.347	0.894
R^2	0.327	
F(22.2056)	45.45	(0.000)
No. of obs.	2079.000	

Table 3.5.2. Parameter estimates, saithe

Variable	Coef.	St. Error
d1988	0.093	0.221
d1989	-0.052	0.224
d1990	0.302	0.243
d1991	0.227	0.237
d1992	-0.014	0.206
d1993	-0.102	0.223
d1994	-0.002	0.231
d1995	-0.495	0.252
bo1	0.009	0.163
bo2	-0.088	0.071
pers1	-1.109	0.311
pers2	-0.269	0.109
pers3	-0.193	0.072
pers4	-0.078	0.049
ald1	-0.431	0.545
ald2	-0.179	0.273
ald3	-0.015	0.182
ald4	-0.057	0.139
ald5	-0.030	0.112
Married	-0.062	0.158
Price	-0.956	0.088
Income	0.149	0.104
Constant	5.337	1.416
R^2	0.326	
F(22,358)	31959	(0.000)
No. of obs.	381	

Table 3.5.3. Parameter estimates, salmon and trout

Variable	Coeficient	St. Error
d1988	0.241	0.279
d1989	-0.040	0.278
d1990	-0.127	0.242
d1991	-0.254	0.292
d1992	-0.120	0.246
d1993	-0.102	0.279
d1994	-0.120	0.283
d1995	-0.599	0.298
bo1	-0.439	0.225
bo2	-0.071	0.086
pers1	0.021	0.453
pers2	-0.076	0.145
pers3	-0.018	0.097
pers4	-0.046	0.064
ald2	-0.002	0.149
ald3	-0.039	0.099
ald4	-0.058	0.085
ald5	-0.058	0.068
Married	0.295	0.215
Price	-0.208	0.139
Income	0.052	0.154
Constant	3.830	1.975
R^2	0.121	
F(21,140)	0.92	(0.566)
No. of obs.	162	

Table 3.5.4. Parameter estimates, shrimps and crustaceans

Variable	Coeficient	St. Error
D1988	0.082	0.227
D1989	-0.127	0.253
D1990	0.174	0.236
D1991	0.251	0.223
D1992	0.032	0.216
D1993	0.424	0.225
D1994	0.681	0.261
D1995	0.387	0.255
bo1	0.389	0.180
bo2	0.163	0.076
pers1	0.108	0.342
pers2	-0.025	0.106
pers3	-0.078	0.067
pers4	0.039	0.047
ald1	-0.534	0.525
ald2	-0.297	0.260
ald3	-0.124	0.174
ald4	-0.117	0.134
ald5	-0.077	0.108
Married	-0.061	0.174
Price	-0.337	0.124
Income	0.403	0.123
Constant	-0.619	1.657
R^2	0.144	
F(22.293)	45323 (0.001)	
No. of obs.	316	

In Table 3.5.3, the results from the demand equation for salmon and trout are reported. A problem here is that there are even fewer observations, only 162. These observations seems to have little systematic variation as R^2 is as low as 0.121, and the null hypothesis that all right hand side parameter jointly are zero cannot be rejected. Since no parameters are statistically significant, this does not allow us to derive many conclusions. In passing we may note that the price elasticity is estimated at about-0.2, but not significantly different from zero, and the expenditure elasticity is positive, indicating a normal good, but with no strong expenditure effect. However, given the few observations and lack of explanatory power, one can certainly question the reliability of these results.

The last demand equation to be estimated here is the demand for shrimp and crustaceans, where shrimp has a dominating share. These results are reported in Table 3.5.4. The explanatory power of our model is not too good with an R^2 of 0.144. However, the null hypothesis that the right hand side variables jointly are statistically insignificant is clearly rejected. The annual dummies are all insignificant. This indicates that in general the combined effect changes in the surroundings, including the prices of other goods do not affect the demand for shrimps very much. In contrast to the other goods, where the household is located seems important, as both households in mid-sized and large communities are more likely to consume shrimps then households in small communities. However, household size and age and marriage status of the head of the household dose not seem to be important as all these parameters are statistically insignificant. The price elasticity is significantly different both from zero and –1 at –0.337. Hence, demand for shrimp seems to be highly price inelastic. The expenditure variable is positive and statistically significant at 0.403. Hence, shrimp seems to be a normal good, where consumption increases with total food expenditure, although the budget share decrease.

3. 6. Discussion of the demand results

Unfortunately, the first thing one must mention when discussing the results from the estimated demand equations is the question of reliability of the results. It seems like relatively few consumers eat seafood often enough for our consumer panel data set to give a good picture of seafood consumption. Moreover, as almost no respondent consume several species, it is not possible to measure substitution between species using these data. Very few demographic dummies are statistically significant indicating that there is few systematic differences in consumption of seafood due to community type, size of household, age or marriage status. Furthermore, there does not seem to be strong substitution between the species considered and other goods in the consumer bundle. As few studies have been undertaken for the demand for seafood with this kind of data, it is hard to evaluate whether these conclusions are reasonable or whether they are artefacts of our data. In the few cases when consumer panel data has been used, there have in general been many more observations of seafood consumers (Wellman, 199?; Salvanes and DeVoretz, 1997). However, several demographic variables are important in these studies. Also contingent choice studies, that certainly have a different approach, tend to indicate that demographic variables are important (e.g. Johnston et al, 2001).

With the exception of salmon, the only parameters that we in general estimate with a high degree of precision are the own price elasticities. Demand for cod seems to be highly elastic, demand for saithe inelastic but close to one in magnitude, while salmon and shrimp is inelastic. Although the elasticity for salmon is questionable, this conforms well with the general pictures we have of retail sales of seafood. During the last decade salmon has become the mainstay in most fresh fish counters and often constitutes a very large share of seafood sales (Asche and Steen, 1998). The traditional species like cod, haddock and saithe can then be regarded as transitory goods that are sold on an irregular basis. This is then possible since the freshefish counter is in operation primarily due to salmon.[5] The elasticities are also of interest with respect to the ability of agents in the value chain to exploit market power. It is well known that a monopolist will always operate at the elastic part of the demand schedule. While this is not necessarily true for oligopolists, it is still clear that with low demand elasticites there is little scope for exploiting market power. Hence, cod is the only species where one can encounter monopoly pricing, while it is virtually impossible to exploit market power for salmon and shrimp. However, as for the results in the market integration tests, this is still only a necesarry but not a sufficient condition for market power.

[5] However, this may be less true at least in parts of Norway then in other European countries as the market share of cod is higher, and the share for salmon lower then in these other countries.

Chapter 4

The French distribution chain for fresh salmon

4.1. Introduction

In this section we will look closer at the value chain for fresh salmon into France. France is the largest and most diversified salmon market in Europe, with Norway as the main supplier followed by Scotland. There is no production of salmon in France. We report cointegration tests between the different distribution levels, and compare some descriptive statistics across these. This procedure makes it possible to make some simple comparisons with the Norwegian distribution chain for fish.

4.2 Data

The analysis use data on different distribution levels; farm gate price, French import price whole fresh salmon and wholesale prices for salmon in France for whole fresh salmon (3-4kg). Other retail outlets in France include fishmongers, fish markets, direct sales etc. In 1998, the share of supermarkets in total retail sales was 74 per cent and is down from about 80% in 1988. The price series cover the period from January 1990 to December 1998. They are illustrated in figure 4.1, but where the retail price is the series for supermarkets and other aggregated into one series to make the figure more readable.[6]

The value chain for fresh salmon sold through fishmongers and supermarkets in France were analysed separately, because each of these end points receive their salmon through different channels. Supermarkets tend to buy their salmon directly through importers, whereas smaller fishmongers and restaurants tend to source their fish through wholesalers and wholesale markets such as Rungis.

[6] The empirical part is to a a large extent based on Guillotreau and LeGrel (2001).

4.3 Empirical analysis

The Results from the cointegration tests are reported in Table 4.1. Unit root tests are not presented here, but the series' statistical properties qualify for cointegration analysis.

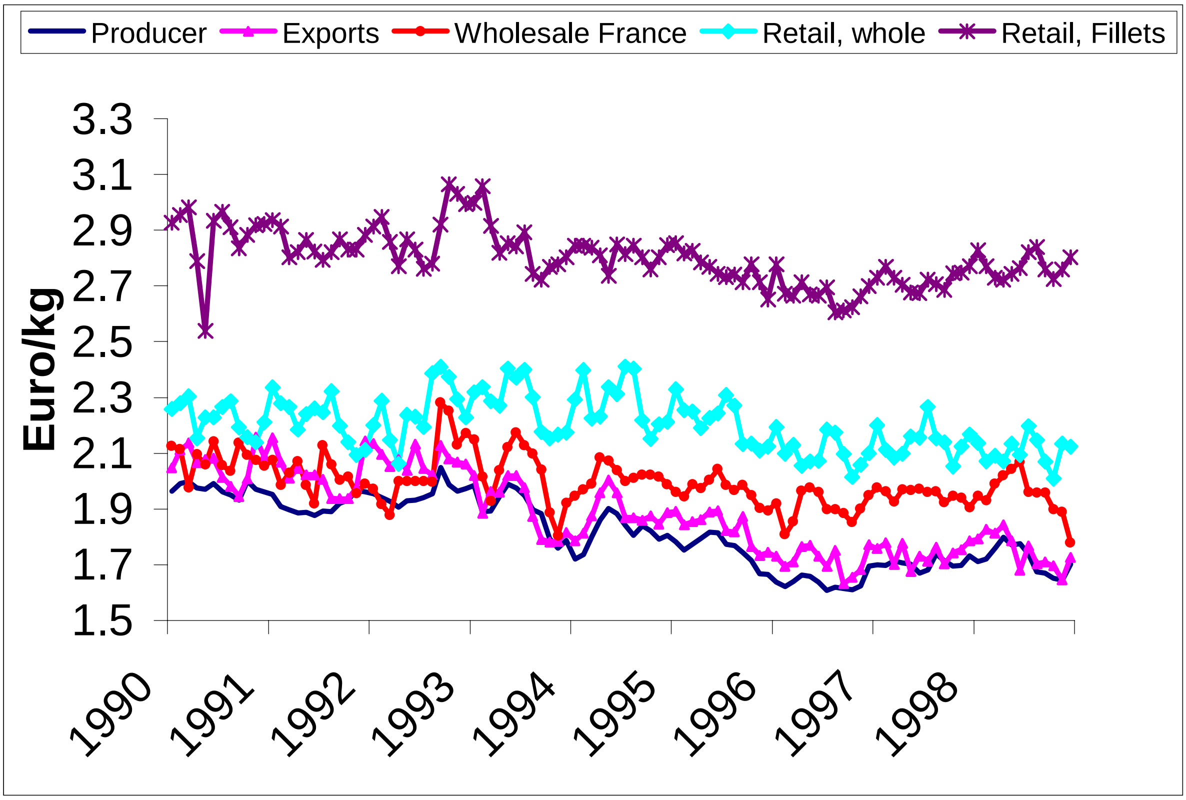


Figure 4.1 Prices in the French value chain for salmon

There is a stable relationship between the production price and the export price. This relationship is stable also through all the links in the value chain for traditional outlets. However, for the supermarket part of the chain, there is not a stable relationship for fresh fillets, although there are for whole fresh salmon. This gives an indication that supermarkets can have scope for exploiting market power. Hence, the closer we get to the consumer level the more scope we find for strategic behaviour.

Table 4.1: Johansen tests for the France value chain for fresh salmon (Guillotreau and LeGrel, 2001).

Ho: rank = p	Max test	Trace test	Autocorrelation test [a]		Proportionality test [b] transmission	Perfect price	Exogeneity test [d]	
			price 1	price 2		trend [c]	price 1	price 2
Producers and exporters [1]								
p = 0	17.94*	26.79**	2.27*	1.49	0.00		0.62	8.38**
p ≤ 1	8.85	8.85	(0.04)	(0.18)	(0.97)		(0.00)	(0.43)
Exports and wholesalers France [2]								
p = 0	26.5**	31.33**	0.66	1.29	18.26**		12.39**	13.76**
p ≤ 1	4.84	4.84	(0.70)	(0.27)	(0.00)		(0.00)	(0.00)
Exports and supermarkets whole fresh France[3]								
p = 0	18.73*	22.84*	1.45	1.79	12.02**		0.10	14.23**
p ≤ 1	4.11	4.11	(0.19)	(0.10)	(0.00)		(0.75)	(0.00)
Exports and supermarkets fillets fresh France[4]								
p = 0	13.97	17.59	0.57	1.71		-	-	-
p ≤ 1	1.62	1.62	(0.78)	(0.12)				
Exports and other retailers whole fresh France[5]								
p = 0	29.08**	37.84**	0.73	0.91		0.40	3.56	15.70**
p ≤ 1	8.75	8.75	(0.65)	(0.51)		(0.53)	(0.06)	(0.00)
Exports and other retailers fillets fresh France[6]								
p = 0	26.93**	35.33**	0.87	0.92	7.41**		6.34*	13.95**
p ≤ 1	8.40	8.40	(0.52)	(0.48)	(0.01)		(0.01)	(0.00)
Wholesalers and other retailers whole fresh France [7]								
p = 0	22.42**	30.55**	0.69	1.15	2.13		9.16**	2.76
p ≤ 1	8.14	8.14	(0.66)	(0.34)	(0.14)		(0.00)	(0.10)

** Indicates significant at 1%, * Indicates significant at 5%

Notes: **a.** The LM test for autocorrelation up to the 12[th] lag. **a. b. c. d.** *p*-values in parenthesis. **1.** System estimated for 3 lags. A seasonal component was included in the cointegration space unrestricted and a constant term was restricted to enter only in the long run. Autocorrelation was present in the vector for production in the UK at the 5 per cent level of significance. **2.** System estimated for 3 lags. A seasonal component was included in the cointegration space unrestricted and a constant term was restricted to enter only in the long run. Dummy variables were added to correct for outliers in September 1992, December 1998, July 1991, November 1990, February 1996, December 1991 and September 1996. **3.** System was estimated for 3 lags. A constant term was included in the cointegration space over the long run. **4.** System estimated for 2 lags. A seasonal component and a constant term were included in the cointegration space unrestricted and a trend was included restricted. Dummy variables were added to correct for an outlier in May 1990. **5.** System estimated for 2 lags. A constant term and seasonal components were included in the cointegration space in the short run and a trend was included over the long run. **6.** System estimated for 4 lags. A constant term was included in the cointegration space in the long run and seasonal components in the short run. Dummy variables were added to correct for outliers in the series for other retail sales of fresh fillets in May 1990, June 1990, July 1995, December 1995, August 1995, October 1992 and August 1996 and in the series for exports of fresh salmon in the UK in September 1992, November 1990, December 1991 and June 1998. **7.** System estimated for 4 lags. A constant term was included in the cointegration space in the long run. Dummy variables were added to correct for outliers in September 1992 and July 1991.

Descriptive statistics for the price series analysed in the UK-France value chain are given in Table 4.2. Interesting to note, however, one can also see from the descriptive statistics that the supermarkets price also is lower then the price at traditional sales outlets. Hence, there are also indications that supermarkets provide cheaper distribution and processing, and at least a part of these gains are transferred to the consumers through lower prices.

The most striking result from table 4.2 is the difference in variability between retail prices for fresh salmon in France and prices for salmon at levels higher up the chain in the UK, namely at production and export of the salmon. Retail prices for fresh salmon in France are less variable than prices for salmon at production- and export level in the UK. This may be one of the reasons that relationships between these price series are not found to be proportional. That is, price fluctuations at export are not being perfectly transmitted through to the retail level. It is possible that variability in prices at retail levels in France is lower because retailers are more than likely trying to keep the price of salmon to consumers relatively constant throughout the year. They do this by absorbing the costs of making losses at certain times of the year when prices they pay for salmon are higher and then offsetting this by making a gain at times when prices they pay for salmon are slightly lower.

Comparing these results to the Norwegian distribution chain provide some interesting insight. To the extent that we find scope for market power, it is close to the consumer level, and not on the producer or importer level. Furthermore, if we apply the findings on the French supermarkets on Norway, where we lack data on this level in Norway, it is tempting to generalize the cost effect. More specifically, the increased efficiency from distribution via supermarkets seems to a certain extent to be transferred to the consumers. This gain however, must be traded off against the possible increase in market power from a more concentrated consumer-level distribution.

Table 4.2 Descriptive statistics and margins for the UK-France fresh salmon chain (Prices are in Euros/kg).

Price 1	Price 2	Mean	Standard deviation	Coefficient of variation percent	Margin in Euro	Margin in percent	Proportionality
Producers UK		3.99	0.61	15			
	Exporters UK	4.35	0.78	18	0.36	9	Yes
Exporters UK		4.35	0.78	18			
	Wholesalers Fra	4.92	0.51	10	0.57	13	
	Supermarkets whole fresh Fra	5.75	0.57	10	1.4	32	
	Supermarkets fillets fresh Fra	10.21	0.84	8	5.86	135	
	Other retailers whole fresh Fra	7.97	0.82	10	3.62	83	
	Other retailers fillets fresh Fra	11.81	0.76	6	7.46	171	
Wholesalers France		4.92	0.78	10			
	Other retailers whole fresh Fra	7.97	0.82	10	3.05	62	Yes
	Other retailers fillets fresh Fra	11.81	0.76	6	6.89	140	

Chapter 5

The Norwegian distribution chain for fish:

A summary

The first part of this report looks at the price interdependencies in the distribution chain for fresh fish in Norway. Using cointegration methodology we look at the relationship in prices between different distribution levels. The second part investigates the demand for fresh fish in Norway on the consumer level. Here we apply logarithmic demand models and estimate own-price elasticities for several fish species. Finally in the last part we report a cointegration analysis of the French distribution chain for salmon and compare this to the Norwegian results.

In the first part we analyse some of the most important Norwegian market segments for wild caught fish. We have tried to uncover to which extent the Norwegian market is integrated across regions and along the distribution chain. We started out with the producer level to see whether producer prices across Norway were interdependent or not. Then we analysed retailer prices to see to which extent also the consumer prices across regions differed or not. Finally, we used the same econometric techniques to analyse also the development in the margin between the producer and consumer prices. We analysed different product forms of cod, saithe, and prawns. We found five main results.

1. The producer level is clearly an integrated market. This holds for all the species analysed and across all five co-operatives.
2. The consumer prices is less integrated. We found local markets for "cod head on" and prawns, the other three groups, "cod head off", fishfingers and saithe was integrated across the three Norwegian regions.
3. We find a stable long run mark up between producer prices and consumer prices for prawns across the country.

4. The South-West region (Region 2) is found to exhibit a changing markup relationship between producer and consumer prices for all three cod products and saithe.
5. Within the product groups “cod head on” and fishfingers we can find basically no cointegration between any consumer prices and the producer price, suggesting a changing mark up over time.

Hence, to the extent that there is room for independent pricing across Norway this is possible for cod head on and fishfingers. Note however, that this is a necessary condition for explotation of possible market power, but not a sufficient condition. For all the other products analysed – saithe, cod head off and prawns, both producer markets and consumer markets are integrated and the long run markup is stable over time suggesting a more competitive distribution chain.

Turning to our demand results, the first thing one must mention when discussing the results is the question of reliability of the results. It seems like relatively few consumers eat seafood often enough for our consumer panel data set to give a good picture of seafood consumption. Moreover, as almost no respondent consume several species, it is not possible to measure substitution between species using these data. Very few demographic dummies are statistically significant indicating that there are few systematic differences in consumption of seafood due to community type, size of household, age or marriage status. Furthermore, there does not seem to be strong substitution between the species considered and other goods in the consumer bundle. As few studies have been undertaken for the demand for seafood with this kind of data, it is hard to evaluate whether these conclusions are reasonable or whether they are artefacts of our data. In the few cases when consumer panel data has been used, there have in general been many more observations of seafood consumers (Wellman, 199?; Salvanes and

DeVoretz, 1997). However, several demographic variables are important in these studies. Also contingent choice studies, that certainly have a different approach, tend to indicate that demographic variables are important (e.g. Johnston et al, 2001).

With the exception of salmon, the only parameters that we in general estimate with a high degree of precision are the own price elasticities. Demand for cod seems to be highly elastic, demand for saithe inelastic but close to one in magnitude, while salmon and shrimp is inelastic. Although the elasticity for salmon is questionable, this conforms well with the general pictures we have of retail sales of seafood. During the last decade salmon has become the mainstay in most fresh fish counters and often constitutes a very large share of seafood sales (Asche and Steen, 1998). The traditional species like cod, haddock and saithe can then be regarded as transitory goods that are sold on an irregular basis. This is then possible since the freshfish counter is in operation primarily due to salmon.[7] The elasticities are also of interest with respect to the ability of agents in the value chain to exploit market power. It is well known that a monopolist will always operate at the elastic part of the demand schedule. While this is not necessarily true for oligopolists, it is still clear that with low demand elasticites there is little scope for exploiting market power. Hence, cod is the only species where one can encounter monopoly pricing, while it is virtually impossible to exploit market power for salmon and shrimp. However, as for the results in the market integration tests, this is still only a necesarry but not a sufficient condition for market power.

Comparing the results from the last part the report for the French distribution chain to the results from the Norwegian distribution chain provides some interesting insight. To the extent that we find scope for market power, it is close to the consumer level, and not on the producer

[7] However, this may be less true at least in parts of Norway then in other European countries as the market share of cod is higher, and the share for salmon lower then in these other countries.

or importer level. Furthermore, if we apply the findings on the French supermarkets on Norway, where we lack data on this level in Norway, it is tempting to generalize the cost effect. More specifically, the increased efficiency from distribution via supermarkets seems to a certain extent to be transferred to the consumers. This gain however, must be traded off against the possible increase in market power from a more concentrated consumer-level distribution.

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