Cod Prices for Fishermen and Consumers[1)]

John Roald Isaksen

In this article I address the Norwegian market for fresh fish. More specific, my aim is to examine whether or not a long-run equilibrium between the ex vessel price and consumer price for fresh cod in the Norwegian market exists. To observe how the same good, fresh gutted cod without head, differing only in time and space, incur severe price mark-ups from quay to grocery shop have attracted my attention for some time. In Norwegian media and the general debate around the fishing industry, the emphasis is mostly on the export side of the industry. The domestic market is often neglected, but although some 90-95 percent of the production is exported, estimates over the Norwegian market points it out to be the fifth largest in value terms. It is often stated that to succeed on foreign markets in the industrialised countries, the best way is to master the domestic.

The two groups I am investigating, fishermen and consumers, have adverse connected interests: Fishermen want a price as high as possible to maximise the profit from the fishery, whilst the consumers want the lowest possible price, to maximise their utility from a given budget constraint. However, under changing surroundings the effect is not straightforward identified, and in the following I have concentrated on telling the story of the purchasing and selling of fresh cod in the domestic market, (*i.e.* Norway). In the period from 1990 to 1997, the ex vessel prices for cod fell with roughly 30 percent[2)], without the consumers profiting from this through lower retail prices. And when the ex vessel price fluctuates, can these variations be identified in the retail price as well, depending on which time horizon that is regarded? This is together with the pricing behaviour in the retail market for fish, one of the questions I want to find an answer to in this paper.

Cod is chosen because it is the most important fish species for both the Norwegian fishing fleet as well as for the Norwegian consumers. For major parts of the fishing fleet, and especially the coastal fleet, cod represents most of the income. In 1995, the catch of codfish constituted 28 percent of total quantity of caught fish on 2.5 million tons, while the first-hand value of cod amounted to 4.5 billion NOK, or 55 percent of total landed value from caught fish that year. As far as consumption is concerned, fish is no big expenditure item for the Norwegian consumers. In the last consumer inquiry reported by Statistics Norway, only 0.9 percent of each household's yearly total consumption expenditure are spent on fish and fish products. But cod amounts up to 1/3 of total bought fresh fish, which again constitutes almost 30 percent of the consumption of fish and fish products.

In short, the approach to the problem is to investigate whether the relation between ex vessel and retail prices for cod can be represented by a long-run equilibrium.

Several inputs have initiated this special treatment, and among them, some earlier research works. In my own thesis (Isaksen, 1997) the emphasis was made on the price mark-ups through the various links in the distribution channel of cod in Norway. Others have also contributed to enlarge my understanding of the Norwegian market for fish. Among these are Holbæk-Hansen & Rogne (1977), Gildestad (1987) and Dreyer *et. al.* (1994). Strand (1996) and Nævdal (1996) have both been made use of to understand the underlying mechanisms within pricing of perishable consumer goods, together with Stern & El-Ansary (1992) who give an introduction to the complexity of the marketing channel. For the methods used in later sections, textbooks in econometrics like Maddala (1992), Harris (1995), Charemza & Deadman (1992), Berndt (1991) and Gujarati (1995) have been frequently employed.

In the next section I will provide a general view of the Norwegian fishing industry, regarding employment, value of output and exports. Then the distribution channel for fresh cod will be referred to, with special attention to the start and end points. Thereafter three the market concept and the market in general will be visited, before I regard the participants' adjustments in the Norwegian market for fresh cod. I also discuss vertical integration and give some theories around pricing before the model is introduced. At the end some possible data sets on both first

0803-6799/99/090109+23

hand and consumer levels are investigated, and I make a choice among these, based on strengths and weaknesses. Finally I draw some conclusions from the findings in empirical analysis.

The fishing industry and the distribution channel for fish

> "When information about the sale towards the last link in the distribution channel are regarded, much of the (fishing) industries knowledge is based on assumptions, not facts." Hanssen (1992:10), own translation.

Norwegian fishing industry has historically been an important part of our economic performance. Naturegiven conditions have given us a fertile coastline and fish resources to manage. As in every other part of society, the fisheries have faced major restructuring in the last five decades, and in addition to the conventional fishing, an aquaculture industry has in later years been built up that is in charge of about one third of value added in the total industry. Norway is the number eleventh biggest fishery- and fish farming industry in the world, and in quantity our share of world wide fish catch and farming is above two percent, (1994). Our share of the cod fisheries is approximately 23 percent.

Some key statistics

Fishing and aquaculture are the backbone of the economy along large parts of the coast, with perhaps the most importance in the three northernmost counties, together with Møre and Romsdal (Northwest Norway). The industry provides work to more than 23,600 people in the fishing fleet, (of whom more than 17,000 have fishing as their sole or main occupation), about 12,000 people in the fish processing industry and accounts for some 3,000 man-years at fish farms. The industry's share of total employment is about 0.9 percent.

In addition to the directly employed, the industry generates considerable ripple effects in the form of shipbuilding and ship--yard operations, the fishing gear industry, production of technological equipment, feed production, packaging, transport, research and development.

The fishing fleet consists of 8,600 decked vessels, and even though the coastal fleet is said to be the backbone of the industry, the bigger and more mobile 350-400 vessels in the offshore fleet bring ashore more than three quarter of the total catch. The coastal fleet, without possibilities to transport the fish over long distances, depends on dispersed terminals on land. The processing and conservation of fish takes various forms, and on different parts of the coast, freezing, drying, salting and preserving takes place. While the 25 largest establishments (in turnover) constituted about half of the export value in 1981, the same share in 1995 was 75 to 80 percent. The production of farmed salmon rose from 9,000 tons in 1981 to 249,000 tons in 1995.

A measure of the industry's significance at a national scale, is the value of what is produced. What is the fishing industry's contribution to the Norwegian GDP? In 1996 the gross value of production from fisheries, aquaculture and the fish processing industry exceeded 31 billion NOK. The gross product in the same year was about 8 billion NOK, a share of the national GDP at about 0.8 percent, which has been relatively constant the last 15 years. If the offshore oil industry is kept outside this calculation, the appurtenant number is 1.1 percent.

Figures for 1996 show that over 2.8 million tons of fish with a landed value of NOK 8.6 billion were brought ashore. Aquaculture sales in 1996 totalled close to 290,000 tons of Atlantic salmon (including 13,000 tons of trout), with a first hand value of more than NOK 6.5 billion. Exports of fish and fish products amounted to NOK 22.5 billion. Of this, more than NOK 7 billion came from the aquaculture industry. Approximately 90 percent of Norwegian caught or farmed fish were exported, and Norway currently sells fish to more than 150 countries. Our most important trading partners for fish are (in order of sale) France, Denmark and Japan, who's share is more than 30 percent. To the European Union goes more than 60 percent of our fish exports. Since 1990 salmon has been a more important export commodity than cod. Norway also import a great deal of

fish from other countries, especially from Russia, Denmark and Iceland, and the landed value of imported fish have increased from NOK 1.5 billion in 1990 to almost NOK 3 billion in 1995.

Norway's combined exports of goods in 1996 totalled nearly NOK 320 billion. Exports of oil and gas dominated, accounting for 54 percent, followed by fish with almost seven percent.

First hand sale of fish in Norway

The fishing industry is an industry characterised by uncertainty, regarding both factor inputs and sale. It is based on a resource marked by fluctuations and depends on international markets where prices fluctuate. The authorities have realised the demand for regulations, and today laws, quotas and concessions are used to control the industry. The fish is a common resource, and the only investment necessary for potential users of this is the direct cost connected with harvesting. The problem is the risk of overexploitation, and if no limitations are made for the use of this common resource, the danger exists that the necessary conditions to assure the resources prolonged maintenance, will not be fulfilled. *Homo economicus* will maximise his own return without taking into account the negative externalities it inflicts on other users of this common resource and the resource itself in the form of a possible collapse. This is what is called "*the Tragedy of the Commons"* as accounted for in Hardin (1968).

The basis for all Norwegian first hand sale of fish is the Raw Fish Act of 1951. It's background was the inter-war market crisis, and it's aim was to ensure stable external conditions through an organised domestic sale. The fishermen's sales organisations were given monopoly on first hand sale of fish, and the Exports Act of 1955 and the Producers Act were important constituent parts of the industry regulations. In later years these market instruments have been altered or replaced with more liberal ones.

Another instrument for the authorities to pursue their objectives in the fishery policy has been the Annual Agreement, where various economic subsidies have been carried out in order to improve the fisheries profitability. It has existed since 1964, and up to 1990 the support measures were estimated to have been nearly 15 billion NOK, (Holm & Mazany, 1995:303). Flaaten and Isaksen (1998) shows that the support have been falling throughout the 1990's, where most of the support have been granted to structural and social measures.

Today six first hand sales organisations exist in Norway, all covering different geographic areas except one that only buys pelagic fish (*i.e.* herring, mackerel, capelin and others) from all of Norway. Fifteen years ago the number was 13. Although their tasks are founded on the Raw Fish Act, the different organisations perform their sales in different ways. One operates with minimum prices, others through auctions and the last one also exercise monopoly in secondary markets as well, where the fishermen get paid from what the catch on average is paid at resale after industrial processing.

The sales organisations were also responsible for distributing the price support that was contributed over the Annual Agreement. Until the EFTA agreement on free trade for fish came into effect in 1992, some sales organisations applied price discrimination between the different utilisation of the fish, where the raw fish price was highest for the best employment. This is no longer allowed, as it is considered distorting the competition.

Pushed to the extreme, the economic laws are superior to the Raw Fish Act. When as much as 90 percent is exported, it is a natural consequence that the sales organisations have to consider the world market prices when minimum prices are to be set. In addition, they have to reflect on demand situations and the buyers' willingness to pay. In reality, the sales organisations freedom of action to unilaterally set the minimum prices is substantially limited by the world market prices on fish products and the processing industries capacity to pay. In this way the fishing industry differ from the agriculture and it's negotiations, where the world market prices only as an exception are allowed to affect the prices on agricultural prices. The dissimilarity also exists on the other side of the trade balance: While our agricultural production is totally protected against import competition, there are no restrictions

against import of fish products. The import of raw fish is canalised through the sales organisations and is therefore included by the minimum price scheme. So even if the imported fish was cheaper than the Norwegian, it should not inflict the domestic price formation in the short run. The canalising through the sales organisations therefore function as a variable import duty, that evens out the difference between inland and foreign price level. Though fishermen have claimed that the big quantities that were supplied the Norwegian sale system at the beginning of this decade contributed to press the raw fish prices down.

In later years, Norwegian exporters have met tough competition from low-cost countries like Chile and Russia. The rise of regional blocks in world trade creates customs problems not only for the farmed salmon. For «white fish» the changes have occurred the latest 6-7 years, where Russia have dispatched considerable amounts of cod and pollack to the international market, and on the other hand big catches of hake outside South America have contributed to the fact that Norwegian cod is out competed from some markets. This, among other things, has lead to a 30 percent price decrease in the period 1990 to 1996[3)].

One can, however, conclude this by stating that the fishermen's sales organisation to some extent is exposed to competition, in accordance to what is mentioned above. Later years we have seen a softening of the legal framework which implies that the authorities are willing to let the market govern more of the business development. Our body of law is adjusted according to the agreements with the EU, the EEA and the EFTA, and it has not been accepted that an industry with a potential of earnings like the fisheries is based on governmental control and assistance. It has been stated that since 1970 we have left a period of free conduct at sea and regulated conduct in the markets, and have gone towards a situation of regulated conduct at sea and free conduct in the markets.

The distribution channel for fresh fish

A distribution channel or a marketing channel is in Stern & El Ansary (1992) defined as:

> "...a set of interdependent organisations involved in the process of making a product or a service available for use or consumption ".

Marketing channel is used to emphasise that the channel includes tasks other than transport and storage only: It shall not only satisfy the demand but stimulate it as well. For fresh fish, and particularly on the domestic market, I am of the opinion that *distribution channel* is a just as adequate concept to use as marketing channel for the product's path between producer and consumer. The promoting activity for this product is insignificant and is often financed by public institutions like the Norwegian Nutrition Council and the Norwegian Seafood Export Council. The latter is responsible for generic marketing of fish, and its total scope of generic marketing in 1996 was NOK 110 million, where about 10 percent was used in Norway. It has been claimed that fish is strongly under-marketed compared with competing products, and Norwegian agricultural industry used more than six times as much in marketing their products in 1996. In the press, the debate has circulated whether the subsidies to the farmers, that are partially financed over the tax bill, are a disadvantage for the fishing industry, since the differing marketing effort can imply a consumption-distortion from fish to meat. (*e.g.* Dagens Næringsliv, 2. and 3. May 1997)

The home-market is probably the most important single market for our fishing industry[4)], but the big market participants do not show much interest of it. Borch & Pedersen (1995) enlist the following items to explain this:

- It is a rather small volume of total sales, with only ten percent of total catches.
- A great deal of "grey market sales" takes place.
- It is good access to fish from leisure fishing along the Norwegian coast.
- It is relatively small willingness to pay for fish on the domestic market.

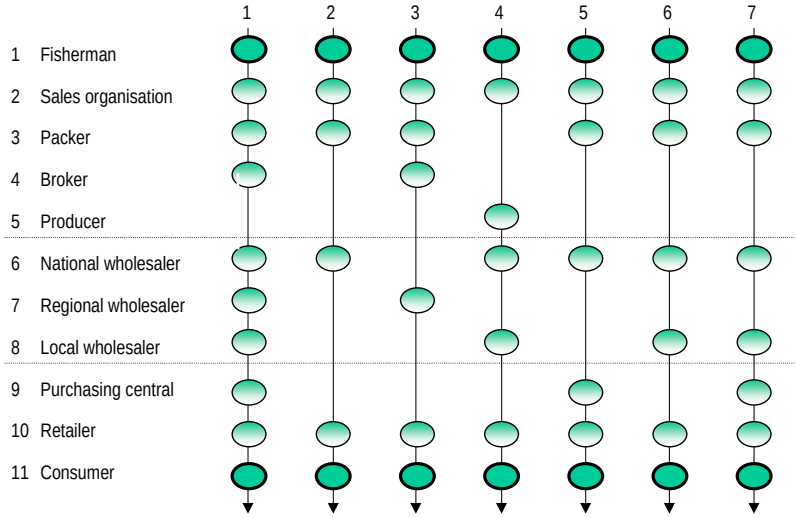

Figure 1 Different commodity-flows in the distribution of fresh fish. Source: Holbæk-Hansen & Rogne (1977)

- The fresh fish market is identified by a poorly developed distribution system where great parts of the demand are met by smaller fishmongers and fish lorries.

The distribution channel for fresh fish are not uniform, and many agents can be involved. There are different forms to organise the distribution and illustrate the complexity in the domestic distribution. The figure shows seven different patterns for fresh fish distribution, where the circles illustrate which links in the channel the product visits on its way from fisher to consumer. Arrow number two and five appears most often. The fact that the fresh fish distribution finds many and various links, are explained through the specific conditions that assert oneself for products with limited durability that are transported over long distances. And fresh fish is perhaps the most quality sensible food article there is, which demands a quick and careful distribution, with continuos cooling. However, the figure above is meant to survey the domestic market conditions in 1973, and without exaggerating, transport, infrastructure and logistics have undergone vast changes the last 25 years.

What the figure do exhibit, is the established links in the sale of fresh fish. What it can not account for is the great parts of the fresh fish consumption that stems from gifts, from gifts, own catch and sale outside of the established structures: from quay, boat or lorry. Berge (1996) estimates the sale of fish and fish products from groceries to constitute 2/3 of total sales, but it is plausible to assume that the corresponding ratio for fresh fish is even smaller.

Gildestad (1987) shows that there are regional price differences on fresh fish, and that groceries in Oslo and the surrounding area keeps a relative high price profile. He is supported by Directorate of Prices (1983) and Statistics Norway who find that the fish and fish product prices are four to seven percent higher in East Norway, than in other parts of the country. In the same survey, prices in densely populated areas are found to be higher than those in sparsely populated areas.

If the ex vessel prices mirror the conditions on the world market, then these prices also should mirror the domestic consumer prices. And if this hypothesis holds water, then the prices that Norwegian consumers pay for fish and fish products should not differ much from the prices the customers in our neighbouring countries pay[5)]. This is, however, not the case. In a survey, the Statistics Norway (1989) brings the price level variation between Norway and the EEC into focus. One of the commodity group investigated was fish and fish products, and prices

where collected in the capital areas in all OECD countries in November 1984 and April 1986. The EEC-price index is set to be 100 where Britain is 22 percentage points below this, while French consumers pay 10 percent more than the EEC-average. But Norway and Sweden are found on the top of the list with a price level 30 percent over the EEC average. Only Japan lies over with its 145 points. Dulsrud (1994) means that the background for this is the generally high cost level in Norway, or that the distribution costs are especially high and that inefficiency exists in the different links in the channel. Another explanation can be how little interest Norwegian fish producers takes in the inland market. Dulsrud also claims that fresh fish has gained bigger percentual mark-ups on its way from quay to consumer the last 15 years, and that the generally high prices on food article prices in Norway have lead to a development where the distribution links have lacked incentives to increase the efficiency and reduce the costs within the distribution.

The retailer's link

The development in the grocery industry, that may have been the most dramatic in all businesses later years, can not be explained isolated without regarding the changes in society moreover. With importance to the grocery trade these trends can be identified during the last one and a half decade:

- The chain structure has changed and general rationalisations together with workforce cuts have taken place.
- Besides, Norway has undergone strong economic turnarounds. Main features have been:
  - *1984-87:* A tight labour market with a pronounced increase in private consumption.
  - *1987-92:* Dramatic fall in private consumption an increasing unemployment.
  - *1992-94:* Marked economic growth with decreasing unemployment.
  - *1994-97:* High private and public consumption together with low interest levels.
- The agricultural and fisheries policy has undergone major changes, concerning both our relations to international agencies like GATT, WTO, EEC and EU, and the transition from a public detail regulation to a stronger market regulation.

The retailing sector has during the last 20 years undergone vast structural changes. In addition to the shutting down of many groceries, an explosive growth of discount chains has resulted in a chain concentration on top in Europe. From 1982 to 1992 the number of grocery shops decreased with nearly 30 percent, from 8.100 to 5.900. Big grocery chains have at the same time consolidated their market power, and a considerably integration, both horizontally and vertically, has occured. This has shown a tendency of closing the channel on the wholesaler link, and various forms of co-operation between retailers, processing industry and producers have seen the light of day. In 1981, 35 percent of the grocery shops were associated different chains and held 42 percent of total sales, while the respective figures in 1992 were 82 percent of the shops and 96 percent of total sales. The present-day conditions are the same, where four retail chains hold 97 percent of the market. Economic theory predicts a price increase when fewer and bigger participants are found in a market. This, however, has not been the case in Norway. While the consumer price index rose with 26 percent in the period 1987-93, the price increase for food were only 15 percent. The explanation for this paradox can be that the market power of the retailer chains has released the potential for efficiency improvements in production, distribution and sale. The progress of the chains has benefited the consumers, but if the competition on the retailer's link weakens, the predictions of the oligopoly theory can threaten.

The market entry of the discount chains may have reduced the consumers' option to choose, and the assortments of fresh meat and fish have probably been the most injured part. Although the discount chains in recent years have extended their number of articles, offering perishable goods like fish and meat are considered a cost increasing activity.

In 1967, 48 percent of all dinners in Norway were fish dinners. In 1991, the respective share was 34 percent. Meat dinners kept their share (46 percent) in the period, while other dinners increased from six to 20 percent. At the same time, the number of fishmonger's was substantially reduced. From 1975 to 1995, 200 shut down their business from originally 550 retailers with fish. But fish is also sold from cars and fishing boats. In 1995, 68 percent of acquired fish and fish products came from groceries, four percent from fishmongers and eight percent were bought from cars, boats and others, while 20 percent were obtained through gifts from others or own fishing, (Berge, 1996).

Markets, pricing and market conduct

"The market is a democracy where every penny gives a right to vote." (Fetter, 1905).

The statement above is often connected to the term *consumer sovereignty*, where consumers hold market power only by virtue of the decision to buy or not to buy a product that is offered in a market. But in a market you do not need a majority to get what you want, and the principle "one man-one vote" does not apply: The wealth is unequally distributed among buyers, and with resemblance to perfect competition, consumer sovereignty is seldom observed in real world. Producer sovereignty could be more adequate, as the way of influence is reversed, were big enterprises making use of vast resources to affect people's desires and motives.

The market

Schelling (1978:23) defines the market as: *"...the entire complex of institutions within which people buy and sell and hire and are hired and borrow and lend and trade and contract and shop around to find bargains."* In this complexity, the market allocates and regulates people and their activities in the service of the self interest: individuals maximises their self-interest and production units their profits. In the moment the State enters, it is merely to maximise a social welfare function, through reallocating resources.

Within market theory one separates between commodity- and factor markets, where the last-mentioned provide the producers with input components for the production of goods and services. The market for one product can not be isolated, but must be regarded in relation to the interaction with other markets. The Walrasian law establishes that if *(n-1)* markets are in equilibrium, then the *n*'th market also is in equilibrium. Then the price that clears supply and demand is a result of many markets interacting.

The EC commission defines a product market as: *"...the market for all the products and/or services that the consumers regard as substitutes, because of their nature, price and range of use."* The price is the most important constituent of the market both as information communicator and as incentive mechanism. In addition the price has a production motivating role, as well as a resource and utility rationing function: In a competitive market the participants will act based on the information the prices give, and assuring a production level and an allocation of resources with the highest obtainable *economic* surplus. The relative prices must therefore mirror the opportunity cost of producing a good. In this, firms offer goods which prices are sufficient to cover production costs, and consumers buys goods, which prices give them best utility compared to other goods. When these choices are made, prices will be set, and to these prices, quantities bought and sold will just balance supply and demand. If market imperfections exist, the price will not reflect the actual scarcity of the good, and some market participants will be disillusioned.

To define the market, and setting it's limits, is no simple task. In most definitions a space related component, a clarification of participants and their motives together with a delimitation of products/services are included. The main ingredient however, is that a *transaction* of a product takes place.

Which products belong at the same market? One answer is that all homogenous products are included, so the relevant market exists from substitutes. A measure for substitutability is the cross price elasticity. It

expresses how big percentual increase in demand product A can expect if the price of product B rises with one percent. It is however, no simple answer on how big this elasticity has to be before we can call the goods near substitutes, and therefore belonging in the same market. Some weaknesses with such a measure are also present. If the market is perfect competitive, and both producers have just as small market shares, a heavy price increase on good A will only give a minor increase in demand on the other, although the goods are perfect substitutes. The cross-price elasticity alone can not define the relevant market. In addition, the comparison must be between "competitive" prices, as the difference in price between substitutes can reflect the market power of one of the producers. In the cases where a monopoly-product is offered, the competitive price should be regarded when the cross-price elasticity is evaluated.

For food this is problematic, since two different goods, *e.g.* fish and meat, can give the same satisfaction of needs for the consumers. In this way the food market can function as a joint market since people can substitute one food item with another. But since food is necessities, another commodity group can not replace it. Another important question is whether the consumers find the goods to be substitutes. Saithe and frogfish *can* be substitutes but this is not necessary revealed within the consumers consumption patterns. Whether the product prices are close to one another and move parallel or independent can also unveil important information. Easily exchanged products are often in the same price range as the competition between them is fierce. Big price differences indicate that the products aim to different groups of purchasers, or uses.

One also have to set restrictions for the geographic dimension of the market, and crucial here as well, is the nature of the product. Again, from the EC commission the relevant geographic market is understood as: *"…the area where all the actual enterprises sell their goods or services, that have sufficient homogenous conditions of competition and can be separated from adjacent areas because of substantial differences in the competition terms. Among the significant elements for identifying the relevant geographic market are factors concerning the character of the good or service, possible impediments for the access to this area, consumers' habits, greater differences between the enterprises' market shares in this and adjacent areas, or greater price differences."* The nature of the product is of vital importance concerning both transport costs and freshness requirements. Fresh fish can serve as an example. By transport, the good looses its freshness over time and the feature the consumers' demand. If consumer preferences in a specific geographic area differ from other areas, this can lead to an advantage for local producers.

The definition above also includes hindrance for the access to the area and great price differs. One way to limit the market for some products is to view the quantities that are imported into and exported out of a region. Sheperd (1990:58) claims that a region can not be said to be an own market, but rather a part of one if more than one tenth of the regional consumption of a good is imported and if more than a tenth of own production is exported out of the region.

How the economic agents adjust in the Norwegian market for fish

Before the adjustment of fishermen's, sales organisations', and producers' and retailers' activity in the Norwegian market for fish are accounted for, a short introduction to fisheries in general and to the various strategic classes of producers will be given. The latter concept originates from Frisch, who distinguished between the *fixed price quantity adjuster* who sets his production to given prices, and the *elasticity affected price-quantity adjuster*, who's choice of price or quantity has effect on the supply or demand of the product, (Serck-Hanssen, 1979).

Fisheries is one of several industries that is harvesting from a renewable natural resource, and have been described as a fully negative externality in production: One fisherman's catch of a fish stock has absolute negative consequences for other fishermen's catch. In addition, the near coastal waters are regarded as a public good: It is difficult to prevent anyone from utilising it, and one consumer's use of it hardly influen-

ces others' consumption of these waters. Being a renewable natural resource, fisheries call on limitiations in consideration of a sustainable development. Free entry to this industry can imply the *tragedy of the commons*, which is not consistent with maintaining the resource on a sustainable level, in order to harvest from it in the future as well. Lorentzen (1996:20) puts it like this: *"Free access fisheries involves a production- or efficiency loss compared with a regulated fishery, i.e. free access is not a Pareto optimum."* The agents under free access fisheries have no incitements to reduce own catch to preserve and sustain the fish stock to later periods, as long as he can not influence others decision on fishing. In this way the social costs are not included in the individual decision to fish, and the activity may continue although it is not socio-economic profitable.

How do fishermen adjust their trade to the surroundings? Their main object is to maximise their income through fishing, given the cost structure and restrictions they are facing. The latter can be number of fishing nets or the quota given by the authorities. The income relies on the raw fish price, which again depends on where the fisherman lands his catch. That is depending on which sales organisation is responsible for the first hand sale in the particular geographic area. In this way, bigger mobile vessels can canalise their catch to the area that pays the most for the fish. Smaller vessels are more attached to one locality, and deliver to the nearest buyer in a traditional way. Quality has also been a factor deciding the price of the raw fish, and quality does again depend on which fishing gear that is employed, handling and storage on board and the period between catch and delivery. As a main rule, the fisher must be considered *fixed price quantity adjuster*, (so-called *atomist)*. He operates in a market characterised by some of the properties of a perfect market. Some of the assumptions are not present, but the individual fisher has no chance to affect the price, as long as the delivered quantity is not of vital importance for the buyer. Though, a reduction in the minimum price will not necessarily lead to a reduction in supplied quantity from the fisher, as he is subject to a regulated production system (through quotas and concessions). The fishermen might initially be producing less than they wish, and even though the price declines they will maintain their level of production, to generate the highest possible incomes. In the context of market power, the distribution of catch/quotas on the number of vessels will be determinant for the productivity and at this the price structure in the first links in the distribution channel. But crucial for the market power relations is the organisation of the first hand sale: *The statutory market co-operative* by virtue of the sales organisations.

The sales organisations role as sole sellers of raw fish on first hand fixed by law is decisive for the market power structure in the fishing industry. Stoltz (1960) refers to it as a *"horizontal marketing cartel with atomistic supply"*, with the market administrators function that creates more stability than if the producers acted independently. The minimum price system works as a price floor for the fishermen – within each period there is an absolute limit for what the fishermen are paid for the catch. And by lasting failure in demand, the price will be renegotiated and adjusted downwards. Lorentzen (1996) refers to the first hand market for fish as a short-term spot-oriented market, where the minimum price is the long term element. By a failure in demand, the minimum price can work as an excessive price and the fishermen can load some of the income failure over on the buyers. It can be claimed that the monopoly situation of the sales organisations are of more institutional than market economic nature. By negotiating the minimum prices, the participants are equal in ability, although the sales organisations can bring these to bear. It is in the interest of both parts that these prices are to live with. The market power will first crystallise in the situations where it is only one buyer and many sellers (and vice versa) and this is faced with a sufficient supply.

The minimum price system is however, not compatible with perfect competition, which assumes flexible prices that mirror the real scarcity of raw material, factor inputs and products. Prices, that are meant to channel the resources to the most profitable utilisation, will because of the rigidity in the system, not be able to take care of this cru-

cial job. Therefore, Pareto-optimum will not be attained, as perfect information for one thing do not exist. The minimum price will therefore be a dysfunction, but as a mean to ensure stability it is undoubtedly useful. Useful both in order to ensure stable incomes to the fishermen and in order to reduce some of the uncertainty of the producers. The sales organisations can therefore, from the above-stated, be considered as *elasticity affected price-quantity adjusters*.

The fish buyers/manufacturers are like the fishermen no homogenous group. One can separate between traders, that merely arranges sales between sellers and buyers, and manufacturers and industrial companies who prepare raw fish to a manufactured product. Either way, this group can be considered as *elasticity affected price-quantity adjusters*. One does not need much imagination to see that the manufacturer can be a *monopsonist* in the input markets, and therefore price setter, in both labour and raw fish markets. The spot-oriented organising of the raw fish market involves a risk for the buyers. They therefore prefer to be compensated in the form of a high-expected return. The economic antagonism between industry and fleet, who separately controls resources that are complimentary dependent of one another, is leading to an inefficiency in the first hand market. The industry also has a conflict of interest towards the sales organisations, and the parties can employ strategic use of information when minimum prices are set. The uncertainty on the supply side in the first hand market implicates that the unambiguous relation provided by perfect competition, between product price and offered quantity, lapses. Knowledge about quotas, minimum prices and demand conditions in the consumer markets, can reduce this uncertainty among the buyers. The less factor competition among the buyers, the less do they have to pay for the raw fish. From these arguments it should follow that the fish buyers/manufacturers are to be considered as *elasticity affected price-quantity adjusters*.

The retail trade of fish is as earlier mentioned a variety of sale points, but since fresh cod is the most used seafood product in Norway, one could assume that most fishmongers will offer this item as a part of their assortment. The market adjustment of the individual retailer will depend on the actual competitive situation. For most of the sale points one can assume that some degree of market power is present. As the requirements for freshness are strongly present, one could claim that there are several local markets for fresh fish. As a whole, the market for fresh fish is dominated by several economic actors that can affect the market price. Different wholesalers' co-operation with retail chains, where they are sole suppliers of some fish products, can serve as an example. For specific located shops that offers fresh fish (not cars or boats), the market conduct, and especially their pricing behaviour, will be affected by the number of retailers that operate in the same market. The geographic market can be divided into three components: The *primary* market, where the residents have shorter way to the existing shop than to the competitors. The *secondary* market, where the existing shop is a realistic alternative to the competitor. And the *distant* market, where the retailer can allow for occasional purchases from more peripheral consumers. It all come down to the fact that the consumers wishes lowest possible transport costs, and chooses to buy where the good is easiest accessible. For big centres, market boundaries are indistinct, and as the purchasing habits go towards shopping once a week, fresh fish loose ground to frozen products. This group of market actors within trade of fresh fish can according to what is stated above, also be considered as *elasticity affected price-quantity adjusters*.

What influences the mark-up?

Perfect competition equilibrium in the short run requires marginal cost pricing, which is seldom observed in reality. In the long run, when entry and exit are allowed for, the firms must at least have zero profit to find it suitable to stay in the market. The contribution to the production from sale must at least cover expenditures, and a better goal than the marginal cost to cover these is the long run average cost. Only as an exception do auctions or similar organisational arrangements clear markets, and the reality firms in

a markets face, is a scenario where themselves have to set a price on their product in order for the demand to accommodate to this. When the product price is set, the firms' sale will depend upon the size of the market and the extent of competition in the market. The usual pricing conduct in most industries is to add a mark-up for profits on the calculated average cost of production. And when the price is set, the firm can meet the demand through varying the capacity utilisation in production. In the short run both price and capacity are given, but in a longer run both will vary. The price will then be direct proportional to the excess demand in the market, and the mark-up can be regarded as a function of the price elasticity. The utilisation of capacity and the average cost often co-varies, as the labour costs can be a heavy component in the last mentioned. Mark-up pricing implies that the firms do not wish to maximise profit in the short run, although this is the long-term goal for the firm. In short, the mark-up is the portion of the price that the seller adds onto average variable cost in order to cover overhead expenses and yield a net profit. In price analysis it is common to employ labour cost per unit to attend to the cost perspective by pricing. In what follows I will pursue the mark-up pricing strategy by two different approaches to state the reason for my model.

Primary and derived supply and demand

What is the theoretical framework for mark-up between producer and retailer? If we define the mark-up as the difference between what the consumers pay and what the producers (*i.e.* fishermen) get, and thereafter introduce the notion *derived supply* and *derived demand*[6)], then the figure underneath can display the origin of the mark-up. The derived demand is then the demand meeting the fisherman, while primary demand is the demand from consumers. For the fishermen, derived demand is expressed mainly by buyers/sales organisations, while the primary demand is the demand for fresh cod that consumers aim towards the retailers. Likewise for the supply: Primary supply is what the fishermen offer the buyers/sales organisations, while derived supply is what the retailers offer for sale.

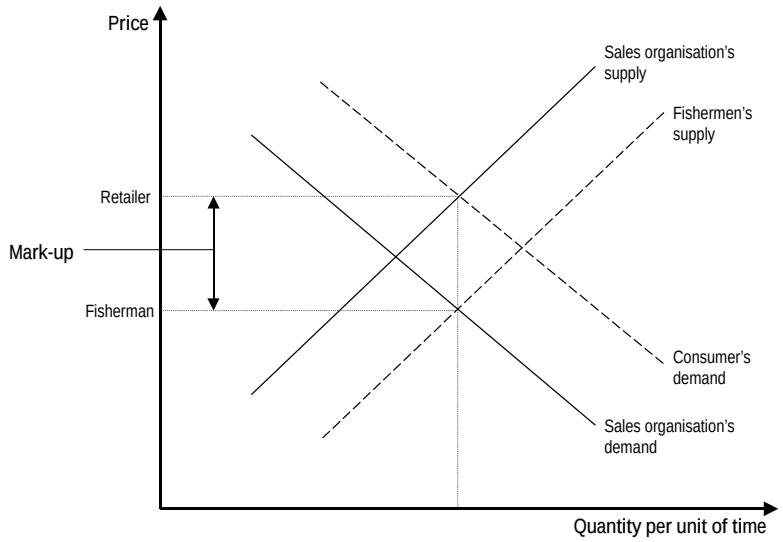

Figure 2 Mark-up, primary and derived supply and demand. Based on Tomek & Robinson (1990)

The mark-up can then easily be interpreted as the discrepancy on the price axis between the market clearing price in the first hand market and the retail market for fresh fish. Tomek & Robinson (1990:106) refers to the mark-up as the difference between producer and retail price, or: *"…the price of a collection of marketing services that is the outcome of the demand for and supply of such services."*

The figure above is static, but the mark-up can change over time in consequence of shift in the supply and/or the demand functions. Derived demand can be widely interpreted. It can include the relationship between elasticities on different market levels, and be applied for the relationship between elasticities among similar products and factor inputs they are derived from, (*op.cit.*). The key to account for *one* market level, on behalf of knowledge of another, (*i.e.* moving towards the primary demand curve from the derived), is to know which factors that decides the behaviour of the mark-up. In the simplest, and perhaps most unlikely form, the mark-up can be regarded as a constant. That is, the mark-up is constant independent of which quantities are brought to the market. Then the demand curves will be parallel. The constant, c, will then equal $D - P$, where d is the retail price for fresh fish, and P is the price paid to the fisher. Then $D > P$, and the price ratio $P / D < 1$. This ratio will be the same as the fishermen's share of the retail price.

Another possibility is a constant percentual mark-up, where it constitutes a certain percentage of the retail price. This form is also somewhat unrealistic, although some enterprises make use of percentual mark-ups. In practice, the mark-up will contain components of both constant and percentual margins on the producer price. These can vary depending on which quantities are supplied to the market. If we let M be the margin between retail and ex vessel price and let c being the constant mark-up and a be the percentual share of the retail price, then

$$(1) \qquad M = c + a \cdot D, \text{ where } \begin{matrix} 0 \le c \\ 0 \le a < 1 \end{matrix}$$

By specifying the mark-up in this way, the unit mark-up will diminish with falling retail prices. Though the mark-up will still be given as the discrepancy between retail and ex vessel prices, and by inserting this in (1) we get that

$$(2) \qquad D = \frac{c}{1-a} + \frac{1}{1-a} \cdot P$$

If we let $c/(1-a) = \alpha$, and $1/(1-a) = \beta$ then (2) can be expressed as

$$(3) \qquad D = \alpha + \beta P$$

If we add the subscript t to the retail- and ex vessel price variables, in sense of the different observations in a time series, then (3) an be interpreted as a model that gives the long-term relation between retail and ex vessel price for fresh cod.

A supply/demand model

The market price is not set solely by the firms, and to incorporate that the equilibrium price depends on the interaction between supply and demand, we start with a retailer that is faced with a falling demand curve:

$$(4) \qquad D(x) = P_r = A - B \cdot x$$

where P_r is the retail price for fresh cod, x is quantity and A, B > 0, which look after that the price of cod decrease as demand increase.

The supply of fresh cod is limited by the costs appurtenant in bringing it to the market for sale, and according to the arguments in basic market theory, the retailer will supply the cod for sale, only if the price he obtains is sufficient to cover his long-run average costs. We assume a long-run cost function:

$$(5) \qquad LTC(x) = P_f \cdot x + \frac{D}{2} \cdot x^2$$

where P_f is the price to the fisher and D > 0 is a constant parameter which show the progress of the variable costs, *i.e.* the labour

costs. Underlying is a long-run consideration, where no costs are regarded as fixed.

If we assume free competition in the market, the retailer's supply function will equal the part of the marginal cost curve that exceed the long run average cost. With equal cost structure in the market, the equilibrium price and quantity will be found where aggregated profit, π, equals zero, (because of the "free entry/exit" condition), and the retailers adjust where the aggregated supply meet the demand, where the to curves intersect. Then the retail price, P_r, equals the long run average cost, since

$$(6) \qquad \pi(x) = P_r \cdot x - LTC(x) = \left[P_r - \frac{LTC(x)}{x} \right] \cdot x = 0 \Rightarrow P_r = LAC(x)$$

Then it can be demonstrated that

$$S(x) = LMC(x) = P_f + D \cdot x$$

and that the long run average cost equals

$$LAC(x) = P_f + (D/2) \cdot x .$$

Then the equilibrium price will be:

$$(7) \qquad P_r^* = LAC(x^*) \Rightarrow A - Bx^* = P_f + \frac{D}{2} x^*$$

$$x^* = \frac{2(A - P_f)}{D + 2B}$$

We employ this result and inserts it in the demand relation (4). Then we have:

$$(8) \quad P_r^* = A - B \cdot x^* = \frac{AD}{D + 2B} + \frac{2B}{D + 2B} \cdot P_f$$

Then the equilibrium price consists of an autonomous component and a component dependent of the purchasing cost. The result is then nothing else than what was found under the last section and if we let

$$\alpha = AD/(D + 2B)$$

and

$$\beta = 2B/(D + 2B) ,$$

then (8) can be expressed in the same way as (3).

In other words: it can be proved that in a perfect market, the price that clears the supply and demand for fresh cod, can be expressed as

$$D = \alpha + \beta P ,$$

under a long term perspective.

More about the model

The retailers decision of a sale price is based on a realistic coverage of fixed costs connected with having fresh fish in the assortment, (represented by α), and the variable costs that accumulate for each unit of this supply, (attended to by β). In addition, a mark-up accrues, to cover the retailers risk and a certain profit margin on the sale. This is also incorporated in β.

For the various sales points, different costs are accumulated in the process connected with selling the product. Usually, the fishmongers utilise an absolute mark-up on the purchasing cost of the fish. In a perfect market, with resembling cost structures, this price would equal the purchasing cost of fish; *i.e*. the price paid to fisher. The Norwegian market can however not be characterised as a perfect market, and the function

$$D = \alpha + \beta P$$

serves as a more realistic approximation. However, it is a strong simplification. The retail price should reflect the supply of, and demand for fish, which the model does not

consider particularly. Moreover, the price setting of the marketing channel links lying between the retailer and the fisher would naturally serve a stronger role than what this model can incorporate in β. In addition, the retailer will have to look to the competitors' prices, when considering the market demand. And finally, the fixed and variable costs could have been better specified in the model through explanatory variables as for example the lapse of fish stores and the wage development in the grocery industry in the period.

On the other hand, the price of fish depends on the scarcity of this product as well as the costs connected with bringing the catch to the market, which in the model is included only through the ex vessel price. Various regimes are employed to set the ex vessel price, but mainly the market situation at the end markets, especially in Europe, will tend to be dominating. The rather distinctive economic development in Norway, compared with other OECD-countries, (see Asche *et. al.*, 1998)can have explanatory power, when our retail price increase although the ex vessel price decreases due to a recession among our trade partners. The cost structure in the fishing fleet will affect the ex vessel price as well. Since our fish export mainly consist of products with little degree of processing, the end markets will be characterised of proportionally low supply- and demand elasticities, which makes the prices very sensitive for changes in quantity. Comparisons between the retail and ex vessel prices can therefore easily be considered odd, as the elasticities that the consumers meet generally are higher.

In the short run, the market clearing is allowed to deviate from the long run equilibrium, because of sluggishness in the market system where it takes time before the retailers respond to changes in the ex vessel price. If price changes appear as delayed adaptations, it is natural to model these as *distributed lags*. The time-delay between cause and effect is called a lag, and when consumption demand is explained, price changes are regarded as *cause*, and change in quantities as *effect*. The effect is more likely to occur over time, than simultaneously with the cause. Distributed lags then stem from delayed responses, that is spread over time.

Market power can be revealed by observing how the retailers react on price fluctuations at the producer level. If the retailers can be characterised by free competition, a price reduction at first hand level are assumed to benefit the customers entirely, and relative quick. If the retailers hold market power, the same unambiguousness between the price series can not be expected. So-called asymmetric price reactions can give information on the market conditions at the retailer's link. It is crucial how the price alterations are transferred vertically in the marketing channel. Fishermen consider themselves as possessors of the value of the fish, while consumers fear steadily rising prices on food items. Prices at the first and last link in the marketing channel should be highly correlated for perishable products with a minimal degree of processing. Of particular importance is how information, and especially the price as carrier of information, are transported through the marketing channel. Similar to vegetables, fresh fish should have strongly connected vertical price connections. In the short run the supply of fresh cod will be approximately inelastic, and shifts in demand should imply direct price effects throughout the vertical channel of distribution, although sluggishness can delay the process. A cod is nevertheless a cod, so the elasticity of substitution for a wholesaler or others should equal zero.

Ward (1982) reveals that retail prices (on vegetables) to some extent resist price increases at the producer link. A price increase on this level is not fully incorporated in the retail price. This because perishable products require high turnover, and higher prices may reduce the sales and increase the percentage of shrinkage. In addition, upward price indolence may exist if the industry exhibits an oligopolistic structure. In his analysis, Ward also finds that for price reductions on earlier links, these were directly transmitted to the consumers. This as a parallel to international trade theory and the Pricing to Market-strategy, where exporters, with considerable market shares, undertake the extra cost associated with a depreciation/ devaluation of the foreign exchange.

Grinell (1980) claims that retailers do not apply a standard mark-up or a joint margin on all articles. Instead, a variable price mark-up is exercised, where the mark-up varies. The target is to get an aggregated margin as a percentage of total sales through supplying products, to which the consumers are price sensitive towards, to low prices, and demanding high prices for other products. Price sensitive goods are the products that consumers buy much of, and especially the expensive ones – and therefore amounts to greater parts of the shop's total sale.

In spite of these critical remarks, the model remaining is this:

$$(9) \qquad D_t = \alpha + \beta P_t ,$$

where *t* is the time of the observation of the variable. This will be referred to more thoroughly later.

Ex vessel prices and consumer prices

To conduct my announced analysis consistent to the approach, I need good data, in the form of time series over ex vessel and consumer prices for fresh cod. In this sections these will be presented together with their pros and cons.

Ex vessel prices

The central supplier of statistics for the fishing industry in Norway is the Directorate of Fisheries. By each settlement of landed fish, a contract note is issued, where quantity and value of the catch, fishing gear and -ground, usage and place of delivery is stated. These data are underlying for the annual Fishery Statistics that is published by Statistics Norway, which' monthly prices over the ex vessel price for cod, I have found to employ for this purpose. However, for the later years official statistics are not yet published, and I have therefore put to use preliminary figures obtained from the Directorate of Fisheries. The prices are found by dividing value by ding value by quantity, and are therefore average prices paid to the fishermen over monthly intervals, and include spawning cod and Finnmark young cod. To ensure consistency with the consumer prices, this series has been converted from round (wet) weight, as it occurs in the statistics, to gutted without head in accordance with existing, conversion factors. Through this, one observes the same product, at both ex vessel and retail level.

By employing an average price some of the features are hidden. It can be shown that ex vessel prices of cod tend to increase the longer south in Norway it is landed, and the bigger fishing vessel that lands it. The first is thought of as a consequence of nearness to the main markets (Europe, central Eastern Norway), or due to the different pricing regimes of the sales organisations. The latter can be explained due to the potential market power of big vessels and their ability to land the catch where it is paid the best. Included in the ex vessel price applied here is an 11,11 percent VAT, which is lower than what the other links in the marketing channel are charged, (20 to 23 percent in the period investigated).

Consumer prices

Statistics Norway gathers consumer prices on more than 800 specified commodities from approximately 2000 firms and public bodies each month, which enter into their computation of the official Norwegian consumer price index. The composition of goods and their weight in the index depends on the Norwegian average consumption, as it emerges in the survey of consumer expenditure for the last three years. In the latest survey, food's weight in the index is 13.6 percent; a budget share that has been steadily decreasing the last 20 years. Within this group we find 20 fish products, and among them, fresh cod over 1.5 kg, gutted without head, which has been registered monthly since September 1981. It's reference price in 1979 (=100), and through the indexed values I have been able to compute the average retail price[7)].

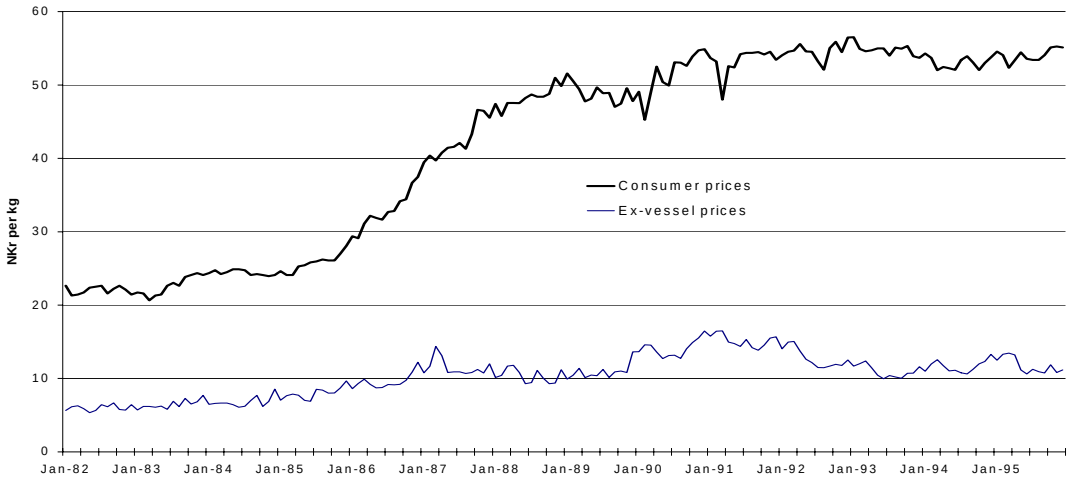

Figure 3 Prices for fresh cod, VAT included, January 1982 – December 1995

Included in this price is the Norwegian VAT, which was 20 percent until 1. January 1993, 22 percent from this date of and until 1. January 1995, and thereafter 23 percent. The price series are not adjusted for this, since it is of no real economic meaning for the consumers, as they can not deduct the VAT from their household accounts. In addition, such a scalar will not change the economic realities in the analysis.[8)] In the figure above the price series for ex-vessel and consumer prices are plotted.

The figure shows the average prices received by fishermen and claimed from consumers. The ex-vessel prices' share of the consumer prices fluctuates in the period between 18 percent (June 1993) and 36 percent (March 1987), and its overall performance tendency is sinking over the period. Whether a long-term equilibrium exists between these price series, is a question that will be raised in the next section.

Time Series Analysis

This analysis will rely on the theoretical bricks accounted for above. I have earlier denoted the domestic market for fresh cod as a market where monopolistic competition is the most adjacent market model. But in stead of product differentiation, this market can be distinguished by *geographic* differentiation at the end point. That is; the distance between the sellers sets their relative market power, contingent on the search- and transport costs of the consumers: The distance to the retailer is the consumer's barrier when he in his choice ranks the suppliers up against each other. To prove monopolistic behaviour makes other demands on data set and tool of analysis than what is applied here. the analysis relies on the exposition of the econometric method that is described in Harris (1995), Charemza & Deadman (1992), Gujarati (1995), Kennedy (1992) and (Pesaran & Pesaran, 1991).

The model

The model presented has its basis in the pricing conduct in the retail link. The main assumption is that the ex-vessel price is the most important observable single component when the retailer sets his or her prices. Then the market clearing price can be represented by a long-term equilibrium, where the first hand price is independent, and the retail price the dependent variable, as shown below:

$$(10) \quad D_t = \alpha + \beta P_t + \vartheta_t ,$$

where D_t is the retail price, P_t is the ex-vessel price, α and β are parameters, and ϑ_t is a random error term with zero mean and constant variance, $\vartheta_t \sim (0, I\sigma^2)$. Equation (10)

is then the statistical parallel to equation (9), and refers to a linear relationship between ex-vessel and retail price, where α is a constant or intercept and β reflects the slope coefficient. The economic interpretation should follow from section 3, but in short, the retailers price decision is based on a realistic coverage of the fixed costs connected to offering fresh cod (α) and the variable costs that follow each unit (kilo) of such an offer, (β).

In the short run, deviations from long-term equilibrium are allowed. This is due to sluggishness in the market system caused by delays between a change in the ex-vessel price and the respective retail price: It takes time before the retailers react on a first hand price change, and therefore before the market is back to its long run equilibrium price. This conduct can be compared with a *pendulum movement* that after an external influence swings for a while before it after several adjustments again settles down.

Method

Time series analyses are employed to study the dynamics, or the temporal structure, in data sets. When such are made use of to test whether several variables, measured at different points in time, are connected, one must be aware of the complexity of such correlation. The effect of one variable on another might depend on the horizon of time, and sometimes the effect of a change in one variable can only be measured after some time. Dividing long- from short time effects can therefore often be meaningful. In the following, only long-term changes will be examined, but first important concepts like stationarity, integration and cointegration will be examined.

In analysing more than one time series it is substantial that the series exhibits the same stationarity properties, *i.e.* either stationary or nonstationary. The observations in a stationary time series will be independent of time, *i.e.* mean and variance are constant over time, and in addition the covariance between observations of the same variable on different moments of time, will be constant and therefore independent of time.

By studying stationary time series one avoids problems caused by nonstationary series, which may generate *spurious regressions*[9], where the econometric results originates from identical time trends in the data, not the true association between the variables. And a distinctive characteristic with economic time series is that they tend to trend, because of the underlying processes that are common to them all. *Autocorrelation*, which means that the observations repeat the last observation without bringing anything new to the series, then becomes important. Autocorrelation, or serial correlation, mirrors the fact that the error terms from the regression are dependent of time.

To establish whether the error terms are serially correlated, the *Durbin Watson-test* is employed. This test statistic, however, looses its power when lagged values of the dependent variable enter the regression. In those cases a *Godfreys Lagrange Multiplier-test* can be employed.

Price series are usually not stationary in terms of level but exhibits the right stationarity qualities after one differencing operation. Before a regression can be carried out on a time series, one have to determine the *order of integration*. A nonstationary time series can be made stationary after differencing *n* times. Such a series is said to be *integrated* of n^{th} order, or *I(n)*. A stationary series is therefore I(0).

To establish the stationarity properties of time series, they undergo a “unit root test”, which will reveal the order of integration. Here an Augmented Dicky Fuller-test (ADF) is employed. A stationary time series tends to return to its mean and fluctuate around it within more or less fixed limits, that is *constant variance*. A nonstationary time series has different mean depending on time, and often variance increases with time. To decide whether a time series is stationary, one need to know if it has a unit root. The simplest test to verify this, is the Dickey Fuller-test, DF-test.

The DF-test examines under the null hypothesis H_0: $\delta = 0$ against the alternative; H_1: $\delta < 0$. If H_0 can not be rejected, one differences the variable again and repeats the test, until it is rejected and the result is a stationary variable. In this manner, a variable that passes the DF-test:

$$\Delta X_t = (1+\delta)\Delta X_{t-1} + \varepsilon_t,$$

will be integrated of first order; $\Delta X_t \sim I(1)$. It is a problem that the DF-test does not allow serial correlation in the residuals. If the equation is an incorrect specified form of the data generating process, so that $X_t \sim AR(p)$, not $X_t \sim AR(1)$, then the error terms will be serially correlated to compensate for the misspecification of the structure of the series.

The *Augmented Dicky Fuller test* (ADF-test) meets this by adjusting for autocorrelation through insertion of earlier values of the dependent variable in the regression. The ADF-test is comparable with the simple DF-test, but one have to add an unknown number of the lagged first difference of the dependent variable, to include the autocorrelation that otherwise would have entered the error term. This is assumed to be normally distributed with constant mean and variance equal to σ^2.

$$\Delta X_t = \delta X_{t-1} + \sum_{i=1}^{k} \delta_i \Delta X_{t-i} + \varepsilon_t$$

The sufficient number of lags, *k*, that is included in the test depend on the following: It have to be enough to eliminate any autocorrelation, but still as few as possible in order not to loose degrees of freedom. The lag length is crucial: If one include too few lags, it is easier to reject the null although it is true, and by including too many lags, the test looses it's strength. The test procedure is the same as the DF-test, but in practice one will first have to test the residuals for each choice of number of lags, to determine the optimal lag length. For higher order autocorrelation one would have to test with a Godfreys LM-test or an LMF-test[10]. These can be employed on models with or without lagged dependent variables, and are therefore better suited than the DW-test on higher orden autoregressive models. The chosen number of lags is therefore based on the LMF-test values.

Stationarity is in other words an absolute requirement to succeed in econometric analysis of time series. If one has to differentiate the series to attain this, one looses the long-term properties of the series. To mend for this, the series are examined for *cointegration.*

Cointegration

Cointegration is a statistical concept that involves finding a common stochastic trend between two or more time series. Assume two time series; $Y_t \sim I(1)$ and $X_t \sim I(1)$. These are said to be *first order cointegrated*, if it exists a β so that $Y_t - \beta X_t$ is I(0). In the right notation; $Y_t, X_t \sim CI(1,1)$.[11] Then there is a long-term relationship between the series. If they are not cointegrated, the regression above will only produce a spurious correlation between the variables, (Maddala, 1992:588). Cointegration therefore demands that the series are integrated of the same order, *d*, and that a linear combination of these variables exists, which is integrated of order *d - b*. The most interesting case will be when the series through cointegration produces a stationary linear combination. Then *d = b = 1*, and the coefficients in the cointegration vector will be the true parameters that give us the long-term characteristics of the series. Two series that are cointegrated in this way will then form a long-term equilibrium property. The difference between them will then be stable, and the cointegration imitates the existence of the equilibrium that the system converges towards over time. The error term will then be the disequilibrium term in the regression, which illustrates the discrepancy from the equilibrium.

There are different ways to decide this cointegration vector, and since my estimations only consider two variables I have chosen to employ the *Engle and Granger Two Steps Procedure*, in accordance with Harris (1995:21). He states that in such cases, only one cointegration vector exists. First stage in the Engle and Granger procedure is to estimate the static long-term relationship by OLS, in order to find the parameters in the cointegration vector. Thereafter a test is carried out on the residuals from the regression $Y_t = \alpha + \beta X_t + \varepsilon_t$, to test whether they are I(0)[12]. The representation theorem states that if two variables are cointegrated, then they can be represented by an *error correction model* (ECM), and vice versa. *Step two* will then be to use the esti-

mates from the OLS-regression in the form of levels in an autoregressive ECM, wich will not be conducted here, as it considers the short time effects.

The line of action in the empirical analysis will then be to (a) test for stationarity and order of integration in the price series and (b) test for cointegration between the series by employing an Engle-Granger test. Before a regression analysis can be conducted, the variables' order of integration must be identified, which can be done with an augmented Dicky Fuller (ADF) test for Unit Root on each of the series D_t and P_t. Thereafter, an Engle-Granger test will decide whether a long term relation exists between the price series. This test is performed with a modified Dickey Fuller test on the estimated error term.

In short: If a long-term relation exists between two nonstationary time series, then a cointegration test will unveil whether deviations from the long-term path;

$$(11) \quad D_t = \alpha + \beta P_t + \vartheta_t ,$$

are stationary or not. The price series D_t and P_t are said to be cointegrated of order *d, b*, where $d \geq b \geq 0$, if D_t and $P_t \sim I(d)$ and $D_t - \beta P_t \sim I(d - b)$. If the variables are *CI(1,1)*, with a cointegration vector [1, $-\beta$], then the deviations from the long-term path in equation (11) will be *I(0)*.

Empirical Analysis

The starting point is the variables accounted for in section four: ex-vessel (P_t) and retail prices (D_t) for fresh cod in Norway, and the aim is to examine whether a long-term relationship exists between these.

Tests for integration

The first step is to find the order of integration of the series, which is done with the Dickey-Fuller and the Augmented Dickey-Fuller test to test for a unit root. The chosen number of lags accepted in the latter is decided by the results from the LMF-test. The null hypothesis is that the variable has a unit root, which is tested within a 95 percent confidence interval. If critical value exceeds observed value (absolute value) then the null can *not* be rejected. The results from the DF-test are reported in the table below.

For both prices in terms of levels, it is not possible to reject the null hypothesis of nonstationarity from the DF-test. Though, for prices in first differences we can strongly reject the null hypothesis.

Table 1 Results from the Dickey Fuller test

Variable	*Observed testvalue*	*Critical value (95% CI)*	*Reject Null*	*Do not reject*	*Order of Integration*
P_t	-2.312	-2.879		x	I(1)
ΔP_t	-15.160	-2.879	x		
D_t	-1.159	-2.878		x	I(1)
ΔD_t	-16.275	-2.878	x		

Table 2: Results from the augmented Dickey Fuller test (ADF)

Variable	*No. of lags (k)*	*Observed test value*	*Critical value (95% CI)*	*Reject Null*	*Do not reject*	*Order of Integration*
P_t	2	-1.749	-2.879		x	I(1)
ΔP_t	2	-8.535	-2.879	x		
D_t	2	-1.307	-2.879		x	I(1)
ΔD_t	2	-8.879	-2.879	x		

For both ΔP_t and ΔD_t the Durbin *h*-test[13)] indicate that the residuals are not serially correlated. Still, we expand the testing, and employ the Augmented DF test, which allows for the data generating process to be characterised by a higher autoregressive order than AR(1). The findings are reported in table 2, and number of lags are decided from the results of the modified Lagrange Multiplier test; LMF. Observed and test value are reported here as well.

It was not necessary to regard trend in any of the tests above, and again it appears that the variables P_t and D_t both are *I(1)*. For the retail price variables we find that the residuals for two lags are not serially correlated of any order, but for the ex-vessel price, on the other hand, one can not exclude autocorrelation in the residuals for an order greater than 5. Serially correlation of any lower order is ruled out by the LMF-test. I have not found any support in the literature for whether this will exclude the variable from being integrated of first order or not. I therefore, in the rest of the analysis, accept its properties from the former tests, as nonstationary in terms of levels, but stationary after one differentiation. Then it is determined that D_t and P_t are integrated of the same order, I(1), and we can perform a cointegration test on the regression equation to establish whether a long-term relation exists or not.

Cointegration test

Here we apply the first step in the Engle and Granger two step procedure, as outlined above. By applying Ordinary Least Squares (OLS) method on equation (11)

$$D_t = \alpha + \beta P_t + \vartheta_t ,$$

and estimated with the help of Microfit 3.0, the regression gives the following result:

$$(12)^{14)} \qquad D_t = \underset{(2.054)}{1.744} + \underset{(0.190)}{3.864} \cdot P_t ,$$

with $R^2 = 0.713$, $\overline{R}^2 = 0.712$,
DW=0.285, ADF(1) [15)] = -3.602 (-3.438).

The computations show that in equilibrium, the retail price will rise with 3.86 NOK after a unity increase in the ex-vessel price. The coefficient of determination (R^2) tells us that our model is able to explain 71 percent of the total variation in the retail price. Adjusted R^2, ($\overline{R}^2$), allows for the number of degrees of freedom that are spent in order to estimate the parameters in the model. This is close to the original, as N=168 and only two degrees of freedom are lost during the estimation. The DW-statistic indicates that the residuals are strongly postive autocorrelated, while the ADF-test suggest that the error term is stationary, $\vartheta_t \sim$ I(0). To assure that the residuals hold this quality, we apply a test method called *modified Dickey Fuller test*, as outlined in Griffiths et.al. (1993:701). Modified since it is founded on the calculated residuals from an OLS-regression, and since the two series (P_t and D_t) are both I(1), the *t*-value will not indicate the accuracy of the OLS-estimate in the cointegration regression in (12). That is the cointegration parameter. With the residuals from the cointegration regression in (12), an AR(1)-model is formed:

$$(13) \qquad \hat{\vartheta}_t = \rho \cdot \hat{\vartheta}_{t-1} + \varepsilon_t$$

With parallels to the DF-test: If (5.4) is stationary, then $|\rho| < 1$. But if $|\rho|=1$, then the residuals are nonstationary and $\vartheta_t \sim$ I(1). To ϑ_{t-1} test the null hypothesis H_0: $\rho = 1$, we subtract from both sides, and are left with

$$(14)\ \Delta\hat{\vartheta}_t = (\rho - 1)\hat{\vartheta}_{t-1} + \varepsilon_t = \delta \cdot \hat{\vartheta}_{t-1} + \varepsilon_t$$

The null hypothesis, H_0: $\rho=1$ or $\delta=0$, can then be rejected from a one tailed *t*-test if observed *t*-value is less or equal to the critical value, $t \le t_c^*$. The critical value for our sample, N=168, at a five percent level of significance, equals –3.37, (t_c^* = -3.37). The results from the regression is then, (with standard deviations in brackets):

$$(15) \qquad \Delta\hat{\vartheta}_t = \underset{(0.0403)}{-0.138} \cdot \hat{\vartheta}_{t-1}$$

And with a reported *t*-value of –3.42 indicates that the residuals from the static OLS-regression are integrated of order 0, $\vartheta_t \sim I(0)$, since $t = -3.42 \leq -3{,}37 = t_c^*$. One can therefore (with caution) conclude that D_t and P_t are cointegrated. The OLS regression of equation (11) that resulted in equation (13) is then said to give a super consistent estimate of the *cointegration parameter* β, which describes a long-term stabile equilibrium relationship between D_t and P_t, (*op. cit*.). It is thereby demonstrated that the variables *ex-vessel* and *retail price* of cod are *cointegrated*. Hence, there is a causal relationship between the two price series. It is in other words very likely that the same processes are generating the price series that we have been examining. Then it is plausible to assume that it in this market persists a long-run equilibrium, although chocks in the short run may cause it to deviate from this.[16)]

So even if the results are not implicitly unambiguous, I attach importance on the modified DF-test that concluded with stationary error terms.

Concluding remarks

I have in this paper given an outline for the Norwegian fishing industry, with special emphasis on the characteristics of the Norwegian market for fresh cod. In addition, an overview is given over different market conditions, power, approaches and behaviour; from a monopoly on first hand embodied by law to a heterogeneous retail link with many unequal participants. And I have argued for a mark-up pricing behaviour in the trade with fresh fish. Then a model is implemented, explaining how the ex-vessel price is thought of as an explanatory feature for the retail price of fish. At the end, an empirical analysis is executed, establishing a long run relationship between the two price series.

A great importance is attached to create insight to the practise of the marketing channel, though it might give the impression of an exaggeration. However, the intermediaries lying between the start and end point of the channel might seem neglected, but in fact, they have fallen out as a consequence of a lacking knowledge and evidence. Crucial concepts of this analysis are the idea of derived demand and the use of mark up pricing among the intermediaries. It can be shown that when the intermediaries' production technology contains only one variable input factor, then derived demand elasticities provide information on consumer demand elasticities, as these will coincide. This implies that the ex-vessel and the retail prices will be proportional, (Asche *et. al.* 1998). As we have found the two price series to be proportional in the long run, this imply that consumer demand elasticity equals derived demand elasticity, which gives the opportunity to get information about consumer demand using lower level data. For instance export prices as a proxy for import country consumer prices.

To recapture, I will quote the words of Gardner (1975:406), and stress the fact that much more work are required to understand thoroughly the processes involved in forming prices on the two examined levels:

> "...no simple markup pricing rule – a fixed percentage margin, a fixed absolute margin, or a combination of the two – can in general accurately depict the relationship between the farm and retail price. This is so because these prices move together in different ways depending on whether the events that cause the movement arise from a shift in retail demand, farm supply or the supply of marketing inputs."

Using only price data means a simplification from modelling a system of demand and supply equations, as price data are more available than quantity data, especially at the retail level for perishable goods. This, however, remains for later research.

References

Asche, F., Flaaten, O., Isaksen, J.R. & T. Vassdal (1998). Derived Demand and Price Relationships: An Analysis of the Norwegian Cod Sector. Paper presented for the *IXth biannual IIFET-conference*, Tromsø.

Berge, S. (1996). Anskaffelse av fisk og fiskevarer. Utprøving og evaluering av statistikkopplegg (in Norwegian). Rapport nr. 7. Norsk Institutt for Landbruksøkonomisk Forskning (NILF), Oslo.
Berndt, E.R. (1991). *The Practice of Econometrics – Classic and Contemporary*. Massachusets: Addison-Wesley Publishing Company Inc., Reading.
Borch, O.J. & E. Pedersen (1995). Trender i markedene for norske fiskeprodukter - konsekvenser for fiskeri- og havbruksregionen Vesterålen (in Norwegian). Rapport nr. 20. Nordlandsforskning, Bodø.
Brattvoll, O. & T. Vassdal (1996). En analyse av markedet for hvitfisk (in Norwegian). Christiania Bank og Kredittkasse, Eksportutvalget for fisk, August.
Charemza, W.W. & D.F. Deadman (1992). *New Directions in Econometric Practice*. Cambridge:Edward Elgar Publishing Ltd., University Press.
Dreyer, B., T.E. Martinussen, R. Richardsen & S.G. Ulve (1994). Norsk eksport av tørrfisk til Italia (in Norwegian). Rapport. Fiskeriforskning, Tromsø.
Dulsrud, A. (1994). Mat, marked, makt. Betingelser for forbrukerinnflytelse (in Norwegian). Rapport nr. 9. Statens Institutt for Forbruksforskning (SIFO), Lysaker.
Flaaten, O. & J.R. Isaksen (1998). Governmental Financial Transfers to the Norwegian Fishing Industry: 1977-1996. Rapport nr. 7. Fiskeriforskning, Tromsø.
Flaaten, O. & F. Skjold (1997). The consumption of salmon and other fish and fish products by Norwegian households some preliminary findings. Paper presented for the *European Association of Fisheries Economists IXth Conference*, Quimper, 28.- 30. April.
Gardner, B.L. (1975). The Farm-Retail Price Spread in a Competitive Food Industry. *American Journal of Agricultural Economics*, **57**, pp. 399-409.
Gildestad, B. (1987). Analyse av distribusjonssystem for fisk og fiskevarer (in Norwegian). Transportøkonomisk Institutt (TØI), Oslo, Prosjektrapport.
Griffiths, W.E., R.C. Hill & G.G. Judge (1993). *Learning and Practicing Econometrics*. New York: John Wiley & Sons.
Grinell, G. (1980). Pricing Policies of Food Retailers. *National Food Review*, **12**, pp.10-11.
Gujarati, D.N (1995). *Basic Econometrics*, 3rd ed.. Singapore: McGraw-Hill.
Hamilton, J.D. (1994). *Time Series Analysis.* New Jersey: Princeton University Press.
Hanssen, B.A (1992). Suksesskriterier i detaljhandel med fisk. Supermarkeder og fiskebutikker (in Norwegian). Rapport nr. 13, Fiskeriforskning, Tromsø.
Hardin, G. (1968). The Tragedy of the Commons. *Science*, **162**.
Harris, R.I.D. (1995). *Cointegration Analysis in Econometric Modelling.* Hertfordshire: Prentice Hall/ Harvester Wheatsheaf.
Heien, D.M. (1980). Markup Pricing in a Dynamic Model of the Food Industry. *American Journal of Agricultural Economics*, **62**, pp. 10-18.
Holbæk-Hanssen, L. & T. Rogne (1977). Handel med fisk og fiskeprodukter i Norge: Hovedrapport om undersøkelser av den innenlandske distribusjon av fisk og fiskeprodukter (in Norwegian). prosjektrapport nr. 16Fondet for Markeds- og Distribusjonsforskning, Oslo.
Holm, P. & L. Mazany (1995). Thalassorama. *Marine Resource Economics*, **10**, pp.299-312.
Isaksen, J.R. (1997). Det norske marked for fersk torsk (in Norwegian). Hovedfagsoppgave i sosialøkonomi, Norges Fiskerihøgskole, Universitetet i Tromsø.
Judge, G.G., W.E. Griffiths, R.C. Hill, H. Lütkepohl & T-C. Lee (1992). *The Theory and Practice of Econometrics.* 2nd ed.. New York: John Wiley and Sons.
Kennedy, P. (1992). *A Guide to Econometrics*, 3rd ed.. Cambridge USA.: Blackwell.
Lorentzen, T. (1996). Organisering av råfiskmarkedet og debatten om langsiktige kontrakter (in Norwegian) SNF-rapport 56/96, Bergen.
Maddala, G.S. (1992). *Introduction to Econometrics*. Englewood Cliffs, New Jersey: Prentice-Hall Inc.,.
Nævdal, E. (1996). Prisdannelse i sentrale norske matvaremarkeder (in Norwegian) NILF-rapport nr. 2, Oslo.
Pesaran, M.H. & B. Pesaran (1991). *Microfit 3.0 – User manual*. Oxford: Oxford University Press,.
Prisdirektoratet (1983). Prisnivået i ulike deler av landet i 1982. Undersøkelse gjennomført av Forbruker- og Adm.dep. og Prisdirektoratet, i samarbeid med SSB. *Pristidende* (in Norwegian), **14**.
Schelling, T.C. (1978). *Micromotives and Macrobehavior*. New York: W.W. Norton & Co.
Serck-Hanssen, J. (1979). *Strategiske typer i norsk næringsliv* (in Norwegian). Revidert utgave, Oslo: Universitetsforlaget.
Shepard, W.D (1990). *The Economics of Industrials Organization.* 3rd ed.. Englewood Cliffs, New Jersey: Prentice Hall.
Statistics Norway (1989). Analyse av strukturelle prisforskjeller mellom Norge og EF-landene (in Norwegian). Prosjektrapport, Delrapport 1, Statistisk Sentralbyrå, Oslo.
Stern, L.W. & A.-I. El-Ansary (1992). *Marketing Channels*. 4th ed.. Englewood Cliffs, New Jersey: Prentice Hall.
Stolz, G. (1960). Horisontalt salgskartell med atomistisk tilbud (salgssamvirke) (in Norwegian). Memorandum fra Sosialøkonomisk Institutt, **1** (23), Universitetet i Oslo.
Strand, M. (1996). Matvarepriser i endring (in Norwegian). Rapport nr. 3, SIFO, Lysaker.
Tomek, W.G & K.L. Robinson (1990). *Agriculture Product Prices*, 3rd ed.. Ithaca: Cornell University Press.
Ward, R.W. (1982) Asymmetry in Retail Wholsale, and Shipping Point Pricing for Fresh Vegetables. *American Journal of Agriculture Economics*, May, **99,** pp. 205-212.

Notes

1) Findings have earlier been presented in my post-graduate thesis at the University of Tromsø, (Isaksen, 1997).
2) See figure 3.
3) See *e.g.* Brattvoll & Vassdal, 1996.
4) The statement stems from Hanssen (1992:2) and relies on an estimate over the fish consumption on 46 kilogram round weight, total quantity 190 000 tons at the price each kilo of 30 NOK. Then the total domestic annual turnover on retail level will be roughly NOK 5 billion.
5) The price of fish should perhaps be lower here since we are self-supported with seafood and have a rather long coast where everyone can harvest.
6) Tomek and Robinson (1990:26) give this explanation: *"The consumer is buying food (inputs) to produce meals that are nutritious, have variety, are tasty, and so forth, and the demand for the food commodities may be viewed as being* ***derived*** *from the demand for a nutritious meal."*
7) The price series over fresh fish consumer prices, which I have employed, deviates to some extent from other sources. Two other series, (one from the consumer expenditure survey and one from the GfK Norge (Berge, 1996)), are known, and these show both somewhat lower prices over the years. The reason for omitting these have been that the latter only goes two years back in time, and both exhibit few and varying numbers of observations. However, their level of details could have contributed to understanding regional differences in the consumer prices.
8) From 1974 until 1981 a reimbursement scheme existed, where wholesalers were compensated for the VAT by sales of fresh fish to domestic consumption. But this had no effect in the period investegated here.
9) An indication can be that the coefficient of determination, R2, is greater than the corresponding value of the Durbin-Watson test.
10) The LM-test has an asymptotic χ2-distribution with *k* degrees of freedom, while the LMF-test follows the F-distribution with *(k, T-m-k)* degrees of freedom, where *T* is the number of observations entering the regression and m is the number of regressors. Both tests are under the *null hypothesis* that the residuals are not serially correlated. Charemza & Deadman (1992:92) points out that the last mentioned has better statistical qualities, since the LM-test has a tendency to reject the null, although it is true.
11) In generally: If $Yt \sim I(d)$ and $Xt \sim I(d)$, then *Yt* and *Xt* is $CI(d, b)$ if $Yt - \beta Xt \sim I(d\text{-}b)$ and $b > 0$.
12) Two series Yt and Xt can be defined as cointegrated if both are I(1), and there exists a linear combination of them, $\varepsilon t = Yt - \alpha - \beta Xt$ which is I(0).Then β is called the c*ointegration parameter*
13) Durbin's *h*-test is a special test used to test whether the residuals have an autocorrelation order greater than 1, *i.e.* $\rho \cdot \varepsilon t\text{-}3$, and is only applied when the regression equation include one single one-period lag of the explanetory variable. This because the DW-test is invalid in such cases.
14) Standard deviation reported in brackets under the regressors.
15) The reported ADF-value is for one lag on the residuals from the regression, where the critical value is reported in brackets.
16) *Digression:* The quality of this conclusion must be emphasised to be uncertain. Charemza & Deadman (1992:153) points at the following rule of thumb concerning cointegration: If the usual DW-statistic, which is calculated for the error term of the static model representing the long-term equilibrium, is close to 2, then the risk of the variables not being cointegrated is very little. However, in this case, the DW-value is very low, (0.29), indicating that the variables are not cointegrated. In addition, it is only for one lag that the ADF-test and the DF-test on the residuals, that the software program reports a test value compatible with a stationary error term.