# Demand for Organic Salmon in the European Union

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**Abstract**. This paper provides an analysis of the market potential for organic salmon, primarily in the European Union. There has been a substantial growth in the demand for organic food products in industrialised countries in the course of the past decade. Legislation for organic production is now being extended to aquaculture, and limited quantities of certified organic salmon have been marketed in the European Union. We examine the experience gained in other organic food markets, and draw some conclusions from these markets with relevance to salmon. Organic salmon fills a dietary need among organic consumers, but at the same time it has some characteristics which may present obstacles to successful marketing. We analysed price premiums for organic salmon compared to conventional salmon. Positive price premiums were found, but it is hard to predict how they will evolve when the supply of organic salmon is expanded. Experience from other organic foods that are supplied in large volumes suggests that it may be possible to obtain price premiums even with substantially higher production.

## 1. INTRODUCTION

This paper is a study of the potential demand for organic salmon.[1] We analyse experiences from other organic food product markets, and try to draw some conclusions from these. We also attempt to estimate the potential price premium for organic salmon, based on sales transaction data from an organic salmon producer, the Norwegian company *Giga*, and the findings from studies of other organic products.

The production of organic food in the industrialised countries has increased substantially during the past few years. This may be seen as a result of the increasing concern of consumers regarding food safety and the negative effects of large-scale, intensive agricultural activities, with most emphasis being placed on human health, animal welfare and the environment.

Until recently, the concerns of consumers have mainly focused on terrestrial food production, but as the consumption of seafood increases it is reasonable to expect consumers to take a greater interest in how and where their seafood is produced or caught (TemaNord, 1998). The first signs of response to this change or expected change in consumer attitude have already been seen both in fisheries and in aquaculture. Unilever, one of the major companies in seafood, is introducing eco-labeled fish products in cooperation with the World Wildlife Fund. The *International Federation of Organic Agriculture Movements* (IFOAM), which is the international umbrella organisation of national organic certification bodies, has proposed international norms for organic aquaculture.

Organic production is based on four principles.

I. Consumers are entitled to know what they are eating, i.e. what the products contain and how they are produced.
II. The welfare of animals should be taken into consideration in such a way that their natural needs are attended to.
III. The production must be sustainable, i.e. there should be efficient use of resources and minimum pollution.
IV. The food must not contain chemical compounds that are potentially harmful to human beings or to the environment.

In order for a product to be certified as organic, the principles described above must be incorporated into detailed standards of production. In western Europe each country has one or several certification bodies which has specified detailed standards for organic agriculture. Recently, standards have also been introduced for aquaculture in the UK (*Soil Association*, *Food Certification*), Norway (*Debio*) and Sweden (*Krav*). Producers which are certified according to the standards can market their product with the label of the organic certification body. Debio, the Norwegian certification body for organic primary production, certified the products of the salmon farming company Giga, which we have data for.

Section two surveys the literature on the markets for organic agricultural produce in the EU and USA. The relevance of this comparison and why the markets for organic salmon may differ from markets for other organic foodstuffs is also addressed. Section three offers a descriptive and econometric analysis based on the sales data from Giga. Summary and conclusions are provided in section four.

## 2. ORGANIC FOOD MARKETS IN THE EU AND USA

The main problem for an analysis of the demand for organic salmon is that the quantities that have been supplied to the market so far are too small to provide the basis for a traditional econometric demand analysis. For this reason, we examine the empirical evidence from studies of other organic foods, which are produced in larger quantities, to see what lessons we can draw from them.

### 2.1. Regulation of Organic Produce

The EU countries, the United States and Canada all have certification schemes for production of organic food. Historically, regulations for organic production have been designed at the national level, with an independent certification body being responsible for the certification and monitoring of farms. However, there also exists international standards, such as those specified by the world wide umbrella organization of the organic agriculture movement, the *IFOAM Basic Standards of Agriculture and Food Processing*, which specify minimum requirements for organic farming and which influence the design of national regulations.

[1] Due to space constraints we have omitted several sections from the original version of this paper. The full paper is found in Reithe & Tveteras (1998).

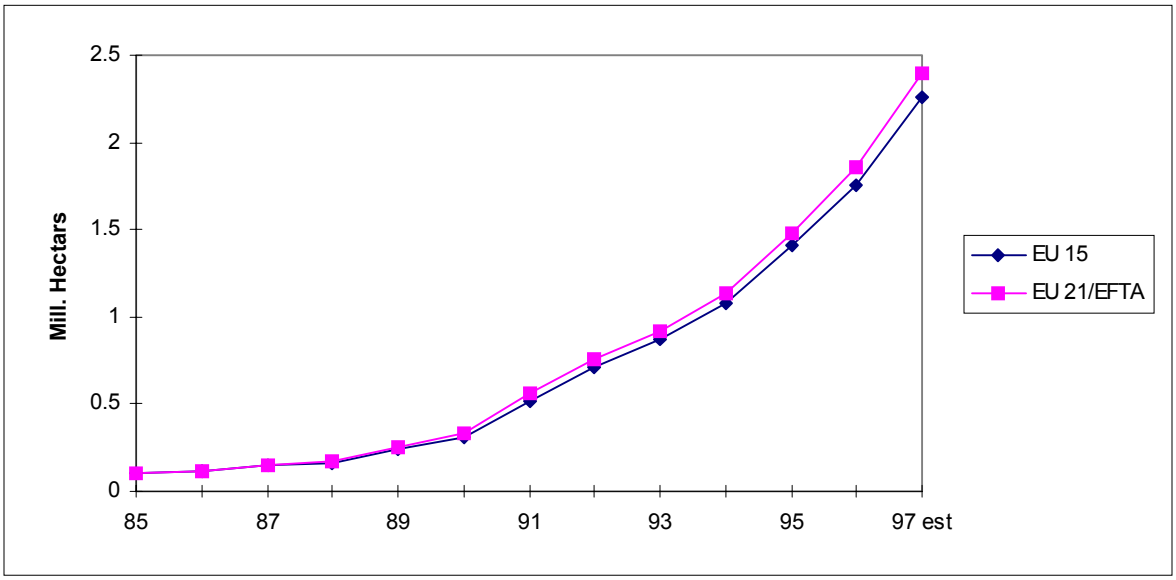


**Figure 1. Certified and Policy-Supported Organic and In-Conversion Land Area in Europe. (Source: Welsh Institute of Rural Studies)**

Furthermore, during the 1990s EU regulations which cover organic production have come into effect. EC directive 2078/92 covers agricultural production methods compatible with environmental conservation and maintenance of the countryside, and EC regulation 2092/91 covers the certification of organic food labelling. Regulation 2092/91/EEC is statutory law and it is directly applicable in all EU member states. Of significance is also the European Union regulation 258/97/EC "Novel Food" and regulation 1139/98 "Repair Regulation" This Regulation is statutory law and directly applicable in all Member States. It regulates the labeling of genetically manipulated organisms (GMOs) in food products. The "Repair Regulation" tries to cover GMO products which were no longer "novel", but on the EU market, when regulation 258/97/EC entered into force May 1997. [2]

In the USA regulation and certification have so far been decentralised, with various state and private certification agencies administering organic certification. Certification may cover individual farm fields, whole farms, processors or distributors. Twelve state governments and 32 private agencies provided organic certification in 1996. The certification programmes vary in size and nature, but standards are fairly uniform among the states and private agencies (Duram, 1998). In 1997 the United States Department of Agriculture (USDA) published a "National Organic Program Proposed Rule".[3] After an extensive hearing round USDA is soon expected to propose official national standards for organic producers, processors and distributors.

[2] Source: http://members.aol.com/schmidt1/index.html.

[3] Published in Federal Register Volume 62. No. 241 on December 16, 1997. See also http://www.ams.usda.gov/nop/rule.htm.

### 2.2. Size of Markets for Organic Produce

Consumers in industrialised countries have expressed growing concern over food safety and the environmental effects of modern agriculture (Misra *et al*., 1991). The question is to what extent these concerns have materialised into changes in purchasing behaviour. Are consumers substituting conventionally produced food with organically produced food, which promises a higher degree of food safety and smaller environmental impacts? Furthermore, are consumers willing to pay a premium for organic produce?

The statistics on the expansion of organic land area suggest that conversion from conventional to organic agricultural production has generally been profitable until now. Although some farmers may switch to organic production on idealistic grounds, profit considerations are probably more important for most of them. There is some evidence from the USA that the first generation of organic farmers entered the market for lifestyle, ecological and health concerns, but that subsequent entrants are mainly motivated by profitability considerations (Lohr & Park, 1995).

Figure 1 plots the dramatic growth of organically farmed land in Europe from 1985 to 1997. The organic land area has grown by an average of 30 % annually in the European Union during this period. Assuming that there is a linear relationship between land used for organic production and output of organic food, the production of organic food has been increasing at an exponential rate since 1985.

**Table 1. Organic Markets in Selected Countries**

| Country | Approximate Retail Value (mill. US$) | Year[a] | Organic Share of Total Food Sales | Import Share of Organic Sales | Average Retail Price Premium |
|---|---|---|---|---|---|
| Austria | 270 | 1997 | 2.5 % | 30 % | 20 % - 30 % |
| Belgium | 75 | 1997 | 1.0 % | 50 % | 20 % |
| Denmark | 190 | 1997 | <3.0 % | 25 % | 15 % - 40 % |
| France | 508 | 1996 | 0.4 % | 10 % | 25 % - 35 % |
| Germany | 1600 | 1997 | 1.5 % | 60 % | 30 % |
| Netherlands | 230 | 1997 | 1.5 % | 60 % | 15 % - 20 % |
| Sweden | 200 | 1997 | 2.0 % | 30 % | 15 % - 50 % |
| United Kingdom | 445 | 1997 | 2.0 % | 70 % | 0 % - 30 % |
| Canada | 68 | 1995 | 1.0 % | 80 % | 30 % |
| USA | 4200 | 1997 | 1.0 % -1.5 % | Not available | Not available |
| Australia | 60 | 1995 | 0.2 % | 0 %-13 %[b] | 12 % - 65 %[b] |
| China[c] | 1200 | 1995 | 6.0 %[d] | 0 % | 30 % |
| Japan[c] | 1700 | 1997 | 1.0 % | 1 % | 20 % - 30 % |

[a] Year given is for retail value data. [b] Varies by state. [c] In this country, organic includes "low chemical". [d] Based on production value, not retail sales.
Source: L. Lohr (1998) and references cited therein.

It is difficult to obtain figures on sales of organic food, since few governments keep statistics. The 1997 organic food market in the EU is estimated to be worth $4.5 billion (Lohr, 1998). According to table 1, Germany ($1.6 billion), France ($508 million) and the United Kingdom ($445 million) have the largest organic retail sales. In the EU 20 % to 38 % of consumers regularly or occasionally purchase organic foods (Lohr, 1998). The market share of organic foods is still relatively small in EU countries, ranging from over 3 % in Denmark to 0.4 % in France.

In the United States 1.13 million acres were certified as organic in 1994, comprising 0.34 percent of the approximately 330 million acres of cropland harvested (Dunn, 1994). It is estimated that sales of organic products have been increasing by 20 percent annually since 1989. In 1996 total sales were estimated at $3.5 billion (Duram, 1998). It is currently estimated to be around $6 billion.[4]

### 2.3. Distribution Channels

Direct or local distribution from producers to consumers is common for organic produce. One reason for this is that consumers are more likely to buy an organic produce when they know the producer. This problem may be remedied by a credible organic label. Another reason is concern about the hidden costs of excessive transportation and packaging on the environment (Powell, 1995).[5]

In Germany it is estimated that 1/3 of organic food is sold through organic food shops, 1/4 through conventional food retailers, and 1/5 through direct marketing such as local markets (Willer, 1998, pp. 83-84). In the Netherlands it is estimated that organic speciality shops sell 75 % of the organic food, while supermarkets have a 20 % share of the organic food market (Willer, 1998, p. 260). In the UK, supermarkets started selling organic food in 1981 (Powell, 1995). The five largest supermarket chains sell organic food, and 70 % of organic food is now distributed via this channel (Willer, 1998, p. 163).

The most important distribution channel in the US is via natural products stores, with sales of 1.9 billion US$ in 1996 (54 % market share). Direct sales to consumers and exports were estimated at $872 million (25 %). Organic sales through supermarkets were around $210 million in 1995 (less than 10 %).

According to table 1 there are large variations in the share of imports in organic foods markets. Within the EU, France imports only 10 % of the organic foods sold domestically, while the UK imports 70 %. Germany and the Netherlands also have high import shares – around 60 %. These figures indicate that proximity to the producer is not a prerequisite for organic consumers.

### 2.4. Price Premiums for Organic Produce

Table 1 indicates that organic foods obtain price premiums between 0 % and 50 % relative to conventional foods in EU countries. In most countries premiums seem to lie at around 15 % to 25 %. However, these estimates should be judged with care, since reliable official statistics are not generally available.

[4] See http://www.usda.gov.

[5] The SAFE Alliance, a coalition of farmer, environmental, animal welfare, consumer and Third World groups, has called for action to promote the marketing of food within the local area and thus reduce global food transportation (Powell, 1995).

**Table 2. Comparison of Organic and Conventional Prices in the United States**

| Crop Commodity And Year | Prices (US$/bu) [a] | | | Price Premium [a] | |
|---|---|---|---|---|---|
| | Organic farm [b] | Conv-CBOT or MGE [c] | Conv-U.S. Cash | Organic-Farm/Conv-CBOT or MGE | Organic-Farm/U.S. Cash |
| Corn, 1995 | 3.46 | 2.83 | 2.56 | 22 % | 35 % |
| Corn, 1996 | 5.12 | 3.86 | 3.55 | 33 % | 44 % |
| Corn, 1997 | 4.50 | 2.77 | 2.60 | 62 % | 73 % |
| Soybeans, 1995 | 12.52 | 6.16 | 5.85 | 103 % | 114 % |
| Soybeans, 1996 | 13.41 | 7.54 | 7.23 | 78 % | 85 % |
| Soybeans, 1997 | 17.80 | 7.66 | 7.40 | 132 % | 141 % |
| Spring Wheat, 1995 | 6.09 | 4.33 | 3.95 | 41 % | 54 % |
| Spring Wheat, 1996 | 7.63 | 5.07 | 4.78 | 50 % | 60 % |
| Spring Wheat, 1997 | 6.49 | 4.00 | 3.74 | 62 % | 74 % |
| Oats, 1995 | 1.97 | 1.64 | 1.46 | 20 % | 35 % |
| Oats, 1996 | 3.17 | 2.06 | 2.00 | 54 % | 59 % |
| Oats, 1997 | 2.96 | 1.64 | 1.71 | 80 % | 73 % |

Source: Dobbs (1998)

[a] Average prices and premiums computed on basis only of months for which organic price data were available.

[b] The organic soybeans refer to Clear Hilum, cleaned.

[c] Chicago Board of Trade (CBOT) for corn, soybeans and oats; Minneapolis Grain Exchange (MGE) for spring wheat.

An extensive analysis of price premiums for organic crops in the US is provided by Dobbs (1998). According to table 2 organic crop provides significant price premiums compared to conventional crops. The premium ranged from 20 % for oats in 1995 to 132 % for soybeans in 1997 when compared to futures prices for conventional crops (i.e. Conv-CBOT or MGE in table 2). When compared to U.S. cash crops the premium ranged from 35 % for corn in 1995 and oats in 1995 to 141 % for soybeans. Overall, prices for certified organic crops were substantially higher than for the same commodities produced by conventional farming methods.

Price premiums for organic grain, milk and milk-products have been estimated for Germany by Dwehus and Meyer (1997), cf. table 3. Based on data from a sample of 49 organic farms they found that grain provides the highest price premium, 139 %, while milk and milk products give a premium of 26 %.

**Table 3. Comparison of Organic and Conventional Prices for Grain, Milk and Milk Products in Germany (DEM)**

| Commodity | Organic Price | | | Conv. Price | Price |
|---|---|---|---|---|---|
| | Average | Min. | Max. | Average | Premium |
| Grain | 56.57 | 34.00 | 120.00 | 23.67 | 139.0 % |
| Milk and milk products | 72.78 | 54.00 | 180.00 | 57.70 | 26. 1 % |

Source: Dwehus and Meyer (1997).

[a] Price difference as percent of average conventional price.

### 2.5. Relevance for Salmon

It is natural to ask to what extent findings from studies of other organic food products have relevance for salmon. Salmon has several characteristics that differentiate it from more 'traditional' organic foods, and which mean that lessons learned from other foods may not always be relevant. Table 4 compares the attributes of traditional organic produce with salmon. One important difference between salmon and traditional organic foods is that the latter are consumed more frequently than salmon. Focus group interviews suggest that some people may be more concerned about the food they eat on a daily or weekly basis, than food that is eaten infrequently.

Most organic food consumed today consists of vegetables, fruit and grain. It is uncertain how current or potential organic consumers will respond to organic meat products. Vegetarians may be overrepresented in this group, which means that they will reject salmon as a part of their diet (Schifferstein & Ophuis, 1998). Others may be concerned about the welfare of the fish. Criticism of organic salmon production due to fish welfare considerations has already emerged. The scepticism against salmon as an organic product is also based on the fact that wild fish is used as an ingredient in the feed (Edwards, 2000). Some argue that this practice is not sustainable, since wild fish stocks may be over-exploited.

**Table 4. Characteristics of Traditional Organic Foodstuffs and Salmon**

| Characteristics | Grain, Milk a.o. Agricultural Produce | Salmon |
|---|---|---|
| Frequency | Consumed daily/weekly | Consumed on irregular basis |
| Market proximity | Local/domestic consumption | Consumed abroad |
| Cosmetic defects | Present for vegetables | Similar to conventional? |
| Animal welfare concerns | Only for milk | Yes, if concerned about fish welfare |
| Distribution channels | Mainly directly to consumers/ specialty shops/ supermarkets | Via importers/wholesalers to retailers/restaurants |
| Differentiation from conventional products | Consumers' perceptions: No chemicals, no genetic manipulation | Consumers fail to perceive any differentiation from conventional salmon? |

The distribution channel from producers to consumers will be longer than is generally the case for organic foods. It is an open question what this will mean for the credibility of organic salmon compared to organic foodstuffs that are produced closer to the consumer. Organic salmon may also be distributed by agents who are not generally associated with organic products (e.g. fish importers), and organic retailers or consumers may have less confidence in these suppliers.

All these factors suggest that organic salmon will have to overcome some barriers which may have been of less importance to other organic foodstuffs.

## 3. ANALYSIS OF DEMAND FOR ORGANIC SALMON FROM NORWAY

Consumption of conventional salmon has grown dramatically in the EU countries from the 1980s. Total consumption was almost ten times higher in 1997 than in 1980.[6] The *per capita* consumption was 0.21 kilo in 1983, but by 1989 it had risen to 0.34 kilo, while by 1996 per capita consumption had increased to 0.86 kilo. In other words, the average EU citizen ate four times more salmon in 1996 than in 1983.

The analysis in this section relies to a large extent on transaction data from the Norwegian organic salmon producer Giga, which has produced fresh salmon in 20kg boxes and smoked salmon in whole sides and 100g, 150g and 200g packages. The products were mainly exported to Switzerland, Germany, Belgium and Japan, but small quantities were also exported to the UK.

The sales data from Giga are rather sparse. In order to obtain a picture of the price development for as long a period as possible, the data for organic smoked salmon had to be aggregated over product types. The aggregation of prices and quantities gave us some problems in terms of the comparability of exports of organic salmon to different countries, between organic and conventional and between periods. It is normally more expensive to produce smaller samples and a higher price does thus not necessarily indicate a higher profit. Differences in the proportions of the various product categories may also cause the price to vary.

Another problem is that the quantities corresponding to the prices of the organic and conventional salmon are vastly different. This means that we are on different points of the demand schedules which are thus not directly comparable unless we can assume that they have the same slope, i.e. that they are parallel. Without this assumption it there is no way to determine whether the difference in price is due to the difference in quantity or due to a price premium generated by the organic production method.

An empirical analysis of price premiums for organic salmon over conventional salmon can draw on the econometric framework which is available for testing the *Law of One Price* (*LOP*). The price relationship between two goods is often expressed as

$$\ln P^1 = \alpha_0 + \alpha_1 \ln P^2,$$

where $P^i$ is the price of good $i$.

The LOP is usually applied in the *geographic space*. In its most simple version LOP states that for identical goods arbitrage should ensure that price differences between separate geographic markets are only due to differences in transportation costs, implying that $\alpha_1=1$ and that $\alpha_0$ is different from zero only if transportation costs differ.[7] In the *product space* LOP can be linked to the discussion in section 2. Goods that have the same attribute vector should of course obtain the same price. If the goods are only marginally different with respects to attributes their market prices should be very similar. As goods become

[6] Inclusion of new member states into the EU have contributed to some of this growth.

[7] See Stigler (1969), Cournot (1971), and Isard (1977) for formulations of LOP.

more distinct with respect to attributes the price differential between the goods should increase. In the extreme case, when the attributes are so different that two goods are no longer considered to be substitutes, a change in one price should not lead to a change in the price of the other, ie. $\alpha_1=0$.

Our analysis is based on the sales data from Giga for 1996 and 1997, with a total of 391 observations. A useful first impression of the price premiums for Giga's organic salmon can be obtained by comparing simple overall average prices. Table 5 compares the average price of Giga's organic salmon products to the average Norwegian export price for conventional salmon products to the same country in the same time period. The table shows that Giga on average obtained a price premium of 23.9% for fresh salmon, and a price premium of 37.5% for smoked salmon.

**Table 5. Average Price of Giga's Organic Salmon and Average Norwegian Export price for Conventional Salmon to the Same Country in Same Time period (in NOK)**

| | No. of observations | Price Organic (NOK) | Price Conv-entional (NOK) | Organic in % of Conventional |
|---|---|---|---|---|
| Fresh | 187 | 33.52 | 27.05 | 123.9% |
| Smoked | 204 | 134.41 | 97.77 | 137.5% |

Source: Giga and Norwegian Fish Export Council.

The next step is to undertake an econometric analysis. A conventional econometric cointegration analysis, which is the natural approach for testing the law of one price, was considered first. However, there are several problems associated with this approach for the current data set. First, the time intervals between organic sales transactions differ. This is problematic since econometric cointegration analysis assumes that observations are evenly spaced in time. Aggregation by month is ruled out since this would provide insufficient observations (20). Nor is weekly (or bi-weekly) aggregation possible, because we have to aggregate different product types (e.g. fresh and smoked salmon) in order to obtain a more or less continuous time series of organic prices. The price series would have been severely influenced by the fact that the volume shares of different product types change from week to week. Aggregation would also have made it impossible to control for other characteristics of the transactions, e.g. type of buyer, destination country. Hence, much relevant information is lost in an aggregation process.

Another problem is the short time span from the first observation to the last observation – January 1996 to August 1997 – which means that there will be limited variation in the price of conventional salmon, which is observed on a monthly basis.

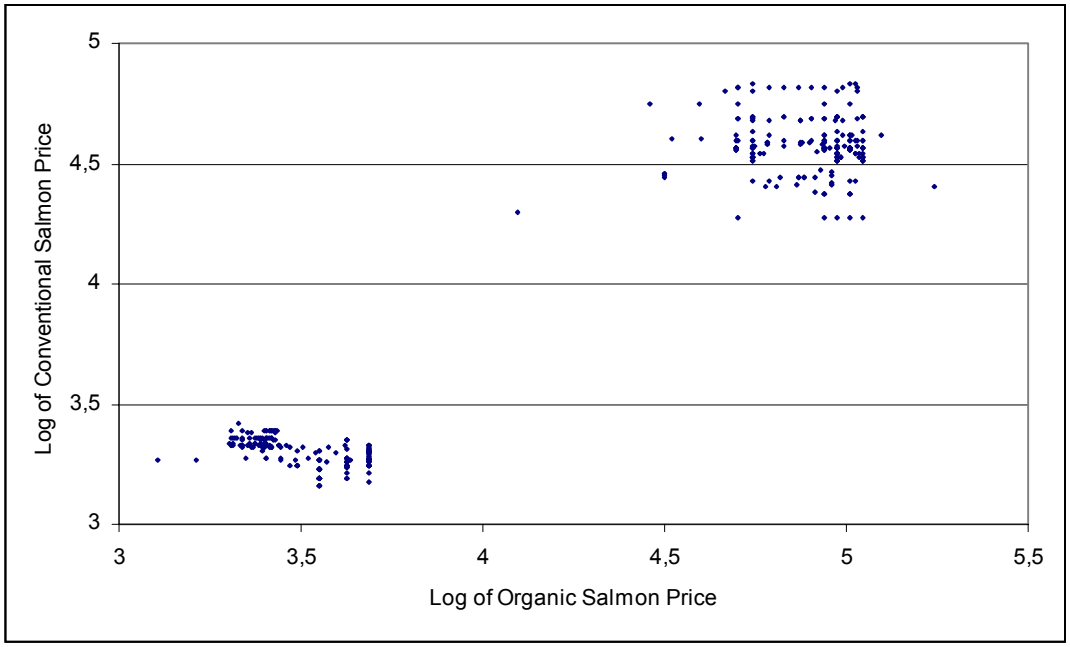


**Figure 2. Plot of Log(Organic Salmon Price) Versus Log(Conventional Salmon Price)**

It is difficult to visually observe any positive correlation between organic salmon prices and associated conventional salmon prices, at least within product groups. This can be seen from figure 2, which plots the logarithm of organic salmon prices versus the logarithm of conventional salmon prices. The dots in the lower left-hand corner of figure 2 are fresh (and a few frozen) salmon price pairs, while those in the upper right-hand corner are smoked salmon price pairs. Within each of the two product groups one can hardly observe any positive correlation between organic and conventional salmon prices. In other words, it is difficult to plot an upward-sloping regression line that fits the data. For the fresh salmon, there seems to be a negative correlation, and for smoked salmon there appears to be no correlation between conventional and organic prices. A positive correlation (or upward-sloping regression line) for the dots in figure 2 can only be found if one combines the two product groups.

Visual analysis of the data gives some cause for pessimism with respect to finding a cointegration between organic prices and their conventional counterparts. We estimated two econometric model specifications which confirmed what the visual analysis suggested, bearing in mind the potential statistical problems associated with the irregular spacing of observations in time.

Which variables should be included in an econometric model? It is reasonable to assume that prices may differ by country and by type of product. Countries may have domestic salmon markets that are structurally different with respect to supply demand and supply conditions, particularly in the less developed organic market segment. For example, the difference in the price of smoked salmon (net of transportation costs) sold to Germany and fresh salmon sold to Japan is substantial (Reithe & Tveteras, 1998). For equivalent products the price also seemed to vary from country to country. How the type of business might influence the price of organic salmon can not be seen from the figures, but it might be reasonable to assume that prices obtained by selling directly to a restaurant would be higher than those obtained from a wholesaler. It was thus thought necessary to include these variables in the model.

Visual inspection of the price series showed that there were no trends or cycles (Reithe & Tveteras, 1998). Furthermore, the series have a finite variance.[8] Thus, they can be treated as stationary series in the econometric analysis, which implies that ordinary least squares estimation is valid.

[8] Ideally, we would have liked to undertake unit root tests. However, unit root tests are not valid for our price series because the observations are not evenly spaced in time.

The most general econometric model specification is given by

$$\begin{aligned}&\mathrm{LN}(\textit{price organic salmon}_i) = \\ &a_0 + a_1 \cdot \mathrm{LN}(\textit{price conventional salmon}_i) \\ &+ a_{2i} \cdot \textit{country}_i + a_{3i} \cdot \textit{product}_i \\ &+ a_{4i} \cdot \textit{business type}_i + \Sigma_m a_{5m} \cdot \textit{month}_m + u_i,\end{aligned}$$

where $i$ denotes transaction and
$\textit{price organic salmon}_i$ = FOB-price of organic salmon in sales transaction $i$
$\textit{price conventional salmon}_i$ = average price of same product category of conventional salmon sold to the same country and in the same month as the organic salmon in transaction $i$,
$\textit{country}_i$ = dummy variable defining country sold to in transaction $i$,
$\textit{product}_i$ = dummy variable defining type of salmon product sold in transaction $i$,
$\textit{business type}_i$ = dummy variable defining the type of business which bought the salmon in transaction $i$,
$\textit{month}_i$ = dummy variable representing the month of transaction $i$.

However, in the first model to be estimated we included only a constant and the logarithm of the conventional salmon price as regressors. According to this model the conventional and organic salmon markets are integrated, and organic salmon provide a statistically significant positive price premium (Reithe & Tveteras, 1998). In the second model we added buyer type dummies, month dummies and a dummy for product type to distinguish between fresh and smoked salmon. When this model is estimated we no longer find that the conventional and organic salmon markets are integrated, according to the coefficient of the conventional salmon price (Reithe & Tveteras, 1998). According to several test statistics model 2 is a more appropriate model specification than model 1.[9]

The most credible estimated model fails to find a significant linkage between conventional salmon prices and organic salmon prices. Nevertheless, the graphic analysis leads us to believe that there is a relationship between these markets. The short data period and a thin market for organic salmon may be the underlying causes for the econometric results.

Let us next examine the price premium of organic salmon relative to conventional salmon. We observed in Table 5 that organic salmon provides a price premium both fresh

[9] Null hypotheses of autocorrelation, autoregressive conditional heteroskedasticity and non-normality are rejected for model 2 but supported in the case of model 1. Furthermore, Ramsey's RESET test rejects misspecification for model 2 but not for model 1.

and smoked. Due to the problems with the previous model specifications we would also like to estimate models in which the price premium is the dependent variable. Two different sets of models have been estimated – one with the absolute difference between the organic and conventional price as dependent variable, and one with the logarithmic difference between the two prices. Table 6 reports the econometric results with heteroskedasticity-consistent t-values.

**Table 6. Regression Models of Price Premium for Organic Salmon Exported by Giga**

| Variable | Price differential in original form | | | | Price differential in logarithmic form | | | |
|---|---|---|---|---|---|---|---|---|
| | Model A | | Model B** | | Model C | | Model D** | |
| | Est. | t-ratio* | Est. | t-ratio* | Est. | t-ratio* | Est. | t-ratio* |
| Smoked | 30.180 | 18.734 | 19.960 | 4.874 | 0.108 | 5.801 | -0.068 | -1.624 |
| Wholesaler | | | 16.680 | 0.993 | | | 0.145 | 0.767 |
| Exporter | | | 19.860 | 1.185 | | | 0.185 | 0.984 |
| Importer | | | 9.301 | 0.550 | | | 0.084 | 0.443 |
| Retailer | | | 29.940 | 1.746 | | | 0.335 | 1.770 |
| Restaurant | | | 24.721 | 1.475 | | | 0.300 | 1.591 |
| Switzerland | | | 5.497 | 2.508 | | | 0.024 | 1.182 |
| Norway | | | -13.783 | -3.408 | | | -0.161 | -3.967 |
| Japan | | | -17.424 | -3.849 | | | -0.370 | -7.724 |
| Belgium | | | -23.574 | -3.477 | | | -0.287 | -5.022 |
| Constant | 6.464 | 16.147 | 3.373 | 0.191 | 0.207 | 16.250 | 0.285 | 1.454 |
| R-squared | 0.455 | | 0.496 | | 0.079 | | 0.380 | |

* White's heteroskedasticity consistent t-ratios. ** Dummies for fresh salmon, Germany and organic buying circle are omitted.

The two simple specifications with only a constant term and a dummy for smoked salmon (models A and C) predict a significant positive price premium for both fresh and smoked organic salmon. However, when buyer type dummies and country dummy variables are introduced (models B and D), the results become less clear-cut. The constant term is no longer significantly positive. Since the data set contains relatively few observations on some combinations of country, type of business and product category, the results should be interpreted with some caution.

According to both models A and B smoked organic salmon obtained a higher absolute price premium. In models C and D, which estimate the determinants of the relative price difference, the coefficient of the "Smoked" dummy has opposite signs.

Models B and D predict that smaller price premiums, both absolute and relative, were obtained in Norway, Japan and Belgium, than in the reference country Germany or in Switzerland.

When we compare the results across buyer types, we find that restaurants and retailers paid the highest price premiums. With the exception of the reference category organic buying circle, importers paid the lowest premiums, followed by wholesalers and exporters.

Overall, the results suggest that price premiums can be obtained for organic salmon. However, these premiums may vary significantly across countries, distribution channels and product categories. Our results suggest that the evolution of organic salmon farming will depend on the ability of producers to identify and develop segments that are willing to pay a premium for organic salmon.

## 4. SUMMARY AND CONCLUSIONS

This paper has attempted to shed some light on the market potential for organic salmon.

Section three showed the impressive growth in organic production that has taken place in Europe during the past decade. The figures suggest that demand for organic produce has been growing at an increasing rate. This suggests in turn that there is a growing potential for other organic food products, such as organic salmon. Organic foods' market share of the total food market was still small at the end of the 1990s, typically 1-2% in the EU and North America. The organic food market was estimated to be worth 4.5 billion US$ in the EU in 1997, and 3.5 billion US$ in the US in 1996.

Direct or local distribution has been more usual for organic foods than for conventional foods in industrialised countries. Organic speciality shops have also been an

important distribution channel. However, distribution is now shifting to conventional supermarkets. With increasing volumes of organic foods being supplied to the market it will be necessary for organic producers to exploit distribution channels which reach a larger number of consumers. This development coincides with the entry of the agro-business industry into the organic market segment, a niche which until recently has been occupied by small-scale producers who have often had other than a financial motivation for entering organic production.

Although volumes have reached considerable levels for some organic foods, studies suggest that large price premiums over conventional foods can still be obtained. This has been demonstrated for crop commodities such as corn, soybeans, spring wheat and oats.

It is reasonable to believe that consumers will demand a greater variety of organic food products in the future, and that this demand will also extend to organic fish products. On the other hand, some degree of caution with respect to the market potential for organic salmon would be appropriate, at least in the short run, since there exist some important structural differences between salmon and traditional organic produce.

Section four analysed the sales of organic salmon made by a Norwegian producer. The sales records suggest that it is possible to obtain price premiums compared to conventional salmon. However, it is difficult to say at what volumes these premiums will disappear or become too small to sustain organic production. This will depend among other factors on the credibility of organic labelling and to what extent consumers are drawn further towards organic food in the future.

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