ORGANIC SALMON – CONSIDERED A FISHERIES OR AGRICULTURAL PRODUCT AMONG CONSUMERS?

Ankamah-Yeboah Isaac*, Max Nielsen, Rasmus Nielsen

Department of Food and Resource Economics, Faculty of Science, University of Copenhagen, Denmark
*Corresponding author. Tel: +45 353-33755 Email: iay@ifro.ku.dk

ABSTRACT

The year 2016 is groundbreaking for organic aquaculture producers in EU, as it represents the deadline for implementing a full organic life cycle in the aquaculture production. Such a shift induces production costs for farmers and if it should be profitable, they must receive higher prices. This study identifies the price premium on organic salmon in the Danish retail sale sector using consumer panel scanner data for households by applying the hedonic price model. A premium of 20% for organic salmon is found. Since this premium is closer to organic agriculture products than to ecolabelled capture fisheries products, it indicates that consumers consider organic salmon as an agriculture product more than fisheries product.

Keywords: price premium, organic seafood, fisheries ecolabel, salmon

JEL Classification: C23, D12, Q11, Q22
1. Introduction

As the year 2016 approach for EU’s implementation of the full organic aquaculture production life cycle, producers are skeptic given the resulting upward shift in production costs. A higher price is needed to maintain profitability and the necessary condition is consumers’ identification of organic seafood products.

The purpose of this article is to reveal whether there exists a price premium for organic farmed salmon products in the Danish retail market. The paper questions further, whether organic farmed salmon is considered a “fisheries” or “agricultural” product among consumers. This is an implication of the size of the estimated price premium. The estimated premium is therefore compared to the magnitude of price premiums found in literature for ecolabelled fisheries (Marine Stewardship Council) and organic agricultural products. The workhorse for the study is the hedonic price model.

The study is important in contributing to the lack of literature on the evidence of revealed organic price premiums in an emerging seafood market. Though the implication has benefits for producers in Norway\(^1\), Scotland and Faroe Islands for the case of salmon, it is motivating for substitute products like organic trout for which Denmark is the leading producer.

Environmental friendliness has for decades become a major part of the food production process and consumer food choice decisions, and more recently in the seafood sector. Despite the established importance of seafood as a global source of protein, nutrition and health benefits (FAO, 2012; Daviglus et al., 2002; Brunsø et al., 2008); there has been growing concerns about the environmental impacts of the production process (Asche et al., 2012; Roth et al., 2000; Asche and Bjorndal, 2011). The traditional “command and control” techniques have been recognized to be inadequate on their own to address these concerns (Nielsen 2011, 2012 and Nielsen et al 2013). Market based incentives such as eco-labelling (Roth et al., 2000) has emerged as an auxiliary instrument. Eco-labelling permits consumers to identify eco-food products and if valued positively has the tendency of providing a win-win situation by increasing consumer utility, offsetting extra costs incurred by producers and subsequently profit increments. The most dominant and studied is the Marine Stewardship Council (MSC) in the fisheries sector (MSC, 2014, Roheim et al., 2011). The Aquaculture Stewardship Council established in 2010 is also emerging for farmed fish (ASC, 2014). Following the introduction of the EU Regulation 710/2009 in 2010, the EU organic aquaculture ecolabel was also introduced that is accepted by member states. There are many other national and private organic aquaculture labels. To build on consumer confidence, certified organic farmed fish in Denmark are labelled with the well-established and known label – a red Ø, which is financed and controlled by the Danish government.

Most studies rely on stated preference methods to establish willingness to pay for ecolabelling in the seafood market (e.g. Olesen et al. 2010). Those relying on actual market data are limited and evidences provided include the existence of about 13% price premium for both salmon (Asche et al., 2012) and cod and haddock (Sogn-Grunvåg et al., 2014), 10% for chilled haddock (Sogn-Grunvåg et al., 2013), 14% for frozen Alaska pollock (Roheim et al., 2011), all in the UK market for MSC. For organic salmon, about 25% price premium is found in the UK (Asche et al., 2012). A mean price difference of 10% is estimated for MSC Baltic cod in Sweden (Blomquist et al., 2014) and 24% and 38% for organic fresh and smoked salmon respectively in Norway (Aarset et al., 2000). For eco-labelled agricultural products, there is evidence of price premiums ranging from 15-60% in UK and Danish markets for various products (Wier et al., 2008 and Baltzer, 2004). Generally, organic price premiums for agricultural products appear to be larger than the range 10-14% identified for the fisheries eco-labels.

\(^1\) Norway, though not a member, follows the EU rules on organic aquaculture since the EU market is important for Norway (Anonymous expert opinion).
Using a consumer panel data, this study establishes that there is a premium of about 20% for organic salmon. The magnitude of the premium implies consumers consider organic farmed fish as agriculture rather than fisheries. Hence the higher cost of producing organic fish is compensated by a higher willingness to pay from consumers. This is first-hand good news for producers based on the assumption of transmittal of price differences. However, since the organic seafood is an emerging market, economies of scale could lower production costs and decrease the size of the premium over time.

The article is organized as follows; the next section introduces the Danish seafood market followed by a description of data used for the analysis. The theoretical model and the empirical specification are then discussed before presenting the empirical results and finally the conclusion.

2. The Danish Seafood Market

Denmark is the sixth largest exporter of fish and fishery products in the world (FAO, 2012) and has a long and well established tradition for aquaculture production. It plays a major role in EU self-supply of fresh fish (Nielson et al., 2012) with Germany being the largest destination market (Nielson et al., 2011). The total annual aquaculture production is about 43,000 tonnes of which 90 percent is exported. The most dominant species produced is rainbow trout which constitutes 90 percent of the production (Statistics Denmark, 2014). In 2014, Denmark became the largest producer of organic trout by passing France with a production volume of 1080 tonnes. The production of salmon is modest. Norway, Scotland and Faroe Islands are the most important salmon markets serving the Danish import demand (Asche and Bjorndal, 2011). Exports of seafood are equally as important as imports because of its role as an intermediary transit market (Eurofish, 2007) and the importance of the fish meal and oil processing industries. The imports of salmon are fairly evenly divided into fish that are re-exported with little or no processing and fish that are used for processing (Asche and Bjorndal, 2011).

The local market is limited due to its small population; however the per capita consumption of 24 kg/year/per capita is relatively high. The domestic supply outlets include supermarket chains, independent fish-mongers/specialized stores, online retailing, restaurants and catering services. Supermarket outlets command the largest share of the supply followed by fish-mongers. According to Brunsø et al. (2008), the most frequently consumed fish species and their consumption shares include herrings (22%), tuna (19%), mackerel (17%), salmon (11%) and plaice (10%). Canned, marinated and fresh fileted fish are the three most frequent product categories. In 2008, Fisheries Economy (2011) estimated salmon to be the most consumed fish in terms of value (DKK 1200 million) in Denmark followed by cod (DKK 940 million). The value of fresh salmon consumed was DKK 534 million, smoked salmon DKK 464 million and frozen salmon DKK 210 million. The total domestic fish consumption was about 127,000 tonnes.

The domestic consumers have been active in the sustainable food market, ranking the second highest for per capita organic food consumption and the first for organic market share (FiBL and IFOAM, 2014). The first organic fish (i.e. trout) hit the retail market in 2005 (Larsen, 2014). All organic salmon products are from imports. Organic fish is labelled with the Danish red-Ø label since it is well known and accepted among most consumers. MSC eco-labels can also be found in retail shelves. The

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2 Perfect price transmission can rarely be the case since intermediary markets (processors and retailers) may tend to exercise their market power to retain price margins. Further study beyond this is needed to show if eco-labelled price premiums are transmitted along the value chain and if any, whether what is received can cover the extra production costs incurred.

3 Danish import from EU in 2012 was estimated at 436,800 tonnes (3,800 million DKK) and exports, 575,100 tonnes (13,800 million DKK).
consumption of fish is motivated by health benefits, availability, convenience, taste and traditions and to a limited extent income. High prices however, deter consumers from purchasing (Nielsen, 2000). Frequency of fish consumption for elderly people is at least twice as young people (Olsen, 2004). On the average, the consumption frequency is 1.4 times a week compared to the European average of 1.5 and the recommended level of twice a week (Brunsø et al., 2008).

3. Data

In order to determine the existence and magnitude of retail price premium for organic-labelled salmon products, the analysis was based on scanner data. The use of scanner data from retail sales of products became widely employed in the 1980s (Roheim et al., 2011). The data used in this study originates from GfK Panel Services Denmark that among other things maintains a demographically representative consumer panel of Danish households. We consider an emerging organic fish market for which observations were only recorded starting from the year 2011. Hence, observations span from 1 January, 2011 to 31 December, 2013. The data contains the daily purchases of over 2000 households, with about 20% of the households replaced each year by similar type of households. The data can best be described as a refreshed panel data⁴. Unlike the traditional panel data, we observe repeated time values that cannot be aggregated over time to provide unique values (i.e. households report multiple purchases at a single point in time for salmon products with different characteristics)⁵. Aggregation would lead to loss of information especially for the organic products since it represents a small fraction of the total observations. Since households do not purchase goods in a continuum of time, say every week, observations are reported in an irregularly spaced time intervals to reflect their shopping trip and purchasing behavior over time.

For each shopping trip, the household reports the purchases of food including the date and time of purchase, the shop name, the expenditure and volume of product purchased. For each unit of salmon purchased, households report information on whether the product had/was: organic label; brand or private label; fresh or frozen; smoked, marinated, breaded, stuffed or other processed form; filleted or whole fish, purchased on a special offer or at normal price. A summary statistics of data and description of variables obtained to estimate the model are presented in Table 1. Some drawbacks to the GfK data identified are that, it does not identify the kind of organic label (e.g. the Danish Ø-red logo) indicated on the product. Likewise, the name of the brand or private label is not identified. The brand-private label characteristic has no relation with organic or any environmental label, but identifies whether the package label was that of the supplier (brand label) or customized to the retailer (private label).

After subsampling household salmon purchases and removing unusable observations (such as observations without any descriptive information, errors/outliers in data), we were left with 18,471 observations from 2,342 households. The volume of purchase measured in grams was converted to kilograms while the value of purchase was divided by the volume to retrieve the price per kilo (DKK/Kg). The mean of the dummy variables shown in Table 1 represent the fraction of the total observations for the respective attributes. For instance, organic salmon products represent about 0.3% of the total number of observations used in the analysis while salmon fillets represents about 90% relative to whole-fish purchases. The organic market share of the data was about 0.5% of the total

⁴ See Fitzmaurice et al. (2012) and Frees (2004) for a discussion of features of data types with repeated observation.

⁵ This presents a challenge in modeling the time series property of the data such as temporal autocorrelation. Autoregressive models are less appealing for unequally spaced data.
salmon market sales in volume. Inflation over the study period has been quite low and hence we do not expect it to affect food prices much in this short period, hence the model was estimated with the nominal market prices.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Variable Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price_Dkkkg</td>
<td>158.73</td>
<td>65.50</td>
<td>Price measured in DKK per Kg</td>
</tr>
<tr>
<td>Organic Price</td>
<td>190.98</td>
<td>109.06</td>
<td>Price of organic salmon in DKK per Kg</td>
</tr>
<tr>
<td>Conv. Price</td>
<td>158.63</td>
<td>65.31</td>
<td>Price of conventional salmon in DKK per Kg</td>
</tr>
<tr>
<td>Ln(price)</td>
<td>4.98</td>
<td>0.44</td>
<td>Log of price</td>
</tr>
<tr>
<td>Volume (Vol)</td>
<td>0.28</td>
<td>0.23</td>
<td>Volume purchased in Kg</td>
</tr>
<tr>
<td>Organic (Org)</td>
<td>0.003</td>
<td>--</td>
<td>Dummy variable: 1 if organic, 0 otherwise</td>
</tr>
<tr>
<td>Brand (Br)</td>
<td>0.77</td>
<td>--</td>
<td>Dummy variable: 1 if brand label, 0 private label</td>
</tr>
<tr>
<td>Fresh (Fr)</td>
<td>0.86</td>
<td>--</td>
<td>Dummy variable: 1 if fresh, 0 frozen</td>
</tr>
<tr>
<td>Pr_Smoked (Prc)</td>
<td>0.50</td>
<td>--</td>
<td>Dummy variable: 1 if smoked, 0 otherwise</td>
</tr>
<tr>
<td>Pr_Marinated (Prc)</td>
<td>0.22</td>
<td>--</td>
<td>Dummy variable: 1 if marinated, 0 otherwise</td>
</tr>
<tr>
<td>Fm_Fillet (Fi)</td>
<td>0.90</td>
<td>--</td>
<td>Dummy variable: 1 if fillet, 0 whole fish</td>
</tr>
<tr>
<td>Specoffer (Sp)</td>
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<td>--</td>
<td>Dummy variable: 1 if on special offer, 0 normal price</td>
</tr>
<tr>
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<td>--</td>
<td>Dummy variable: 1 if year 2011, 0 otherwise</td>
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<tr>
<td>Year_2013</td>
<td>0.34</td>
<td>--</td>
<td>Dummy variable: 1 if year 2012, 0 otherwise</td>
</tr>
<tr>
<td>Year_2011</td>
<td>0.30</td>
<td>--</td>
<td>Dummy variable: 1 if year 2013, 0 otherwise</td>
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<td>Season1 (Se)</td>
<td>0.23</td>
<td>--</td>
<td>Dummy variable: 1 if quarter 1, 0 otherwise</td>
</tr>
<tr>
<td>Season2 (Se)</td>
<td>0.26</td>
<td>--</td>
<td>Dummy variable: 1 if quarter 2, 0 otherwise</td>
</tr>
<tr>
<td>Season3 (Se)</td>
<td>0.23</td>
<td>--</td>
<td>Dummy variable: 1 if quarter 3, 0 otherwise</td>
</tr>
<tr>
<td>Season4 (Se)</td>
<td>0.24</td>
<td>--</td>
<td>Dummy variable: 1 if quarter 4, 0 otherwise</td>
</tr>
</tbody>
</table>

Notes: Abbreviations in parenthesis were used in the model expression (see below).
Source: Authors own calculation

4. The Hedonic Price Model

Recognizing the inability of neoclassical theory of consumer demand to explain why consumers derive utility from commodities and predicting the demand for new products, the characteristics theory (hedonic price model) was proposed by Lancaster (1966, 1971) to address some of these inherent limitations (Smith et al., 2009). Although Bartik (1987) note that the first formal contributions to hedonic price theory were made by Court (1941) and Tinbergen (1951, 1956), earlier application has been referenced to Waugh (1928) who study the quality factors influencing prices of vegetables. The Waugh (1928) introductory section also makes note of earlier applications to other agricultural commodities. The application of the hedonic model was however pioneered by Rosen (1974) and has since been widely used in the literatures on housing, environmental economics, labour markets and gaining attention in marketing and industrial organization (Bajari and Benkard, 2005). The Lancastrian theory presumes that consumption is an activity for which goods, singly or in combination, are inputs and in which the output is a collection of characteristics. This theory plays a crucial role and lays the necessary conceptual framework in the development of modern hedonic analysis (Huang and Lin, 2007). Rosen further refined this theory with particular emphasis on market equilibrium.

The hedonic approach postulates that goods are made up of a myriad of attributes that combine to form bundle of characteristics which the consumer value. The demand for various desired characteristics can be estimated from consumer willingness to pay for a product. As such, the marginal or implicit values can be imputed for each attribute at the observed purchase price linked to the myriad
of attributes contained in the good. The hedonic model operates on the premise that consumers and producers consider the same set of attributes when valuing a good. As a result, the choices each group makes lead to an equilibrium condition that neither have any incentive to change. The equilibrium price determination introduced by Rosen (1974) requires simultaneous estimation of both supply and demand equations. Following Wilson (1984), we make the implicit assumption that the supply of product attributes is perfectly inelastic with respect to its marginal implicit price in any given time period. Given such assumption, the empirical hedonic price model requires only market clearing prices rather than both demand and supply schedules (Kim and Chung, 2011).

The retail market for salmon meet consumer needs by differentiating products. Products are presented with different brand labels, eco-labels, processed forms and other desirable characteristics. Due to the heterogeneous nature of the products, the determination of organic premium from observations of prices alone becomes a challenge. The hedonic framework permits the estimation of the price for organic characteristic that is distinct from the other characteristics. Consider a consumer’s purchase of a unit of salmon. Salmon consists of \( n \) component characteristics: \( z = z_1, z_2, \ldots, z_n \). Consumers maximize utility subject to a nonlinear budget constraint where utility is a function of a numeraire good, \( x \), and the purchase of the differentiated good, \( z \) (the vector of characteristics). Thus,

\[
\max U(x, z) \quad \text{s.t.} \quad m = x + p(z_i)
\]  

(1)

Here \( m \) represents the total income available and the consumer is assumed to choose a bundle of product that optimizes the total combination of product characteristics to maximize utility. Utility is maximized when the marginal rate of substitution between a characteristic \( z_i \) of the product and the composite good is equal to the marginal price of \( z_i \). The solution to the first-order conditions from the constrained optimization for price yields the standard hedonic price equation:

\[
p_i = f(z_i)
\]  

(2)

where the price of a heterogeneous good is a function of product characteristics. The derivative of price with respect to the \( i \)th characteristics yields the implicit marginal price of that characteristic all things being equal. Our goal is to estimate equation 2, also known as the first-stage hedonic price function. In this stage, the observed market clearing prices are regressed on the product characteristics. The derivative of price with respect to an attribute gives the marginal implicit price of that attribute.

5. Empirical Model Specification

Generally, economic theory does not provide guidance for the specification of hedonic price model functional forms. While some researchers make assumption of the functional forms, this can lead to incorrect conclusions and therefore, using the data to determine the appropriate functional form is recommended (Faux and Perry, 1999). The Box-Cox transformation of the dependent variable which improves the normality of a variable (Box and Cox, 1964, 1982) was used to test for the functional form where the log-linear model is selected over other alternatives. This functional form aids with the ease of interpretation of parameter estimates and shows the nonlinear relationship between prices and

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6 The nonlinearity of the budget constraint fulfills that arbitrage of characteristics is not possible. Hence, product attributes cannot be disentangled and repackaged.
product attributes. Following this, we expand the hedonic price function in equation 2 in a log-linear form of salmon price for product $i$ at time $t$ and represent it as:

$$\ln P_{it} = \alpha + b Vol_{it} + \beta \text{Org}_{it} + \delta \text{Br}_{it} + \phi \text{Fr}_{it} + \sum_{n=1}^{p-1} \gamma_n \text{Prc}_{nt} + \phi \text{Fi}_{it} + c \text{Sp}_{it} + \sum_{j=1}^{s-1} \theta_j \text{Se}_{it} + e_{it}$$ \hfill (3)

The equation above is estimated by ordinary least squares where the description of variables are as represented in Table 1. Since the data spans over multiple years, it is possible to include year dummies to exploit the year to year price changes. The estimation of equation 3 is based on the assumption of independent observations.

The data represents a structure where reported observations or purchases of salmon are nested within households. In such a situation, observations from household units are most likely non-independent. Thus, observations from the same household are more likely to be similar than observations from different households. The estimation of non-independent observations with ordinary least squares methods leads to incorrect conclusions because the parameter estimates and their standard errors become biased and inefficient (Andreß et al., 2013; Musca et al., 2011). We therefore consider the class of longitudinal models able to account for such nesting structure of the data and operate on the assumption of independence across household units, but not with each household’s observation. The basic idea in this application is that there may be some natural unobserved household heterogeneity that allows households to choose prices that may be high or below the average market price. For instance, households may be naturally attracted to shops with high/low salmon prices than the average. Alternatively, organic consuming households are more likely to choose organic products on subsequent shopping trips than non-organic households.

The choice of models used to handle the unobserved characteristic (i.e. household heterogeneity) is usually the fixed effect and random effect models. While fixed effects analysis only support inference about the sampled households, the random effects allows one to make inference about the entire population from which the sample was drawn. The random effect appears to fit our analysis since we are estimating hedonic model to derive organic premium for a representative population in Denmark. Therefore we consider a variant of random effects model called multilevel model (MLM)\(^7\); a general class of models that takes into account the nesting structure (i.e. non-independence) of the data. The simple random intercept version was considered with 2 level modeling; observed products purchases (level 1 unit) nested in household units (level 2 unit). Most often both the unconditional and conditional models are estimated in order to estimate the amount of variation explained by the independent variables. The unconditional random intercept model can be written as:

$$\ln P_{ij} = a + u_j + e_{ij}; \ i = 1...n \ \text{products,} \ \ j = 1...m \ \text{households}$$ \hfill (4)

The conditional model with the product attributes is also specified by expanding the equation 4 as:

$$\ln P_{ij} = a + b Vol_{ij} + \beta \text{Org}_{ij} + \delta \text{Br}_{ij} + \phi \text{Fr}_{ij} + \sum_{n=1}^{p-1} \gamma_n \text{Prc}_{nj} + \phi \text{Fi}_{ij} + c \text{Sp}_{ij} + \sum_{h=1}^{s-1} \theta_h \text{Se}_{ij} + u_{0j} + e_{ij}$$ \hfill (5)

In equation 4 and 5, we change the notation of subscripts to denote household $j$ (level 2 unit) observe the purchase of product $i$ (level 1 unit) at multiple occasions. In simple terms if one considers

\(^7\) Multilevel models are also referred to as mixed-effects model.
an intercept only model of equation 3, then the purchase of product \( i \) by household \( j \) is given by a function of market wide price \( \alpha_0 \) plus a differential \( u_{0j} \) for each household \( j \) (referred to as household heterogeneity or level 2 unit or household residuals): \( \alpha = a + u_j \). The right side of equation 5 can therefore be divided into two parts in the language of multilevel models: (1) fixed effects (comprising of the parameters to be estimated) and (2) random effects (made up of the level 2 residuals and the idiosyncratic error/level 1 residuals, \( e_{ij} \)). The error terms are assumed to be normally distributed; \( u_j \sim N(0, \sigma_u^2) \) and \( e_{ij} \sim N(0, \sigma_e^2) \). The model can be expanded by including the household unit characteristics as explanatory variable which is not the focus of this study since we are modeling equilibrium prices based on the assumption that the consumer and producer are operating optimally such that none can alter prices. Also, the first stage of the hedonic model is traditionally an estimation of prices on product characteristics.

6. Estimation Results

Reports on the coefficient estimate and goodness-of-fit of models estimated from equation 3 (OLS) and 5 (MLM) are shown in Table 2. Overall, both models were highly significant since a joint test of all independent variables show a \( P \)-value < 0.01 using an \( F \)-test for OLS and \( x^2 \)-test for the MLM. The OLS model showed an \( R^2 \) of approximately 0.48, indicating that the independent variables explain about 48\% of the total variation in prices. The MLM model on the other hand presents two different \( R^2 \) for both the level 1 and level 2 units. The computed Snijder and Bokser (1999, 1994) \( R^2 \) indicates that the independent variables explain about 48\% of the variation in prices while the unobserved household heterogeneity (level 2 unit) explains about 52\% of the variation in prices. A likelihood ratio test of \( H_0: \sigma_u^2 = 0 \), rejected the null indicating that a model with the unobserved household heterogeneity provides a better fit. The intra-class correlation not reported in the MLM estimation output was 0.29 and indicates the correlation of measurements reported by the same household. Variants of the models were estimated with the inclusion of year dummies, weekly and monthly trends in order to control for price changes. However, these were not significant and therefore have been dropped from the model.

The values reported for the Akaike Information Criterion\(^{10}\) for the two models presented in Table 2 indicate that the MLM provides the better fit. Given this selection, we restrict the interpretation of the parameter estimates to the MLM model. One can however see that there is robustness in the parameter estimates between OLS and the MLM except for the organic variable. The parameters were estimated by acknowledging the presence of heteroskedasticity; hence heteroskedastic (cluster for MLM) robust standard errors were estimated.

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\(^8\) In repeated time value data with sparse observations, it is unappealing to use time series operators such as lags or differences.

\(^9\) If \( \sigma_u^2 = 0 \), then the linear regression model (OLS) provides a better fit (thus the \( u_j \) should be omitted from the model).

\(^{10}\) Bayesian Information Criterion values not reported show similar pattern.
Table 2  Parameter Estimates

<table>
<thead>
<tr>
<th>Variables</th>
<th>---------OLS---------</th>
<th></th>
<th>---------MLM (Random Intercept)-------</th>
<th>Cluster Rob. Std. Error</th>
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<tbody>
<tr>
<td></td>
<td>Coefficient Estimate</td>
<td>Robust Std. Error</td>
<td>Coefficient Estimate</td>
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</tr>
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<td>Volume (Kg)</td>
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<td>0.021</td>
<td>-0.503***</td>
<td>0.028</td>
</tr>
<tr>
<td>Organic</td>
<td>0.363***</td>
<td>0.033</td>
<td>0.180***</td>
<td>0.061</td>
</tr>
<tr>
<td>Fresh</td>
<td>0.294***</td>
<td>0.008</td>
<td>0.263***</td>
<td>0.011</td>
</tr>
<tr>
<td>Pr_Marinated</td>
<td>0.265***</td>
<td>0.008</td>
<td>0.258***</td>
<td>0.011</td>
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<tr>
<td>Pr_Smoked</td>
<td>0.248***</td>
<td>0.007</td>
<td>0.239***</td>
<td>0.011</td>
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<td>0.053***</td>
<td>0.010</td>
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<td>0.021***</td>
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<td>Special offer</td>
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<td>Season1</td>
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<td>-0.005</td>
<td>0.006</td>
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<tr>
<td>Season2</td>
<td>-0.014**</td>
<td>0.006</td>
<td>-0.013**</td>
<td>0.006</td>
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<tr>
<td>Season3</td>
<td>0.034***</td>
<td>0.007</td>
<td>0.026***</td>
<td>0.006</td>
</tr>
<tr>
<td>Constant</td>
<td>4.712***</td>
<td>0.015</td>
<td>4.718***</td>
<td>0.019</td>
</tr>
</tbody>
</table>

\[
\sigma_u^2 = 0.030 \\
\sigma_e^2 = 0.074 \\
AIC = 9777 \\
Prob > LR-x^2 (\sigma_u^2 = 0) = 0.000 \\
Prob > F/x^2 = 0.000 \\
R_1^2 = 0.477 \\
R_2^2 = 0.476 \\
\]

Observations 18,471  Number of Households 2,342

***, **, * indicates significance at p<0.01, p<0.05, p<0.1. MLM, multilevel model. \( \theta \) is parameter estimate.

All parameter estimates of product attributes appear to have the expected sign, according to economic theory or logical reasoning. Considering the volume of salmon products purchased, we observed a negative parameter estimate that is significant at the 5 percent level. The negative relationship between volume and the natural logarithm of price is an indication of a nonlinear price-quantity discount. The larger the quantity of a product purchased, the lower the marginal increase in price. Depending on the initial volume of salmon purchased, the extra kilogram purchased could be discounted by about 50 percent, ceteris paribus.

The remaining variables were dummy variables and their individual coefficients can be interpreted as the percentage change in price for a change in the reference attribute to the preferred attribute if the parameter is multiplied by 100, i.e. 100 * \( \beta \). For instance considering the parameter of the variable organic, which is the focus of this study; we can say that there was the existence of a premium of about 18%. However, a more precise percentage premium results from subtracting 1 from the exponential of the parameter \( (e^{0.180} - 1) * 100 \), as that represents the proportionate difference, ceteris paribus. These precise estimates are reported in the last column of Table 2 for the dummy variables. Hence, we note that there is the existence of a premium for organic salmon in retail markets in Denmark given that it was highly significant at the 1 percent level. Households in Denmark therefore pay a premium of
about 19.7% over the conventional salmon products after accounting for other product attributes. Estimates from the OLS indicates consumers are paying a premium of about 44 percent for organic salmon if one was to discard the assumption of non-independence and the fact that observations were repeatedly observed from the same household units.

From the data, we observed that salmon products were presented as either fresh or frozen products. The estimation indicates that households tend to attribute a higher value to fresh salmon products compared to frozen products. As shown above, fresh products commanded about 30% extra price over frozen ones, *ceteris paribus*. Likewise, some value is added to products to meet the heterogeneous preferences of consumers by further processing. Processed product groups identified in the data were marinated, smoked, breaded, stuffed and other unidentified products. The last three of these processed products were not significantly different in price valuations and so were combined as the reference group. The results indicate that salmon consuming households in Denmark have higher preference for smoked and marinated salmon. The smoked and marinated salmon products respectively commanded about 27% and 29% extra price compared to the stuffed, breaded and other processed products, holding other attributes fixed. Roheim et al. (2011) argued in similar results that these so called “value added” products such as breading, battering or stuffing could actually be a process form that masks some of the quality control issues generated along the supply chain, hence belittling the level of consumer trust.

Product branding has in the last decades become a marketing tool for differentiating products by retailers. Salmon products are identified with supplier brand labels. However, retail chains have preference for their own custom private labeling from the main producers. The data therefore distinguishes products with brand labels from private labels. Our analysis reveals that significant differences exist between the two labels with consumers valuing the brand labels with a magnitude of about 2% extra after controlling for other product attributes. Brand-private labels are competition strategies in the retailing market. As stated in Sogn-Grunvåg et al. (2014), private labels strategically may come as economy packs that seek a ‘value for money’ position with low priced acceptable quality similar to the supplier brands. Alternatively, they may be used as premium labels to present the consumer with greater choice and build retailing image. The former appears to be the case of Danish retailers in the salmon market.

Moreover, consumers tend to like salmon fillets than whole-fish as they appear to place a value worth approximately 5% on fillets. This could be explained by the fact that fillets are more convenient and easy to prepare. As explained earlier, convenience is a major determinant for seafood consumption among the Danish consumers and it is no surprise one would pay more for fillets compared to whole-fish. Sometimes, the salmon products were sold in the retail chains at a discount for various reasons. The magnitudes of the discount differ with retail shops as well as when they near the expiry dates. Controlling for discounted salmon products revealed that products were on the average approximately 17% lower than the normal average market prices if discounted.

Lastly, we used quarterly dummies to account for seasonality as defined in Table 1. It was evident that prices observed in the first season (January - March) were not significantly different from the reference season, season four (October - December). However, we observed that prices were significantly lower in season two (April - June) and higher in the third season (July - September). The third season appears to suite the summer season when prices were higher than all the other periods. An expanded form of the model was estimated to examine the individual month-to-month variation in salmon prices. Prices were not significantly different from November to February and in March and April. Prices were significantly higher in the remaining months. The highest prices were observed in

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11 This model was not presented since it neither changed the estimates of the other parameters nor the model fitness significantly.
July and August with respective premiums of 5 percent and 6 percent above the reference December prices. This was not surprising in that, salmon is a seasonal commodity where most growth occurs in summer/early fall. As with other seasonally perishable commodities, volatility is greatest just prior to the period of harvest due to low stocks (Oglend, 2013). Hence, the generally held notion of “boosted Christmas prices are not a general rule (Forsberg and Guttormsen, 2006)” for the salmon market in Denmark just as in Norway (ibid).

7. Conclusions

In this study, a hedonic price model is used to disentangle the marginal values of salmon product attributes with the aim of identifying whether a significant price premium exist for organic products. A consumer panel scanner data for salmon purchases in the Danish retail market is used to estimate a random effect model and an ordinary least squares model. The former is selected based on model selection criterions. The findings indicate that there is about 20 percent price premium for organic salmon compared to the conventional alternative. Comparison of the size of the price premium to ecolabels in the fisheries sector (i.e. MSC) and the agricultural sector (i.e. mainly organic) shows it is higher than the former. This implies that Danish consumers consider organic farmed salmon as agriculture rather than fisheries. Valuing organic fish in the retail market is first-hand motivating information for organic aquaculture producers given the expected shift in cost structure following EU's full implementation of organic aquaculture life cycle next year. However, as an emerging market, it is expected that the size of the premium will reduce with reduction in production costs over time due to economies of scale. For farmers to receive the price premiums, the market must exhibit a competitive behavior where premiums are transmitted to the producers. The nature of price transmission (i.e. speed and size) and whether the size of the premium can cover producers extra cost is something beyond this study and merits future inquiry.

It was also revealed from the estimation that the issue of convenience leads to valuing fillets more than whole fish. Fresh products are valued higher than frozen, marinated and smoked products are valued more than breaded and stuffed product forms as these processed forms can mask the quality of fish along the supply chain. As a competition strategy, retailers make use of private labels as opposed to brand labels to provide consumers with economy valued products.

Though the model specification appears good, there is a limit to how far the conclusions can be taken. First of all, the inability to distinguish aquaculture, wild fisheries and fisheries ecolabels from the data is a major limitation as these could boost the explanatory power. Secondly, the lack of data and evidence from literature compelled us to compare the estimated price premium to fisheries ecolabel in a different market (i.e. UK), a situation that is undeniably suboptimal. However, the similarities between the Danish and UK retail market permit us to some extent. As portrayed by Wier et al. (2008), the two markets in Europe have greater share of organic products distributed through mainstream conventional retail chains. They have concentrated organic food markets based on high proportion of imports, in some cases highly processed, large-scale units of production, processing and distribution.

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12 Peak harvest periods occur in September and October.
References


