The Impact of Animal Welfare and Environmental Information on the Choice of Organic Fish: An Empirical Investigation of German Trout Consumers

Isaac Ankamah-Yeboah, *Copenhagen University and National University of Ireland, Galway*; Jette Bredahl Jacobsen, Søren Bøye Olsen, Max Nielsen, and Rasmus Nielsen, *Copenhagen University*

ABSTRACT

This article examines the effect of information on consumer preferences for farmed fish in the context of EU organic aquaculture production principles. A choice experiment was used to examine German consumers' preferences for farmed rainbow trout. Respondents were split into separate groups, each receiving different levels of information about organic aquaculture production. The results show that most consumers have positive preferences for organic labeled fish, translating into an average additional willingness to pay €1.2/kg relative to nonorganic farmed trout. Informing consumers specifically about animal welfare consequences associated with the organic label significantly increases the likelihood of choosing the labeled product and increases the marginal willingness to pay €2.4/kg for organic trout. No effect was found when providing additional information about environmental consequences. Hence, focusing on animal welfare when promoting organic aquaculture production is likely to resonate with consumers, thereby potentially increasing market shares and producer revenues.

Key words: Ecolabel, animal welfare, organic, trout, information, consumer preference.
JEL Codes: Q13, Q22, Q51, D12.

INTRODUCTION

Meeting the global demand for fish is a challenge, given the existing limitations in natural resources and fish stocks. In response, aquaculture has evolved to complement fisheries output. Aquaculture is currently the fastest-growing animal food producing sector and is growing faster than other major food production sectors, exhibiting an estimated annual growth rate of 5.8% between 2000 and 2016. Aquaculture currently contributes more than half of total fish for human

Dr. Isaac Ankamah-Yeboah, Department of Food and Resource Economics, Faculty of Science, Copenhagen University, Rolighedsvej 25, 1958 Frederiksberg C, Denmark and Socio-Economic Marine Research Unit, Whitaker Institute, National University of Ireland, Galway, Ireland (email: Isaac.ankamahyeboah@nuigalway.ie). **Jette Bredahl Jacobsen** is a professor, Department of Food and Resource Economics, Faculty of Science, Copenhagen University, Rolighedsvej 25, 1958 Frederiksberg C, Denmark (email: jbj@ifro.ku.dk). **Søren Bøye Olsen** is a professor, Department of Food and Resource Economics, Faculty of Science, Copenhagen University, Rolighedsvej 25, 1958 Frederiksberg C, Denmark (email: sobo@ifro.ku.dk). Max Nielsen is an associate professor, Department of Food and Resource Economics, Faculty of Science, Copenhagen University, Rolighedsvej 25, 1958 Frederiksberg C, Denmark (email: max@ifro.ku.dk). Rasmus Nielsen is an associate professor, Department of Food and Resource Economics, Faculty of Science, Copenhagen University, Rolighedsvej 25, 1958 Frederiksberg C, Denmark (email: rn@ifro.ku.dk).

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consumption (FAO 2018). The impressive growth in this sector can partly be attributed to substantial investments in aquaculture worldwide and rapid innovation in breeding of cultured species, feed practices, and rearing systems (Anderson 2002; Asche 2008; Troell et al. 2014). Along with this expansion comes controversy with respect to negative environmental impacts (Dierberg and Kiattisimkul 1996; Primavera 2006), such as eutrophication; emission of substances such as antibiotics, hormones, and biocides; and mangrove destruction. Consumer concerns regarding environmental impacts have shifted their preferences towards wild fish (Honkanen and Olsen 2009). It is only recently that awareness of the seafood sustainability movement has prompted consumer preferences for farmed species (Carlucci et al. 2015). In addition to environmental concerns, animal health and welfare concerns are gaining momentum in aquaculture production and consumption, particularly in EU aquaculture (EC 2014).

Bridging the information gap between producers and consumers regarding environmental and animal welfare concerns has been made possible through voluntary third-party certification programs, such as ecolabels. Over the last decade, the aquaculture sector, similar to other food sectors, has experienced considerable growth in the diversity of ecolabels that seem to signal strong interest from stakeholders. Though ecolabels have different degrees of certification standards, they share common goals. On the positive side, the diversity of ecolabels offers more choices to producers and consumers. This diversity can potentially drive innovation and consolidation through competition (Prag, Lyon, and Russillo 2016). Under the assumption of price transmission along the value chain, producers of sustainable products may secure economic incentives in the form of price premiums or long-term contracts to maximize profits (Roheim et al. 2018). The challenge on the demand side is that the growth in diversity of ecolabels can create confusion and mistrust among consumers due to overlapping objectives or claims and subsequently drive demand lower and less market penetration (Prag, Lyon, and Russillo 2016; Brécard 2014; Comas and Seifert 2012). Such actions can lead to weakening of the underlying regulatory standard arising from decreased consumer utility.

Circumventing these consequential effects partly originates from the demand side, where consumers' understanding of and preferences for labels play a central role. Despite the growth in the number of ecolabels, few studies have been conducted with the aim of exploring consumers' preferences and willingness to pay (WTP) for ecolabels related to farmed fish; particularly animal welfare labels. The extensive literature largely relates to environmental labeling in the wild-caught seafood market using either actual purchases or hypothetical scenarios. Empirical evidence shows that the majority of Europeans prefer ecolabeled products (Brécard et al. 2009), and ecolabeling is important in fish choice (Wessells, Johnston and Donath 1999; Jaffry et al. 2004). Markets are, however, segmented (Brécard et al. 2012), and individual WTP estimates have a wider range (Fonner and Sylvia 2014). In a comparative study, Johnston et al. (2001) show that the presence of price premiums for ecolabels of approximately 50% significantly reduced the probability of choosing ecolabeled fish from 74 to 32% for Norwegian consumers and 88 to 68% for US consumers, indicating that price sensitivity varies across borders. Teisl, Roe, and Hicks (2002) found that the implementation of dolphin-safe labeling is linked with an increased market share for canned tuna compared to meat substitutes. With the emergence of the Marine Stewardship Council certification (MSC label) for fisheries management, studies exploring actual consumer purchases have evolved. Price premiums in the range of 10–14% have been observed for various fishery products in the UK (Asche et al. 2015; Sogn-Grundvå, Larsen, and Young 2013, 2014; Roheim, Asche, and Santos 2011) and Sweden (Blomquist, Bartolino, and Waldo 2015). A range of 4–30% has been identified as the average price premium for MSC-labeled products in Germany (Asche and Bronnmann 2017).

Labels associated with aquaculture can either be based on generic labels already known and used in the agricultural sector, such as organic and animal welfare labels, or can be specific labels, such as the Aquaculture Stewardship Council (ASC) and Best Aquaculture Practices (BAP). Prior to EU regulation of organic aquaculture in 2010 (EC 2009), organic fish production was based on a few member states and some private initiatives. In the same year, the ASC label was introduced (ASC n.d.). A few studies have examined the impact of such labeling. Based on actual purchases, Ankamah-Yeboah, Nielsen, and Nielsen (2016) identified an approximately 20% organic price premium for salmon in Denmark, and Asche et al. (2015) found an approximately 25% premium in the UK. In stated choice experiment study, Bronnmann and Asche (2017) and Jonell et al. (2016) examined the tradeoffs between fisheries and aquaculture ecolabels and concluded that environmental labeling of farmed fish can stimulate pro-environmental purchasing behavior that is sufficient to offset the negative price premiums of farmed fish. However, Bronnmann and Hoffmann (2018) found that such an effect was secured solely by information of sustainable fisheries and that the presence of an ASC label had no effect.

What lies behind the different labels matters to consumers. According to Rickertsen et al. (2017), farmed fish are perceived as better for environmental sustainability and animal welfare, while wild fish are seen as better for safety and health. Olesen et al. (2010) elicit Norwegian consumers' WTP and found an approximately 15% price premium (2 euros per kg) for both organic and welfare-labeled salmon of the same color. Along with environmental labels is the recognition of welfare labels in farmed seafood, despite earlier European surveys ranking farmed fish as the third least important animal group to receive improved welfare or protection (Eurobarometer 2005). Finnish consumers have also shown less concern towards fish welfare (Kupsala, Jokinen, and Vinnari 2013). However, studies including research by Grimsrud et al. (2013); Ellingsen et al. (2015); and Solgaard and Yang (2011) have identified significant consumer preferences and WTP for certain production methods with welfare labeling.

Alfnes, Chen, and Rickertsen (2018) provide an extensive review of general labeling in aquaculture and highlight the limited scope to which detailed farmed seafood labeling studies have been conducted. The use of ecolabels in aquaculture, such as the well-known organic and ASC labels, overlap in attributes by offering varying degrees of improved fish welfare, as well as environmental and socially responsible production systems. While ASC offers no specific requirements covering animal welfare (Geerts 2015), EU organic regulation has rules encouraging high standards of animal welfare and requires farmers to meet specific behavioral needs of animals. Organic labeling, therefore, typically offers more stringent requirements than the ASC by, for example, prohibiting GMOs, limiting antibiotic use, and regulating feed sources and stocking densities (EC 2009 [Regulation No 710/2009]).

Literature focused on seafood ecolabeling usually contrasts wild and farmed sources or studies each in isolation. A question raised in this study regards the competitiveness of aquaculture ecolabels (organic versus ASC labels) and how providing information on the attributes of organic labels in terms of environmental and fish welfare affects consumer demand. In this article, we use a stated choice experiment to assess German consumers' demand for farmed, portion-sized rainbow trout. We provide information to consumers on selected organic fish farming management requirements, including feed source, antibiotic use, stocking density, genetic modification, and use of synthetic chemicals for environmental and animal welfare standards improvement.

The choice of fish (trout) and country of study (Germany) occupy important economic positions in the European market. In the EU, trout is the second most valuable farmed fish after salmon, having an estimated value of €614 million. Apparent consumption of trout is 100% farmed, and it has a self-sufficiency rate (ratio of total domestic production to total consumption) of 89% after cod and herring. Germany is the largest consumption market, and trout is its fifth most consumed fresh fish species. Organic fish is still a niche, new market in the EU. The consumption of organic seafood in the EU reached an estimated 50,000 tonnes in 2016, representing an increase of 73% from 2012. Germany is the second largest consumer market (14,000 tonnes) for organic seafood after the UK (23,000 tonnes), and consumption in both countries has been increasing constantly (EUMOFA 2018). The top suppliers of trout to the EU market are Turkey and Denmark. In 2014, Denmark surpassed France to become the leading producer of organic trout worldwide with an estimated volume of over 1,000 tonnes. Approximately 90% of all trout produced in Denmark are destined for the German market. Turkey, on the other hand, is the second largest producer of trout globally, with approximately 30% of its production arriving on the German market (EUMOFA 2017).

What follows in the remainder of this study is the experimental design, empirical model, results and discussion, and finally the conclusion.

CHOICE EXPERIMENT DESIGN AND DATA COLLECTION

Consumers' preferences for varying attributes of portion size-trout were elicited using a choice experiment questionnaire survey. The questionnaire (in English) was developed and tested in Denmark by discussing the importance of selected attributes and ambiguities. Revisions were implemented, and it was then translated to German and tested in another focus group in Germany. The final German version was pilot tested online among 65 German consumers. The final data were collected using an internet questionnaire survey implemented by Userneeds Denmark in an online panel from the Research Now database in July 2016.[1] The recruitment of panel members for the panel survey was based on samples of German residents, ranging from 18–65 years of age. Data collection was spread over northern (Hamburg/Schleswig-Holstein), eastern (Berlin/Brandenburg), and southern (Bayern) areas of Germany. This approach was employed to cover diversity in consumption that might arise due to geographical factors.

The data used in this study are composed of a split of a larger survey, where the other part was used in Ankamah-Yeboah, Jacobsen, and Olsen (2018). The experimental design divided respondents randomly into four groups: a control group and three information treatment groups. Prior to the treatment, respondents' knowledge of selected European organic aquaculture production principles was tested using a quiz consisting of four multiple-choice questions. The matrix of the information treatment is provided in the appendix. The production principles included antibiotic use, GMO, hormones and synthetic additives, feeding, and stocking density requirements. After answering each multiple-choice question, respondents were provided with the correct answer. Then, information was provided to respondents regarding the main reason for the specific production principle. This information marks the differences between the treatment groups. The control group had no information provision. Treatment group 1 was informed that

1. Userneeds and Research Now are professional marketing firms in Denmark and Germany, respectively.

the reason for each of the organic production requirements selected was due to *environmental* concerns (hereafter labeled "info_env"), while treatment group 2 was informed that it was due to *animal health and welfare* concerns (hereafter labeled "info_welfare"). Treatment group 3 was informed that *both* concerns mattered (hereafter labeled "info_both").

The choice sets presented to respondents were designed using the software Ngene (ChoiceMetrics 2014) and applied a D-efficient Bayesian design with updated priors estimated from a multinomial logit model using the pilot data. The choice set attributes and attribute levels used in the final survey are displayed in table 1. Attribute and level selection were adapted from previous literature (see literature review by Carlucci et al. 2015), as well as the focus group discussions.

The choice experimental design consisted of a total of 36 choice sets composed of 3 blocks. Respondents were randomly assigned to the treatment groups and the three blocks. Each respondent faced 12 choice sets of 3 alternatives and an opt-out. The opt-out option was included in order not to force respondents to choose undesirable products. The order of appearance of choice tasks and alternatives was randomized. A sample of the choice set presentation is shown in figure 1.

Table 1. Attributes and Levels

Attribute	Description	Level	Variable
Product form	Indicates whether the trout is whole or has been filleted	Whole Fish	Reference
		Filleted with skin and bone	Fillet (skin and bone)
		Filleted with skin but no bone	Fillet (skin and no bone)
		Filleted without skin and bone	Fillet (no skin and no bone)
Storage form	Indicates processed and stored form	Frozen	Reference
		Smoked	Smoked
		Fresh (chilled conditions)	Fresh
Place of purchase	Indicates where the fish is sold	Specialized fish store	Specialized store
		Grocery store	Reference
Production method	Indicates the production process used	Conventional	Reference
		Organic certification	Organic
		Aquaculture Stewardship Council certification (ASCC)	ASC – Ecolabel
Country of origin	Indicates country where trout is farmed	Germany	Germany
		Denmark	Denmark
		Turkey	Reference
		Other EU country	Other EU Country
Price (€)	Price per package of trout (0.35 kg)	2.99, 4.49, 5.99, 7.49, 8.99, 10.49	Continuous variable

Note: Reference indicates that the variable in the category is used as the reference variable in the model.

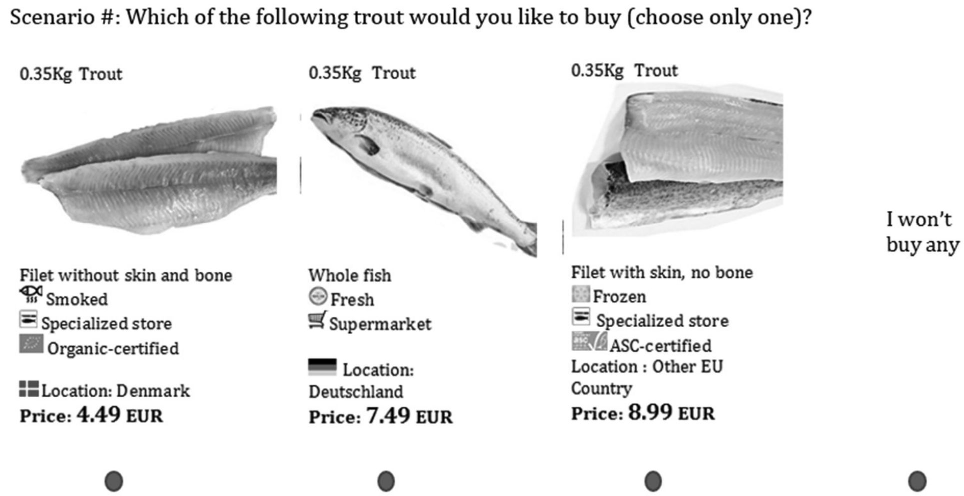

Figure 1. Sample Choice Card

Data from a total of 1,236 respondents were extracted from the survey, with a response rate of 12%. The low response rate can skew the sample from the population characteristics. However, we observed a median and mean age of 42 years with 54% female representation. This is only slightly different from the German population, with 41% females and a median (average) age of 40.5 (44) years. The respective sample sizes were 308, 310, 309, and 309 for the control, info_env, info_welfare, and info_both groups, respectively. The summary description of the socioeconomic characteristics of the sample is presented in table 2. The last column in table 2 presents the probability values of the Pearson chi-square joint test of independence between the splits and the socioeconomic variables. The test fails to significantly reject the null hypothesis that the treatment groups belong to the same population. Thus, the treatment groups can be compared without correcting for socioeconomic differences. A test between each of the levels of the treatment groups and the control group indicated by superscripts "a," "b," and "c" were significant at the 5% level. The joint test on the a priori knowledge level and the groups are not independent given the 1% significance level. Regarding the knowledge test, we observed that the majority of respondents had low scores for the overall sample and in each treatment group, except for the control group. In the control group, approximately 90% of the 308 respondents had high prior knowledge of the organic production principles.

DISCRETE CHOICE MODELING: GENERALIZED MIXED MULTINOMIAL LOGIT

Developed by McFadden (1974), random utility theory is the theoretical framework for the analysis of choices in discrete choice experiments (DCE). The approach can estimate marginal values for different attributes of a good in line with Lancaster's (1966) theory. If person i faces a set of alternatives $Q = \{Q_1, Q_2, \ldots, Q_J\}$ at time t and vectors of x attributes specific to respondents and alternatives, then each chosen alternative j, thus $Q_j \in Q$ has a corresponding net utility, U_{ijt} for individual i that is assumed to be composed of two separable parts; the systematic (V_{ijt}) and random (ε_{ijt}) components expressed as (Train 2009):

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt}. \quad (1)$$

Table 2. Sample Distribution by Socioeconomic Characteristics (%)

Characteristic	Full Sample	Control	Info_Env	Info_Welfare	Info_Both	P(x^2)
Gender						0.23
Male	46.1	45.1	51.0	43.0	45.3	
Female	53.9	54.9	49.0	57.0	54.7	
Age (years)						0.14
18–34	32.8	39.6	29.4[a]	32.4	29.8[c]	
35–49	34.5	30.5	46.5[a]	34.3	36.6[c]	
50–65	32.7	29.9	33.9[a]	33.3	33.7[c]	
Region						0.42
Bayern	34.5	37.0	32.9	32.4	35.6	
Berlin/Brandenburg	32.0	29.5	32.6	30.7	35.3	
Hamburg/Schleswig-Holstein	33.5	33.4	34.5	36.9	29.1	
Household Size						0.65
1 person	20.5	19.2	21.9	20.1	20.7	
2 persons	38.9	39.3	38.1	38.2	40.1	
3 persons	21.0	20.8	19.7	23.3	20.1	
4 persons	14.6	17.5	14.8	11.7	14.2	
> 5 persons	5.1	3.2	5.5	6.8	4.9	
Occupation						0.71
Part-time	16.1	18.2	15.8	15.9	14.6	
Full-time	62.0	58.1	61.3	63.4	65.0	
Other	21.9	23.7	22.9	20.7	20.4	
Household Monthly Income						0.40
< €1.000	10.3	13.3	7.7	11.3	8.7	
€1,000 to < €1,500	10.4	11.4	11.3	8.7	10.0	
€1,500 to < €2,000	11.7	10.1	14.5	9.7	12.6	
€2,000 to < €2,500	12.1	10.4	11.0	15.5	11.7	
€2,500 to < €3,000	13.3	13.0	12.6	13.6	13.9	
€3,000 to < €3,500	10.5	9.7	11.9	9.4	11.0	
€3,500 to < €4,000	9.2	10.7	8.1	7.8	10.4	
€4,000 to < €4,500	7.0	8.8	5.2	7.1	6.8	
> €4,500	15.5	12.7	17.7	16.8	14.9	
Family Status						0.51
Single	24.7	28.6	21.0	24.6	24.6	
Married/registered partner	48.5	45.8	53.5	46.0	48.9	
Live together	17.8	17.9	16.1	20.1	17.2	
Separated/widow/divorce	9.0	7.8	9.4	9.4	9.4	
Education Level						0.30
Basic education	8.1	7.8	9.0	5.8	9.7	
Secondary school	28.2	27.6	28.4	31.1	25.9	
Higher secondary school	9.0	7.1	11.6	8.7	8.4	
Post-secondary education	19.6	22.4	15.8	21.0	19.1	
Tertiary education	34.1	33.1	34.5	33.0	35.6	
Other	1.1	1.9	0.6	0.3	1.3	
Level of Objective a priori Knowledge of Organic Production Principles						0.00
High (score >2/4)	31.1	90.9	39.0[a]	41.1[b]	35.0[c]	
Low (score <=2/4)	68.9	9.1	61.0[a]	58.9[b]	65.0[c]	
Total observations	1,236	308	310[a]	309[b]	309[c]	

Note: Values are expressed as the percentage of total observations in each category. a, b, and c indicate statistical significance at the 5% level between the control group and groups info_env, info_welfare, and info_both.

The idiosyncratic error term is assumed to be independent and identically distributed extreme value. The probability that individual i chooses alternative j from a particular set, Q, can be written as:

$$P_{ij} = P\left(U_{ij} > U_{iq}; \forall \ q(\neq j) \in Q\right) = P(\varepsilon_{ij} + V_{ij} - V_{iq} > \varepsilon_{iq}; \forall \ q(\neq j) \in Q). \quad (2)$$

Traditionally, the multinomial logit (MNL) model would be estimated. However, the past two decades have seen the development of competing models that allow for taste and/or scale heterogeneity, relaxing the restrictive assumptions of the independence of irrelevant alternatives linked to MNL specification. In this study, we utilize the more flexible generalized mixed multinomial logit (GMNL) specification (Fiebig et al. 2010) and express the systematic component of the utility function in equation (1) as:

$$V_{ijt} = \beta_i x_{ijt} = [\sigma_i \beta + \gamma \eta_i + (1 - \gamma)\sigma_i \eta_i] x_{ijt}, \quad (3)$$

where β_i is the individual specific taste parameter confounded with a scale of the error term. It is assumed to follow a multivariate distribution with means and variance-covariance matrix Σ, $\beta_i \sim f(\beta, \Sigma)$. Decomposing β_i to follow the square bracket terms in equation (3) allows heterogeneity to be described by scale heterogeneity (i.e., scaled multinomial logit - SMNL), taste heterogeneity (i.e., mixed or random parameter logit - RPL), or some combination of the two (GMNL type models). From equation (3), assuming $\sigma_i = \sigma = 1$ collapses the formulation to RPL where η_i is the individual specific deviations from the means and is assumed to follow a certain distribution. The parameter $\gamma \in [0, 1]$ determines how the variance of the residual taste heterogeneity varies with scale. GMNL-I and GMNL-II result from restricting $\gamma = 0$ and $\gamma = 1$, respectively. The scale coefficient of the GMNL is individual specific, $\sigma_i \sim lognormal(1, \tau)$ or $\sigma_i = \exp(-\tau^2/2 + \tau\eta_i)$, where τ is a key parameter in the GMNL type models that reflects the level of scale heterogeneity.

An important feature for considering GMNL in the present study is the ability to simultaneously account for preference heterogeneity and scale differences arising from different data sets. Scale may vary across data sets due to differences in sampling or information provided to respondents (Hensher, Louviere, and Swait 1998), as designed in this study. Failing to account for these differences when combining data sets may lead to incorrect conclusions. Moreover, controlling for heterogeneous treatment effects of information on the scale parameter permits heterogeneous predictability, such as perceived randomness of agent's choices by the modeler (Czajkowski, Hanley, and LaRiviere 2016). We follow Hensher, Rose, and Green (2015) on combining data sets in choice modeling and allow τ to be a function of a series of dummy variables that identify the presence of scale heterogeneity between the different data sets from the sample or information treatments. Thus, $\tau = \tau + \delta D_s$, where δ is a data-specific scale parameter, and $D_s = 1$ for data set s and 0 otherwise, with $s = 1, 2, \ldots, S-1$. This approach has advantages over studies that derive ratios of parameters from separately estimated models as a way of canceling out data-specific scales. This property is employed because the ratios of parameter methods lead to the possibility of confounding differences in attribute preferences with the marginal utility of income (Czajkowski, Hanley, and LaRiviere 2016).

RESULTS AND DISCUSSION

Model selection was based on a search process to determine the best fitting model. The models initially estimated included the MNL, SMNL, RPL, and GMNL-type logit models. For random parameter assumptions, different distributional assumptions were also considered. The best fitting model based on the simulated log-likelihood values, McFadden pseudo r-square and Akaike information criterion, is the GMNL model presented in table 3. The model was estimated using parameter estimates from a RPL model as the starting values with 1,200 Halton draws.

The model was estimated with normally distributed random parameters, allowing for correlated parameters to control for unobserved effects that are correlated among alternatives in a given choice situation. The attribute production method and country of origin were treated as random parameters following a normal distribution, while the other parameters were treated as nonrandom. Treating all variables as random parameters leads to identification challenges due to the large numbers of parameters that need to be estimated. Hence, we focus on variables of primary interest. The price variable was converted from per 0.35 kg to per kg.

We treated the price parameter as nonrandom; i.e., fixed across respondents. This choice is motivated by Bliemer and Rose (2013), who indicate that the choice of distribution on the cost parameter is of importance in the sense that distributions with a positive probability mass at zero are problematic (i.e., yields infinite WTP). The fixed cost coefficient allows for easy derivation of WTP (Goett, Hudson, and Train 2000), but may lead to inferior models (Daly, Hess, and Train 2012). Scarpa, Thiene, and Train (2008) note that a fixed cost coefficient is counterintuitive and that preferences and/or scale should vary across respondents with regard to cost. In this instance, while fixed in preferences, the price coefficient varies with the individual specific scale parameters.

In table 3, we present two models where one considers attributes only and the other considers the interaction of socioeconomic characteristics with the attributes. Between the two models, we observe that the attributes-only model performs slightly better than the socioeconomic interaction model in terms of the log-likelihood estimates and the McFadden pseudo r-square. The general observation is that for most of the attributes in the socioeconomic model, there is a slight decline in attribute parameters. We, therefore, focus more discussion on the attributes-only model.

Parameter estimates distinguishing heterogeneity in the error variance from the preference heterogeneity are presented under the subheading *Covariances of the Random Parameters*. The *Tau-scale* parameter (τ), which reflects the level of scale heterogeneity among individuals, is statistically significant at the 1% level. This finding indicates the presence of significant unobserved scale heterogeneity in the sample. Controlling for scale heterogeneity due to differences in information treatment reveals that there are no statistically significant differences in scale across treatment groups. This lack of differences is shown by the insignificant estimates from the interaction of the scale parameter with the dummies for the treatment groups (Tau*Info_Groups).

Because there are no differences in scale between the treatment groups, we can explicitly allow the data from the four treatment groups to be estimated in one model. Hence, we interact the treatment groups with attributes as a way of estimating differences in preferences between treatments.

In table 4, the WTP estimates for trout attributes are computed as the ratio of the attribute parameter to the cost parameter ($wtp_{attribute} = \beta_{attribute}/\beta_{price}$). The Delta method (Bliemer and Rose 2013) was used to determine the standard error and confidence interval estimates.

The parameter estimates from the attributes present some interesting findings. From table 3, a positive value of 0.806 linked to fillets without skin and bone indicates that respondents have positive preferences for this product form relative to whole trout. Considering all product forms, the results show that whole fish are preferred to fillet with skin and bone. The product form fillet with skin and bone is a whole fish cut into pieces, with the bone and skin intact, which does not

Table 3. Generalized Mixed Random Parameter Logit Model

Variable	Attributes Only		Socio-Economics Interaction	
	Coefficients	Std. Errors	Coefficients	Std. Errors
Random Parameters (means)				
ASC – Ecolabel	–0.090	0.068	–0.303***	0.074
Organic	0.212**	0.088	0.111	0.090
Germany	1.558***	0.178	1.195***	0.136
Denmark	1.147***	0.142	0.8679***	0.108
Other EU Country	0.881***	0.123	0.633***	0.106
Nonrandom Parameters				
Price/kg	–0.169***	0.013	–0.204***	0.014
Fillet (skin and bone)	–0.073**	0.031	–0.059*	0.033
Fillet (skin and no bone)	0.475***	0.027	0.421***	0.028
Fillet (no skin and no bone)	0.806***	0.035	0.729***	0.035
Fresh	0.376***	0.029	0.370***	0.030
Smoked	0.011	0.023	0.041*	0.023
Specialized store	–0.009	0.024	–0.007	0.023
Organic*Info_Env	0.086	0.061	0.085	0.068
Organic*Info_Env*PostSHS			0.073	0.127
Organic*Info_Welfare	0.193***	0.057	0.242***	0.081
Organic*Info_Welfare* PostSHS			–0.065	0.159
Organic*Info_Both	0.126**	0.053	0.206**	0.081
Organic*Info_Both* PostSHS			–.4261***	0.150
No purchase	–1.558***	0.048	–1.835***	0.050
Std. Dev. of Random Parameters				
ASCC – Ecolabel	1.029***	0.086	0.829***	0.080
Organic	1.461***	0.107	1.125***	0.085
Germany	2.345***	0.155	1.632***	0.112
Denmark	1.623***	0.113	0.869***	0.081
Other EU Country	1.522***	0.127	1.041***	0.105
Covariances of Random Parameters				
Tau Scale	1.287***	0.074	1.424***	0.060
	Heterogeneity in Tau(i)			
Tau* Info_Env	0.076	0.062	0.031	0.070
Tau* Info_Welfare	–0.004	0.062	0.011	0.059
Tau* Info_Both	0.017	0.061	–0.039	0.053
Weighting Parameter Gamma in GMX Model				
Gamma MXL	0.257***	0.029	0.345***	0.036
	Sample Mean	*Sample Std. Dev.*		
Sigma(i)	0.958	1.664	0.945	1.823
Log-likelihood	–16,067.280		–16,423.113	
Restricted log likelihood	–20,561.518		–20,561.518	
Chi-square (36)	8,988.518***		8,276.811***	
McFadden pseudo R-square	0.219		0.201	
AIC	32,206.6		32,904.2	
AIC/N	2.171		2.218	
Panel groups	1,236		1,236	
Observations	14,832		14,832	

*** indicates significance at the 1% level.
** indicates significance at the 5% level.
* indicates significance at the 10% level.

Table 4. Marginal Willingness to Pay Estimates of Parameter Ratios

Attribute	Estimates (Euro/Kg)	95% Confidence Interval
ASC - Ecolabel	–0.528	(–1.326, 0.269)
Germany	9.201***	(7.939, 10.464)
Denmark	6.774***	(5.781, 7.766)
Other EU	5.199***	(4.087, 6.311)
Fillet (skin and bone)	–0.433**	(–0.795, –0.071)
Fillet (skin and no bone)	2.804***	(2.275, 3.333)
Fillet (no skin and no bone)	4.76***	(3.918, 5.602)
Fresh	2.221***	(1.73, 2.711)
Smoked	0.067	(–0.203, 0.336)
Specialized store	–0.053	(–0.326, 0.22)
Organic WTP for Treatments		
Organic Control	1.254***	(0.301, 2.207)
Organic Info_Env[d]	0.510	(–0.202, 1.222)
Organic Info_Welfare[d]	1.138***	(0.457, 1.819)
Organic Info_Both[d]	0.743**	(0.111, 1.375)
D (Info_Welfare - Info_Both)	–0.395	(–1.201, 0.411)

*** indicates significance at the 1% level.
** indicates significance at the 5% level.
* indicates significance at the 10% level.
[d] indicates the marginal WTP between information treatment groups and the control group.
D(.) indicates the test of equality between the Info_Welfare and Info_Both groups.

involve more value added. The marginal utility of filleted trout increases with more value added in the sense that fillets with skin and no bone are preferred over whole trout with a WTP value of €2.8/kg, and fillets with no skin and no bone are preferred above all, with a value of €4.87 kg.

A reason for the preference for this added value might simply be that consumers prefer more edible fish; thus, since all packages of fish are specified to have a net weight of 350 g, the edible weight will be lower in the less processed product forms, assuming that skin and bones are not eaten. Alternatively, filleted fish come at an extra cost, but might be preferred because it comes with convenience in preparation, since less time would have to be invested in removing unwanted parts. This preference is supported by Brunsø et al. (2008), who show that most European consumers have difficulty removing fish bones and, therefore, prefer filleted fish.

In terms of the storage form (frozen trout as reference), there is no significant difference in marginal utility between smoked and frozen trout products. The place of sale, either a grocery store or specialized fish store, appears to have no impact on consumers' choice. As such, these attributes command no WTP values under the assumption of homogenous preferences.

The marginal utility from fresh trout is significantly higher than frozen and smoked trout products and comes with a value of €2.2/kg. Fresh fish, as described here, has received no treatment other than chilling and has remained above –1°C. The fresh attribute appears to be an important factor in fish consumption in Germany because according to EUMOFA (2018), fresh fish, including salmon, pollack, cod, mussels, and trout alone, accounted for 53% of fresh fish species consumed in German households. According to Olsen (2004), the quality of seafood is determined by the degree of freshness, and to the consumer, freshness is most often associated with safety, reassurance, and superior taste (Olsen 2004; Wang et al. 2009).

The alternative specific constant included in the model captures the utility associated with the "no purchase option." This is negative and significant, indicating that respondents, on average, would always opt to buy trout, rather than buying anything, regardless of the levels of the attributes associated with the presented alternatives.

For the random parameter estimates, we observed that both the production method and country of origin reveal unobserved heterogeneous preferences among respondents, as indicated by the significance of the attribute level standard deviations. First, considering the country of origin with Turkey as the reference, respondents have the highest preference and marginal WTP for local German-produced trout (€9.2/kg), followed by production from Denmark (€6.8/kg), and then from other European countries (€5.2/kg), confirming a pattern observed in Ankamah-Yeboah, Jacobsen, and Olsen (2018). Denmark and Turkey occupy important positions in the portion-sized rainbow trout market in the EU, particularly Germany. The EU is the world's principal consumer of portion-sized trout (Lasner et al. 2017), and Germany is the largest market (Nielsen et al. 2007). Excess demand is principally met by Turkey (Lasner et al. 2017), which supplies approximately 70% of total EU imports (EUMOFA 2014). For German imports, Denmark is the most important internal EU supplier (Lasner et al. 2017). Denmark exports approximately 90% of its trout production to Germany.

The preference for locally produced (also evident in Jaffry et al. 2004; Uchida et al. 2014; Sogn-Gundvag, Larsen, and Young 2014) German trout might be linked to some of the emerging issues presented in the literature regarding country of origin. For instance, the EU requires farmed seafood to be labeled with a country of origin label so that countries associated with high seafood quality can distinguish themselves from producers from countries with inferior product image. Hence, while this labeling signals quality (Liefeld 1993; Peterson and Jolibert 1995; Verlegh and Steenkamp 1999; Loureiro and Umberger 2003; Lusk and Anderson 2004; Chung, Boyer, and Han 2000), other explanations, including ethnocentrism, economic development, and cultural distance, have been suggested (Alfnes, Chen, and Rickertsen 2018).

In the absence of locally farmed fish, fish farmed in Denmark is the second most preferred product, which could be related to the cultural or geographic distance between Germany and Denmark. An alternative reason might be that Denmark has relatively stringent environmental requirements for aquaculture production that might be closer to the production standards in Germany. Denmark, for example, has structurally transformed a substantial part of its commercial freshwater trout production systems into recirculated trout farms, reusing water and inducing a considerable reduction in the nutrient discharge per kilo of fish produced. As opposed to Turkey, both countries have production systems that are regulated under a common EU aquaculture policy. Moreover, the preference for trout farmed in other EU countries reveals a deviation not too far from the value placed on Denmark. Other EU countries are within the common EU aquaculture production policy, which might explain the significant WTP. This WTP is, however, lower than in Denmark because the attribute level does not identify a specific country and, hence, might reveal some level of consumer uncertainty.

Central to this study are the results concerning production method (i.e., ASC and organic labeling) and the influence of information type on consumers' choice of organic ecolabeled products. Consumers' preferences for these production methods are heterogeneous, as indicated by the significant standard deviations. The nonsignificance of the ASC[2] label mean parameter combined

2. Caution should be taken comparing the ASC label with organic labels given that respondents were pre-conditioned towards organic due to the information treatment but not the ASC.

with a large standard deviation indicates that preferences are in approximately equal proportions in the positive and negative domains of the normal distribution. The significant and positive parameter of the organic label indicates that most consumers have a positive preference for organic labeled fish and are willing to pay approximately €1.3/kg more.

In our study, the organic label commands stronger effects than the ASC label, likely because the organic label was used prior to EU regulation implementation in 2010, while ASC was introduced in 2010. Moreover, the organic fish label uses the standard organic label used in the agricultural sector. In the EU, organic fish is certified by private or national organizations with their unique logos in combination with the EU euro-leaf. Fish packaging containing the organic logo is, therefore, well-known and recognized among consumers. Moreover, the degree of consumer preference linked to organic and ASC labels might be due to compliance with stringent environmental and fish welfare regulations that the organic label represents.

Interaction terms from the information treatment and organic labels reveal that treating respondents with information on organic production by focusing on environmental concerns (*organic*info_env*) is not significantly different from the control sample, where no additional information is provided (i.e., status quo market) and adds no price premium. However, providing information on animal health and welfare concerns (*organic*info_welfare*) significantly increases the chance that consumers choose organic products and increases their marginal WTP for organic fish by another €1.14/kg. When the information focuses on both environmental and animal health and welfare concerns (*organic*info_both*), respondents' marginal utility of organic is larger than in the control sample but smaller than in the animal welfare sample and comes with a premium value of €0.74/kg. A statistical test of equality of mean parameters between info_welfare and info_both suggests that this difference is not significant.[3] The results indicate that the provision of organic production information focusing on animal health and welfare concerns alone, or in combination with environmental concerns, might increase consumers' choices of organic fish products.

The information effects indicate that consumers probably know environmental attributes are embedded in the ecolabel and hence feel they are already paying for it once the choice of organic product is made. The information on fish welfare may be new to them, and this information is received with value. While ecolabels are information labels, there is a limit to the amount of information conveyed, given that they are simply presented in logos on products. Further information for creating awareness of sustainability can increase the value of ecolabels. This effect has been observed among Japanese consumers who were willing to pay approximately 20% more for MSC-ecolabeled salmon when they were provided with information on the status of the global fish stocks and the MSC program (Uchida et al. 2014).

Although not all kinds of information may imply extra value, our study shows that in the case of farmed trout, German consumers value information related to fish welfare; hence, its integration in ecolabels can lead to a substantial increase in market share. The significant effect associated with fish welfare information is motivated by the animal welfare perceptions literature, as consumers' perceptions of animal welfare have been found to be linked to ethical concerns and have a direct impact on human health from food-related hazards and food safety risks (Harper and Makatoumi 2002; Verbeke and Viaene 2000). This association is evident by consumers'

3. See the Wald test of WTP presented in table 4.

concern regarding various negative food reports and the consequential food scares that have previously plagued Europe (Naspetti and Zanoli 2009).

CONCLUSIONS

The study sought to determine whether consumers are willing to pay more for aquacultured fish products with organic labels when informed specifically about environmental and animal welfare aspects of the production criteria. A generalized mixed MNL model based on random utility maximization theory was employed to analyze data from online choice experiments elicited by German consumers.

It is shown that consumers prefer convenient fish products, such as fillets, where highly filleted products with or without bones and skin come with higher monetary values. Compared to frozen trout, fresh, chilled trout with no additional processing is preferred and is often linked to high quality and taste by consumers. Country of origin significantly affects consumers' preferences, with local German trout being the most valued by consumers, followed by fish produced in Denmark and other European countries, compared to products originating from Turkey. The finding suggests that German producers have a competitive advantage over other imported trout products. To realize the highest revenues through increased demand, convenience should be a core element of product innovation and should not be traded off with processing inferiority of any kind. This is reflected in consumer preferences for fresh trout products.

In terms of ecolabeling, we observed that ASC-ecolabeled trout is an important attribute in the purchase decisions of approximately half of the respondents. However, organic ecolabels are preferred by most respondents, on average, and attract more than twice the value of ASC ecolabels. The information effect shows that environmental information adds no extra value to the organic label, indicating that environmental protection is perceived to be paid for with the organic label. Preferences increase when additional information on fish welfare aspects of production is provided to consumers. With increasing consumer concern for animal welfare-related issues, the findings suggest that addressing animal welfare issues at the production stage could be pivotal in streamlining aquaculture sustainability.

In general, the findings imply that targeted information is important to satisfy consumer preferences for ecolabel information in order to avoid consumer saturation due to ecolabel multiplicity. In the case of organic labels used in trout farming, the results imply that awareness of the fish welfare component of the label, or the combined environmental and welfare components, are important sources of information to increase consumer demand. For the sake of exposition, the most valued portion-sized trout on the German market is fresh that is farmed in Germany, filleted with no bone or skin, and carries an organic label. On average, the animal-welfare informed German consumer is willing to pay an extra €18.6/kg compared to a whole fish that is frozen, farmed in Turkey, and without an ecolabel. Because of this, German producers have the competitive advantage to reap approximately 50% of the value.

APPENDIX

KNOWLEDGE AND INFORMATION PROVISION MATRIX

	1. Antibiotics Use	**2. Stocking Density**	**3. GMO, Hormones and Synthetic Additives**	**4. Feed Source**
QUIZ	Which of the following is permitted in organic fish farming regarding the use of antibiotics when there is an outbreak of disease?	Which of the following statements is true about the stocking density of fish in ponds for organic farming?	Which of the following management practice is allowed in organic fish farming?	What is the required source of feed (fish meal and fish oil) for fish in organic farming?
a)	Antibiotics are permitted in very strict limits	Fish stocking density in organic farming is far lower than conventional fish farming	Hormones, GMO and synthetic hormones are allowed in strict limits	Feed obtained from fish caught from the sea
b)	Antibiotics are not allowed at all	Fish stocking density in organic farming is the same as that of conventional fish farming	Hormones, GMO and synthetic hormones are prohibited	Feed coming from sustainable fisheries caught for human consumption
c)	Antibiotics are allowed all the time	Fish stocking density in organic farming is higher than conventional fish farming	Hormones, GMO and synthetic hormones are always allowed	Feed from farmed fish and fish caught from the sea
d)	I don't know	I don't know	I don't know	I don't know
	Answer is a) & Reason:	**Answer is a) & Reason:**	**Answer is b) & Reason:**	**Answer is b) & Reason:**
The following reasons are provided as information to the requirement				
Environmental Group	<u>**Treatment 1**</u> Organic fish farming has strict limits on the use of antibiotics in case of disease outbreak; thus, antibiotics may be permitted only twice a year to *reduce environmental pollution risks*, but first requires that natural substances from plants, animals and minerals must have been tried.	<u>**Treatment 1**</u> Low stocking density in organic fish farming compared to the conventional farming is required to prevent parasites infestation that can spread into *the environment to infect other living habitats*.	<u>**Treatment 1**</u> *Because of the fear of possible environmental impacts*, GMO, synthetic additives and the use of hormones in organic fish farming is strictly prohibited.	<u>**Treatment 1**</u> In organic fish farming, there is strict regulation on the sources of fish meal and fish oil to *protect the environment and promote a balanced marine ecosystem*. Therefore, feed sources should be obtained from trimmings of sustainable fisheries caught for human consumption or other farmed organic fish.

	1. Antibiotics Use	2. Stocking Density	3. GMO, Hormones and Synthetic Additives	4. Feed Source
Animal Welfare Group	**Treatment 2** Organic fish farming has strict limits on the use of antibiotics in case of disease outbreak; thus, antibiotics may be permitted only twice a year to *allow fish health and welfare*, but first requires that natural substances from plants, animals and minerals must have been tried.	**Treatment 2** Low stocking density in organic fish farming compared to the conventional farming is required to prevent fish injury and diseases which affect *the health and welfare of fish*.	**Treatment 2** *Because of the fear of possible fish health and welfare impacts* (that may result in fish less fit for life in their natural habitats or have impaired survivability), GMO, synthetic additives and the use of hormones in organic fish farming is strictly prohibited.	**Treatment 2** In organic fish farming, there is strict regulation on the sources of fish meal and fish oil *in order to maintain the marine food web which has impact on marine health and welfare*. Therefore, feed sources should be obtained from trimmings of sustainable fisheries caught for human consumption or other farmed organic fish.
Both	**Treatment 3** Organic fish farming has strict limits on the use of antibiotics in case of disease outbreak; thus, antibiotics may be permitted only twice a year to *reduce environmental pollution risks and allow fish health and welfare*, but first requires that natural substances from plants, animals and minerals must have been tried.	**Treatment 3** Low stocking density in organic fish farming compared to the conventional farming is required to prevent parasite infestation, disease and fish injury which can affect *fish health and welfare and spread into the environment*.	**Treatment 3** *Because of the fear of possible environmental and fish health and welfare impacts* (thus, that may result in fish less fit for life in their natural habitats or have impaired survivability), GMO, synthetic additives and the use of hormones in organic fish farming is strictly prohibited.	**Treatment 3** In organic fish farming, there is strict regulation on the sources of fish meal and fish oil *to protect the environment and a balanced marine ecosystem and maintain marine health and welfare*. Therefore, feed sources should be obtained from trimmings of sustainable fisheries caught for human consumption or other farmed organic fish.

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