Measuring Consumer Preferences for Ecolabeled Seafood: An International Comparison

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An analysis of consumer preferences for seafood labeled with information about environmental production attributes is introduced into the food labeling literature. International seafood ecolabeling programs have been proposed to create market-based incentives for fisheries managers to promote sustainable fisheries. We investigate differences in consumer preferences for ecolabeled seafood across the United States and Norway. Using a contingent-choice telephone survey of random households in each nation, a wide range of factors is found to influence consumers' likelihood of purchasing ecolabeled seafood. Consumer preferences differ by price premium, species, consumer group, and certifying agency. The effect of these factors often differs between the United States and Norway, suggesting heterogeneity in international reactions to seafood ecolabels.

Key words: consumer preferences, contingent choice, ecolabeling, food labeling, seafood

Introduction

Concern over the status of natural resource stocks, combined with well-known limitations of command-and-control management mechanisms, has led to a variety of ecolabeling initiatives in resource-based industries (Swallow and Sedjo; Wessells, Donath, and Johnston). In general, such programs evaluate the production process with regard to established environmental standards set by an independent third party. If the process meets these standards, the producer or marketer may buy a license to display a specific ecolabel on their product. In effect, the label conveys to the consumer otherwise unobservable information concerning a product's environmental impact. The increasing use of such programs for many consumer products notwithstanding, ecolabeling initiatives worldwide have met with varying degrees of consumer acceptance [Organization for Economic Cooperation and Development (OECD)].

Within the seafood industry, both industry and non-industry groups have proposed ecolabeling as a means to identify seafood harvested under management regimes that demonstrably prevent over-exploitation of natural stocks. Presumably, consumers who value sustainable harvest as an attribute of seafood products will reveal a greater demand for labeled seafood products than for unlabeled products, thereby creating a market incentive for "sustainable" management.

For example, the Marine Stewardship Council (MSC) was created in 1996 through a cooperative effort of the World Wildlife Fund (WWF) and Unilever, a multi-national corporation (McHale; MSC). The goal of the MSC is to provide a standardized mechanism for certifying and labeling seafood products worldwide.[1] The MSC ecolabel may only be applied to a product after certification by an independent certification firm that the fishery is well managed. Several large supermarket chains in the United States and Europe have become MSC partners, pledging to promote and buy only certified seafood from sustainable sources, once the certification program is well established. In contrast to the international program promoted by the MSC, several regional governmental labeling programs are being promoted (e.g., through the Nordic Council), as well as programs promoted by other environmental groups (e.g., the Audobon Society), and programs promoted by the seafood industry.

. With a few exceptions (Wessells, Donath, and Johnston; and Tiesl, Roe, and Hicks), the economic literature regarding the potential impact of seafood ecolabels is sparse. However, work in food product labeling establishes that the ultimate economic impact of labels depends on consumer acceptance (e.g., Caswell and Mojduszka; Caswell). Moreover, as certification programs often involve some degree of unavoidable cost, the extent to which consumers are willing to pay a price premium may have a significant impact on program success (Gudmundsson and Wessells). Although past research indicates most consumers prefer ecolabeled products to nonlabeled products, ceteris paribus (Blend and van Ravenswaay; Forsyth, Haley, and Kozak), and many consumers are willing to pay a premium for such products (Nimon and Beghin), consumer acceptance is likely to differ across product classes, demographics, and consumer preferences.

Consumer acceptance may also be influenced by other factors: the credibility of the agency providing the ecolabel, perceptions of the links between product choices and environmental impact, and understanding of the label's meaning [U.S. Environmental Protection Agency (EPA)]. Finally, cultural and other differences may lead otherwise similar consumers in separate countries to have varied reactions to international product certification programs (OECD; U.S. EPA). International ecolabeling or certification programs based solely on research conducted in a single country may therefore face unanticipated obstacles or even outright failure, if consumers in all nations do not react similarly to the labeling program.

This study evaluates factors that may influence consumers' acceptance of an ecolabeling program for seafood products. To evaluate potential differences in consumers' acceptance of seafood ecolabels in different countries, we compare the results of parallel consumer preference research conducted in both the United States and Norway. The primary goal is to assess: (*a*) whether consumers prefer ecolabeled seafood, (*b*) what factors influence those choices, and (*c*) whether these determinants or their impacts differ across countries.

As no large-scale market for ecolabeled seafood currently exists,[2] this study relies on the results of a multi-attribute contingent-choice survey (Opaluch et al.). Although often

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[1] Additional information on the MSC is provided through its web site at www.msc.org.

[2] Consumers may purchase dolphin-safe tuna. However, the purpose of ecolabeling of tuna is to protect dolphins; it does nothing to prevent overfishing of tuna. In addition, because there are no unlabeled canned tuna products in the U.S. market, consumers have no choice but to buy ecolabeled canned tuna. In other words, we have no data available to measure consumers' preferences for ecolabeled canned tuna. In a 1997 study, Tiesl, Roe, and Hicks measured demand changes for canned tuna between the periods of pre- and post-labeling.

used to assess tradeoffs in the design of multi-attribute public policies, such analysis is also useful in the consideration of new or proposed market products for which there is little available data concerning consumer demand (Anderson and Bettencourt). Previous analyses of food markets (Blend and van Ravenswaay), and in particular seafood markets, have employed contingent-choice techniques (Holland and Wessells).

The Contingent-Choice Model

The contingent-choice survey format asks respondents to make a discrete choice among multiple product alternatives. By analyzing preferences for a variety of potential products differing according to a chosen set of variables, researchers can estimate the relative importance of particular variables in determining respondents' choices. In the present case, the contingent-choice approach is applied to consumers' choices of eco-labeled (certified) versus nonlabeled (uncertified) seafood. An underlying assumption of the chosen model is that for a given seafood species, consumers will choose either certified or uncertified seafood on any single purchasing occasion, but will not buy a combination of the two products.

Utility from a seafood product is assumed to be a function of the attributes of the product including certification, the cost of the product to consumers, and the characteristics of the consumer. We assume the principal shopper of the household has previously made a selection of the desired seafood species, based on the characteristics of that species relative to substitute products. The consumer must then choose between certified (ecolabeled) and uncertified (nonlabeled) products for that species. Specifically, we only model the choice of certified versus uncertified products within particular species groups; we do not model the choice among different seafood species.[3]

To model discrete-choice behavior, the contingent-choice method relies on the random utility model, in which individual utility is divided into observable and unobservable components (Hanemann). Within this framework, the utility derived from seafood product i is assumed to be a function of physical characteristics of the product (a vector $\mathbf{X}_i$); environmental characteristics of the product, represented by the presence or absence of an ecolabel (L_i, set equal to 0 for uncertified product and 1 for certified product); the agency backing or guaranteeing the ecolabel (G); the consumer's demographic attributes (a vector $\mathbf{D}$); household income (Y) minus the price of product i (P_i), and a vector of other goods ($\mathbf{S}$). This may be formally represented as:

(1) $$U_i(\mathbf{X}_i, L_i, G_i, \mathbf{D}, Y - P_i, \mathbf{S}) = v_i(\mathbf{X}_i, L_i, G_i, \mathbf{D}, Y - P_i, \mathbf{S}) + \varepsilon_i$$
$$\text{for } i = \{A, B\},$$

where $U_i(\cdot)$ is the total utility related to the seafood purchase, $v_i(\cdot)$ is a function representing the empirically measurable component of utility, and ε_i is a term representing the unobservable component. Note that (1) represents the utility of a representative household food shopper, assuming a single person is the primary shopper for each household. Accordingly, the vector of relevant demographic attributes ($\mathbf{D}$) may include

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[3] It is possible the presence of a certified seafood product could alter consumers' choices among different seafood species. However, the goal of this study is to address consumers' choices of certified versus noncertified products for a given species, not to address inter-species choices.

demographic household attributes (e.g., the size of the household) together with individual consumer attributes (e.g., age, education).

The consumer compares the utility derived from a certified seafood product, identified by the subscript A, and an otherwise identical noncertified seafood product, identified by the subscript B. Thus, for the certified product, $L_i = L_A = 1$, and for the noncertified product, $L_i = L_B = 0$. Also note that the agency backing the ecolabel (G_i) only influences utility if the certified product is chosen; hence, $G_i = 0$ for the uncertified product.

The premium for the certified product may be positive, zero, or negative, with the difference between the price of the certified and noncertified product given by:

$$(2) \qquad P_A = P_B + P_L,$$

where P_B represents the per unit "base price" for the unlabeled product, and P_L denotes the premium paid over P_B for the certified product. We assume the quantity of seafood to be purchased is fixed in the short run (i.e., fixed at the amount of seafood needed to feed the household), where we define the short run as a single shopping trip. This assumption is based on the results of focus groups and survey pretests with seafood consumers. (The rationale for this assumption is discussed further in the following section.)

The difference in utility (dU) resulting from the purchase of the certified versus uncertified product is specified as:

$$
\begin{aligned}
(3) \qquad dU &= U_A\big(\mathbf{X}_A, L_A, G_A, \mathbf{D}, Y - (P_B + P_L), \mathbf{S}\big) \\
&\quad - U_B\big(\mathbf{X}_B, 0, 0, \mathbf{D}, Y - P_B, \mathbf{S}\big) \\
&= v_A\big(\mathbf{X}_A, L_A, G, \mathbf{D}, Y - (P_B + P_L), \mathbf{S}\big) \\
&\quad - v_B\big(\mathbf{X}_B, 0, 0, \mathbf{D}, Y - P_B, \mathbf{S}\big) - \big[\varepsilon_B - \varepsilon_A\big] \\
&= dv - \theta,
\end{aligned}
$$

where $U_i(\cdot)$, $v_i(\cdot)$, and ε_i are as defined above. Accordingly, dv represents the difference in observable utility between the two competing products, and θ represents the difference in the unobservable or stochastic component.

Although dU is unobservable to the researcher, respondents' choices may be observed between the certified and uncertified products. That is, the respondent compares the two products, assesses the difference in utility between the two products, and indicates the sign of the utility difference (dU) by choosing either the certified product or the uncertified product. If one assumes θ follows a logistic distribution, the probability of choosing a particular product (e.g., the certified product) can then be modeled using the standard conditional logit model (Maddala). As this model does not allow for a "status quo" response in which survey respondents may choose to purchase neither the certified nor the uncertified product (Adamowicz et al.), model findings should be interpreted as *conditional* on the choice to purchase the specified seafood product. Hence, the model addresses factors influencing the choice of certified versus noncertified products, given a prior decision to purchase a particular type of seafood. Although this assumption constrains the interpretation of model results, it matches common purchase behavior revealed in focus groups.

The Econometric Specification

The logit model specifies the probability of choosing certified seafood as follows:

$$\text{(4)} \qquad \Pr(certified) = \frac{1}{1 + e^{-dv}},$$

where dv represents the utility-difference function shown in (3). In order to test for differences in preferences between Norwegian and U.S. consumers, we supplement the linear specification of dv with a set of dummy variables allowing for differences in intercept and partial slopes between the two groups. The resulting econometric specification is given by:

$$
\begin{aligned}
\text{(5)} \qquad dv = {} & \beta_0(NR) + \beta_1(X)(NR) + \beta_2(\mathbf{D})(NR) + \beta_3(\mathbf{S})(NR) + \beta_4(P_L)(NR) \\
& + \beta_5(G)(NR) + \lambda_0(US) + \lambda_1(X)(US) + \lambda_2(\mathbf{D})(US) + \lambda_3(\mathbf{S})(US) \\
& + \lambda_4(P_L)(US) + \lambda_5(G)(US),
\end{aligned}
$$

where X is a dummy variable identifying the seafood species under consideration (cod or shrimp), $\mathbf{D}$ is a vector of demographic variables including household income, and $\mathbf{S}$ is a vector characterizing the household's general seafood shopping patterns and budget. The latter variables serve as a proxy for information regarding other seafood goods purchased by the consumer. P_L is the premium paid for the certified product, and G is a variable characterizing consumer trust in the particular certifying agency under consideration. US is a dummy variable identifying observations from United States consumers, where $US = 1$ for U.S. consumers, and $US = 0$ for Norwegian consumers. NR is a dummy variable identifying observations from Norwegian consumers, where $NR = 1$ for Norwegian consumers, and $NR = 0$ for U.S. consumers. Finally, $\beta_0, ..., \beta_5$ and $\lambda_0, ..., \lambda_5$ are parameters (or conforming vectors of parameters) to be estimated.

The coefficients corresponding to variables multiplied by NR ($\beta_0, ..., \beta_5$) measure effects on dv for Norwegian consumers. Effects for United States consumers are given by coefficients corresponding to variables multiplied by US ($\lambda_0, ..., \lambda_5$). Table 1 describes the set of variables included in the final model.

Rationale Underlying Quantity Assumptions

As noted above, we assume the quantity of seafood to be purchased is fixed in the short run, where the short run is defined as a single shopping trip. This assumption, based on evidence from focus groups, suggests household shoppers generally buy the quantity of seafood they perceive to be sufficient to feed household members. More specifically, seafood purchases of any given product, on a given shopping trip, may be viewed as a discrete choice. Depending on the price and quality attributes of the product, the consumer will either buy an approximately fixed quantity of the product, or will forego the product entirely and substitute another seafood, meat, or other food product.

Second, consumers in many cases use rules of thumb such as the "size of the fillet" to measure seafood quantity—i.e., when purchasing seafood, consumers often base their selection on the apparent size of the piece of fish, rather than according to a known weight measure. Indeed, a number of those interviewed indicated they did not really know the number of pounds of fish they typically bought, but they almost always bought

Table 1. Model Variables and Their Definitions

Variable Name (U.S., Norway)	Definition	Mean Value	
		U.S.	Norway
US_INTERCEPT NR_INTERCEPT	Model intercept	1.00	1.00
US_PERCENT NR_PERCENT	Certification premium as a percentage of the price for uncertified product	0.27	0.22
US_COD NR_COD	Dummy variable with a value of 1 if species in observation is cod	0.49	0.51
US_TRUST NR_TRUST	Dummy variable with a value of 1 if respondent's most trusted agency is the reported certification agency for purposes of discrete-choice questions	0.23	0.25
US_ANTI-ECO NR_ANTI-ECO	Factor score indicating latent aspects of ecological purchasing behavior (see main text and tables 2 and 3)	0.38	-0.33
US_NO_PURCH NR_NO_PURCH	Factor score indicating latent aspects of ecological purchasing behavior (see main text and tables 2 and 3)	0.09	-0.08
US_NO_CHANGE NR_NO_CHANGE	Factor score indicating latent aspects of ecological purchasing behavior (see main text and tables 2 and 3)	-0.14	0.11
US_ENVIR NR_ENVIR	Dummy variable with a value of 1 if respondent is a member of an environmental organization	0.15	0.05
US_FRESH NR_FRESH	Dummy variable with a value of 1 if respondent most often purchases fresh seafood	0.58	0.43
US_OFTEN NR_OFTEN	Dummy variable with a value of 1 if respondent consumes seafood at least once a week	0.34	0.87
US_LOWB NR_LOWB	Dummy variable with a value of 1 if respondent's weekly seafood budget is less than U.S. $10 or 80 NOK	0.66	0.40
US_HIEDU NR_HIEDU	Dummy variable with a value of 1 if respondent has at least a 4-year college degree	0.46	0.45
US_FEMALE NR_FEMALE	Dummy variable with a value of 1 if respondent is female	0.65	0.50
US_OLD NR_OLD	Dummy variable with a value of 1 if respondent's age is at least 45	0.49	0.47
US_INCOME NR_INCOME	Dummy variable with a value of 1 if respondent's income is greater than U.S. $75,000 or 200,000 NOK	0.21	0.47

the same size fillet or steak. Consequently, introducing an explicit weight measure into choice questions would have added a form of methodological misspecification, as it would have presented choice scenarios different from those commonly understood by respondents.[4]

Primary Data

A telephone survey format was chosen for data collection, allowing random nationwide sampling in both Norway and the United States. The survey was administered in the United States in the summer of 1998, and in Norway during spring 1999. Telephone

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[4] Households purchasing greater (or lesser) quantities of seafood per shopping trip possibly would be either more or less willing to purchase certified seafood at any given premium. However, statistical evidence suggests such patterns do not influence respondents' choices in this case. For example, household size, which one would expect to be highly correlated with quantity of seafood purchased, could not be shown to be statistically significant in any model specification.

numbers to be called were generated by random digit dialing within regions of each country, where the number of surveys completed within each region was determined by regional population relative to national population. Thus, more heavily populated regions generated proportionately more respondents. Regions were defined as states in the United States, and *fylke* within Norway (roughly the equivalent of a U.S. county). The U.S. sample includes 1,640 completed surveys; the Norwegian sample includes 2,039. Surveys were completed by the "principal shopper" in seafood-consuming households; households that did not consume seafood were excluded from the survey. The final data therefore represent a stratified random sample of seafood-consuming households in each country.[5]

Survey development included background research, interviews with those involved in seafood ecolabeling initiatives, interviews and focus groups with seafood consumers, and extensive pretesting. Focus groups and pretests emphasized both the need to provide respondents with sufficient information to make informed product choices, and a requirement that product descriptions and survey language be kept straightforward and succinct. Hence, the number of attributes of each seafood species considered by respondents was minimized to include only those central to the choice of certified versus uncertified seafood.

Respondents considered the choice of certified versus uncertified seafood for two different species: cod and shrimp. The order in which the species were considered was randomized, to prevent question-order bias (Mitchell and Carson). For each species, certified seafood was described simply as being "caught under strict controls that prevent too much fishing." The survey emphasized the fact that both certified and uncertified seafood were of equal quality, texture, and freshness. Prior to the presentation of discrete-choice questions, respondents were provided with background information detailing the meaning of certified seafood, and reminding respondents of their budget constraint.

For each choice instance, respondents were provided with both the price of the uncertified product and the price of the certified product (per pound in the United States, and per kilogram in Norway), where the premium is defined as the difference between the two prices. These premiums ranged from −20 Norwegian kroner (NOK) to +50 NOK in Norway, and from −$2 to +$5 in the United States.[6] Although the surveys expressed this premium in either dollars or kroner, as appropriate, the data analysis converts price premium to a percentage of the uncertified price. This convention was adopted as a means to compare premiums across countries.

In addition to species, price, and premium, each survey listed a specific "certifying agency" for each set of questions for any one respondent, maintaining the same agency for each respondent. These certifying agencies included the World Wildlife Fund (WWF) and the Marine Stewardship Council (MSC) in both countries, as well as the National Marine Fisheries Service (NMFS) in the United States and the Norwegian Fisheries Directorate (NFD) in Norway.

The three certification organizations for each country can be regarded as representatives from: (*a*) a national governmental body, (*b*) a well-known environmental organization, and (*c*) an unknown initiative. Fractional factorial design was used to construct the

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[5] There are no data on the population of seafood consumers; thus it is impossible to make a general comparison between our samples and this population. We can compare our samples to the overall population of each country, which indicates we have oversampled households with high income and education levels.

[6] At the time of this writing, the exchange rate for Norwegian kroner was approximately 9.0 per U.S. dollar.

range of discrete-choice question attributes (Addelman and Kempthorne), resulting in 54 unique contingent-choice questions, divided among 18 survey versions in each country.

In addition to the discrete-choice questions described above, the survey incorporated questions addressing a number of factors including: (*a*) seafood consumption behavior and budget, (*b*) trust in potential certification agencies, (*c*) demographic characteristics, (*d*) the extent to which environmental concerns influenced past purchasing behavior, and (*e*) perceptions regarding the status of particular seafood stocks.

Characterizing Respondents' Ecological Purchase Behavior

Respondents often display heterogeneous preferences for environmental goods or attributes (Swallow et al.). In some cases, differences among respondents' preferences may be explained through the inclusion of demographic variables in the utility difference function. However, in other cases, heterogeneity in responses may be due to unobservable, latent factors which influence behavior (Bollen). These factors are often estimated through analysis of Likert-scale responses to multiple questions linked to a set of underlying concepts (e.g., Variyam, Jorday, and Epperson). Details of the various methods of factor and principal component analysis are presented by numerous authors (see, for example, Harman; Reyment and Jöreskog).

In an attempt to better model preference heterogeneity, each survey included a set of 10 questions designed to characterize the extent to which environmental concerns influenced respondents' purchasing behavior. These questions were selected from the standardized ecologically conscious consumer behavior (ECCB) scale (Roberts), which asks respondents to rate the veracity of various statements regarding their purchase behavior with respect to environmental product attributes. Responses to these questions are summarized in table 2.

Following Variyam, Jorday, and Epperson, factor analysis is conducted to estimate a small number of underlying constructs which together account for a large percentage of the observed variation in responses. Responses are analyzed using principal-component factor analysis of the response correlation matrix, with three factors retained and rotated using the VARIMAX method (Kaiser). Retained factors were chosen based on a threshold eigenvalue of one (Variyam, Jorday, and Epperson). Rotated VARIMAX factor loadings are illustrated in table 3.

Factor 1 is characterized by high factor loading (with values appearing in bolded italics in table 3) on questions 4, 7, 8, 9, and 10, where high loadings indicate respondents considered the statements to be less true. These statements tend to reflect a consumer's willingness to forego desired products for abstract environmental reasons—no personal economic gain is involved and no specific purchases are described. High scores on these questions reflect a lack of willingness to give up products solely for abstract environmental reasons. This factor is accordingly characterized as "anti-environmental" (denoted *ANTI-ECO*).

Factor 2 is characterized by high loading on questions 1, 2, and 3 (table 3). These questions concern the likelihood of purchasing specific types of environmentally-friendly products, often with potential long-term economic benefits to the purchaser. These include products with low energy costs or reduced packaging. Hence, this factor is characterized as representing the degree to which a consumer has made expenditures for

Table 2. Ecologically Conscious Consumer Behavior (ECCB) Questions and Response Statistics

Quest. No.	Syntax	U.S. Mean[a] (Std. Dev.)	Norway Mean[a] (Std. Dev.)	Difference of Means[b]
1	I have purchased a household appliance because it uses less electricity than other brands.	2.91 (1.11)	3.01 (1.53)	0.11**
2	I have purchased light bulbs that are more expensive but saved energy.	2.88 (1.12)	2.25 (1.46)	-0.62***
3	I will not buy products that have excessive packaging.	2.95 (1.04)	2.74 (1.34)	-0.21***
4	If I understand the potential damage to the environment that some products can cause, I do not purchase these products.	2.32 (0.94)	1.76 (1.14)	-0.56***
5	I have switched products for ecological reasons.	2.85 (1.01)	2.79 (1.57)	-0.06
6	I have convinced members of my family or friends not to buy some products that are harmful to the environment.	3.24 (1.13)	3.44 (1.60)	0.20***
7	Whenever possible, I buy products packaged in reusable containers.	2.53 (0.98)	1.82 (1.21)	-0.70***
8	When I have a choice between two equal products, I always purchase the one less harmful to other people and the environment.	2.24 (0.93)	1.83 (1.13)	-0.42***
9	I will not buy a product if the company that sells it is ecologically irresponsible.	2.34 (0.96)	1.94 (1.16)	-0.39***
10	I do not buy household products that harm the environment.	2.40 (0.87)	1.86 (1.07)	-0.55***

Note: Questions were selected from Roberts' 1996 ECCB Scale.
[a] Scoring scale: always true = 1, mostly true = 2, sometimes true = 3, rarely true = 4, and never true = 5. Note that *higher* numbers represent a *lower* probability of engaging in the particular behavior.
[b] Double and triple asterisks (*) denote significance at $p < 0.05$ and $p < 0.01$, respectively.

Table 3. Rotated VARIMAX Factor Loadings: Responses to ECCB Questions

Quest. No.[a]	Factor 1	Factor 2	Factor 3	Quest. No.[a]	Factor 1	Factor 2	Factor 3
1	-0.024	*0.778*	0.154	6	0.081	0.133	*0.838*
2	0.236	*0.705*	-0.039	7	*0.537*	0.305	0.219
3	0.254	*0.535*	0.226	8	*0.654*	0.196	0.147
4	*0.731*	0.056	0.071	9	*0.753*	0.091	0.123
5	0.266	0.112	*0.757*	10	*0.771*	0.118	0.104

[a] Refer to table 2 for the syntax corresponding to questions 1–10.

specific energy- or packaging-related environmental benefits. Because high scores for this factor indicate an unwillingness to undertake this sort of specific behavior, we characterize this factor (denoted *NO_PURCH*) as "no specific energy-packaging purchases."

Factor 3 (table 3) is characterized by high loading on questions 5 and 6—questions addressing an active change in behavior in response to environmental information. Those with high scores on this factor will not change products in response to ecological

information, nor will they convince others to do so. Therefore, this factor is characterized as indicating an "unwillingness to change" (denoted *NO_CHANGE*) purchase patterns for environmental reasons.

The three factors are included in the logit model as standardized factor scores—i.e., the original factors are transformed so as to have a mean of zero and standard deviation of one. This procedure simplifies interpretation of estimated logit parameters, as the scores indicate the extent to which a factor score for a particular respondent differs from that of the sample mean (Kline).

Model Results

Logit results for the choice of certified versus uncertified seafood are reported in table 4. After deletion of observations with missing data for variables, the final model includes 6,220 observations. Of these, 3,100 are U.S. observations and 3,120 are Norwegian observations.[7] A log-likelihood ratio test ($-2 \text{LnL} = 1,838.354$, df = 30) shows the model is significant at $p < 0.0001$. Of 28 non-intercept variables in the model, 18 are statistically significant. The model predicts 76% of in-sample observations correctly.

A log-likelihood test of the unrestricted model versus a restricted model in which U.S. and Norwegian effects were constrained to be equal indicates the restrictions have a statistically significant impact on the model at $p < 0.0001$ ($\chi^2 = 340.915$, df = 15). We conclude that statistical differences exist between the choices of Norwegian and U.S. respondents, although the pairwise statistical equivalence of U.S. and Norwegian parameter estimates cannot be rejected for all variables.

Table 5 provides results of log-likelihood χ^2 tests of pairwise equality between U.S. and Norwegian parameter estimates. The null hypothesis of pairwise equality may be rejected at $p < 0.10$ for eight of the 15 model variables considered, including the intercepts. In the discussion below, we examine implications of these results, as well as the implication of the signs and magnitudes of particular parameter estimates. Following the variable groupings of equation (5), we focus the following discussion on the effects of price premium (P_L), species (X), agency trust (G), environmental purchase and seafood consumption patterns (**S**), and demographics (**D**).

Price Premium

A log-likelihood test ($\chi^2 = 662.465$, df = 2) clearly indicates joint significance of variables associated with the price premium P_L (*US_PERCENT*, *NR_PERCENT*) ($p < 0.0001$), confirming the results of individual tests of statistical significance. As expected, the price premium measured in percentage terms has a negative impact on consumers' likelihood of choosing certified seafood. Although the negative effect holds in both countries, it is more pronounced in Norway: the variable *NR_PERCENT* is greater in absolute value than *US_PERCENT*, and the difference is statistically significant at $p < 0.0001$ (table 5).

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[7] The 1,640 U.S. surveys generated 3,280 observations (one observation each for cod and shrimp per survey). However, 180 observations were dropped due to missing data. The 2,039 Norway surveys generated 4,078 observations (again, one observation each for cod and shrimp per survey). Of these, 958 observations were dropped due to missing data. Data most often missing include demographic data such as income and education.

Table 4. Logit Model Results for Choice of Certified versus Uncertified Seafood

Variable	Parameter Estimates	Standard Error	Wald χ^2	Prob > χ^2
US_INTERCEPT	1.67	0.15	119.44	0.0001***
NR_INTERCEPT	0.47	0.16	9.23	0.0024***
US_PERCENT	-2.45	0.16	231.92	0.0001***
NR_PERCENT	-3.57	0.19	350.94	0.0001***
US_COD	0.47	0.10	22.79	0.0001***
NR_COD	0.40	0.08	23.05	0.0001***
US_TRUST	0.08	0.11	0.62	0.4305
NR_TRUST	0.47	0.09	24.87	0.0001***
US_ANTI-ECO	-0.35	0.05	43.11	0.0001***
NR_ANTI-ECO	-0.27	0.04	42.75	0.0001***
US_NO_PURCH	-0.13	0.05	6.50	0.0108**
NR_NO_PURCH	-0.01	0.04	0.11	0.7458
US_NO_CHANGE	-0.11	0.06	3.53	0.0604*
NR_NO_CHANGE	-0.14	0.04	15.85	0.0001***
US_ENVIR	0.32	0.14	5.66	0.0174**
NR_ENVIR	0.11	0.18	0.34	0.5608
US_FRESH	0.33	0.09	13.52	0.0002***
NR_FRESH	0.07	0.08	0.64	0.4228
US_OFTEN	-0.15	0.10	2.43	0.1191
NR_OFTEN	-0.02	0.12	0.03	0.8662
US_LOWB	-0.46	0.11	18.48	0.0001***
NR_LOWB	-0.19	0.09	5.19	0.0228**
US_HIEDU	0.09	0.09	0.96	0.3265
NR_HIEDU	-0.44	0.08	27.52	0.0001***
US_FEMALE	0.13	0.09	2.06	0.1509
NR_FEMALE	0.61	0.08	55.67	0.0001***
US_OLD	0.10	0.09	1.35	0.2457
NR_OLD	0.19	0.08	5.07	0.0243**
US_INCOME	0.10	0.12	0.66	0.4177
NR_INCOME	0.20	0.09	5.45	0.0195**

No. Observations = 6,220
-2LnL   = 6,784.397
-2LnL χ^2 = 1,838.354 (df = 30)   0.0001***

Note: Single, double, and triple asterisks (*) denote significance at $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

The greater price sensitivity of Norwegian consumers may appear counterintuitive, given Norwegians are in general more willing to change purchase behavior based on environmental concerns (table 2). However, Norwegians' greater attention to environmental attributes, combined with Europeans' more significant experience with ecolabeling programs in general (U.S. EPA), may generate a greater awareness of tradeoffs associated with premiums paid for labeled products. More specifically, Norwegians' greater experience with ecolabels and greater seafood consumption may provide a better defined sense of when a price premium is "too high" relative to premiums for other ecolabeled products, leading to the potential for greater price sensitivity.

Table 5. Results of Log-Likelihood Test of Equality Between U.S. and Norway Parameter Estimates

Null Hypothesis	Wald χ^2	Prob $> \chi^2$
US_INTERCEPT = NR_INTERCEPT	30.04	0.0001***
US_PERCENT = NR_PERCENT	20.22	0.0001***
US_COD = NR_COD	0.36	0.5493
US_TRUST = NR_TRUST	7.50	0.0062***
US_ANTI-ECO = NR_ANTI-ECO	1.56	0.2124
US_NO_PURCH = NR_NO_PURCH	3.52	0.0605*
US_NO_CHANGE = NR_NO_CHANGE	0.16	0.6923
US_ENVIR = NR_ENVIR	0.94	0.3330
US_FRESH = NR_FRESH	4.78	0.0288**
US_OFTEN = NR_OFTEN	0.71	0.3983
US_LOWB = NR_LOWB	3.67	0.0553*
US_HIEDU = NR_HIEDU	18.13	0.0001***
US_FEMALE = NR_FEMALE	15.03	0.0001***
US_OLD = NR_OLD	0.50	0.4802
US_INCOME = NR_INCOME	0.44	0.5071

Note: Single, double, and triple asterisks (*) denote significance at $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

Species

To evaluate the relative importance of species on respondents' choices, the model includes dummy variables (*US_COD, NR_COD*) identifying observations associated with cod rather than shrimp for U.S. and Norwegian observations. These variables are significant and positive ($p < 0.0001$), indicating both U.S. and Norwegian consumers are relatively more likely to choose certified cod than certified shrimp. Because there is no statistical difference between the parameter estimates for the U.S. and Norway (table 5), we conclude that the same choice patterns hold for U.S. and Norwegian respondents. Hence, certification appears to have a stronger influence on purchase behavior for cod, compared to shrimp. The existence of such effects suggests the success of ecolabeling programs will likely differ across species.

   Although one might conclude the preference for certified cod is due to frequent media reports regarding the depletion of cod stocks (Cramer), in fact only a low percentage of respondents stated they believed cod to be "severely overfished." Moreover, preliminary models could establish no significant correlation between a belief that cod stocks were overfished and the likelihood of choosing certified cod; this belief variable was subsequently deleted from the model.

Agency Trust

Prior to discrete-choice questions, the survey asked respondents to indicate which of a list of agencies would be most trusted to guarantee certification. U.S. respondents could

choose among the World Wildlife Fund (WWF), the Marine Stewardship Council (MSC), and the National Marine Fisheries Service (NMFS). Norwegian respondents were given a choice among the WWF, the MSC, and the Norwegian Fisheries Directorate (NFD). Respondents were not provided additional information regarding these agencies, to mimic actual buying conditions in which consumers would likely not have on-site access to additional information regarding a certifying agency.

Of the agencies considered by U.S. respondents, the NMFS garnered the highest trust ratings, with 49% of respondents indicating they would trust this agency most to provide certification. The WWF was chosen by 23% of respondents, and the MSC by 5%. The remaining 23% were unsure of their most trusted agency. Approximately 81% of Norwegian respondents reported they would trust the government agency most to provide certification. The WWF was chosen by 16% of Norwegian respondents, and the MSC by 3%. Private (e.g., seafood industry) certifying organizations were not considered, as prior research regarding seafood safety has shown seafood consumers place relatively little value on guarantees offered solely by industry groups (Wessells and Anderson).

While trust in the certification agency might be expected to influence the probability of selecting certified products, model results support this conclusion only for Norwegian consumers. More specifically, in cases where the discrete-choice selection of certification agency for guaranteeing certification was also reported as the respondent's "most trusted" agency, Norwegian respondents were more likely to choose the certified product (*NR_TRUST* is significant and positive). However, this effect did not hold for U.S. consumers (*US_TRUST* is not statistically significant).

Based on these findings, choice of certifying agency may be an important element in the success of a certification program. Certifications offered by little-known organizations (such as the MSC) may in some cases result in a lower probability that consumers will choose a certified product, compared to certifications offered by better known government agencies. Although consumer trust in such agencies may be bolstered by public-relations or educational campaigns, the efficacy of such programs will likely vary across nations, just as the relative importance of trust in the certification agency differs. In nations where significant changes in consumer acceptance are associated with agency trust (e.g., Norway), costly promotional and educational campaigns may be particularly advantageous; such activities may be less effective in countries where agency trust has little or no demonstrable impact on consumer behavior.

Environmental Purchase Patterns

An initial log-likelihood test was employed to assess the role of heterogeneity in respondents' ecological purchase behavior, as measured by the 10 ECCB-scale questions (table 2) characterizing the extent to which environmental concerns influenced respondents' purchasing behavior (Roberts). Six model variables are constructed from these questions, with *NR_ANTI-ECO*, *NR_NO_PURCH*, and *NR_NO_CHANGE* representing factor scores for Norwegian observations, and *US_ANTI-ECO*, *US_NO_PURCH*, and *US_NO_CHANGE* representing the corresponding scores for U.S. observations (table 1). Hypothesis test results ($\chi^2 = 117.381$, df = 6) document the joint significance of these variables at $p < 0.0001$, and confirm that the factor loadings successfully capture underlying preferences which influence respondents' hypothetical choices for certified seafood.

The individual latent factors derived from ECCB responses can help identify types of consumers who may be particularly likely or unlikely to respond to seafood certification programs. For example, consumers who score highly on the first factor measuring abstract anti-environmentalism (*NR_ANTI-ECO* and *US_ANTI-ECO*) in both Norway and the United States are less likely to select certified seafood than those with lower scores for this factor. The impact of this variable cannot be shown to be different across the two countries (table 5). Similarly, the third factor (*NR_NO_CHANGE*, *US_NO_CHANGE*) is significant for both countries and negative, indicating respondents who score highly on the *"unwillingness to change"* factor are less likely to choose certified seafood. In contrast, the second factor (*NR_NO_PURCH* and *US_NO_PURCH*, denoting no specific energy-packaging purchases) has no apparent influence on the behavior of Norwegian respondents. This may be due to the relatively high profile of energy supply issues in Norway (Kalgraf, Owens, and Raaholt); such issues may be viewed as distinct from other environmental concerns such as overfishing. However, for U.S. respondents, high scores for this factor are associated with a lower probability of selecting certified seafood ($p < 0.02$).

Summarizing these results, anti-ecological purchasing tendencies as measured by high scores on the three latent factors are associated with a significant decrease in the estimated probability of selecting an ecolabeled seafood product. Moreover, the effects appear largely the same across the two countries, notwithstanding differences associated with the second factor. These results suggest that active targeting of marketing and information toward consumers with identifiable tendencies related to ecological purchasing behavior may be an important determinant of the success of seafood ecolabeling programs.

One might also seek to characterize heterogeneity in respondents' environmental attitudes and behavior using directly observable variables, such as those indicating membership in various environmental organizations (Swallow et al.). Unlike the latent variables discussed above, which have largely similar impacts on Norwegian and U.S. choices, the effects of environmental organization membership appear to differ. Holding all else constant, membership in environmental organizations (*NR_ENVIR* = 1) cannot be shown to have a statistically significant impact on the likelihood of choosing certified seafood for Norwegian respondents.[8] For U.S. respondents, environmental organization membership (*US_ENVIR* = 1) is associated with a significant increase in the likelihood of choosing certified seafood. However, despite the difference in statistical significance, we cannot reject the equality of the two parameter estimates at $p < 0.10$ (table 5). Hence, we cannot appropriately claim the effect differs between the two countries.

Seafood Consumption Patterns

From the model results, Norwegians who most often purchase fresh seafood products rather than frozen (*NR_FRESH*) are no more likely to choose certified seafood. However, U.S. respondents who most often purchase fresh seafood (*US_FRESH*) are more

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[8] Although it is possible that degrading multicollinearity between ecological purchasing behavior and membership in environmental organizations could contribute to the insignificance of the latter variable, these variables are not, in fact, highly correlated. For example, the Pearson correlation coefficients between *NR_ENVIR* and the three factor scores for ecological purchasing behavior are in all cases less than 0.093 in absolute value. Moreover, assessing the condition indices of the data matrix reveals that the largest condition index is 25.90.

likely to select certified seafood. Such patterns could be of importance in the development of certification programs, as Unilever, a co-founder of the MSC and a primary private-sector proponent of seafood ecolabeling, is a large-volume seller of frozen seafood to both Europe and the U.S. under the Gorton's® and Bird's Eye® brands (McHale).

Frequency of seafood consumption does not influence consumers' choices of certified seafood in either country, despite substantial differences in the average rate of seafood consumption in the two countries surveyed. Neither *NR_OFTEN* nor *US_OFTEN* can be shown to be statistically significant. However, model results do support the hypothesis that those with low weekly seafood budgets are less likely to purchase certified products. Norwegian consumers with relatively low seafood budgets (see table 1) are less likely to choose certified products ($p < 0.0228$). The variable *US_LOWB* is also negative and significant ($p < 0.0001$), revealing less likelihood for U.S. consumers with a relatively low seafood budget to choose certified products. Hence, although the frequency of seafood consumption is not a key indicator of preferences for certified seafood, the average weekly budget for seafood products is a significant factor.

Demographics

Demographic factors also influence respondents' preferences for certified seafood products. However, the impacts of these variables are not consistent across the two countries surveyed. For example, the independent variables *US_HIEDU* and *NR_HIEDU* identify respondents with at least a four-year college degree. For Norwegian respondents, this variable is associated with a lower probability of selecting certified seafood; for U.S. respondents, it cannot be shown to have a statistically significant effect. The coefficients of gender (*US_FEMALE, NR_FEMALE*), age (*US_OLD, NR_OLD*), and income (*US_INCOME, NR_INCOME*) have the same sign across both countries, but differ in statistical significance, magnitude, or both. For example, a greater likelihood of selecting ecolabeled seafood is associated with females in Norway, but not with females in the United States. Those identified as being in a high-income group (cf. table 1) are more likely to select certified seafood in Norway, but this effect is not statistically significant in the United States. The results suggest significant heterogeneity across countries with regard to the role of specific demographic indicators.

Forecasting the Probability
of Selecting Ecolabeled Seafood

Although the significance and magnitude of specific effects may differ across countries, this in itself does not guarantee the average probability of selecting ecolabeled seafood will differ to a statistically significant degree. To assess potential differences in the overall probability across the two sampled countries, table 6 forecasts the probability that an "average" consumer will choose certified seafood, at different premium levels. To offset potential effects related to differences in the demographic characteristics of the two samples, consumer characteristics are fixed at sample means for both countries combined. Table 6 displays the probabilities of an identical consumer in Norway and the United States. Forecasts are generated for price premium percentages of 0%, 24.2% (the premium sample mean across both countries), 50%, and 75%, with all except the 75% premium representing in-sample forecasts. Probabilities may also be calculated using

Table 6. Estimated Probability of Selecting Certified Seafood: U.S. versus Norway

Price Premium (PERCENT)	U.S. Estimated Prob. (Std. Error) [c]	Norway Estimated Prob. (Std. Error) [d]	Probability Difference (Std. Error)	t-Statistic (H₀: Prob. Diff. = 0)
0%	0.880 (0.009)	0.735 (0.014)	0.142 (0.016)	8.87***
24.2% [a]	0.802 (0.010)	0.539 (0.014)	0.263 (0.017)	15.47***
50%	0.682 (0.014)	0.317 (0.016)	0.364 (0.021)	17.33***
75% [b]	0.538 (0.021)	0.160 (0.015)	0.378 (0.027)	14.00***

Notes: Asterisks (***) denote significance at $p < 0.01$. All variables except PERCENT are held constant at mean values.
[a] The 24.2% price premium is the sample mean across both countries.
[b] Out-of-sample prediction.
[c] If U.S. probabilities are calculated using means for U.S. observations only, they become (moving down the column) 0.868, 0.784, 0.658, and 0.511.
[d] If Norwegian probabilities are calculated using means for Norway observations only, they become (moving down the column) 0.749, 0.556, 0.333, and 0.17. Differences from U.S. probabilities remain significant.

the mean values for each country's sample—i.e., U.S. sample means used to calculate U.S. probabilities and Norwegian sample means used to calculate Norway probabilities. These latter results are shown in footnotes (c) and (d) to table 6.

Estimated probabilities are calculated directly from estimated model parameters and mean values for associated variables, based on the logistic function (4). Following Poe, Welsh, and Champ, and Krinsky and Robb, standard errors for the estimated probability are generated using a bootstrap of the estimated variance-covariance matrix. This simulation method may be used to establish the empirical distribution of any estimator which is a nonlinear function of estimated parameters, and explicitly accounts for both the variability associated with estimated coefficients and interactions among coefficients (Park, Loomis, and Creel). We randomly draw 10,000 sets of coefficient estimates from the maximum-likelihood estimates and accompanying variance-covariance matrix. Probability estimates are calculated for each of the 10,000 draws, resulting in an empirical distribution of probability for each scenario (Poe, Welsh, and Champ). This distribution is used to calculate standard errors for the probability of choosing certified seafood. Finally, these estimated standard errors are used to generate t-statistics for the null hypothesis that the difference between estimated Norwegian and U.S. probabilities is equal to zero.

In all cases shown in table 6, the estimated probability difference—for otherwise identical consumers at identical premium levels—is statistically different from zero at $p < 0.05$. For example, at a 0% price premium, the estimated probability of a Norwegian consumer choosing certified seafood is approximately 74%. The equivalent estimated probability for a U.S. consumer is 88%. This probability difference is significant at $p < 0.01$. Moreover, Norwegian respondents are apparently more sensitive to increases in the price premium. For example, from table 6, a change in price premium from 0% to 50% of the uncertified price leads to a 0.42 percentage point decrease in the probability of selecting certified seafood for Norwegians, but only a 0.20 percentage point decrease

for U.S. respondents. Similar changes occur between all in- and out-of-sample premium levels, with Norwegian consumers always less likely to choose certified products.[9] These results are particularly notable, given that Norwegian respondents report a greater importance of ecological attributes in general purchase behavior (cf. table 2).

These results contrast with results found in past international studies of consumer willingness to purchase "environmentally friendly" products. The few existing international comparisons of ecological purchasing behavior often indicate U.S. residents are *less* willing to pay premiums for improvements in environmental or ecological product attributes. For example, a recent international study concluded U.S. residents were more reluctant to pay a premium for Mexican shade-grown coffee—a production method offering environmental and other benefits—than were Canadian or Mexican consumers (Commission for Environmental Cooperation). In the case of seafood, the ubiquity of seafood consumption in Norway may lead to a greater awareness of price distributions for various seafood products, and hence a greater awareness of cases in which a premium would place the price of a particular seafood product far out of line with the prices of competing seafood products.

Implications

The organizational blueprint for the Marine Stewardship Council was developed by the consulting firm of Coopers & Lybrand (McHale). According to this firm, "the power of [this eco-seal] is in how customers, voting with their pocket, actually exert economic leverage all the way back up the value chain" (R. Cooke, quoted in McHale, p. 38). Consumer reactions may influence the impact of an ongoing labeling program on seafood harvest patterns, as well as the very existence and economic viability of labeling, given that the revenue-generating capacity of an ecolabel may or may not provide funds sufficient to support required monitoring and management activities (McHale). The results of our analysis suggest that the long-term viability and impact of a seafood ecolabel will depend on a wide range of factors, including the characteristics of consumers, the country in which the label is used, popular trust in the labeling agency, and the species chosen for labeling.

Because the market for seafood is global, with large volumes traded among countries, popular acceptance of an ecolabel in a single nation or group of nations (e.g., the European Union) may be insufficient to prevent overfishing of valued stocks, particularly for migratory species or stocks which straddle national boundaries. The necessity of international acceptance, combined with heterogeneity in consumer behavior across nations, highlights the importance of flexibility in the implementation of labeling programs across national borders. The marketing of a successful ecolabeling program for seafood products cannot follow a simple "one-size-fits-all" approach.

Based on our model results, differences among countries may have significant implications for the success of such programs. For example, differences in price sensitivity

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[9] Equivalent results are found for various alternative methods of estimating the "average" probability of selecting certified seafood. Equivalent results are found if one: (a) calculates probabilities according to the different means for each country, or (b) calculates the probability of purchasing certified seafood for each observation, and then assesses the mean across all observations.

between the United States and Norway may lessen the ability of the seafood industry to charge a constant price premium in some countries sufficient to cover costs associated with labeling programs.[10] To cover costs across the global market, price discrimination by international corporations across different countries may be required.

Model results also have potential implications for the targeting and marketing of seafood ecolabeling programs. For example, programs targeted at consumers of fresh seafood may meet with relatively greater success in the United States, where those who generally purchase fresh seafood are more likely to select certified seafood, compared to those who generally purchase frozen seafood. However, such patterns are not apparent in the Norwegian sample, suggesting this type of targeting may be less effective in Norway. Unless labeling programs incorporate the flexibility necessary to account for these and other differences in consumer behavior across national borders, unilateral international ecolabeling programs may lead only to a reallocation of trade patterns, without any long-term benefit to fish stocks.

In summary, model results highlight the need for thorough analyses of consumer preferences for ecolabeled seafood, particularly given that seafood ecolabels must compete with other valued attributes of fish—safety, quality, price, brand, etc.—to attract consumer purchases. Model results also highlight the significance of cultural and other differences across nations; we find substantial divergence between Norway and the United States concerning the impact of a wide range of variables. A comparison between consumers in industrialized versus developing nations would likely yield even more interesting results, but limited funding temporarily prevents such a study.

Despite the insights provided by comparisons of Norwegian and U.S. survey responses, this research has important limitations that may be addressed by future research. First, the lack of an actual, large-scale market for ecolabeled seafood necessitated a stated-preference approach, which may result in upwardly biased estimates of consumers' actual willingness to pay to obtain ecolabeled products or probability of selecting such products at any given premium (Arrow et al.). Second, restrictions on quantity purchased, although a direct result of consumer behavior in focus groups, limit the welfare information which may be estimated from the random utility model. Finally, the model addresses the choice of ecolabeled seafood contingent on the prior choice to purchase a particular seafood species. It does not address the impact of labels on consumers' choices among different seafood species, or among seafood and other food products. Research which addresses these limitations may provide yet additional information relevant to the design of international seafood ecolabeling programs.

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[10] There are four costs of bringing ecolabeled fish to market. First, there are the costs of certification, which vary according to complexity of the fishery being certified. For three fisheries certified, one was paid for entirely by the fishing industry (Thames River herring, UK), one by a combination of industry and government (Western Australian rock lobster), and the third entirely borne by the Alaska state government (Alaskan salmon). Second, there are costs associated with licensing the use of the logo (label). These costs are based on total sales of the firm. Third, chain-of-custody certification is required at several levels of the market to ensure certified fish products are not mixed with noncertified products. Finally, there are costs of achieving a sustainable fishery, which may require better data collection and better management systems. Such costs are highly variable, and depend on the characteristics of the fishery. These costs are typically borne by the government.

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