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# THE IMPACT OF HEALTH, ENVIRONMENTAL AND SOCIAL ATTRIBUTES OF SALMON CHOICE IN THE UNITED STATES

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## Abstract

In recent years, U.S. consumers have increasingly sought information about the health implications of their food purchases, as well as the environmental and social impact of the food production process. While this growing consumer demand has helped facilitate the development of several seafood certification programs, no accessible public or private data shows that U.S. shoppers are willing to pay a premium for certified seafood. To estimate whether a price premium exists for current and forthcoming certifications for wild and farmed salmon producers, and to better understand U.S. consumers' preferences for salmon, we surveyed a representative sample of 955 shoppers from the United States. We then conducted a conjoint analysis on their willingness to pay for different methods of production (wild or farmed), countries or regions of origin, the Marine Stewardship Council's wild seafood 'ecolabel', and hypothetical certifications assuring that the salmon product is associated with fewer health risks, environmental impacts, or negative social issues. Of the factors which affect consumers' salmon purchasing decisions, the combination of fresh salmon's method of production and its region of origin is generally a stronger determinant of U.S. salmon shopper's purchasing decisions than the salmon's certifications. Consumers strongly favor wild salmon to farmed salmon, prefer salmon from the United States to salmon from other countries, are willing to pay the largest premiums for environmental certifications, and state they are willing to pay the lowest premium for the health and safety certification. Results show that 1) fresh salmon producers and retailers have financial incentives to display social and environmental labels at seafood counters in markets, 2) a price premium for a health and safety certification of farmed salmon would be limited, since salmon consumers are more responsive to negative than positive information related to health issues associated with the salmon that they purchase, and 3) certifying agencies, and all retailers have financial incentives to inform consumers about the benefits and risks of salmon production and consumption, because informed consumers are willing to pay more for certified fresh salmon as well as most types of uncertified fresh salmon.

## 1. Introduction

In recent years, consumers have increasingly been demanding intangible attributes from their food products. Along with health characteristics, some consumers also seek information about the origin of their food purchases, along with the environmental and social impact of the food production process.

Seafood is of special concern because it is particularly prone to food safety problems, but it is also associated with environmental and labor issues. Fisheries worldwide are often ineffectively managed, overexploiting fish stocks while providing inadequate or unsafe labor conditions for employees. An alternative to fishing is aquaculture, which produces nearly half of all seafood worldwide and is the world's fastest growing food production industry. While this expanding industry has the potential to reduce the unsustainable exploitation of fisheries while meeting the world's growing demand for animal protein and fat, it has generated several environmental problems and social conflicts. These challenges

range from the excessive use of antibiotics to the mistreatment of workers. One of the most recent examples of ineffective animal health management systems affecting aquaculture's growth occurred in Chile's salmon industry: the ISA virus decimated the nation's growing salmon industry beginning in 2007, cutting the industry's output by nearly half in 2010, from peak production in 2008.

Despite the numerous environmental, health, and social issues facing or created by the seafood industry, market-driven mechanisms are currently being developed to reduce these negative impacts while maintaining the industry's economic viability. Growing interest in third party or governmental certifications, which provide assurances regarding the method by which a food product was produced, have the potential to improve the safety, social equity, and sustainability of the industry, if seafood producers improve their production methods to meet agencies' certification criteria.

The Marine Stewardship Council (MSC), founded by the World Wildlife Fund (WWF) and Unilever (a multinational manufacturing corporation) in 1996, is the largest of these initiatives, and is the leading third party organization which certifies wild capture fisheries as sustainably managed. The organization has established partnerships with several seafood retailers in the United States and Europe that sell MSC - certified seafood products and that have pledged to only purchase seafood from "sustainable" sources, demonstrating that certification agencies can help promote the consumption of quality, safe, and environmental friendly seafood.

In response to the MSC's success and the increasing demand for sustainable and safe seafood, several initiatives to establish environmental, health, and social standards and certifications for aquaculture producers are currently being developed. These projects include the Global Aquaculture Alliance's Best Aquaculture Practices certification program, and the WWF–coordinated Aquaculture Dialogues, which is an international coalition of conservation organizations and aquaculture industry stakeholders that are developing standards for responsible aquaculture.

Despite the recent emergence of certification programs for wild and farm raised seafood products, the financial viability of these programs is unclear: authors were unable to locate market data demonstrating that consumers pay a premium for certified seafood products. This finding was unexpected, because certification programs in any market can only influence production processes if producers are provided with incentives to obtain certifications, namely a premium for certified products.[1] It is the aim of this study, therefore, to estimate the premium that U.S. consumers would pay for health, environmental, and social attributes of salmon, which has grown in popularity internationally and is now one of the most frequently-consumed types of fish in the US. Results could enable salmon producers and certification agencies to more precisely gauge the potential financial benefits of obtaining a forthcoming certification, and to better understand the determinants of salmon demand.

To elicit consumers' willingness to pay for certifications and other product attributes, the conjoint analysis (also known as stated preference) methodology has been used in several studies to analyze consumer demand for certified seafood. Holland and Wessells show that the preferences between salmon products are most strongly driven by the presence of a safety inspection, while farmed salmon are preferred to wild salmon. Wessells, Johston and Donath demonstrates that U.S. consumers prefer ecolabelled over non-eco-labelled cod, shrimp, and salmon, with respondents' demographic characteristics not significantly affecting preferences. Johnston et al. (2001) show that demand exists for certified seafood products in both the United States and Norway, but the relative importance of certifications and other product attributes (e.g. species, price, frozen or fresh, origin) vary between these counties. Jaffry et al. (2004) utilize the conjoint analysis methodology to analyze U.K. consumers' preferences for seafood with quality and sustainability labels, determining that these labels are more important determinants of consumers' seafood preferences than other product attributes such as origin and mode of production (i.e. wild or farmed). Fonner analyzed Oregon consumers' preferences for seafood information attributes, finding that Oregon seafood consumers show a greater preference for 'sustainability' and 'local' labels than labels assuring the quality or safety of the seafood product.

[1] Increased profits per unit are not the only potential benefit for producers for obtaining a certification. Producers may also be incentivized to obtain product certifications if they increase a producer's access to markets or market share.

This study builds upon the existing literature in three distinct ways: first, the survey designed for this study uses hypothetical certifications that refer to specific, measureable, and enforceable production practices which will be included as criteria to obtain forthcoming aquaculture certifications.[2] Similar studies have used broadly defined or unrealistic environmental and safety attribute definitions. The use of more precise certifications which refer to feasibly implementable production practices could provide clearer incentives to the industry to reduce specific risks and impacts associated with salmon production. Second, this study compares consumer preferences for a social certification with environmental or safety certifications. Media coverage of the challenges facing the seafood industry has primarily focused on the environmental and health issues associated with seafood production and consumption. Social concerns – particularly in developing countries, which catch or produce an important proportion of wild and farmed seafood worldwide and often lack strong regulatory frameworks to monitor and enforce worker protections – have received limited international attention. This study seeks to determine if consumers' shopping preferences reflect this lack of public attention on labor issues relevant to both farmed and wild-caught seafood production, and if not, whether sufficient demand exists to incentivize salmon producers to obtain certifications of their labor standards. Third, we explore the role that a more informed consumer might have on preferences, to this end two different survey versions are applied to U.S. consumers. One sample of participants was given comprehensive, detailed background information on the issues that are addressed by the certifications (subsequently referred to as the info-rich version), and the other sample of participants was provided a survey that seeks to mimic information–restricted shopping scenarios (hereafter referred to as the info-poor version). A comparison of the preferences of informed and uninformed salmon shoppers would allow salmon industry stakeholders to estimate the economic implications of running educational campaigns to increase public awareness about the benefits and the issues associated with salmon production and consumption.

[2] These practices are included in the Salmon Aquaculture Dialogue's draft of standards.

The following section of this paper presents the conceptual model which serve as the basis for the conjoint analysis methodology used in this study, followed by an explanation of the survey design and data collection process. The next section presents the survey results, while the last section summarizes the findings and presents implications for salmon producers and retailers, third party and governmental certification agencies, policy makers, and food choice and policy researchers.

## 2. The Model

The model estimated is the conditional logit model which allows for individual and choice specific characteristics as independent variables and was developed by McFadden.[3] This model can be interpreted in the context of random utility maximization (RUM), where individual *n* chooses between *J* alternatives, obtaining a utility of $U_{nj}$ when choosing alternative *j*. The individual maximizes her utility by choosing the alternative that yields the highest utility, thus the probability of individual *n* choosing alternative *i* is given by:

$$P_{ni} = prob(U_{ni} > U_{nj} \; \forall j \neq i). \tag{1}$$

But the utility can be decomposed in to two different components: one that is deterministic and a function of the attributes of each alternative and the individual's characteristics, and the other that is random, the error term. Thus the utility can be written as $U_{ni} = V_{ni}(x_{ni}) + \varepsilon_{ni}$, where $x_{ni}$ represents a vector of alternative and/or individual characteristics. Therefore (1) becomes,

$$P_{ni} = prob(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj} \; \forall j \neq i).$$

Assuming the $V_{ni}(x_{ni}) = \beta' x_{ni}$, where $\beta$ is vector of coefficients, and that the *J* error terms are independent and identically distributed with Type I extreme value distribution, then the probability of individual *n* choosing alternative *i* is given by

$$P_{ni} = \frac{e^{\beta' x_{ni}}}{\sum_{j=1}^{J} e^{\beta' x_{nj}}}. \tag{2}$$

[3] Also see Maddala or Green for a brief introduction.

The estimation of the model proceed by maximum likelihood, thus $\beta$ is estimated by maximizing

$$\log L = \sum_{n=1}^{N} \sum_{i=1}^{J} y_{in} \log P_{in},$$

where $y_{in}$ is equal to one if individual $n$ selects alternative $i$.

## 3. Data Collection Structure of the Survey

Data were collected by means of an online survey, which was developed by reviewing the existing literature on the determinants of consumer demand for seafood, communicating with key studies' authors, holding focus groups, and extensive pre-testing. Early drafts of the survey were provided to 32 regular U.S. salmon consumers in several focus groups,[4] who reviewed and discussed the survey with researchers to help determine appropriate prices for hypothetical salmon products, and to identify potential sources of bias or confusion within the survey. With the support of three undergraduate and recent college graduate interns, the survey pilot was programmed using QuestionPro, an online survey software package, and taken by 300 U.S. salmon consumers in February and March of 2010. Participants of the pilot study were recruited by distributing informational flyers at supermarkets and highly-trafficked retail shopping zones, through advertisements on Craigslist.org and similar websites featuring free classified advertisements, and online social networks, and by university online resource websites.

The results of the pilot study were used to further modify the survey's structure, which was finalized and emailed to 105,342 U.S. consumers in April 2010 by Survey Sampling International (SSI), a market research company contracted to administer this study. The sample of consumers who received the survey was representative of the U.S. population in terms of its distribution of age, gender, income, and geographic location,[5] allowing for the comparison of the demographics of regular U.S. salmon shoppers and the U.S. population,

4 Regular salmon consumers are defined as individuals who eat fresh, unfrozen salmon at home at least once every three months.

5 The 2008 U.S. Census Data was used to determine the distribution of demographic characteristics across the sample. Since males and 18-26 year olds are less likely to participate in surveys that SSI provides them, SSI distributed a disproportionate number of survey invitations to these demographic groups, such that the expected participation of males and young adults in the sample would be proportionate to their population size relative to the United States population.

and the estimation of national demand for fresh salmon product attributes. Of the 105,342 adults who received an invitation to participate in this study, 2,304 started the online survey,[6] but 834 were screened because they stated that they did not eat fresh, farmed salmon at home at least once every three months (representing 36.2% of the respondents who started the survey), 509 either did not complete the entire survey or provided erroneous information (22.1% of the sample that started the survey), and 955 respondents successfully completed the entire survey.[7]

Two versions of the survey where developed, in order to evaluate the impact of providing background information about the issues and benefits associated with salmon production and consumption on salmon shoppers' preferences and purchasing decisions. One survey version included comprehensive background on the positive and negative effects of both wild and farmed salmon, including detailed information about the public health benefits and risks, social impacts, and environmental effects of consuming salmon or generated by the international salmon industry. Specifically, the survey summarized issues concerning salmon industry labor practices and worker's rights, the health benefits of eating salmon, and the environmental and public health concerns associated with farmed and wild salmon production. Issues relating to farmed salmon which were summarized in the survey included the use of veterinary medicines, salmon feed production, salmon farming's impact on water quality, and the effect of escaped salmon on aquatic ecosystems. Relevant concerns regarding wild salmon production were also included in the survey, ranging from those associated with the vulnerability of the species, the use of hatcheries to raise a significant percentage of "wild-caught" salmon sold in the U.S., and the impact of bycatch. The info-rich version of the survey also provided information about several certification and product labeling programs which were developed to incentivize salmon fisheries and farms to reduce their negative impacts, including the Marine Stewardship Council's

[6] To minimize survey selection bias, invitees were not provided information about the survey's content before clicking on the hyperlink to the online survey.

[7] The following criteria were used to determine if a participant's response should be removed from the final sample: the participant a) claimed to have 15 or more children, or 15 or more people in their household, b) stated that they bought salmon at unreasonable prices (on average less than $4.00 per pound or more than $25.00 per pound), c) selected either only option A, only option B, or only "neither" for all decisions in the choice experiment without providing explanations for their answers, d) did not provide a valid US zip code, and had an IP address identifying their location as being outside of the United States, d) took less than 3 minutes to complete the info – poor survey version, or less than 6 minutes to complete the info – rich survey version (these cut off times were set to be approximately 25% shorter than the authors' fastest survey completion times)

ecolabeling program for fisheries, Social Accountability International's SA8000 standard, and the International Fishmeal and Fish Oil Organisation's certification program for the responsible supply of fishmeal and fish oil.

The info-poor version of the survey was structured to more closely mimic shopping scenarios that survey takers might encounter in the stores or markets where they purchase fresh salmon, and therefore did not provide the above background information. Other than the difference between the amount of background information provide, these two survey versions were identical. Of the 955 respondents who completed the survey, 392 and 563 received the info-rich and info-poor versions of the survey, respectively.[8]

Both versions of the survey included four sections, which consisted of a series of required multiple choice and optional open ended questions. Section One included questions regarding respondents' purchasing patterns of fresh farmed and wild salmon, seafood, and groceries, and determined where survey takers primarily purchase fresh salmon to prepare at home. Respondents who did not purchase farmed salmon at least once every three months were screened from the online survey, but were asked follow up questions to determine their annual salmon consumption and to understand why they do not regularly purchase fresh farmed salmon. These questions were included to estimate the percentage of the salmon sold in the US purchased by irregular salmon consumers, to ensure that our sample was representative of the population of farmed salmon consumers in the United States, and to better understand the factors which effect consumers' decision to purchase or reject different types of salmon.

Section two included a choice experiment (often referred to as a conjoint analysis) which presented hypothetical labels of salmon products with different attributes to survey takers, brief definitions of product certifications included in some of the hypothetical labels, and asked respondents to indicate which of the salmon options they would choose to purchase if they were shopping for fresh salmon to prepare at home. Salmon options were comprised of

[8] The info-poor sample is larger than the info-rich sample because the market research company unintentionally emailed the info-poor survey invitation to a larger sample. Since both survey versions were provided to samples that are representative of the U.S. population, survey results demonstrate the effect of background information on salmon shoppers' purchasing decisions.

several attributes, including price, country or region of origin, type of production method used (i.e. wild-caught or farm raised salmon), and real or hypothetical certifications indicating that the salmon producer had reduced its negative health, environmental, or social impacts. See table 1 for an explanation of each product attribute, and the attribute levels used in the choice experiment.

**Table 1 Attributes and their levels used in the choice experiment**

| Attributes | Levels |
|---|---|
| Method of production | Wild, Farmed |
| Price ($ $lb^{-1}$) | *Farmed salmon:* 4.99, 7.49, 9.99, 12.49. *Wild salmon:* 10.99, 13.99, 16.99, 19.99 |
| Region of origin | *Farmed salmon:* Canada, Norway, Chile. *Wild salmon:* Canada, Alaska, Washington state |
| Socially Responsible label | Present, not present. |
| Sustainably Fed label | Present, not present. *(Farmed salmon only.)* |
| Responsible Use of Medicines label | Present, not present. *(Farmed salmon only.)* |
| Marine Stewardship Council Certified | Present, not present. *(Wild salmon only.)* |

Price levels for farm raised salmon ranged from $4.99 to $12.49 per pound, while levels for wild salmon ranged from $10.99 to $19.99. Ranges were selected based on a survey of 54 supermarkets, upscale or natural grocery stores, and club warehouses throughout the United States, and through focus groups participants' answers to questions about fresh salmon prices.[9] Chile, Canada, Norway, Washington state, and Alaska were selected as the regions of origin to be included in the choice experiment, because these regions produce the greatest volume of fresh salmon sold in the United States. One existing seafood certification was included in this study, the Marine Stewardship Council's "eco-label", because it is the only certification available to salmon fisheries that has been widely adopted by salmon producers and marketed by retailers in the United States. Hypothetical certifications were based on the environmental and social standards currently being developed by the Salmon Aquaculture Dialogues, which is an international coalition of

[9] In order to estimate a representative range in the price of fresh salmon paid by US shoppers, the sample of surveyed stores were selected to reflect the distribution of the US population between urban and rural areas and across the four United States Census Bureau regions.

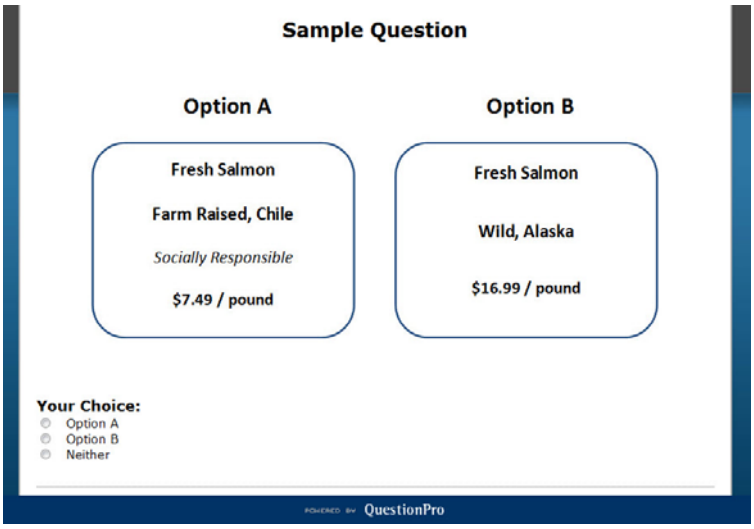
non-profit conservation organizations and salmon producers, and were selected according to 1) their estimated value to consumers, as determined by a review of the related literature and focus group discussions, 2) the ease by which the certification could be explained to consumers without confusing them or invoking bias, 3) the likelihood that salmon producers could feasibly meet the certification's requirements, and 4) the subsequent enforceability of the hypothetical certification. Similar studies (Wessells et al., 1999; Johnston et al. 2001; Jaffry et al. 2004; Johnston and Roheim) follow the first two criteria outlined above to define the hypothetical ecolabels of seafood included in their choice experiments, but do not refer to specific production methods, established industry standards, or existing certification programs. Because the hypothetical certifications used in these studies would be difficult to implement or enforce, salmon producers cannot use these studies' findings to accurately estimate the potential financial benefits of obtaining certifications for their products, which in some cases could lead to improvements in their production methods. The hypothetical certifications that were selected for inclusion in this study were the socially responsible, sustainably fed, and responsible use of medicines labels, which are defined in the appendix.

With attributes and levels presented in table 1, a full factorial design (including restrictions) results in 144 combinations of the salmon product attributes levels. Similar studies use a fractional factorial design which randomly selects combinations of attribute levels to include in the choice experiment. Orthogonal designs, try to minimize correlations between attributes levels across choice sets. This study uses a D-optimal design that instead seeks to minimize the standard errors of the parameter estimates. Because the size of the standard errors of the parameter estimates is a more important determinant of design quality than a design's orthogonality, efficient designs produce more accurate results than fractional designs, ceteris paribus (Kuhfield, Tobias and Garrat; Huber and Zwerina; Bliemer and Rose). D-optimal designs are typically created using survey design software which uses some prior information about the parameter estimates (which might be obtained from the literature or pilot study) to estimate the standard errors of these parameter estimates that are generated by the survey design (Kuhfield, Tobias and Garrat).

In this study, the parameter estimates from the info-rich and info-poor sub-samples of the pilot study were used to generate two survey designs using Ngene,[10] a stated choice experimental design software, each of which included all 144 attribute level combinations distributed across 9 blocks of 8 choice sets of two salmon product alternatives. While many similar studies include more than two alternatives per choice set in their choice experiments, focus group discussions illustrated that presenting each respondent with more than two salmon choices per question or more than 8 choice sets would increase the likelihood that respondents would not consider all of the attribute levels presented in each choice set before choosing an alternative. Different choice experiment survey designs were generated for the info-rich and info-poor versions of the survey, because the results of the pilot study demonstrated that the parameter estimates for these two samples was significantly different. To more closely align the choice experiment with salmon purchasing environments and to be able to estimate a proper willingness to pay (Alberini, Longo and Veronesi) participants were given the option to choose neither of the salmon products included in choice set. They were also provided an optional, open-ended question after each choice set which asked them to briefly explain why they made their choice. These questions were included to enable a validation exercise of the choice experiment's results, to elicit the beliefs and preferences which influence respondents' salmon purchasing decisions, and to determine whether the utility model included all of the salmon product attributes which affect consumer shopping choices. All participants of the study were given the same sample question (see figure 1), and then randomly assigned to one of the nine blocks of eight choice experiment questions using a tool provided by QuestionPro.

[10] Because the pilot study was not administered to a sample that was representative of the U.S. population, concern existed that using the parameter estimates from the pilot would bias the estimation of the true parameters' standard error, reducing the efficiency of the final survey design. To address this issue, the pilot study's results were weighed to align with the demographic distribution of the United States according to age, education, and income. Our hypothesis was that the demographics of the population of US salmon shoppers would be closer to the demographics of the entire United States population than the pilot study sample. Since none of the weighted parameter estimates varied significantly from the unweighted ones, the unweighted estimates were used to generate the efficient survey designs that were used in the final study.

**Figure 1. An example of a choice set included in the choice experiment**




Section three of the survey sought to elicit respondents' attitudes towards their health, the environment, and social issues, to determine whether a relationship existed between respondents' stated beliefs and their implicit preferences for products with reduced health, environmental, and social impacts. Survey takers were instructed to check all boxes adjacent to statements which they believed to correspond with their attitudes and behavior. Section four included questions regarding respondents' demographic characteristics,, which were used to evaluate the individual-specific factors influencing salmon purchasing decisions.

## 4. Results

Because the surveys were distributed to a sample that was representative of the U.S. population according to regional distribution, age distribution, and income distribution, comparing the demographics of the screened info-rich and info-poor samples with the demographics of the United States provides valuable information about the population of U.S. consumers who regularly purchase salmon. Relative to the average American adult, regular salmon shoppers in the United States tend to be older, more educated, more likely to be living on the West coast or Mid-west, and more likely to be female (table 2). Both samples have income distributions that are similar to the distribution of the US population, and have roughly the same average household size, with slightly fewer children per household.

**Table 2. Summary statistics of info-rich and info-poor survey participants' demographic characteristics**

| Variable | Info-rich sample (%) | Info-poor sample (%) | U.S. Population, Ages 18+ 2008 Census (%) |
|---|---|---|---|
| Age | | | |
| 18 – 24 | 15.6% | 14.4% | 12.9% |
| 25 – 34 | 13.3% | 13.0% | 17.8% |
| 35 – 44 | 7.1% | 11.4% | 18.5% |
| 45 – 54 | 16.3% | 17.4% | 19.3% |
| 55 – 64 | 24.5% | 26.6% | 14.6% |
| 65 – 74 | 18.4% | 13.5% | 8.7% |
| 75+ | 4.8% | 3.7% | 3.2% |
| Gender | | | |
| Female | 65.3% | 64.1% | 51.3% |
| Male | 34.7% | 35.9% | 48.7% |
| Education | | | |
| Less than High School | 1.3% | 1.1% | 14.2% |
| High School Diploma | 17.1% | 15.6% | 30.9% |
| Some college or technical degree | 43.6% | 35.0% | 27.9% |
| College Degree | 25.8% | 32.5% | 17.8% |
| Post Graduate Degree | 12.2% | 15.8% | 9.1% |
| Annual Income ($)* | | | |
| <25,000 | 21.1% | 13.4% | 24.8% |
| 25,000 - 49,999 | 32.2% | 20.8% | 24.9% |
| 50,000 - 74,999 | 19.8% | 19.3% | 17.9% |
| 75,000 - 99,999 | 13.0% | 21.2% | 12.0% |
| 100,000 - 149,999 | 8.4% | 16.9% | 12.2% |
| 150,000 - 200,000 | 3.5% | 4.8% | 4.5% |
| >200,000 | 1.9% | 3.7% | 3.8% |
| Prefer not to respond | 5.9% | 4.3% | |
| Regional Distribution | | | |
| West | 25.8% | 28.0% | 23.2% |
| Mid-West | 23.4% | 25.7% | 21.9% |
| South | 36.2% | 30.5% | 36.8% |
| Northeast | 14.6% | 15.8% | 18.1% |
| Average # of children <18 per household | 0.43 | 0.51 | 0.63 |
| Average household size | 2.52 | 2.73 | 2.56 |

**Notes:** * Percentages in the info-rich and info-poor columns are relative to each sample excluding participants who selected the 'prefer not to respond' option, to facilitate comparisons with the income distribution of the US population.

Regression results for the alternative specific MNL model are reported in table 3, calculated using STATA 10's asclogit command. Following the methodology employed by many conjoint analysis studies, non-price product and individual-specific attributes were coded as dummy variables, e.g. the variable *Socially Responsible* was set to 1 when the hypothetical salmon product in the choice set included the Socially Responsible label, and was set to 0 when this label was absent.

Most findings in table 3 align with expectations: the negative sign of the *price* parameter in both info-rich and info-poor versions indicates that salmon shoppers are less likely to choose a salmon product as its price increases. The positive sign on most certification attributes demonstrates that in most cases, consumers would be willing to pay more for a certified salmon product than uncertified salmon, ceteris paribus. The combination of the effect of a salmon product's method of production and region of origin is generally a more important determinant of US salmon shopper's purchasing decisions than product certifications.[11] A comparison of these parameters for the info-rich and info-poor versions shows that consumers value certifications more after learning about the benefits and issues associated with salmon production and consumption. Wild salmon from the United States (Washington state and Alaska) are preferred over all other types of salmon[12] in both samples, particularly in the info-poor sample, followed by Canadian wild salmon, Canadian farmed salmon, Norwegian farmed salmon, and lastly Chilean farmed salmon. A dummy variable for Chilean salmon was excluded from the model to avoid perfect collinearity, so the parameter estimates for all of the regions of origin listed in table 3 are relative to the utility that respondents derive from the Chile region of origin attribute level.

[11] Since the countries and US states which produce the greatest amount of salmon sold in the United only produce large quantities of either farmed or wild salmon, (except in the case of Canadian salmon), salmon products' type of production (i.e. farmed or wild caught) was highly correlated with their region of origin. For this reason, the value of a salmon products' type of production relative to the value of its region of origin is unclear. Furthermore, the region of origin and production method attributes may represent other product attributes (such as food safety), which were not captured by the survey.

[12] We define a salmon products' type to be a combination of its type of production and region of origin.

**Table 3. Estimated Coeficients from the conditional logit model: Info-rich sample and Info-poor sample**

| Independent variables | Info-rich | | Info-poor | |
|---|---|---|---|---|
| *Price* | -0.11 | (0.01) | -0.14 | (0.01) |
| *SociallyResponsible* | 0.42 | (0.06) | 0.32 | (0.04) |
| *SustainablyFed* | 0.46 | (0.07) | 0.40 | (0.06) |
| *ResponsibleMedicines* | 0.20 | (0.07) | -0.22 | (0.06) |
| *MSCcertification* | 0.52 | (0.10) | 0.56 | (0.08) |
| *Origin_Norway* | 0.38 | (0.08) | 0.48 | (0.07) |
| *Origin_Canadafarmed* | 0.59 | (0.09) | 0.63 | (0.07) |
| *Origin_Canadawild* | 1.21 | (0.13) | 0.79 | (0.11) |
| *Origin_Washington* | 1.32 | (0.13) | 1.38 | (0.11) |
| *Origin_Alaska* | 1.72 | (0.14) | 1.38 | (0.11) |
| Log Likelihood | -3004 | | -4102 | |
| Number of observations | 9408 | | 13512 | |

***Notes:*** Standard errors are in parentheses. All estimates are statistically significant at the 1% level. Both models are globally significant with p-values <0.01 for chi square test.

To establish salmon shoppers' willingness to pay (WTP) for each product attribute, the negative ratio between that attributes' parameter and the price parameter's attribute was calculated. Table 4 presents the WTP of each attribute and level, with standard deviations estimated using STATA's nonlinear combination of estimates (NLCOM) command. All WTP estimates are statistically significant at the 1% level.

Results show that info-poor version respondents are willing to pay more for salmon with the Socially Responsible, Sustainably Fed, and Marine Stewardship Council certifications by \$2.19 $lb^{-1}$, \$2.74 $lb^{-1}$, and \$3.88 $lb^{-1}$ than uncertified salmon products, respectfully, but would on average pay \$1.50 more per pound for uncertified fresh salmon than a salmon product with the Responsible Use of Medicines label. In contrast, info-rich version respondents demonstrate a willingness to pay a premium for all salmon product certifications, including the Responsible Use of Medicines label. The average U.S. consumer provided with background information about salmon production and consumption values all product certifications more than 'uninformed' consumers, and would pay \$1.83 more per pound of salmon with the Responsible Use of Medicines label,

$3.73 lb$^{-1}$ more for the Socially Responsible label, $4.13 lb$^{-1}$ more for the Sustainably Fed label, and $4.61 lb$^{-1}$ more for salmon with the Marine Stewardship Council Certification.

Respondents for both survey versions value wild salmon from Alaska more than all others, at $9.59 lb$^{-1}$ and $15.44 lb$^{-1}$ more than farmed salmon from Chile in the info-poor and info-rich samples, respectively. Wild salmon from Washington was the second highest valued salmon product, at $9.55 lb$^{-1}$ and $11.84 lb$^{-1}$ more than farmed salmon from Chile for the info-poor and info-rich versions. Wild and farmed salmon from Canada were the third and fourth most valued salmon products, at $5.50 and $4.39 more per pound than farmed Chilean salmon for the info-poor version, and $10.86 and $5.30 lb$^{-1}$ more than farmed salmon from Chile for the info-rich sample. Farmed Norwegian salmon is valued less than all types of salmon other than Chilean salmon, at $3.34 and $3.40 lb$^{-1}$ more than farmed salmon from Chile.

**Table 4. Comparison of willingness to pay between samples with and without background information, ($ lb$^{-1}$)**

| Independent variables | Info-rich | | | Info-poor | | |
|---|---|---|---|---|---|---|
| *SociallyResponsible* | 3.73 | (0.60) | 39.2% | 2.19 | (0.32) | 23.1% |
| *SustainablyFed* | 4.13 | (0.70) | 43.4% | 2.74 | (0.43) | 28.8% |
| *ResponsibleMedicines* | 1.83 | (0.62) | 19.3% | -1.50 | (0.42) | -15.8% |
| *MSCcertification* | 4.61 | (0.95) | 48.5% | 3.88 | (0.56) | 40.8% |
| *Origin_Norway* | 3.40 | (0.78) | 35.8% | 3.34 | (0.55) | 35.1% |
| *Origin_Canadafarmed* | 5.30 | (0.86) | 55.8% | 4.39 | (0.54) | 46.2% |
| *Origin_Canadawild* | 10.86 | (1.16) | 114.3% | 5.50 | (0.70) | 57.9% |
| *Origin_Washington* | 11.85 | (1.17) | 124.7% | 9.55 | (0.68) | 100.5% |
| *Origin_Alaska* | 15.44 | (1.36) | 162.5% | 9.59 | (0.70) | 100.9% |

***Notes:*** Percentages reflect the price premium of salmon products with each attribute, assuming the average fresh salmon product sold in the US costs $9.50 (data obtained from market research). WTP estimates and percentage price premiums for regions of origin are relative to the Chile region of origin.
Standard deviations are estimated using STATA's nonlinear combination of estimates (NLCOM) command. All WTP estimates are statistically significant at the 1% level.

We see, then, that respondents who took the info-rich version demonstrated a stronger preference for wild salmon (particularly from Canada and Alaska) than participants of the info- poor version, a reduced preference for Chilean farmed salmon, and an increased preference for Canadian farmed salmon. Almost all (95%) info-rich version participants would pay $0.87 - $7.30 more per pound for Alaskan wild salmon than other types of wild salmon, and $7.42 - $18.16 more per pound than any type of farmed salmon.[13]

## 5. Conclusions

Since no public data shows that consumers pay more for certified seafood, salmon producers and industry stakeholders are interested in learning if there are financial incentives associated with existing or forthcoming certifications which assure consumers that their product is shown to have fewer health risks, environmental impacts, or negative social issues. To answer this question, and to better understand U.S. consumers' preferences for salmon, we surveyed a representative sample of 955 U.S. shoppers. We then conducted a conjoint analysis on their willingness to pay for different methods of production (i.e. wild or farmed), countries or regions of origin, the Marine Stewardship Council's seafood 'ecolabel', and hypothetical certifications assuring that the salmon product met specific and measureable health and safety, environmental, and labor standards.

Out of the various factors which affect consumers' salmon purchasing decisions, the combination of the method of production and the region of origin is generally a stronger determinant of U.S. salmon shopper's purchasing decisions than the product's certifications. Consumers strongly favor wild over farmed salmon, consistent with the findings of several similar studies (Holland and Wessells; Jaffry et al., 2004), but contrary to Wessells et al.(2001). Salmon from the United States is preferred over salmon from other countries, with U.S. shoppers willing to pay between $3.80 and $10.99 more per pound for wild salmon from the US than for farmed salmon, depending on its region of origin.[14] Analysis of the open ended responses after each question in the choice experiment supports

[13] Calculated using standard errors of WTP estimates.
[14] Assumes a normal distribution of salmon shoppers' willingness to pay for product attributes around the mean.

this finding: more respondents stated they preferred salmon produced in the United States or that they were opposed to buying non-American goods than the number of respondents who preferred Canadian, Norwegian, or Chilean salmon combined.[15] Consumers are willing to pay the largest premiums for environmental certifications, the Marine Stewardship Council Certification and the Sustainably Fed label, and the lowest premium for the health and safety certification.

Since participants of the info-rich version were informed that Chile's salmon farming industry uses higher amounts of antibiotics per ton of salmon produced than Norway or Canada, it is intuitive that relative demand for Chilean salmon would decrease. It is surprising, however, that info rich respondents' value of farmed Canadian salmon increased relative to the info poor sample, while the value of Norwegian salmon did not change, since participants of the info - rich version were informed that "Out of the major producers of farmed salmon, Norway's industry uses the least amount of antibiotics per ton of salmon produced, [while] British Columbia's industry uses antibiotics more intensively." This finding suggests that salmon shoppers are more responsive to negative than positive information related to health issues that are associated with salmon purchases, limiting the price premium that could be captured for a health – related product certification.

These findings have several important implications for seafood certification agencies, salmon producers, and fresh seafood retailers. First, seafood retailers in the United States have clear financial incentives to display social and environmental labels not only on frozen fish packaging, but on the fresh farmed and wild salmon that they sell at seafood counters. The Marine Stewardship Council's ecolabel is placed on the packages of certified frozen fish products in many large supermarket chains in the United States, but the ecolabel is not frequently displayed on the price label of fresh, certified salmon sold in supermarket's seafood sections. This study shows that displaying this label could increase salmon price by \$3.88 $lb^{-1}$, or over a 40% average price increase. Similarly, fresh farmed salmon certified and labeled as socially responsible or sustainably fed could increase seafood retailers' revenues by roughly \$2 to \$3 $lb^{-1}$, or approximately 20% to 30%. All salmon producers

[15] Data available upon request from authors.

have incentives to obtain these certifications, assuming that increasing the price of the final product adds monetary value to that product at each step of the industry's supply chain.

Second, while it is unclear if demand exists for a health and safety certification of farmed salmon, results suggest that a price premium for such a label would be limited, since salmon consumers are more responsive to negative than positive information related to health issues associated with the salmon that they purchase. A comparison of uninformed and informed consumers' preferences for Chilean and Norwegian farmed salmon reveals this trend: in the info-rich version of the survey, participants were informed that Chile's salmon farming industry uses significantly higher amounts of antibiotics per ton of salmon produced than Norway or Canada and were subsequently less likely to select Chilean salmon than uninformed consumers. These same consumers valued Norwegian salmon nearly the same as uninformed respondents, despite learning that Norway's industry uses the least amount of antibiotics per ton.

If a future study determines that demand does exist for a health and safety certification for fresh salmon, it should avoid using the word "medicine" on its label. Uninformed salmon shoppers negatively value the Responsible Use of Medicines label at -\$1.50 $lb^{-1}$of salmon, and their responses to the open ended question, "What lead you to choose this salmon option?" helps to reveal why: roughly the same number of respondents stated that they dislike or distrust the idea of medicines being used to produce fish as the number of people that stated that they chose a salmon option because it had the responsible use of medicines label. No more than two respondents stated that they disliked or distrusted any of the other labels. U.S. consumers' avoidance of the responsible use of medicines label contrasts with the importance that some shoppers place on the health issues associated with food production: participants who were screened out from taking the entire survey because they regularly purchase wild and not farmed salmon were over 6 times as likely to cite health and safety issues than environmental issues as their reason for avoiding farmed salmon, and did not refer to social issues.[16] This finding suggests that a health and safety certification of farmed salmon could obtain a price premium and potentially attract shoppers who

[16] Data available upon request from authors.

predominantly purchase wild salmon, if health and safety assurances are made without reference to medicines.

Third, results show that all uncertified and certified salmon producers, other than uncertified producers from Chile, could increase their revenues by supporting initiatives to educate salmon shoppers about both the benefits and the risks of wild and farmed salmon production, because doing so counter-intuitively increases consumers' demand for all non-Chile regions of origin as well as valuations of all product certifications. Informed consumers' demand for Chilean farmed salmon decreases, because Chile's industry uses significantly more antibiotics per ton of salmon produced than other major farmed salmon producers. This suggests it may be possible for education campaigns to eventually increase consumer demand for uncertified Chilean salmon, as the industry collectively reduces its usage of antibiotics. The above findings illustrates that certification programs could further facilitate the adoption of superior production techniques in the salmon fishing and aquaculture industries through collaboration with salmon producers and retailers to inform U.S. shoppers about the issues and benefits associated with eating salmon.

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## Appendix

### Definitions

1. **Marine Stewardship Council Certified:** The salmon comes from a well-managed and sustainable fishery. *(Wild salmon only.)*

2. **Responsible Use of Medicines**: The salmon farm judiciously uses minimal amounts of medicines, according to the standards developed by an international coalition of non-profit conservation organizations and salmon producers. *(Farmed salmon only.)*

3. **Sustainably Fed**: The salmon farm uses feed made from fish that come from responsibly managed fisheries, which have been certified by the International Fishmeal and Fish Oil Organization. *(Farmed salmon only.)*

4. **Socially Responsible**: The salmon farm or fishery is in compliance with Social Accountability International's SA8000 certification criteria: employees are treated and paid fairly, and are ensured safe and hygienic working conditions. *(Both wild and farmed salmon.)*