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Do Japanese consumers care about sustainable fisheries? Evidence from an auction of ecolabelled seafood*

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This paper investigates Japanese consumers' willingness to pay for Marine Stewardship Council (MSC) ecolabelled seafood using a sealed bid, second price auction. Participants in an experiment in Tokyo were provided varying degrees of information about the status of world and Japanese fisheries and the MSC program in sequential rounds of bidding on ecolabelled and nonlabelled salmon products. A random-effects tobit regression shows that there is a statistically significant premium of about 20 per cent for MSC-ecolabelled salmon over nonlabelled salmon when consumers are provided information on both the status of global fish stocks and the purpose of the MSC program. This premium arises from a combination of an increased willingness to pay for labelled products and a decreased willingness to pay for unlabelled products. However, in the absence of experimenter-provided information, or when provided information about the purpose of the MSC program alone without concurrent information about the need for the MSC program, there is no statistically significant premium.

Key words: auction experiment, ecolabel, information treatments, Japan, seafood market, willingness to pay.

1. Introduction

Seafood ecolabelling programs, based upon certification programs for fisheries sustainability, allow consumers to signal preferences for healthier global oceans each time they purchase labelled seafood, thus creating an economic incentive for environmental improvements (Roheim 2008; Marine Stewardship Council 2009; Smith *et al.* 2010). Their effectiveness in achieving

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such improvements depends upon at least two critical components: consumer awareness and consumer acceptance of the ecolabels (Roheim 2002). Awareness of the ecolabel is generally the result of penetration of ecolabelled products into the marketplace. Acceptance of the ecolabel depends upon a number of factors, including but not limited to (i) consumers' understanding of the relevant issues; (ii) consumers' understanding of the connection between relevant environmental issues and product choices; and (iii) the specific actions (e.g. alternative purchase decisions) that are available for consumers to take in response to the information provided by the labelling program (United States Environmental Protection Agency 1998). A testable hypothesis is whether the marginal utility of the environmental attributes conveyed through an ecolabel increases consumers' utility sufficiently to result in a willingness to pay a premium for an ecolabelled seafood product over an unlabelled product (Gudmundsson and Wessells 2000).

Japan has historically been the world's largest seafood importer, importing 16 per cent of seafood traded, and among the highest per capita seafood consumption in the world (FAO 2009). The Marine Stewardship Council (MSC) is the dominant international program for certification of fisheries against a standard of sustainability and consequent seafood ecolabelling (Parkes *et al.* 2010). The MSC introduced ecolabelled products into the Japanese market in 2006, but these products are not yet widely available and represent a smaller portion of the seafood consumed than other industrialised countries with an MSC presence.[1] While studies have been conducted on Japanese consumer preferences for agricultural food attributes, such as genetic modification (McCluskey *et al.* 2003), Japanese consumer preferences for seafood certified as coming from sustainable sources are not well understood. Ariji (2010) evaluates consumers' preferences for farmed versus wild bluefin tuna and found that Japanese consumers state a preference for some type of certification for sustainability associated with bluefin tuna. However, this does not satisfactorily explain whether the paucity of MSC-labelled products in the Japanese market reflects that the Japanese public is unaware of the environmental issues generating the need for the ecolabel and the role of the MSC in that process or is knowledgeable about the seafood certification and simply does not value its function in the marketplace.

We conjecture that Japanese consumers' faith that their retailers are offering the best products (Bestor 2004) has allowed them to defer responsibility for informed purchasing, thus that they have remained rationally ignorant about the status of global fish stocks (Onozaka *et al.* 2010). Thus, we test the hypothesis that when information is provided about the status of global fish stocks and the role of the MSC program in enlisting consumers to support stock recovery, Japanese consumers will be willing to pay a premium for labelled seafood. This provides an important foothold into

[1] See www.msc.org, for a current list of products available in Japan and other countries, and locations where they may be purchased.

understanding whether and how to market ecolabels, using the MSC seafood ecolabel as an empirical example.

The standard approach to analyse consumers' preferences for ecolabelled seafood products has been to use contingent valuation (CV) methods, including Johnston *et al.* (2001), Jaffry *et al.* (2004) and Johnston and Roheim (2006). These studies generally show a portion of consumers in the United States and select European countries that have a statistically significant preference for seafood with ecolabels relative to nonlabelled seafood, but have generally not estimated consumers' willingness to pay for ecolabelled seafood. Limited exploration has been conducted of the effect of consumers' understanding of the issues behind the label or the connection of the environmental issues with the product choices that consumers may make. Johnston *et al.* (2001) and Johnston and Roheim (2006) simply define a seafood ecolabel as any which reflect that a fishery has been certified as not overfished, without explaining the environmental implications of overfished fisheries. However, Brécard *et al.* (2009), in a study of consumers' noneconomic motivations to purchase ecolabelled seafood in Europe, show a relationship between consumers' preference for ecolabelled fish and stated beliefs about the level of fisheries regulation and fish stocks. Salladarré *et al.* (2010) show that French consumers' preferences for ecolabelled seafood are a function of perceptions of the fishing industry.

This paper takes an alternative approach towards estimation of Japanese consumers' willingness to pay for ecolabelled seafood, in three particular respects. First, we allow for explicit analysis of the effect of consumers' exposure to the environmental issues related to the ecolabel and the labelling program on willingness to pay. Second, we explore the depth to which consumers think about sustainability of a product, by finding consumers' willingness to pay for several processed product forms from the same species. This provides some insight into whether the consumer values the ecolabelled *product* or the sustainability of the *species* from which the product derives. Finally, rather than using CV methods, which has some well-known disadvantages in measuring willingness to pay (List and Shogren 1999; Murphy *et al.* 2005; Bougherara and Combris 2009), we employ a framed field experiment (Harrison and List 2004) with a market that sells real products for real payments through a sealed bid, second price auction. Previous applications of this method have measured consumers' willingness to pay for product attributes such as irradiated, genetically modified or organic food products (Fox *et al.* 1998; Lusk *et al.* 2001; Loureiro *et al.* 2002). Using experimental methods to investigate the impact of information and certification, we follow other previous literature such as Cason and Gangadharan (2002), Jin *et al.* (2010) and Burfurd *et al.* (2012).

We use our experimentally controlled process to test three specific hypotheses. First, when measured at the baseline level of information (i.e. their current state of knowledge), are Japanese consumers willing to pay a premium for ecolabelled products? Results show they are not. Second, is there a premium when provided with information about both the status of global

fish stocks and the purpose of the MSC program? Results show an economically significant premium emerges. Third, what is the effect of these pieces of information provided in isolation relative to the joint effect of the information? Results shown in isolation information treatments are insufficient and generate a smaller premium relative to both. Finally, we use multiple products to assess the stability of price premiums across product categories.

2. Conceptual model

Using an experimental market, our focus is on the effect of information about the product on consumers' willingness to pay for the product within a hedonic pricing model (Lancaster 1966). We abstract from the question of *why* information has the effect that it does (e.g. affecting the credibility of the product or its labelling source), instead asking whether there *is* an aggregate effect. In a conceptual model that forms the basis for the hypotheses tests in this paper, the consumer's willingness to pay for a product can be decomposed into values arising from the attributes of the product and the consumer's information state about those attributes, which assumes that the utility from consuming fish and the information attributes accompanying the fish are separable (Gudmundsson and Wessells 2000):

$$WTP = \alpha + \beta_L Label + \beta_I INFO + \beta_{IL}(Label \times INFO). \quad (1)$$

In this formulation, α represents the consumer's willingness to pay for the nonlabelled product in the absence of additional (researcher-provided) information. *Label* is a dummy variable indicating whether the product consumers are bidding on has an ecolabel attached. *INFO* is a dummy variable reflecting whether the consumer has received the researcher-provided information. β_L is the change in value the consumer ascribes to an otherwise identical product that has been ecolabelled; this reflects the baseline value of information about the labelling program. β_I reflects how the addition of particular information about the labelling program affects the value of the nonlabelled product. With both pieces of information about the label and the label itself, willingness to pay changes additionally by β_{IL}. Within this model, information can affect the premium by increasing the willingness to pay for the label attribute (β_{IL}), decreasing the value of the nonlabelled attribute (β_I) or a combination of the two.

We use this framework to guide the treatment design and analysis of our field experiment, in which willingness to pay values are collected from Japanese consumers, via an incentive compatible second price auction.

3. The seafood auctions

To estimate Japanese consumers' current and potential willingness to pay for MSC-ecolabelled seafood, we designed a controlled economic

experiment to auction three different salmon products in labelled and nonlabelled form, under four different information treatments that provide context for the label and product. Our experiment differs from standard auction experiments designed to test bidding theory (see Kagel 1995, for a survey) in that the values subjects receive if they win are not those induced by the experimenter, but rather the participants' private 'homegrown' values for the products being auctioned. To draw the desired inferences from the data, it is important that the bids in the auction reflect subjects' values for the product and are free of strategic misrepresentation. Thus, we use a second price, sealed bid or Vickrey auction (Vickrey 1961) in which the highest bidder is declared the winner, but pays a price equal to the second highest bid. This mechanism is considered 'value revealing' because the bidder's best strategy is to bid her true value, regardless of what others bid.

In induced-value experiments where true values are known, it has been shown that inexperienced bidders will sometimes bid above their true value in an attempt to win (Coppinger *et al*. 1980; Kagel and Levin 1993), but after some experience or explanation, bidders will bid very close to their true values. In homegrown-value auctions designed to measure willingness to pay such as in this study, where bidding strategy is typically explained and demonstrated, this can lead to slightly higher average bids than other methods (Lusk *et al*. 2004). However, this bias should appear equally across treatments, so the relative simplicity among value-revealing mechanisms makes the second price, sealed bid auction a popular tool for measuring differences in willingness to pay for forms of substitute products (Fox *et al*. 1998; Lusk *et al*. 2001; Loureiro *et al*. 2002).

3.1. Information treatments

In order to test our hypotheses about the effects of both fishery and ecolabel program information on willingness to pay, we designed an experiment to conduct auctions under four information treatments: no researcher-provided information (referred to as 'no information'); information describing the MSC program and its certification process ('MSC information'); information describing the current state of fishery resources, stock depletion and illegal fishing ('fishery information'); and both MSC and fishery information ('both information'). These four treatments constitute alternative states of the *INFO* variable in (1).The information packages provided to the subjects in each treatment were compiled from several sources, selected to be as accurate and objective as possible. Information related to the status of fisheries, fisheries management and amount of illegal salmon present in the Japanese market was drawn from FAO (2009) and Clarke (2007). The material in the MSC information treatment was drawn from the MSC website (www.msc.org) and Washington (2008).

3.2. Product treatments

In order to test the robustness of our information treatments to product form, three salmon products were used in the experiments: (i) a lightly salted vacuum-packed coho salmon (*O. kisutch*) fillet (around 370 yen per 100 g at market); (i) a miso-marinated vacuum-packed coho salmon fillet (around 285 yen per 100 g at market); and (iii) a clamshell-type package of pink salmon (*O. gorbuscha*) roe (around 850 yen per 100 g at market.).[2]

One challenge in identifying products for this study was ensuring that labelled and nonlabelled products were otherwise as similar as possible, so that any observed willingness to pay differences could be clearly ascribed to the MSC label (Roheim *et al.* 2011). A wholesaler in the Tsukiji seafood market with MSC chain-of-custody certification cooperated with the study authors and provided MSC-certified products for use in the auctions, packaged with and without MSC ecolabels so that the products were otherwise identical. The MSC ecolabel included both the logo and the required claim defining the meaning the label which accompanies all MSC logos.[3] All products were displayed without retail prices, to limit anchoring or market censorship effects (Harrison *et al.* 2004). No other labels were attached.

3.3. Experiment design

The basic structure of the experiment is shown in Table 1. A total of 16 sessions were run, with each session consisting of 12 rounds of auction with 10 subjects on average. An auction round was the sale of one type of product, and each session included a total of six products – three product types, each with and without MSC label. The order in which product types (salted, marinated and roe) were presented was varied by session to balance any order effects (Harrison *et al.* 2004). For a given product-type, labelled and nonlabelled items were presented in adjacent order.

In sessions I through XII, subjects were given one information set after the fourth round and then the second information set after the eighth round. For example, subjects in sessions I–VI were in the 'no information' treatment in rounds one through four, 'MSC information' treatment in rounds five through eight and 'both information' treatment in rounds nine through 12. Subjects in sessions VII–XII were similar except that they experienced 'fishery information' treatment in rounds five through eight

[2] Coho roe was not available; pink salmon roe is considered a high quality product although it comes from a species whose meat would be considered lower quality than a coho fillet.

[3] There are several versions of the required claims; refer to http://www.msc.org/get-certified/use-the-msc-ecolabel/msc-claim#english for details. The claim shown on auctioned products was 'This product comes from a fishery that has been independently certified to the MSC's standard for a well-managed and sustainable fishery. www.msc.org/jp', written in Japanese.

Table 1 Product and information treatments for each session (Sn)

Sn	*n*	Round													
		1	2	3	4		5	6	7	8		9	10	11	12
I	9	R	LR	S	LS	MSC	R	LR	M	LM	Fishery	S	LS	M	LM
II	12	LR	R	LM	M		LS	S	LM	M		LR	R	S	LS
III	10	S	LS	M	LM		LR	R	S	LS		R	LR	LM	M
IV	9	LS	S	LR	R		M	LM	LR	R		LM	M	LS	S
V	10	M	LM	R	LR		LM	M	LS	S		LS	S	R	LR
VI	10	LM	M	LS	S		S	LS	R	LR		M	LM	LR	R
VII	10	R	LR	S	LS	Fishery	R	LR	M	LM	MSC	S	LS	M	LM
VIII	10	LR	R	LM	M		LS	S	LM	M		LR	R	S	LS
IX	11	S	LS	M	LM		LR	R	S	LS		R	LR	LM	M
X	10	LS	S	LR	R		M	LM	LR	R		LM	M	LS	S
XI	10	M	LM	R	LR		LM	M	LS	S		LS	S	R	LR
XII	10	LM	M	LS	S		S	LS	R	LR		M	LM	LR	R

Sn	*n*	Round												
		1	2	3	4	5	6		7	8	9	10	11	12
XIII	10	R	LR	S	LS	M	LM	MSC + Fishery	LR	R	LS	S	LM	M
XIV	10	S	LS	LM	M	LS	R		LS	S	M	LM	R	LR
XV	10	M	LM	R	LR	S	LS		LM	M	LR	R	LS	S
XVI	10	LS	S	LR	R	LM	M		S	LS	R	LR	M	LM

Note *n* = number of subjects participating. Product codes are R for Roe, S for salted fillet and M for marinated fillet. Ecolabelled products are preceded by L.

instead. Since information that was already given cannot be 'forgotten', rounds after the second information set is provided (round nine through 12) are treated as 'both information' regardless of the order in which two pieces of information were provided.

In sessions XIII through XVI, subjects were given both information packages at the same time. Thus, subjects in these sessions experienced the 'no information' treatment in rounds one through six, then 'both information' treatment in rounds seven through 12. This allows testing for presentation order and accumulation effects.

Each session began by reading the auction instructions aloud, while the subjects followed along on their own copies. Since the objective of the experiment is to measure willingness to pay values rather than test hypotheses about second price auctions, the instructions included an explanation of why truthful bidding is a dominant strategy. This incorporated numerical and graphical examples in which it was shown that bidding above or below value is suboptimal (formally, dominated). To further ensure subjects understood the auction incentives, and to familiarise them with the mechanics of bidding, at the outset of each session, there were three practice auctions for candy bars. In each candy bar auction, the two highest bids were revealed to reinforce the process for determining the winner and the price paid.

Following the practice auctions, each session included 12 auctions for seafood products. After auctions in the 'no information' treatment, printed information pamphlets were distributed to the subjects according to the design described in Table 1. Only the winner was revealed in order to minimise the opportunity for collusion or value affiliation to arise among subjects. To control for wealth and seafood saturation effects, two of the 12 rounds were randomly selected at the end of each session for actual transaction and payment; if the same subject won both selected rounds, she had to pick which one would be implemented.

Experiment subjects were recruited from members of Co-op Tokyo, a large retail cooperative where many Japanese households purchase their food and consumer products. Flyers were distributed at shareholder meetings requesting individuals who were the primary food shopper for their household to participate in 'seafood shopping research'. Each subject was given an allowance of 5000 yen (roughly US$50 at the time) plus transportation cost reimbursement for participating. A total of 160 subjects were recruited during July and August of 2009, and the sessions were held at the WWF Japan office in Tokyo.[4]

Descriptive statistics for the subject pool (Table 2) show that 96 per cent of our sample is female, which is desirably representative of retail seafood buyers in Japan in the sense that Japanese women spend more hours in cooking, cleaning and shopping than men, by factor of six (Miranda 2011). Table 2 also shows that our sample slightly over-represents higher household income brackets and the 40–49 age group.

4. Results

Descriptive statistics of bids (mean and variance) for nonlabelled and ecolabelled products in each information treatment across three product types show some consistent patterns that suggest the quality of the data (Table 3). First, the ranking of mean bids is consistent in each information treatment, that is, mean bids for labelled products are higher than nonlabelled products. Overall, the mean bids for the salted fillet are lowest and slightly higher for the marinated fillet. Bids for roe are significantly higher than the other two products, consistent with market prices. Second, there is little difference in the value of the ecolabelled products in the 'no information' treatment; the differences in mean bids were either statistically insignificant (marinated) or statistically borderline (at 10% level), but the magnitude of the differences was very small. These results are consistent with our conjecture that the Japanese public is either unaware of the

[4] WWF Japan was one of several funding agencies for this project. It is possible that the location of the experiment may have influenced bids by the participants. However, it was also necessary to have a site which the subjects would trust the ecolabel.

Table 2 Comparison of demographic data between sample and Tokyo

Description	Sample (N = 160)	Tokyo*
Gender		
Female	96%	50.2%
Age†		
18–29	3%	6%
30–39	13%	20%
40–49	30%	18%
50–59	22%	20%
60–	32%	35%
Marital status†		
Single	8%	19%
Married	92%	81%
Occupation‡		
Full time worker	2%	29%
Part time worker	29%	14%
Housewife	53%	30%
Other	16%	22%
Annual household income (yen)		
<4 million	19%	27%
4–6 million	21%	28%
6–8 million	25%	30%
>8 million	36%	14%
Monthly household expenses on seafood	10 126 (yen)	8083 (yen)

*Source: Ministry of Internal Affairs and Communication (2008).
Notes: †Age, marital: Only housewives are shown in Tokyo statistic. ‡Occupation: Only females are shown in Tokyo statistic.

environmental issues precipitating the need for the ecolabel or unaware of the meaning of the MSC label.

To formally test whether the bids for labelled and nonlabelled products are different, we conducted a series of Wilcoxon signed-rank tests (Table 3). The results show labelled products receive significantly higher bids (i.e. there is a willingness to pay a premium for the ecolabel) at the 1 per cent level for all but one combination of information treatments and product types (the exception is the roe with MSC information treatment at 10% level). This is consistent with our hypothesis that when provided with the information about fish stocks and/or the role of the MSC program, Japanese consumers are willing to pay a premium for sustainable seafood. The within-subject nature of the signed-rank test reflects that most subjects are paying more, not just that a few are paying much more.

4.1. Regression model

Equation (1) was operationalised through a representative agent model to systematically analyse the effects of treatment attributes on willingness to pay for labelled products. Specifically, our dependent variable is the bids by an individual i for product-type j with information treatment k in round t, denoted as b_{ijkt} (Lusk and Shogren 2007):

Table 3 Means and standard deviations for product bids by information treatments (yen)

Information treatment	Salted		Marinated		Roe		Sample size (bids)
	No label	Labelled	No label	Labelled	No label	Labelled	
No information	165.8 (85.3)	172.1* (90.1)	182.8 (104.2)	185.3 (108.2)	233.7 (142.3)	239.3* (139.8)	119–123
Single information							
MSC information	177.0 (68.6)	195.1*** (67.4)	208.7 (71.3)	222.7*** (81.2)	269.5 (131.1)	286.1*** (139.4)	38–42
Fishery information	163.0 (91.9)	199.7*** (87.5)	165.8 (121.7)	202.5*** (114.1)	198.9 (134.3)	263.9*** (143.2)	40–41
Both information							
MSC → fishery	197.8 (74.2)	208.0*** (67.3)	219.8 (98.9)	237.2*** (84.2)	238.9 (117.1)	277.6*** (123.1)	38–42
Fishery → MSC	167.4 (66.7)	199.0*** (75.0)	176.7 (111.5)	221.0*** (103.9)	212.1 (118.6)	239.0*** (127.6)	41
MSC and fishery	151.3 (92.0)	172.0*** (99.8)	177.0 (97.7)	200.1*** (114.0)	191.9 (123.0)	234.4*** (136.9)	40

Notes: The numbers in parentheses are standard deviations. The pairwise mean difference tests are based on Wilcoxon signed-rank test; their significance levels are noted as * (10%), ** (5%) and *** (1%). For 'both information', the first two rows are the cases where two pieces of information were given sequentially, while the last row is when the two were given simultaneously; refer to experiment design section for details. Ranging sample size for some information treatments is due to the varying number of subjects among the sessions (see Table 1).

$$b_{ijkt} = \beta_0 + \beta_1 Label + \sum_{j=1}^{2} \beta_{2j} PROD_j + \sum_{k=1}^{3} \beta_{3k} INFO_k + \sum_{t=2}^{12} \beta_{4t} AUCTION_t + \sum_{j=1}^{2} \gamma_{1j} Label \times PROD_j + \sum_{k=1}^{3} \gamma_{2k} Label \times INFO_k + \sum_{j=1}^{2} \sum_{k=1}^{3} \gamma_{3jk} PROD_j \times INFO_k + \sum_{j=1}^{2} \sum_{k=1}^{3} \delta_{jk} Label \times PROD_j \times INFO_k + \varepsilon_{ijkt}, \quad (2)$$

where β_0 is a constant and ε_{ijkt} is the observation-specific error term. All variables are binary dummy variables. *Label* variable takes the value 1 when the product is labelled and 0 otherwise. $INFO_k$ is an element of (MSC information, fishery information, both information) and takes the value 1 when the bid was submitted following the respective information treatment described in previous section and 0 otherwise.[5]

This model further refines (1) by testing for differential treatment effects across product types (salted fillets, marinated fillets and roe). This is accomplished with a complete set of interactions of the hedonic attributes in (2) with product-specific dummy variables, $PROD_j$. Finally, because bids are collected from subjects in a sequence of auctions, auction round dummy variables ($AUCTION_t$) are included to control for a potential learning effect, where the bid price might systematically change as subjects accumulate auction experience (Bernard and He 2010).

The data were set up as a panel, which provides us with the ability to control for time-invariant individual characteristics, including those that are unobservable. Based on the Hausman test results (Greene 2003) and since our dependent variable, the subject's bid, is censored at zero, we estimate (2) using a random-effects tobit model (Fox *et al*. 1998; Wooldridge 2002).

4.2. Price premiums for ecolabelled products

To test our hypotheses about price premiums for ecolabelled products, we first estimate (2) to obtain the predicted bids. Table 4 shows the results from two models: Model 1 has only label and information treatment interaction

[5] In this regression, we pool all rounds in which subjects have both pieces of information. A Wilcoxon rank-sum test fails to reject the hypothesis of no order effects in the premium observed in any pairwise comparison of the grouping of 'both information' treatments: MSC information preceding fishery information (sessions I–VI rounds 9–12) is not different than fishery information preceding MSC information (sessions VII–XII rounds 9–12; $P = 0.13$); and the sequential sessions (sessions I–XII rounds 9–12) do not yield different premiums than giving both fishery and MSC information at the same time (sessions XIII–XVI rounds 7–12; $P = 0.49$).

Table 4 Estimation results from random-effects Tobit model

Variables	Coefficients	
	Model 1	Model 2
Main effects		
Constant	171.86*** (7.28)	166.81*** (9.91)
Label	5.86 (5.39)	4.44 (7.99)
MSC information	−2.81 (12.10)	5.03 (14.57)
Fishery information	−17.53 (12.10)	−25.35 (16.15)
Both information†	−11.42 (13.83)	1.49 (15.33)
Salted salmon	−17.84*** (4.05)	−14.72 (7.71)
Salmon roe	45.33*** (4.06)	56.02*** (11.43)
Label interactions		
Label × MSC info	11.30 (10.80)	10.22 (13.69)
Label × fishery info	30.11*** (10.69)	36.32** (16.60)
Label × both info	27.65*** (7.69)	26.78** (11.78)
Labelled × salted	–	3.33 (10.89)
Labelled × roe	–	0.93 (15.37)
Product-type interactions		
Label × salted × MSC info	–	1.44 (26.51)
Salted × MSC info	–	−26.60 (19.11)
Label × salted × fishery info	–	−3.57 (26.10)
Salted × fishery info	–	14.42 (18.91)
Label × salted × both info	–	−12.83 (18.66)
Salted × both info	–	−2.44 (13.39)
Label × roe × MSC info	–	1.96 (26.15)
Roe × MSC info	–	−5.80 (18.77)
Label × roe × fishery info	–	−14.83 (26.21)
Roe × fishery info	–	1.78 (18.91)
Label × roe × both info	–	16.75 (18.88)
Roe × both info	–	−34.91*** (13.57)
Number of observations	1903	1908
Number of groups	159	159
Wald's χ^2 statistics	361.63	385.55
Log likelihood function	−10 843	−10 808

Notes: Significance levels are indicated by * (10%), ** (5%) and *** (1%). Standard errors are in parenthesis. Auction round dummies were included in Model 2 but are suppressed for parsimony of presentation.
†'Both information' includes treatments where both pieces of information were given either sequentially or simultaneously.

terms (*Label* × *INFO*), while Model 2 has all interaction terms described in (2); note that coefficients on the auction round of the session ($AUCTION_t$) are suppressed for parsimony of presentation. Each model is statistically significant based on the Wald's chi-square statistics. Model 2 shows a statistically significant improvement over Model 1 based on the likelihood ratio test, implying that the product-type interaction variables enhance explanatory power of subjects' bids. The coefficients are consistent with our within-subject pairwise tests presented in Table 2.

The predicted price premium for the ecolabel was calculated by taking the difference in predicted labelled and nonlabelled bids (Table 5). Two-tailed Wald's chi-square tests were conducted to determine if the premiums are

Table 5 Predicted premium for the ecolabel by product types and information treatments

Information treatment	Product type		
	Salted	Marinated	Roe
No information	7.8 (9.3)	4.4 (9.3)	5.4 (9.5)
MSC information	19.4 (16.6)	14.7 (16.0)	17.6 (15.8)
Fishery information	40.5** (15.8)	40.8** (16.1)	26.9* (15.8)
Both information	21.7** (9.2)	31.2*** (9.5)	48.9*** (9.6)

Notes: Standard errors are in parentheses. Wald's two-tailed χ^2 tests were conducted to test whether premiums are statistically significantly different from zero. Significance levels are indicated by * (10%), ** (5%) and *** (1%).

significantly different from zero. Once again, the 'no information' treatment results are statistically insignificant for all product types ($P > 0.40$). This supports our hypothesis that, given the prevailing state of knowledge about fish stocks and the MSC program, Japanese consumers are not willing to pay more for ecolabelled seafood.

Can consumers be induced to pay more with additional information? We hypothesise that public understanding of both the fishery information and the MSC program is essential for generating a premium and thus that each type of information alone is insufficient. When both MSC and fishery information are provided, consumers reveal a positive and significant premium consistently across product types, ranging from 21.7 yen (14.4%) to 48.9 yen (25.8%). We also found that 'MSC information' alone is indeed insufficient to generate a statistically significant premium for the MSC label. However, surprisingly and contrary to our hypothesis, we found that 'fishery information' alone resulted in a statistically significant premium for ecolabelled products of all three types, ranging from 26.9 to 40.8 yen.

One possible explanation for 'fishery information' alone yielding a statistically significant premium, while 'MSC information' alone did not, is that some consumers in our sample knew about the MSC or drew correct inferences based on reading the label text that were not further enhanced by our 'MSC information' treatment. To test this idea, we compared the premiums from each of the information treatment against the 'no information'

Table 6 Value of information: predicted premiums

Information treatment	Predicted premium		
	Salted	Marinated	Roe
MSC information	11.7 (19.0)	10.2 (18.5)	12.2 (18.5)
Fishery information	32.8 (18.3)	36.3* (18.6)	21.5 (18.4)
Both information	14.0 (13.1)	26.8** (13.3)	43.5*** (13.5)

Note: Standard errors are in parentheses. Significance levels are indicated by * (10%), ** (5%) and *** (1%).

Table 7 Value of information: predicted bids for labelled and nonlabelled products

Information treatment	Labelled products			Nonlabelled products		
	Salted	Marinated	Roe	Salted	Marinated	Roe
MSC information	−9.9 (16.7)	15.2 (15.9)	11.4 (16.3)	−21.6 (16.7)	5.0 (15.9)	−0.8 (16.3)
Fishery information	21.8 (16.2)	11.0 (16.1)	−2.1 (16.3)	−10.9 (16.2)	−25.4 (16.1)	−23.6 (16.3)
Both information	13.0 (16.0)	28.3* (15.7)	10.1 (15.7)	−0.9 (16.0)	1.5 (15.7)	−33.4** (15.7)

Note: Standard errors are in parentheses. Significance levels are indicated by * (10%), ** (5%) and *** (1%).

treatment (Table 6). The results show that the premium for all product types with 'MSC information' alone was statistically insignificant, as expected. Furthermore, 'fishery information' alone does not strongly support a statistically significant premium above the 'no information' baseline. Thus, when controlled for 'no information' baseline premium, we find that each information in isolation is insufficient to generate a statistically significant premium for ecolabelled seafood.

For the 'both information' treatment, we find consistent results: a significant premium over 'no information' emerged for marinated and roe products ($P = 0.022$ and $P < 0.001$, respectively). This supports our hypothesis that making consumers aware of the status of world's fish stocks and fisheries and how the MSC program seeks to address the issue are collectively important in generating consumers' WTP for ecolabelled products.[6]

We now turn our attention to the question of how premiums for ecolabelled products arise. While much attention has been paid to the issue of whether consumers are willing to pay price premiums for ecolabelled products (Washington 2008; Roheim *et al.* 2011), relatively little attention has been paid to how the premium arises. Premiums can arise through (i) willingness to pay more for products with an ecolabel, (ii) willingness to pay less for nonlabelled products or (iii) combination of the two. Our data allow us to analyse these effects by calculating the difference between the predicted average bids in each information and 'no information' treatments for both labelled and nonlabelled products (Table 7). Positive values in columns 1–3 indicate consumers are willing to pay *more* for labelled products, while

[6] A reviewer was concerned that our measured premiums reflected experimenter demand effects, in addition to responses to the information clearly designed to influence shoppers' willingness to pay. That the size and significance of single information set effects are different depending on the information set and subject-specific 'no information' bids and that the effect size is the same in the 'both information' treatments arising from one-information presentation (demand) in sessions I–XII as that from two-information presentations (demands) in sessions XIII–XVI suggest the measures we took to minimise demand effects were largely successful.

negative values in columns 4–6 indicate information causes consumers to be willing to pay *less* for nonlabelled products.

Mostly statistically insignificant results suggest that significant premiums arise from the combination of the increase in bids for ecolabelled products and the decrease in bids for nonlabelled products. For example, the 'MSC information' treatment resulted in an increase in bids for both labelled and nonlabelled versions of most products. But the bids for labelled products increased more than it did for nonlabelled products, thus leading to a positive premium for ecolabel (albeit statistically insignificant; c.f. Table 6). The 'fishery information' treatment resulted in *decreases* in mean bids for nonlabelled products (relative to the 'no information' treatment), so although the increase in the bids for labelled products was smaller than that for the 'MSC information', the resulting premiums were larger.

These results may be partly explained by a phenomenon observed in Fox *et al*. (2002), wherein unfavourable information had more influence in the subjects' decisions than favourable information. In our context, 'fishery information' could be regarded as unfavourable information in the sense that it describes *problems* with fish stocks, whereas 'MSC information' could be thought of as favourable, since it describes one possible *solution* to the problem. Subjects may be responding to both sources of information, but the negative 'fishery information' is the more important driver of the magnitude that supports a statistically significant premium.

Our last hypothesis is the robustness test of the predicted premiums across product types. Our hypothesis is that there should be no difference, since sustainable fisheries pertain to the harvest of an individual fish and not how it is processed for consumption. For bids, this hypothesis is broadly confirmed, as formal test results on bids are comparable across products (Table 3), and only one of the product-type interactions (roe with 'both information') is significant in the bid regressions (Table 4). However, the product-type interactions are found jointly significant, suggesting that product type matters. Statistical significances are robust broadly across product types in the predicted premiums (Table 5), but subtracting the 'no information' baseline (Table 6) reveals some subtle differences across products. In particular, 'both information' treatment had significant variation in the premiums, with varying contributions from higher bids for labelled products (especially marinated fillets) and lower bids from nonlabelled products, especially for roe (Tables 6 and 7).

Overall we find that the only statistically significant difference among products is that the premium is significantly lower for salted salmon fillets than for salmon roe. While we do not understand the source of this result, it may arise from a difference in the salience of the effect on the potential future stock associated with eating the meat of a single fish, rather than the hundreds of zygotes represented in the roe package.

5. Conclusion

Ecolabels are one of several tools to facilitate movement towards sustainable fisheries and marine ecosystems by allowing consumers to vote with their wallets. Yet, the effectiveness of ecolabels in achieving such improvements depends upon creating economic incentives through the marketplace to affect reform of fisheries management and practices. Consumer awareness and acceptance of the ecolabels are tied to understanding the underlying environmental issues which necessitate the labels, and the connection between those issues and the choices consumers can make about the products they buy. Ecolabels enhance consumers' ability to make those product choices for the issues they value. This paper has tested the hypothesis that global fishery sustainability is of sufficient importance to Japanese consumers to result in a willingness to pay a premium for a MSC-ecolabelled product.

The analysis suggests that, on average, the subjects in these auctions in Tokyo were willing to pay a statistically significant premium of between 21.7 and 48.9 yen, or approximately 20 per cent of the nonlabelled product's bid price, for ecolabelled seafood products. However, this premium is observed only when consumers are provided both pieces of information about the status of global fisheries and the standard marketing of the MSC label program. Closer examination of how these premiums arose revealed that Japanese consumers tend to discount the nonlabelled products in the 'fishery information' treatment, suggesting that the subjects respond asymmetrically such that weighting 'unfavourable' information – the 'fishery information' in that it describes the problems with fish stocks – much more heavily in their decisions. We also found that overall the WTP for ecolabel did not differ across product types.

In sum, we find that there is a potential market for ecolabelled seafood products in Japan. The key to unlock this potential is to inform Japanese consumers of why the ecolabel is needed for seafood and how it can be a solution. Our results suggest that the effectiveness of ecolabelling programs – including but not limited to the MSC – may best be achieved if such organisations partner with other organisations (e.g. environmental groups, university scientists, governmental agencies) to create or expand educational programs for Japanese consumers about sustainability of the world's fisheries.

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