Journal of Agricultural and Resource Economics 38(1):93–106

Japanese Consumers' Valuation of Rice and Pork from Domestic, U.S., and Other Origins

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Adoption of country-of-origin-labeling (COOL) has important implications for U.S. food exports. We assess the impact of COOL on imported rice and pork for Japanese female consumers using an auction experiment. In a first round based only on taste, U.S., Japanese, and third country products were valued similarly. In a second round with information only on product origin, bids for domestic products increased while bids for U.S. and other foreign products declined. Allowing participants to taste products of known origin in a final round did not significantly change an approximate 40% valuation discount for products of U.S. origin.

Key words: country-of-origin labeling, experimental auctions, pork, rice

Introduction

Adoption of country-of-origin labeling (COOL) has been widespread since the late 1990s. Japan mandated COOL for several types of fresh fruit and vegetables in 1996 and extended its mandate to all fresh foods in 2000. Around the same time, the European Union (EU) passed compulsory COOL for beef and subsequently expanded coverage to certain fruits and vegetables, honey, olive oil, wine, seafood, eggs, and poultry products imported from outside the EU. In February 2011, EU farm ministers voted to adopt COOL for pork, lamb, and poultry. South Korea has also adopted COOL for certain food products, including beef and rice. In the United States, following a protracted development process, mandatory COOL was implemented in 2009 for most meats, fish, fruits, nuts, and vegetables.[1] Because export markets help maintain producer prices in the face of productivity growth that continues to exceed growth in domestic demand, understanding consumer valuation of products of U.S. origin in those markets becomes increasingly important.

The United States exports over 20% of its agricultural production, and Japan is one of its largest markets. Since 1968, it has consistently been the largest export market for pork, with 2010 exports valued at over $1.5 billion (USDA Foreign Agricultural Service, 2011). Japan's rice market is protected with an annual tariff rate quota equivalent to around 7% of domestic consumption, above which imports are subject to a prohibitive tariff of 341 yen per kilogram. As of Feb 2012, with rough rice trading at approximately $14 per hundredweight at the Chicago Mercantile Exchange (CME) and the dollar worth around 77 yen, the over-quota tariff was around $2.00 per pound, or almost fifteen times the CME price. The U.S. typically supplies around half of the Japanese import

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The authors thank Dr. Masamitsu Yasaka for assistance with conducting the experiments in Japan and seminar participants at Oklahoma State University and University College Dublin for helpful comments. They gratefully acknowledge funding support from the Kansas Agricultural Experiment Station (contribution no. 12-459-J) and from National Research Initiative of the Cooperative State Research, Education and Extension Service, USDA, Grant # 2005-35400-15838.

Review coordinated by Hayley H. Chouinard.

[1] In November 2011, in response to a complaint filed by Canada and Mexico, a WTO dispute resolution panel found the U.S. COOL law violated the Technical Barriers to Trade (TBT) agreement. The U.S. appealed the ruling in March 2012, but that appeal was rejected in June 2012. At the time of publication the U.S. law remains in effect.

quota, making Japan the second largest market for U.S. rice, after Mexico, and the largest market for japonica-type rice grown in California. In 2010, U.S. rice exports were valued at over $2.3 billion, with Japan accounting for around 10%.

If Japan were to liberalize its rice market by reducing or eliminating the over-quota tariff, as has been mentioned in the context of the proposed Trans Pacific Partnership Agreement, U.S. rice exports could increase significantly; however, evidence suggests that the country-of-origin (COO) attribute is particularly important to Japanese consumers. Schroeder et al. (2006) asked survey respondents in the United States, Canada, Mexico and Japan to choose the top five attributes from a list of fifteen attributes that influenced their food purchase choices. For respondents in all four countries, freshness was the most frequently listed attribute. In Japan, country-of-origin was the second most frequently listed, by 76% of respondents, but this attribute ranked no higher than eighth in any other country (listed by 25% of Canadian respondents).

Empirical studies have found that consumers in most countries prefer domestically produced products. The country-of-origin for meat, particularly beef, has been the focus of many studies, perhaps due to well-publicized health concerns and trade disputes stemming from BSE. Among the studies on beef, Loureiro and Umberger (2003) found a preference for U.S.-labeled beef in the United States, while Alfnes and Rickertsen (2003) reported a preference for Norwegian over U.S. or Irish beef in Norway. Peterson and Yoshida (2004) used a choice experiment to investigate the effect of COO for rice and found a strongly negative perception of imported rice varieties among Japanese consumers. WTP for imported rice from the United States, Australia, and China was significantly discounted by uncertainty about flavor and safety, and flavor was the most important factor explaining the discount for U.S. rice. The authors suggested that the negative perception might be due in part to lack of consumer experience with imported rice. Kim (2010) also found that U.S. pork had a significantly lower reputation among Japanese consumers for perceived quality, taste, country-of-origin image, and other attributes.

Some COOL studies have involved tasting. In a study by Feuz et al. (2004), U.S. consumers participated in an experimental auction of beef steaks to examine the impact of COO and other measurable attributes, such as marbling and aging, on sensory characteristics and bids. Participants rated steaks from Australian grass-fed cattle and Canadian barley-fed cattle lower than steaks from U.S. corn-fed cattle, and WTP bids were significantly higher for domestic U.S. steaks. In a study using pork, Dransfield et al. (2005) found that consumers preferred the taste of pork products labeled as domestic and observed a domestic COOL premium for pork of 5% in Britain, and 11% in France.

This study examines changes in valuation that occur when the origin of a familiar food product is revealed and when respondents taste a country-of-origin (COO) labeled product. Our experiment involves Japanese consumers bidding on rice and pork products, having received signals about either or both the products' experience attributes (via tasting) or its country of origin. Our study contributes to the literature by using a nonhypothetical valuation mechanism to isolate the effect of country of origin from that of the physical experience of the product. Our results support previous findings indicating that Japanese consumers are particularly sensitive to product origin (Schroeder et al., 2006). We find discounts of approximately 40% for products of foreign origin, substantially greater than those reported for European consumers (Dransfield et al., 2005). Because products from domestic and foreign origin were valued similarly based on taste alone, our design further indicates that valuation discounts associated with origin are not due to uncertainty about taste, flavor, or other organoleptic attributes. We also find that product tasting has little impact on valuation once country of origin is known.

Model

Our model is similar to other frameworks in the literature that study households' valuation updating in response to new information (Flores and Strong, 2007; Czajkowski, 2009; Aadland, Caplan, and Phillips, 2007; Whitehead, 2002). Previous frameworks commonly assume that all individuals

follow a Bayesian updating process with a normally distributed prior, but this is a specific behavioral assumption not supported by recent empirical studies (e.g., Charness, Karni, and Levin, 2007; Stone, 2013). Our model leads to a reduced-form empirical specification, which captures the size and direction of subjects' valuation updates while abstracting from the functional form of their priors and from the details of the updating process.

Subjects in our experiments are consumers revealing their WTP for food items of uncertain quality. A subject's utility is assumed to depend on her wealth, w, and the quality of the good, q. We specify utility as the money-metric quasilinear form, $u(w,q) = w + g(q)$, where g represents the utility from product quality.[2] In principle, quality of food items has several dimensions, including flavor, fragrance, texture, and appearance. For simplicity, we assume a scalar quality measure, q, defined on an increasing scale such that $g'(q) > 0$. The consumer's initial wealth and utility levels are w_0 and u_0, respectively.

Subjects are assumed to have subjective probabilities over q, which they update in response to new information. Let $f_0(q)$ denote a subject's prior probability density function of q. If asked to bid on a food item solely based on her prior information, she will reveal her prior WTP, y_0, which is the solution to $E[u(w - y_0, q)|f_0(q) = u_0$. By the definitions above, this equation can be solved explicitly as $y_0 = E[g(q)|f_0(q)]$.

Now consider the subject's response to new quality information. Let s denote a signal of quality observed by the consumer and let $\ell(s|q)$ denote the subject's subjective likelihood function (conditional probability) of observing s if the quality of the good were q. If the subject follows a Bayesian updating rule, she will revise her subjective probabilities of q to the posterior density, $f_1(q) \propto \ell(s|q)f_0(q)$. Proceeding in the same manner as above, the updated WTP, y_1, can be solved as $y_1 = E[g(q)|f_1(q)]$.

As noted above, Bayesian updating is a common assumption in the literature, but recent experimental evidence suggests that many subjects revise their subjective beliefs in a non-Bayesian manner and that updating strategies differ across individuals (Charness, Karni, and Levin, 2007; Stone, 2013). Our experiments were designed to reveal the outcomes of subjects' updating processes rather than their mechanics. During the successive rounds of our experiments (indexed by $t = 1,2,3$), each subject $i = 1,\ldots, I$ was given different signals about the quality of a food product (either rice or pork) from origins $j = 1,\ldots, J$. After receiving the quality signal in a given round, each subject submitted a bid for the product from each origin. Bids were elicited through incentive-compatible auction methods, described below, so that they can be treated as measures of WTP. Let y_{ijt} denote the bid submitted by subject i for the product from origin j in round t. The goal of our model is to quantify the bid adjustments for each origin j over rounds t, while controlling for factors specific to each subject i.

In round $t = 1$ of the experiment, subjects are given a set of samples from each of the origins $j = 1,\ldots, J$ to taste, with the origins hidden (i.e., subjects are told that each sample j is from a different country of origin, but the names of the countries are not revealed). Each subject then submits a set of bids $\mathbf{y}_{i1} = (y_{i11},\ldots, y_{iJ1})$ for a specified quantity of the product from all J origins based on the experience (tasting) signal. In round $t = 2$, subjects are given a new set of samples, this time with country labels affixed to each, but are not allowed to taste the sample before submitting bids. The second-round bids, $\mathbf{y}_{i2}$, are thus based on only a credence (COO) signal. In round $t = 3$, another set of samples are offered for tasting with the COO labels shown, so that the resulting bids, $\mathbf{y}_{i3}$, are based on a combined signal about taste and origin.

Let $C_1,\ldots, C_J$ denote a set of dummy variables indicating country of origin ($C_j = 1$ for country j and $C_j = 0$ otherwise) and let R_2, R_3 denote dummy variables indicating experimental rounds 2 and 3 ($R_t = 1$ for round t and $R_t = 0$ otherwise). We estimate subjects' changes in WTP as a result

[2] This functional form assumes risk neutrality with respect to changes in wealth. This assumption can be justified on the grounds that our experiments involve only small changes in wealth, so that utility functions are approximately linear within the ranges we observe (Just and Peterson, 2010). Moreover, in our experiments, subjects faced uncertainty only with respect to product quality; subjects faced no *ex ante* uncertainty with respect to money payments.

of new information by fitting the model:

$$y_{ijt} = \beta_1 + \sum_{j=2}^{J} \beta_j C_j + \sum_{j=1}^{J} \gamma_j C_j R_2 + \sum_{j=1}^{J} \delta_j C_j R_3 + \boldsymbol{\lambda} \cdot \boldsymbol{Z}_i + \varepsilon_{ijt}. \tag{1}$$

To avoid a dummy variable trap, the base of the model is arbitrarily set to be country $j = 1$ in round $t = 1$, so that the intercept, β_1, represents the mean bid for the country 1 product in that round. $\beta_j (j = 2, \ldots, J)$ is then the mean gap between the round 1 bids for the products from origin j and from origin 1; these coefficients can be interpreted as origin-specific quality premiums (relative to origin 1) based only on taste. γ_j is the difference between the bid in round 2 for the origin j product and the initial bid for that product in round 1, thus reflecting the price premium associated with a given COO label relative to taste. Similarly, δ_j is the difference between the round 3 bid for origin j product and its round 1 bid, capturing the premium based jointly on taste and origin relative to the initial value based on taste alone. Finally, $\boldsymbol{\lambda}$ is a vector of coefficients on subject-specific covariates, $\boldsymbol{Z}_i$, and ε_{ijt} is a mean-zero disturbance term.

While the parameters in equation (1) measure the gap between a given group of bids and their initial round 1 values, also of interest is the derived estimate of a secondary parameter, $\phi_{ij}^B = \delta_{ij} - \gamma_{ij}$, which denotes the adjustment between the second and third rounds and reflects the response to experiencing the good when subjects are already aware of its origin. If $\phi_{ij}^B > (<)\ 0$, then the experienced quality of the good from origin j was higher (lower) than subjects' expectation knowing only the COO.

Experimental Design

Experimental auction sessions were held in three prefectures (political units similar to states): Kyoto, Shizuoka, and Tokyo. Tokyo is the largest metropolitan area and includes the national capital. Kyoto, the historic capital, is adjacent to the second-largest metropolitan area, Osaka, in western Japan, and is known for its distinct culture. Shizuoka, located between Tokyo and Osaka on the Pacific Coast, is more rural and is frequently selected by research firms because its demographics and preferences are comparable to the national average (Akai and Itaoka, 2001). We conducted a total of nineteen sessions: six each in Kyoto and Shizuoka and seven in Tokyo. The sessions in Kyoto and Tokyo were held in a single location, whereas the sessions in Shizuoka were held in western, central, and eastern locations (two per location). Each session lasted approximately two hours. We used local consumer groups to help recruit subjects for what was described as a study about food choices, with the request that subjects be the primary food shoppers for their households. A total of 244 subjects participated, with between 8 and 16 participants per session. Participants were assigned to the sessions that were most convenient for them. They were paid 6,000 yen to participate (about $52, given an exchange rate of approximately 116 yen per dollar). For many Shizuoka participants, transportation costs exceeded 1,000 yen. Those subjects received additional compensation so that their self-reported public transportation costs did not exceed 1,000 yen.

In Kyoto and Shizuoka, sessions were held in conference centers, while in Tokyo they were held on a university campus. All locations were easily accessed by public transportation. Sessions were scheduled during the daytime, on both weekdays and weekends, in order to accommodate suggested dates from the cooperating consumer groups and the facility. When subjects arrived they were assigned to seating areas at tables that were separated with dividing panels. This setup allowed subjects to examine and taste food items, submit bids, and complete surveys in privacy. At the beginning of each session, the purpose of the study was explained and signed informed consent forms were collected. The auction procedure was explained, followed by two rounds of practice auctions using small, individually wrapped chocolates.[3] The results of the practice rounds were explained. A binding round for the practice session was then selected using a coin flip, and the

[3] Complete instructions are available from the authors on request.

winner(s) from the binding round were asked to pay for the chocolates they had purchased. This transaction reinforced for participants the fact that the auction was nonhypothetical and that their bid might result in an actual purchase.

We used two incentive-compatible auction methods. Nine of the nineteen sessions were conducted with a random N^{th} price auction (Shogren et al., 2001), while the other ten sessions used a sealed bid English (SBE) auction (Bernard, 2006). In the random N^{th} price auction, bid sheets were distributed at the beginning of each round concurrent with the three food samples. After subjects examined the samples, they were asked to enter bids for each of the three products representing different origins. Bid sheets were then collected. In order to avoid affiliation effects, no bids were announced during the auction (see Lusk and Shogren, 2007). At the end of the session, after the binding auction round was selected, a number between one and the number of participants in the session was randomly drawn. Subjects whose bid exceeded the randomly drawn N^{th} highest bid purchased the item at the N^{th} highest bid.

In the SBE auction, the reigning price was projected on a screen visible to all participants. This price increased in increments of 10 yen for rice and 5 yen for pork every second. Bid sheets were distributed every round as in the random N^{th} price auction. Subjects were asked to display a bidding card from an opening in the dividing panel (visible to the auctioneer but not to other participants) while the subject remained in the bidding.[4] Subjects were instructed to withdraw their card quietly when they decided to exit the auction, at which point they were to record the price at which they withdrew on their bid sheet. As in the random N^{th} price auction, no bids were announced until all auctions were complete and the winner from the binding auction was announced.

After the practice rounds, rice (2kg of the *koshihikari* variety of domestic, U.S., and Australian origin) and sliced pork (200g of a cut typically used for stir-frying of domestic, U.S., and Danish origin) were auctioned. The *koshihikari* rice variety is the most common in Japan, produced in most, if not all, prefectures, as well as in the United States and Australia. The domestic rice was specified as having been produced in Chiba prefecture, known for rice of average quality. Because imported rice is not readily available at retail in Japan, we used Australian rice that was purchased at the wholesale level and U.S. rice that was purchased in the United States. Domestic and U.S. pork were purchased at grocery stores close to the auction sites a day or two prior to the sessions. Danish pork was not readily available at retail, so we used frozen packages that were purchased directly from an importer, ESS Food Japan Co. Limited, and thawed in the refrigerator for twenty-four hours prior to the auction.

At the beginning of each auction (first rice, then pork),[5] subjects were informed that the products they would bid on represented three different countries of origin. For the first round, bite-size, cooked servings of three products were presented to each subject labeled as country A, country B, and country C. Subjects were asked to taste the servings. They then bid for all three products. In the second round, another set of servings was presented with COO labels—domestic, U.S., and Australia for rice and domestic, U.S., and Denmark for pork. Subjects were asked to examine the servings with eyes and nose only (i.e., without tasting) and submit their bids. In the third and final round, another set of servings with COO labels was presented.[6] Subjects were asked to taste the servings before submitting their bids.

At the end of the session, one binding round was selected at random from the eighteen individual product auctions (three rounds with three items each for two products) and the winners were announced. Subjects were then asked to complete a survey to collect information on their food

[4] To avoid any affiliation effects in the SBE auctions, the price increased up to a predetermined level (3000 yen for rice, 1000 yen for pork) regardless of whether any subject remained in the bidding. The predetermined maximums were set at levels anticipated to exceed the highest reasonable bid.

[5] Rice was auctioned first to avoid having the smell of pork in the room for an extended period. This order was reversed in only one session when the rice cooker malfunctioned.

[6] Samples were freshly prepared for each round.

Table 1. Sample Demographics (n=241)[a]

Variable and Definition	Mean	St Dev	Min	Max
Age				
Age in years	57.4	10.3	26	78
Tokyo (n=91)	52.6	12.4	26	78
Kyoto (n=56)	55.6	6.7	37	69
Shizuoka (n=88)	63.5	6.0	45	76
Income[b]				
Household Income (million yen)	4.99	3.76	2	17
Tokyo (n=89)	7.38	3.98	2	17
Kyoto (n=54)	3.90	3.55	2	17
Shizuoka (n=78)	3.03	1.49	2	8.5
Child				
=1 if lives with at least one child under 18, 0 otherwise	0.26	0.44	0	1
Tokyo (n=92)	0.28	0.45	0	1
Kyoto (n=58)	0.31	0.47	0	1
Shizuoka (n=91)	0.20	0.40	0	1

Notes: [a]Some participants failed to answer the income or age questions, thus the sample size for those variables is less than 241.
[b]Income data reflects midrange values with the lowest category, < 3 million yen, assigned a value of 2 million yen, and the highest category, > 15 million yen, a value of 17 million yen.

shopping behavior, perceptions of food imports, and demographics before receiving their payments, making purchases if needed, and being excused.

Data

Of the 244 subjects who participated, only three were male. Because we would learn little about gender effects based on such a small sample, we decided to delete those observations and focus the analysis on the 241 female participants. Summary statistics for sample demographics are presented in table 1. The average age of our participants was 57.4 years, slightly older than the Japanese female population aged 20 and over, which averaged 52.2 years in 2006. Most sessions were scheduled during business hours on weekdays, which would have been suitable to attract homemakers. Nevertheless, it would have been challenging for parents with young children to attend, and afternoon sessions would have been particularly difficult for parents of young school-age children.

Information about income was elicited by asking respondents to indicate within which range their household income fell (e.g., under 3 million yen, 3 million to 5 million, etc.). Average income was then calculated using midrange values. The computed sample mean of 4.99 million yen is comparable to the 2006 Japanese median household income of 4.58 million yen (Japanese Ministry of Health, Labour, and Welfare, 2007). The pattern of household income across prefectures was as expected: significantly higher in Tokyo and lowest in the rural Shizuoka prefecture. Given that our sample is biased toward older subjects, we also find the percentage of respondents with children eighteen or younger to be below the national average. According to the 2005 Japan Census, 38.9% of households had children less than eighteen years of age, compared with our sample average of 26%.

Average Bids for Rice and Pork

Figures 1 and 2 show the patterns in average bidding for rice and pork from different origins where the initial average bid for domestic product is set at 100. Based on taste alone, the average initial bids

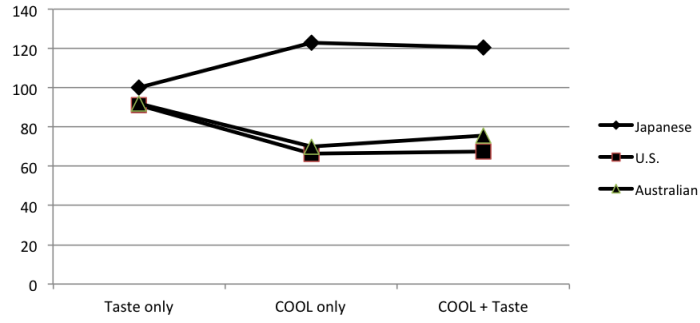

Figure 1. Average Bids for Japanese, U.S., and Australian Rice

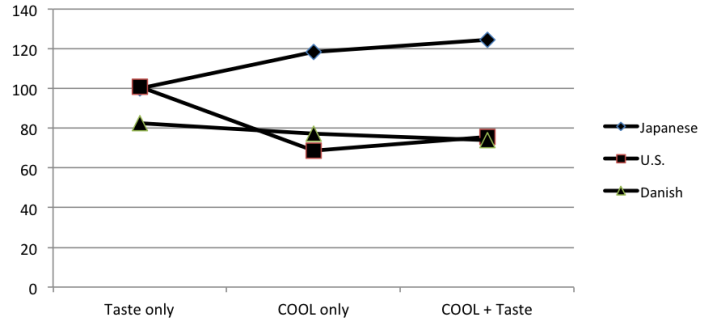

Figure 2. Average Bids for Japanese, U.S., and Danish Pork

for domestic, U.S., and Australian rice were 655, 598, and 602 yen (approximately \$5.65, \$5.16, and \$5.19), with the average bid for Japanese rice significantly greater than that for U.S. ($t = 2.26$) or Australian ($t = 2.23$) rice. For pork, the initial average bids for domestic Japanese and U.S. products are statistically similar at 229 and 232 yen (\$1.97 and \$2.00), both of which are significantly greater than the average bid of 190 yen (\$1.64) for Danish pork ($t > 4.7$). When product origin was revealed in the second round of the auction, bids for domestic rice and pork both increased by about 20%, whereas bids for foreign product fell by more than 20% (except for Danish pork, where the bid fell by 7% from a level that was already 17% below domestic). Bids for U.S. rice and pork fell by 27% and 31%. Average bids changed little between rounds 2 and 3, indicating that once origin was known, additional information about product quality via tasting had little effect on subjects' values.

Table 2 provides a summary of the bids for rice from each origin, separated by bidding round, location, and auction type.[7] The pattern in figure 1 holds at each of the three locations and for both auction types: the average bid for domestic rice increases when origin is revealed, whereas the average bids for U.S. and Australian rice decline. A similar pattern emerges when we examine the percentage of zero bids, which decreases for Japanese rice at all locations for both auction types. For U.S. and Australian rice, the percentage of zero bids generally increases or remains unchanged between rounds 1 and 2, with the only exceptions being the Tokyo SBE auction for Australian rice, where the number of zero bids falls from eight to seven, and in Shizuoka, where the number of zero bids for U.S. rice declines from eleven to seven in the SBE auction. However, the average bid for U.S. rice still declines, despite fewer zero bids.

Between rounds 2 and 3, when participants were allowed to taste the products knowing their country of origin, we found few clear patterns in the changes in bidding behavior. The average bid

[7] A similar table summarizing the pork bids is available from the authors.

Table 2. Average and Percentage Zero Bids for Rice by Round, Auction Method, and Location (n=241)

		Taste Only		COOL Only		COOL + Taste		Rand N^{th}–SBE	
		Avg	% Zero	Avg	% Zero	Avg	% Zero	Avg Nonzero Bid	% Zero
Tokyo, R N^{th}	Dom.	749.1	6.3	887.5	3.1	855.6	3.1		
(n = 32)	U.S.	789.4	9.4	395.0	40.6	461.9	31.3	887.8	18.4
	Aust.	708.7	18.8	401.9	31.3	535.6	21.9		
Tokyo, SBE	Dom.	658.3	5.0	826.8	1.7	859.0	0.0		
(n = 60)	U.S.	631.0	10.0	469.8	21.7	519.2	21.7	752.7	11.3
	Aust.	580.2	13.3	548.0	11.7	534.3	16.7		
Kyoto, R N^{th}	Dom.	684.1	11.1	853.7	3.7	718.1	11.1		
(n = 27)	U.S.	456.7	37.0	401.8	37.0	330.7	48.1	952.5	29.2
	Aust.	565.6	22.2	361.5	48.1	442.9	44.4		
Kyoto, SBE	Dom.	555.5	22.6	762.9	3.2	770.6	6.5		
(n = 31)	U.S.	417.4	45.2	210.6	61.3	256.4	51.6	916.7	33.0
	Aust.	452.6	35.5	374.5	35.5	368.7	35.5		
Shiz., R N^{th}	Dom.	665.3	8.9	744.7	2.2	729.3	2.2		
(n = 45)	U.S.	654.4	11.1	486.7	17.8	480.0	17.8	714.9	11.1
	Aust.	644.7	6.7	461.1	17.8	495.3	15.6		
Shiz., SBE	Dom.	627.6	13.0	783.7	6.5	769.8	10.9		
(n = 46)	U.S.	571.7	23.9	539.6	15.2	481.1	26.1	805.8	16.7
	Aust.	638.9	10.9	494.8	23.9	532.2	19.6		

for Japanese rice decreased in four of the six auctions and increased in the other two (Tokyo SBE and Kyoto SBE). Apart from a 16% decline in the Kyoto random N^{th} auction, the change in the average bid for Japanese rice is less than 4% in absolute magnitude. For Australian rice, tasting resulted in a higher average bid in four of the six auctions, with the largest change being a 33% increase in the random N^{th} auction in Tokyo, which was driven in part by a decline in the number of zero bids. Tasting led to an increased average bid for U.S. rice in three of the six auctions, with the biggest change represented by a 22% increase in the SBE auction in Kyoto.

Overall, average bids were highest in Tokyo, which may reflect higher average incomes, and average bids were lowest in Kyoto, where the proportion of zero bids was highest. Average nonzero bids, however, were highest in Kyoto. Average and percentage zero bids between the two auction methods were remarkably similar; although there were some differences at the individual locations, the overall average bid in the random N^{th} auctions was 594.4 yen ($5.12) compared to 581.5 yen ($5.01) in the SBE auctions. The overall percentage of zero bids was virtually identical: 18.1% in the random N^{th} and 18.0% in the SBE. In the pork auctions, 17.0% of SBE bids were zero compared with 17.4% of random N^{th} bids. An advantage of the random N^{th} design is that it does a better job of engaging marginal bidders compared with a second price auction (see Shogren et al., 1994). These results suggest that the SBE design performs similarly in that regard. Interestingly, no participant submitted a zero bid in all eighteen product auctions, although three participants did bid zero in all nine auctions for rice. Of those, two were in an SBE auction and one was in a random N^{th} auction.

Estimation

Equation (1) was estimated for rice and pork, with Japan serving as the base origin in both estimations (country 1 in the Model section). The coefficients β_j reflect the premium in the bids for the origin j product in the first round relative to the bid for the domestic product in the first round, while the coefficients γ_j, and δ_j reflect the changes in bids for product j between the first and second rounds and between the first and third rounds, respectively. The covariates, $\boldsymbol{Z}_i$, included

several subject- and session-specific factors. First, we controlled for participant demographics using a dummy variable for the presence of children under the age of eighteen in the household and other variables measuring the respondent's age and household income relative to the sample mean. Second, a dummy variable for the random N^{th} procedure assessed the impact of auction method.[8] Third, a block of location dummies, using Tokyo as the base, captured any differences across experimental sites. Fourth and finally, interactions between the location and round dummies assessed how respondents from the different prefectures reacted to new information about the products.

Because bids were restricted to be non-negative, we used tobit models to account for the censored nature of the data. In the tobit model, it is assumed there exists a latent variable, y^*, that represents a subject's true WTP. The relationship between y^* and the observed bid, y, can be expressed as:

$$y_{ijt} = \begin{cases} 0 & \text{if} y^*_{ijt} \leq 0 \\ y^*_{ijt} = \boldsymbol{\theta}_i + \boldsymbol{x}\boldsymbol{\beta} + \varepsilon_{ijt} & \text{if} y^*_{ijt} > 0, \end{cases} \tag{2}$$

where $\boldsymbol{\theta}$ and $\boldsymbol{x}_{ijt}$ represent the full set of model coefficients and regressors, respectively. Because heteroskedasticity has been shown to be an issue in modeling bids from auction experiments (Bernard and Bernard, 2010), we model the heteroskedastic error term as a function of location and auction method.

Results

Table 3 reports the tobit model coefficients and marginal effects estimated using Limdep. The intercept in each model can be taken to represent the initial first-round (latent) bid for Japanese product based on taste alone by an average-aged respondent in Tokyo with average income, no child in the household, and participating in a SBE auction.

Round 1 Bids: Taste Only

In the rice model, the coefficients on the *US* and *Aus* variables are not statistically significant, indicating that Tokyo-based participants valued rice from the different origins similarly based on an initial tasting with origin not revealed. Participants in Kyoto were more discriminating, however, and bid significantly less for U.S. rice, as indicated by the difference between the estimated coefficients for the variables *Kyoto-Japan* (-93.9) and *Kyoto-US* (-336.6). The corresponding marginal effects suggest that Kyoto residents discounted U.S. rice by approximately 225 yen relative to the domestic product, which was calculated as the difference between the lower bid for Japanese rice in Kyoto compared with Tokyo (-86.2), and the lower bid for U.S. rice in Kyoto compared with the bid for Japanese rice in Tokyo (-1.9 - 309.1 = -311.0). The corresponding calculations for Shizuoka indicate a much smaller discount of approximately 50 yen for U.S. rice.

In the pork auctions, participants in Tokyo and Shizuoka bid statistically similar amounts for the domestic and U.S. products in the first round. In Tokyo, the tobit coefficient associated with U.S. pork was a statistically insignificant 6.9, with a marginal effect of 6.4 yen. In Shizuoka, bids for domestic and U.S. pork increased by almost identical amounts (marginal effects 23.1 yen and 22.5 yen) over those in Tokyo. The first-round bids were lower in Kyoto, with the bid for Japanese pork falling by 25.1 yen relative to Tokyo and that for U.S. pork falling by 62.6. The resulting predicted difference in the average bid between Japanese pork and U.S. pork in Kyoto is 31.1 yen.

[8] Data from the two auction methods were pooled on both a theoretical and empirical basis. In theory, the mechanisms are the same and each has been used in the literature to determine consumer WTP. Empirically, an F-test failed to reject the hypothesis that coefficients on all interactions between the auction mechanism and other variables (e.g., Random N^{th} × U.S., Random N^{th} × AgeAboveMean, etc.) were jointly equal to zero (F=1.11, Prob>F = 0.34). Additional comparison of separate models for each auction method showed some inevitable variations in estimates but no differences that would alter the conclusions from the models presented.

Table 3. Tobit Model Coefficients and Marginal Effects for Rice and Pork[a]

	Rice			Pork		
Variable	**Coefficient**	**St Err**	**dY/dX**	**Coefficient**	**St Err**	**dY/dX**
Constant[b]	657.0***	42.3		220.6***	12.6	
US	−2.1	54.1	−1.9	6.9	17.7	6.4
Aus/Denmk	−82.1	54.4	−75.4	−44.5***	16.8	−41.2***
Japan-COOL	168.7***	63.9	154.9***	40.4**	20.1	37.4**
US-COOL	−277.8***	53.3	−255.1***	−81.1***	16.7	−75.1***
Aus/De-COOL	−119.7*	57.7	−109.9**	3.4	17.0	3.1
Japan-Both	167.7**	67.7	154.0**	39.2**	18.6	36.3 ∗ ∗
US-Both	−224.4***	53.4	−206.0***	−63.1***	17.0	−58.4***
Aus/De-Both	−81.4	57.1	−74.80	−9.1	15.8	−8.4
Kyoto-Japan	−93.9	84.6	−86.2	−27.1	27.5	−25.1
Kyoto-US	−336.6***	70.1	−309.1 ∗ ∗	−67.6***	25.7	62.6***
Kyoto-Aus/De	−137.4*	72.7	−126.2*	−30.0	26.2	−27.8
Kyt-Japan-COOL	31.3	136.6	28.7	20.4	48.1	18.9
Kyt-US-COOL	78.9	102.8	72.5	−17.8	35.9	−16.5
Kyt-Aus/De-COOL	−59.2	106.9	−54.3	−47.2	36.1	−43.7
Kyt-Japan-Both	20.1	131.4	18.4	42.1	49.0	39.0
Kyt-US-Both	53.4	101.9	49.1	2.7	35.4	2.5
Kyt-Aus/De-Both	−90.0	107.3	−82.7	−67.1*	35.6	−62.2*
Shizuoka-Japan	−65.5	60.6	−60.1	24.9	21.1	23.1
Shizuoka-US	−117.2**	54.1	−107.6**	24.4	24.5	22.5
Shizuoka-Aus/De	18.9	61.1	17.3	9.4	21.8	8.7
Shz-Japan-COOL	−53.8	88.8	−49.4	−8.6	32.6	−7.9
Shz-US-COOL	182.9**	78.3	167.9**	−6.9	30.5	−6.4
Shz-Aus/De-COOL	−72.2	84.6	−66.3	−31.7	29.5	−29.4
Shz-Japan-Both	−75.7	90.6	−69.5	21.6	32.7	20.0
Shz-US-Both	98.5	76.9	90.5	−5.0	30.4	−4.6
Shz-Aus/De-Both	−66.7	85.1	−61.3	−8.4	28.8	−7.8
Random N^{th}	53.9***	19.9	49.5***	2.4	7.1	2.3
AgeAboveMean	5.5***	1.0	5.1***	0.8**	0.4	0.7**
IncAboveMean	16.3***	3.2	14.9***	−0.8	0.9	−0.7
Child U 18	−12.2	22.2	−11.2	16.5**	7.6	15.3**
Heteroskedasticity terms						
Random N^{th}	0.04	0.03		0.19***	0.04	
Kyoto	0.22***	0.06		0.39***	0.05	
Shizuoka	−0.06	0.04		0.27***	0.04	

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% level. Estimated using Limdep.
[a] N=1935, with 9 observations from each of 215 participants. A total of 26 participants did not reveal either age or income, reducing the sample for estimation from 241 to 215.
[b] In Tokyo, the average first-round bid was 689.9 for domestic rice and 222.4 for domestic pork.

Based on the initial tasting, Danish pork was not as highly valued by participants, but the difference was not unexpected, because the Danish pork had previously been frozen. Tokyo participants discounted Danish pork by about 41 yen relative to domestic product, and the effect was statistically significant. In relation to the average first-round bid of 222.4 yen for domestic pork

in Tokyo, the 41-yen marginal effect represents a discount of 18.5%. The discount for Danish pork was similar in Kyoto, where bids for Japanese and Danish pork were lower by 25.1 and 27.8 yen compared with bids in Tokyo. Bid were higher in Shizuoka, but the implied discount for the Danish product was more pronounced because the bid for Japanese pork increased by 23.1 yen over Tokyo, whereas the bid for Danish pork increased by only 8.7 yen.

Round 2 Bids: COOL Only

Revealing product origin for the second round of bidding had significant effects on valuation for all six products. Bids for domestic Japanese rice increased significantly (see the coefficient on *Japan-COOL*), with no significant differences in the impact across locations (insignificant coefficients on *Kyt-Japan-COOL* and *Shz-Japan-COOL*). In Tokyo, the estimated marginal effect of revealing that rice was of Japanese origin was 154.9 yen, an increase of 22.5% over the average first-round bid of 689.9 yen.

The effect of revealing that rice was of U.S. origin was a decline of 255.1 yen, a reduction of approximately 37% relative to the first-round valuation by Tokyo bidders. The net result for the Tokyo group, with the bid for Japanese rice increasing and that for U.S. rice declining, is a predicted differential of 412 yen, leaving U.S. rice valued at 51.2% that of domestic rice. The marginal effect for Australian origin was a decline of 109.9 yen. Combined with its lower (albeit statistically insignificant) valuation in the first round, the net effect is a valuation equivalent to 59.7% that of domestic rice.

The only significant location effect in the second-round bids was for U.S. rice in Shizuoka prefecture (see coefficient on *Shz-U.S.-COOL*), where participants did not discount U.S. origin to the same extent as their counterparts in Tokyo. In Shizuoka, the discount for revealing U.S. origin is estimated at 87 yen (= -255.1 + 167.9). After accounting for their lower valuation of U.S. rice in the first round of bidding (coefficient on *Shizuoka-U.S.*), the net result is that Shizuoka participants value U.S. origin rice at 67% of domestic rice (493 yen vs. 735 yen).

For pork, revealing domestic origin also led to a statistically significant increase in valuation. In Tokyo, the marginal effect on *Japan-COOL* was 37.4 yen, an increase of about 17% on the initial average bid. Revealing U.S. origin led Tokyo participants to reduce their bids by 75.1 yen, equal to approximately 34% of baseline value (and remarkably similar to the 37% reduction in rice bids). The effect was similar at all three locations. For Danish pork, which had been discounted in the earlier round, revealing Danish origin had no significant effect on values.

Round 3 Bids: COOL and Taste

When subjects were provided information on both taste and origin, most bids did not change significantly from those based on country-of-origin information alone. The estimates show, for example, that the coefficients on the variables *Japan-Both*, *US-Both*, and *Aus/De-Both* are similar in magnitude to those for *Japan-COOL*, *US-COOL*, and *Aus/De-COOL*. The valuation for Australian rice does improve slightly; based on COOL alone it was discounted by 109.9 yen relative to the domestic product, but with added tasting the discount falls to 74.8 yen in Tokyo and is no longer statistically significant. Similarly for U.S. pork, the discount in Tokyo falls from 75.1 yen to 58.4 yen but remains statistically significant relative to the baseline bid for the domestic product. Location effects were not significant when both signals were presented, with only one exception (Danish pork in Kyoto).

Demographic and Auction Effects

The coefficient for the random N^{th} auction is positive, but only in the rice model is it significant. Its marginal effect suggests that, after controlling for other covariates, bids in the random N^{th} auction

Table 4. Estimated Premiums/Discounts Relative to Domestic Based on Taste and COOL

	Rice (yen/2kg)			Pork (yen/200g)		
	Japan	**U.S.**	**Australia**	**Japan**	**U.S.**	**Denmark**
Experience only	base	−66.5*	−56.1	base	−2.0	−49.3***
		(35.38)	(35.32)		(12.64)	(12.70)
COOL only	+143.0***	−245.6***	−204.1***	+36.9***	−83.2***	−61.3***
	(35.12)	(35.68)	(35.44)	(12.61)	(12.78)	(12.72)
Experience + COOL	+131.5***	−231.8***	−173.6***	+49.7***	−61.6***	−71.6***
	(35.14)	(35.66)	(35.49)	(12.60)	(12.74)	(12.77)
Adjustment to experience	−11.5	+13.9	+30.4	+12.9	+21.6*	−10.3
with COOL known (ϕ^B)	(35.04)	(35.09)	(35.79)	(12.56)	(12.87)	(12.84)

Notes: Single, double, and triple asterisks (*, **, and ***) indicate significance at the 10%, 5%, and 1% level. Estimates are derived from a model without location interaction effects. Derived standard errors (in parentheses) are calculated using the delta method.

were about 7% higher than in the SBE auction. Bids from the random N^{th} auctions were more variable, but the effect on the heteroskedasticity term was statistically significant only in the bids for pork. As suggested by Bernard (2006), the transparency of the SBE could reduce overbidding and other bidding errors and lead to slightly lower overall means and a narrower range of bids. Variance in bidding was also affected by location, as indicated by the positive and significant heteroskedastic terms for both the rice and pork auctions in Kyoto and the pork auctions in Shizuoka.

Participant age had a positive and statistically significant effect on bids for both rice and pork. For rice, the marginal effect of 5.1 yen per year corresponds to slightly less than a 1% increase in value for each additional year of age. For pork, the effect is less than 0.5% per year. Rice has traditionally been a staple in Japan, but per capita consumption has been steadily declining as consumers substitute other carbohydrate sources, including bread and pasta. This departure from rice has been noted more among the younger population (Mori, 2007). Income had a positive effect on bids for rice but was insignificant for pork. In Japan, pork could plausibly be considered an inferior good in comparison to beef, and thus the insignificant income effect is not all that surprising. The presence of children in the household had a positive effect on bids for pork, with an estimated marginal effect of 15 yen, or approximately 7%.

Estimated discounts and premiums relative to the initial bid for the domestic product are summarized in table 4. For each product of specified origin, the values of the COO and experience adjustments are derived using marginal effects from a model similar to that reported in table 3 but without location interaction effects for Kyoto and Shizuoka. The estimates thus represent the entire sample. Using baseline full-sample bids of 655 yen and 229 yen for domestic rice and pork, the estimates indicate that revealing domestic Japanese origin causes bids for rice to increase by approximately 22% (143/655) and bids for pork to increase by approximately 16% (36.9/229). Revealing U.S. origin causes bids for U.S. rice to fall by 179 yen (30%) and bids for U.S. pork to fall by 81 yen (36%). Bid adjustments in response to information about product origin are statistically significant at the 99% level of confidence in all cases. Tasting products of known origin results in relatively small marginal adjustments in valuation, significant only in the case of U.S. pork. Given both product experience and information on origin, values for U.S. rice and pork are only 54% and 60% of the values placed on the domestic Japanese counterparts. Australian rice fares slightly better at 61% of domestic product value, whereas Danish pork fares slightly worse at 56%.

Conclusions

Growing consumer interest in food attributes and production processes has led to more widespread adoption of COOL in both the retail and food-service sectors. The ability of exporters to compete now depends not only on product quality in terms of physical attributes, but also on how consumers

view the country of origin. The literature has shown a preference for domestically produced foods, suggesting that demand for imports will decline in the presence of COOL.

Our results support these findings. Our data, collected in nonhypothetical, demand-revealing auctions, showed a more than 20% increase in valuation for domestic rice when country of origin was revealed and concurrent reduction of 30% in the value of U.S.-origin rice. This occurred despite the fact that based on taste alone, the domestic and U.S. products were valued equally. Given information about both taste and origin, U.S. rice was valued at only 54% of its domestic counterpart and pork was valued at only 60%.

These results raise interesting questions and pose challenges for firms marketing U.S. food products in the Japanese market. In the presence of COOL, product quality alone will not be sufficient to compete (in the sense of obtaining the same price) with domestic product. Our results also illustrate a surprisingly negative reaction to the U.S. label. The extent of this reaction creates a difficult task for policy makers, as it is not simply a matter of giving consumers experience with the country's products. Instead, the large discount for products considered equivalent, in terms of physical quality, to the domestic product illustrates the extent to which demand is influenced by consumer perceptions of the exporting country. To counter those perceptions, exporters could try creating programs designed to foster worldwide recognition for the superior quality of a particular U.S. product, much as Australia does with its Australian Lamb campaign.

However, perceptions of a country's foods are outside the control of the exporting sector to a large extent (e.g., contamination events in other exported foods) or even outside the control of the entire food industry (e.g., animal disease events). To address the former, policy makers should consider the international ramifications when dealing with a food-safety issue and perhaps do more to strengthen the impression of system safety beyond U.S. borders. To address the latter, there are limits to what may be feasible. Control of these perceptions may be beyond the abilities of policy makers depending on how strongly consumers prefer their domestic food products or how negative their views towards imports from the United States.

Overall then, under COOL, the increased extent to which demand can be influenced by factors outside the manufacturer's control suggests a higher level of risk associated with food exports. In conjunction with the reduced demand for foreign-labeled products, that additional risk factor will contribute, *ceteris paribus*, to a reduction in food exports. Countries do vary both in terms of their consumers' views about different countries and in the extent to which their consumers are interested in the origin of food. In the latter regard, Japan may be an extreme example, because prior work (Schroeder et al., 2006) suggests that the Japanese are more interested in country of origin and traceability than consumers in other countries. Given that level of interest, and given the importance of the Japanese market for U.S. exports, future work in this area should explore the precise reasons for Japanese consumers' negative views of U.S.-produced foods.

[Received April 2012; final revision received January 2013.]

References

Aadland, D. M., A. J. Caplan, and O. R. Phillips. "A Bayesian Examination of Information and Uncertainty in Contingent Valuation." *Journal of Risk and Uncertainty* 35(2007):149–178.

Akai, M., and K. Itaoka. "A Study on Methodology to Estimate Value of Statistical Life by Contingent Valuation Method." In *Proceedings,* Kyoto, 2001, 240–241.

Alfnes, F., and K. Rickertsen. "European Consumers' Willingness to Pay for U.S. Beef in Experimental Auction Markets." *American Journal of Agricultural Economics* 85(2003):396–405.

Bernard, J. C. "Finding and Retaining the Dominant Strategy: The Second-Price English and 'Sealed Offer' English Auctions." *Journal of Economic Behavior & Organization* 60(2006):553–561.

Bernard, J. C., and D. J. Bernard. "Comparing Parts with the Whole: Willingness to Pay for Pesticide-Free, Non-GM, and Organic Potatoes and Sweet Corn." *Journal of Agricultural and Resource Economics* 35(2010):457–475.

Charness, G., E. Karni, and D. Levin. "Individual and Group Decision Making under Risk: An Experimental Study of Bayesian Updating and Violations of First-Order Stochastic Dominance." *Journal of Risk and Uncertainty* 35(2007):129–148.

Czajkowski, J. R. "Modeling Shifts in Willingness to Pay from a Bayesian Updating Perspective." *Land Economics* 85(2009):308–328.

Dransfield, E., T. M. Ngapo, N. A. Nielsen, L. Bredahl, P. O. Sj odén, M. Magnusson, M. M. Campo, and G. R. Nute. "Consumer Choice and Suggested Price for Pork as Influenced by its Appearance, Taste and Information Concerning Country of Origin and Organic Pig Production." *Meat Science* 69(2005):61–70.

Feuz, D. M., W. J. Umberger, C. R. Calkins, and B. Sitz. "U.S. Consumers' Willingness to Pay for Flavor and Tenderness in Steaks as Determined with an Experimental Auction." *Journal of Agricultural and Resource Economics* 29(2004):501–516.

Flores, N. E., and A. Strong. "Cost Credibility and the Stated Preference Analysis of Public Goods." *Resource and Energy Economics* 29(2007):195–205.

Japanese Ministry of Health, Labour, and Welfare. "Graphical Review of Japanese Households, Income, Savings." 2007. Available online at http://www.mhlw.go.jp/english/database/db-hss/dl/hs091216b.pdf.

Just, D. R., and H. H. Peterson. "Is Expected Utility Theory Applicable? A Revealed Preference Test." *American Journal of Agricultural Economics* 92(2010):16–27.

Kim, R. B. "Value Innovation in Export Marketing Strategy: The Case of a Canadian Firm in Japan." *Journal of Food Products Marketing* 16(2010):361–372.

Loureiro, M. L., and W. J. Umberger. "Estimating Consumer Willingness to Pay for Country-of-Origin Labeling." *Journal of Agricultural and Resource Economics* 28(2003):287–301.

Lusk, J. L., and J. F. Shogren. *Experimental Auctions: Methods and Applications in Economic and Marketing Research*. Cambridge: Cambridge University Press, 2007.

Mori, H. "Trends in Rice Consumption: Cohort Analysis." In *Proceedings,* Kyushu University, 2007. Available online at http://worldfood.apionet.or.jp/simpo/07MarchPapers/2.pdf.

Peterson, H. H., and K. Yoshida. "Perceptions of Quality and Willingness-to-Pay for Imported Rice in Japan." *Journal of Agricultural and Applied Economics* 36(2004):123–142.

Schroeder, T. C., G. T. Tonsor, J. Mintert, and J. M. E. Pennings. "Consumer Risk Perceptions and Attitudes about Beef Food Safety: Implications for Improving Supply Chain Management." Report MF2793, Kansas State University Agricultural Experiment Station and Cooperative Extension Service, Manhattan, KS, 2006. Available online at http://naiber.org/Publications/NAIBER/Consumer.Perceptions.Final.pdf.

Shogren, J. F., J. A. Fox, D. J. Hayes, and J. B. Kliebenstein. "Bid Sensitivity and the Structure of the Vickrey Auction." *American Journal of Agricultural Economics* 76(1994):1089–1095.

Shogren, J. F., M. Margolis, C. Koo, and J. A. List. "A Random nth-Price Auction." *Journal of Economic Behavior & Organization* 46(2001):409–421.

Stone, D. F. "Testing Bayesian Updating with the Associated Press Top 25." *Economic Inquiry* 51(2013):1457–1474.

USDA Foreign Agricultural Service. "Global Agricultural Trade System (GATS)." 2011. Available online at http://www.fas.usda.gov/gats/default.aspx.

Whitehead, J. C. "Incentive Incompatibility and Starting-Point Bias in Iterative Valuation Questions." *Land Economics* 78(2002):285–297.