# WILLINGNESS-TO-PAY FOR INFORMATION: EXPERIMENTAL EVIDENCE ON PRODUCT TRACEABILITY FROM THE U.S.A., CANADA, THE U.K., AND JAPAN.

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## Abstract

Traceable product systems allow one to track the inputs of a final good all through the entire production chain. Such a system can provide valuable information to consumers on verifiable characteristics of the product, can improve the speed of product recall, and can help identify areas of inefficiency in the product chain. Recent examples of traceable systems include those used in the diamond, lumber, and food industries. This article reports results from a case study on traceability using Vickrey auctions to generate willingness-to-pay (WTP) data for traceability and related product characteristics. Specifically, we examine WTP for traceable meat, which is a timely topic given that major U.S. customers and competitors in the multi-billion dollar red-meat market are all implementing traceable meat systems while the U.S. is lagging. We conduct comparable auctions in the U.S., Canada, the U.K., and Japan and find that subjects are willing to pay a nontrivial premium for traceability, but the same subjects show even higher WTP for traceability-provided characteristics like additional meat safety and humane animal treatment guarantees. The implication is that producers can likely implement such a traceable meat system profitably by tailoring the verifiable characteristics of the product to consumer preferences. For other types of traceable products, these results highlight the importance of full exploitation of traceable systems by providing consumers with the *additional* product information that only a traceable system can verify.

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## Introduction

Traceability, or identity preservation, of products is a timely topic in many countries. A traceable food system allows one to preserve the identity of the inputs used in food products throughout the entire production chain. Traceability in the diamond industry is aimed at tracking diamonds from mine to market in order to reduce trade in so-called "conflict" diamonds (i.e., those used to finance wars and arms purchases). Identity preservation in logging can identify illegally logged old-growth forest trees and also provide an information base for calculating dividend payments to a partner upon sale of the timber. Such systems can serve numerous functions, such as providing valued information to consumers, aiding in the speed of product recalls, identifying producer liability in the event of criminal acts or negligence, and identifying inefficiencies in a product marketing chain.

Traceability in lumber, diamonds, and food products (e.g., meats and grains) are all recent examples of a trend towards identity preservation in a wide variety of products. Greenpeace has lobbied for traceability in the logging industry to help protect old-growth forest timber from illegal logging, and the Clean Diamonds Trade Act of 2001 calls for a system of diamond traceability. Though traceable food systems in U.S. competitor and customer markets are becoming the standard and though debate has been active surrounding traceable food systems in the U.S., there is currently very limited legislation mandating food system traceability.[1] The highly publicized outbreaks of *Bovine Spongiform Encephalapathy* (*BSE or "M*ad-Cow" disease) in the U.K., and more recently in Japan, have brought to the forefront the issue of food traceability because Mad Cow originates from the use of contaminated feeds.[2] Though the U.S.

[1] "Country-of-Origin" labeling for meat products was mandated in the current Farm Bill but, this requires no tracking of other characteristics.

[2] Traditional food inspection systems have focused on identifying food contaminated with pathogens such as *E. coli* O157:H7 or *Salmonella* where the principal risks for contamination were at the food processing or food preparation

has yet to experience a verified case of Mad Cow in U. S. meat, food traceability has been at the heart of much discussion for food system improvement in the multi-billion dollar meat and grain industries.[3] This article is an important extension of our earlier work (Dickinson and Bailey, 2002) and provides a unique case study in consumer willingness-to-pay (WTP) for traceable products by examining meat in four industrialized countries that vary in their current experience with Mad Cow disease and other industry setbacks. Our objective is to not only provide general evidence on WTP for traceability versus traceability-provided characteristics in products but to also provide initial evidence on international consumer WTP for meat traceability and other food attributes that can be verified with traceable meat systems. Such initial evidence can then help reduce the cost and risk of larger-scale retail trials of traceable products.[4]

We report results on WTP for traceability, transparency, and extra-quality assurances (TTA) in pork in the U.S., Canada, Japan, and the U.K. We also study WTP for beef in the U.S. and Canada. These countries were chosen to generate data on a reasonable variety of industrialized countries at different stages in their own experience with traceable meat systems. Some also represent large competitors (Canada) and customers (Japan and Canada) with the U. S. in international meat markets. One may view the results of this study as limited to WTP for *meat* traceability in a myopic sense. However, certain results are likely to be of broader interest given that they may indicate a WTP for a particular characteristic in products in general. For example, we find that individuals in the U.S. and Canada are willing to pay even more for food safety guarantees than for traceability alone. This likely implies a general concern for product safety and not just beef or pork safety. Supporting evidence of this view can be found in the

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levels. Mad Cow originates with farm-level inputs rendering traditional inspection systems virtually useless to identify this problem without the ability to track inputs to the farm level.

[3] The value of sales in the beef industry alone approachs$64 billion annually.

recent StarLink corn episode[5], general concerns often expressed over biotech foods (Shogren et al. 2002), or concerns over toy or vehicle safety. Similarly, a WTP for humane animal treatment may reflect a broader WTP for environmentally friendly product attributes. This does not diminish the importance of the red-meat industry as the focus of this study. Traceable meat systems have been at the forefront of the traceability discussions as the U.S. meat industry is likely to be heavily impacted by our country's immediate direction on the traceability issue.

**Background**

Our choice to study traceability in meat is motivated by the importance of this industry in both its magnitude and the widespread affects of any system failure in this industry. Experts generally agree that the U.S. meat industry is vulnerable to large and expensive food recalls (Salin and Hooker, 2001). Contamination in ground beef prompted a 19 million pound recall of ground beef in July 2002. Such large scale recalls are often necessitated by the U.S.'s currently inability to accurately trace the source of a contamination to the product's final location. In the aftermath of this massive recall Lea Brooks, spokeswoman for the California state health department, stated "'[w]e are trying to determine if the product is still on the shelf….We don't know for certain where it has gone.'" (quoted in the *L.A. Times*, July 20, 2002).

Even more recently, bio-security risks have raised new government concerns about efficient food recall in the event of a terrorist-initiated food system contamination. A September 2002 theft of a bacterium from a Michigan State University lab prompted the National Pork

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[4] For example, valuation experiments of this sort have been found good at predicting sales when a price premium is attached to the product (Shogren et al., 1999).

[5] The StarLink episode refers to the September 2000 revelation that StarLink corn had been detected in the human food supply. The corn, which had been genetically modified, had been approved for animal feed but not for human consumption. Estimates of the total cost to Aventis CropScience (makers of StarLink corn) have been reported as high as $500 million.

Board to "…urge producers to be on a heightened state of alert." (www.porkboard.org/News/NewsEdit.asp?NewsID=299). The threat of meat contamination due to either bio-terrorism, negligence, or accident, has the potential to undermine consumer confidence in the U.S. meat industry. The result would not only be reduced consumption of U.S. red meat by domestic consumers, but also the potential loss of market share among our key trading partners as foreign customers become more and more demanding of traceable meat systems in the meat products they import (Liddell and Bailey, 2001). If, for example, falling demand for U.S. beef caused a price decline of merely 10%, this would translate into total annual revenue losses of greater than $3.7 billion dollars.[6] And it may not take much for consumers to react to adverse news in a way that could cause such a drop in retail beef prices. An interesting measure of consumer demand sensitivity for U.S. red meat can be found in looking back on 1996, when beef prices "…fell to their lowest levels in years…" only minutes after a 1996 Oprah Winfrey (talk show) broadcast focusing on Mad Cow disease. Upon learning how infection of Mad Cow could spread in U.S. beef she promptly state that such information "…has just stopped me cold from eating another burger." (quotes from BBC news, http://news.bbc.co.uk/1/hi/world/48964.stm).[7]

Current European meat systems require varying degrees of traceability but were developed in the wake of the Mad Cow crisis. As such, they were developed to allay consumer fears regarding food safety and appear to have been relatively successful in this regard. For example, Sorenson et al. (2003) found that, while per capita beef consumption in Geneva,

[6] Based on an average retail elasticity of -0.65 reported by Huang (1993), per capita beef consumption of 66.2 lbs. in 2001, USDA reported weighted average retail beef price of $3.37/lb. in 2001 as reported by Robb (2002), and estimated U. S. population of 285.9 million in 2001.

[7] Some experts claim that prices fell due to oversupply or other economic factors, but Texas state cattlemen eventually sued Oprah Winfrey for $12 million in a well-publicized libel lawsuit. The case was eventually ruled in favor of Oprah.

Switzerland declined dramatically at the beginning of the crisis in 1996, by 1999 beef consumption levels were almost identical with 1993. However, since full meat traceability systems are not mandatory in the U. S., the issue of consumer WTP for traceability has been of central importance to the U. S. meat industry (Liddell and Bailey, 2001; Bailey, Jones, and Dickinson, 2002). Along this same vein, traceability is an attribute that can be used to certify other potentially valuable product characteristics. An example would be using traceability to certify the processes used in making a product, also referred to as transparency. Or, traceability could be used provide extra-quality assurances about product characteristics that are otherwise invisible such as animal, social, or environmental welfare.

Given the magnitude of the U.S. red meat industry, there is clearly much at stake in surveying the future of domestic demand for U.S. red meat. Representatives for U.S. beef industry have expressed opposition to an industry standard of traceability in meat systems (Brasher, 2002). We feel this to be a very limited way of viewing traceability. While traceable systems are costly,[8] the demand side of the market may be such that producers can exploit such systems in a profitable way. Results from this research show that U. S. consumers are willing to pay nontrivial amounts for meat traceability and other meat characteristics that can be verified through traceable systems. Though the final U.S. direction on traceability in meat and/or grain systems could be a government mandate, our results show that profitable market opportunities likely exist both domestically and abroad for U.S. producers who can successfully convey this valued information to consumers.

**The WTP Experiments**

[8] Bailey, Jones, and Dickinson (2002) report the cost for implementing traceability in a single, meat supply chain as being between $10 million and $14 million.

The experimental design is motivated by the design in Shogren et al. (1994) and is described in more detail in our previous work (Dickinson and Bailey, 2002). Groups of 11-14 subjects participate in an hour-long experiment designed to elicit valuations for food traceability and other food characteristics. At the beginning of the experiment, the subjects are endowed with some cash ($15 U.S. or roughly the foreign equivalent in other countries) and a lunch consisting of, among other things, pork or beef. In all countries except Japan, the meat is included in a sandwich that is part of the subject's lunch. Sliced ham was used as an addition to a ramen bowl in the Japanese lunch for cultural appropriateness of the lunch. The experiment consists of subjects bidding in a theoretically demand-revealing (second-price) auction format. When subjects place bids, they bid on what they would be willing to pay to exchange their endowed sandwich (or ham for Japan) for an auction sandwich (ham) that differed only in terms of the information that could be verified about the meat in the sandwich (ham). Though our subject pools consisted of individual affiliated with the Universities involved in this study, the variety of our experimental groups include student groups, faculty groups, professional staff groups (e.g., accountants, secretaries, etc.), and maintenance staff groups (e.g., buildings and grounds workers, maintenance workers, etc.). As such, though our subject pool is drawn from a University population, there is considerable variation within the subject pool.

Each subject in each group placed bids on four auction sandwiches. The meat in sandwich 1 had verifiable extra measure taken to ensure high-quality or humane animal treatment. Sandwich 2 had extra verifiable safety in its meat. Sandwich 3's meat was verifiably traceable to the farm level, while sandwich 4 was verifiable on all three of these dimensions. These different dimensions of meat characteristics are referred to as TTA (traceability, transparency, and animal assurances) by Liddell and Bailey (2001). Subjects were informed that

the meat in their initially endowed sandwich (or ham), while satisfying national meat standards, did not possess the additional verifiable levels of assurances that the auction sandwich meat contained.[9] In addition to written instructions describing the auction process, instructions were reviewed orally prior to commencement of the experiment. The same experimenters controlled instructions and protocol in each of the experiment locations.[10]

Upon placing bids for auction sandwich 1, subjects then placed bids for sandwich 2, and then sandwich 3, followed by sandwich 4 bids. This constituted one round of bidding. Ten total rounds of bidding were used, and the only difference between the first round and the subsequent rounds of bidding was that subjects in subsequent rounds of bidding were informed of the market price (i.e., the second-highest bid) from the previous round for the auction sandwich prior to placing another bid for that same auction sandwich. Subjects were made aware that bids need not change at all from one round to the next for a particular auction sandwich, but that bids need not stay the same either. Bids were not truncated at zero as subjects were allowed to bid negative. To help clarify the meaning of a negative bid, the subjects were informed that a negative bid would be appropriate only if the subject would require compensation in order to exchange his sandwich with the auction sandwich.

Subjects were also informed that the purpose of having the winning bidder pay the second highest price was to remove the incentive to not truthfully reveal their true WTP for the auction meat. While such information on the theoretical incentives of the auction is not

[9] We made efforts to avoid deception in the information presented to our subjects in these experiments. Depending on the location, either domestic or imported meat was used in order to ensure verifiable TTA characteristics, although meat used in any one location was either all domestic or all imported (in order to avoid WTP differences for domestic versus imported meat infiltrating our data generation process). Traceable U.S. beef was obtained using an individual animal grown on a university farm that was slaughtered in facilities at the university.

[10] In Japan, the authors were present and conducted the experiments through a bilingual (native Japanese speaking) assistant to ensure as much similarity in protocol as possible with the English language experiments. All subject materials (.e.g, instructions, auction ham descriptions, etc) were in Japanese and had been translated by a native Japanese speaker and then reviewed by the assistant who also conducted the oral translation of the experiments.

appropriate for a *theory*-testing experiment, the purpose of these experiments was not to test second-price auction theory, but rather to have subjects comprehend the auction process. It was made clear to subjects that one random round and one random auction sandwich from that round would be chosen at the end of the experiment and the auction would then be consummated.[11] As such, a bid for any auction sandwich in any round stood an equally likely chance of being the binding bid at the end of the experiment, thus preserving the demand-revealing properties of the auction. At the end of the auction, a random round and sandwich was chosen, the auction was consummated and all subjects then consumed their sandwiches while completing a brief questionnaire.

**Experiment Results**

Table 1 summarizes the aggregate findings from our experiments. We compare average experiment group WTP rankings using nonparametric Friedman (1937) tests on the data. Average WTP numbers are found by averaging a given experimental group's bids for the final five experimental rounds for a given sandwich (or ham). The final five rounds are arbitrarily chosen as a more stable measure of subject bids than the initial five rounds (see Shogren et al. (1994), Hayes et al (1995), and Shogren et al. (1995)). The Friedman tests is appropriate where data can be arranged in independent blocks (i.e., each of our experimental groups), but where treatments within a block (i.e., each of the auction sandwiches) can be ranked according to some criterion, which in our case is WTP.

First, it is noteworthy that in every case subjects bid, on the average, higher for meat with all three TTA characteristics than one that only had one verifiable characteristic (bottom three

[11] We did not follow the standard protocol in similar WTP sandwich auctions of conducting a practice auction initially where subjects bid on a small item (such as a candy bar) before the auction of interest was conducted. We did conduct additional experiments as sensitivity tests for our deviations from others' protocols, and our findings

rows of Table 1). Though this may seem obvious since more information is more valuable than less, it is still significant since a traceable system can be used to verify and trace information on multiple characteristics, including those tested. In fact, it is interesting to note that average bids are significantly higher for the combined TTA characteristics than for traceability alone, even though traceability is a necessary condition to verify farm-level food safety measure and animal assurances. The average subject is likely not aware of this (though we did not inquire), which highlights the importance of consumer education in creating profitable markets for TTA products.

Among individual characteristics, traceability alone was less valued than either food safety or animal assurances in the U.S. and Canada (though not significantly less so for beef in Canada). In contrast, there are no significant differences in average bids for individual TTA characteristics in the U.K. and Japan. The fact that both the U.K. and Japan have experienced verified incidents of Mad-Cow disease while the U.S. and Canada have not may be at the heart of this result, though evidence from more controlled multi-variate analysis will shed more light on this. This may imply that profitable U.S. exports markets already exist in countries that have more fully recognized the value of traceability (i.e., in such countries the WTP for traceability alone is *no less* than WTP for meat safety or animal treatment). Characteristics that can be verified through traceable systems are valued in the U.S., but the traceability itself is less valued, on the average. This can change in two obvious ways. First, the U.S. could experience a Mad-cow or similar outbreak, thus "educating" consumers the hard way about the value of traceability. A second way is for producers to better educate consumers on the value of

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show that our results are not sensitive to this differing experimental protocol. Dickinson and Bailey (2002) describe these sensitivity tests in more detail.

traceability and/or on the link between traceability and other extrinsic meat characteristics that they already value.

Table 2 presents parametric analysis of average bid behavior with controls for age, income, education, and knowledge of food-borne diseases. The dependent variable is the subject's average bid from the final five rounds of the experiment for each of the auction meat products. A market price variable measures the average market price for each sandwich from the first five rounds of the auction—market price as defined for the econometric analysis is therefore exogenous. We also include experiment group controls and a random effects component that captures the potential lack of independence of an individual's bid across different sandwiches. That is, we view this data as panel data where individuals are the cross-sectional units and the "time-series" are the bids across sandwiches for that individual.

Results reported in Table 2 show that subjects' WTP across countries is uniformly higher for the combined meat attributes, perhaps not surprisingly.[12] Consistent with table 1 results, subjects in the U.K. do not value meat safety as an individual characteristic any higher than traceability alone, although they are willing to pay an additional premium for assurances of humane animal treatment. In contrast to the table 1 results, Japanese subjects are willing to pay a significantly higher premium for meat safety and animal treatment than for traceability alone. Overall, the treatment variable results from table 2 show that animal treatment and meat safety are general valued more highly than traceability alone, and WTP for the combined attributes is highest. However, raw bid data show that WTP for the combined attributes is less than the sum of the individual characteristics, indicating a diminishing marginal utility for traceability and other extrinsic meat characteristics that can be provided by traceable systems.

We also examine age, income, education, and knowledge of food-borne diseases as key demographic variables that may influence a subject's WTP for the extrinsic meat characteristics we examine. Our results show that older subjects are willing to pay more for the baseline pork product in Japan and in Canada. Higher income Japanese subjects are willing to pay less, and education is an insignificant determinant of subjects' WTP across all samples. The level of subject knowledge about foodborne illnesses, as proxied by the number of articles read on such subjects (*Articles*) shows a curiously opposite effect in the U.S. versus Canada. Additional information, as proxied by *Articles*, increases WTP in the U.S. buy decreases WTP in Canada. Red-meat traceability has been mandated in Canada but not in the U. S. Consequently, one would expect that Canadian consumers have been exposed to more investigative, popular press articles about traceability than American consumers, but many Canadian consumers may still see no immediate need for meat traceability since no Mad-cow crisis has yet developed there. The result may be more awareness about traceability in Canada than in the U. S., but perhaps also a bit more disillusionment about what traceability can actually achieve. That is, well-informed Canadian consumers understand that they will bear at least some of the cost for traceable meat system but they may not yet be convinced about the benefits of traceability. More simply put, it is logical to expect a diminishing marginal benefit of additional information or articles at some point, and a negative coefficient on *Articles* in Canada is consistent with the average Canadian subject being beyond satiation in articles on food-borne illnesses (i.e., a *negative* marginal benefit of additional information).

Overall, across all countries we examine, these demographic variables are often insignificant determinants of subjects' WTP. This is an important finding, because it indicates

[12] The only case in which we fail to reject the null hypothesis (at the $\alpha$=.10 level) of equal coefficients using the Wald test is in comparing the coefficient on animal treatment and the combined attributes in the U.S. pork sample

that the market potential for traceable meat products may be quite broad. Dickinson and Bailey (2002) report that demographic characteristics are likely an important determinant of WTP, but their result are inferred from using group control dummies for each of the different experimental cohorts. Since experimental subjects are grouped into like-types (e.g. all students, all faculty, etc.) for the auction experiments, it is reasonable to consider that group differences in WTP reflect differences in the demographics of the groups. Our current results show that a more detailed analysis of key demographic variables finds less significance overall than anticipated.[13]

Though our results suggest that the variation in WTP across characteristics is largely not affected by the demographics of the subjects, it is still of interest to examine the magnitude of the WTP effects for distinct meat types. Given that we examine both beef and pork in the U.S. and Canada, we conduct Chow tests for structural differences to determine if the coefficients on the three treatment variables (*Animal Treatment, Meat Safety, Combined Attributes*) are significantly different in the beef equation compared to the pork equation for each country. The results indicate that the coefficients on the treatment variables in beef differ significantly from those for pork in both the U.S. and Canada ($F[3,408]=21.6$ for the U.S. and $F[3,416]=3.67$ for Canada) at least at the 5% level. Such results are sensitive to our choice of baseline sandwich value since bids are expressed as a percentage of baseline sandwich value, but recall that *all* details of the subject lunch and sandwich in each country are identical except for the roast beef or ham in the sandwich. These results are most likely *not* an artifact of the baseline auction product value, which may be of more concern in comparing WTP results for products across countries, such as a U.K. ham sandwich and a Japanese ramen bowl with ham. It is for this reason that we do not make any direct comparisons of WTP amounts across countries.

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(p=.18).

The key result from the Chow tests is that subjects seem willing to pay higher premiums for the beef with additional animal treatment, meat safety, or combined traceability attributes guarantees than for pork with similar additional guarantees, independent of the demographics for which we control. The range of price premiums subjects are willing to pay for attributes other than traceability alone in the U.S. is 4%-9% for pork and 9%-28% for beef. In Canada it is 2%-6% for pork and 8%-18% for beef (see treatment variable coefficients in table 2). As such, profitable markets for food attributes that can be guaranteed through traceable systems may be more likely for beef than for pork. This is likely a result of more publicized and serious meat safety scares for beef products than for pork (e.g., the 2002 ConAgra beef recall, the 1996 Mad Cow cases in the U.K., the 1993 Jack in the Box food poisoning incident), but it is nevertheless ironic given that more resistance to implementation of traceable systems has come from the beef industry as opposed to the pork industry.

A final item worth noting is that, though consumers' WTP is significantly positive on average, a significant number of our subjects were not willing to pay any positive amount for certain attributes. Across countries, anywhere from 9% (Japan) to 48% (Canada-beef) of subjects were not willing to pay a positive amount for traceability alone, whereas for the combined attributes it ranges from 4% (Canada-beef, Japan, UK-pork) to 13% (U.S.-pork). To the extent that a higher percentage of a market willing to buy a product at a price premium is a measure of the potential overall market, the promotion of traceability alone would capture the smallest market. Among the individual characteristics food safety would interest the largest number of individuals at some price premium as only from 4% (Japan, U.S.-beef) to 15% (Canada-beef, U.S.-pork) of subjects would not pay a positive amount for additional food safety

[13] Recall that we do include group dummies in the current analysis so that the results in table 2 are controlled for the possibility of experimental group effects.

assurances. These results are similar to estimated treatment effects on WTP, which is further evidence that our treatment effects from Table 2 are not driven by a few aberrant subjects—this would be the case if WTP values were highest for meat safety, for example, and yet for additional meat safety the largest percentage of consumers had WTP equal to zero.

**Conclusions**

The results from this research have implications for traceable or potentially traceable products in general, such as diamonds, lumber, or clothing (e.g., clothing identifiably produced by sweatshop labor). Though traceability may be valued to some extent in and of itself, there is clearly a role for effectively communicating to consumers the additional product information that can be verified with traceability. This should not be surprising since information is a value-added component to a product. Independent third-party verification is clearly a necessary cost of any traceability system (McCluskey, 2000). This is true because asymmetric information would likely generate thin or nonexistent markets unless producers can provide a signal to consumers about the product's invisible attributes (see Akerlof, 1970).

We specifically explore WTP for traceability in food because it is hard to believe that traceable systems are not in the near future for U.S. meat, grain, and other food industries. Our results indicate that traceable systems are not merely an extra cost of production without any additional product benefits for which consumers are willing to pay. The time is now to devote resources to providing traceability where WTP is highest and exploit traceable systems to provide and verify information that consumers and producers value.[14] The alternative is to expend resources on rent-seeking behavior in an attempt to shelter U.S. food industries from this

[14] Though we only examine consumer WTP, such systems offer efficiency improvement opportunities for producers as well (e.g., ability to track efficiency of labor in production). Though difficult to measure, the added value of such efficiency improvements only increases the opportunity for producers to profitably exploit traceable systems.

transition and witness prominent U.S. industries fall further behind competitor-nation industries in their implementation of traceable systems as a standard for food industries.

Traceability is a characteristic separating the World's largest food systems. Dichotomous systems may lead to inefficiencies and confusion. While a requirement in EU-meat systems, the U. S. meat industry has favored private, rent-seeking activities related to traceability rather than a regulatory solution. As a result, willingness-to-pay for traceability has been a critical issue in American meat marketing chains. Our results suggest that not only American, but Canadian, British, and Japanese consumers, on the average, are willing to pay non-trivial positive amounts for red-meat (beef and pork) traceability. However, other characteristics certifiable with traceability are even more valued than traceability alone (e.g., animal treatment, meat safety). This implies that traceability as a characteristic is probably best bundled with additional characteristics.

The results also indicate that demand for traceability-provided characteristics is a general rather than demographic phenomenon for meat. However, our findings also reflect that a significant proportion of consumers in all four countries would not pay for traceability or characteristics that can be verified through a traceable system. This implies that a separate product line might be warranted for traceable products rather than accepting traceability on a general basis in a non-regulated system (i.e., since only a portion of consumers are willing to pay for traceability only a portion of products sold should be traceable). Such systems are likely to be mandated in many industries nevertheless, and so these finding indicate that opportunities for producers to remain profitable under a system-wide traceability mandate will not disappear.

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**TABLE 1: Average willingness-to-pay rankings of TTA attributes**
(average WTP for a TTA attribute(s) is the average across all subjects and all rounds for a given experiment group)

| TTA Attribute Comparison | U.S.A (pork) | U.S.A. (beef) | Canada (pork) | Canada (beef) | U.K. (pork) | Japan (pork) |
|---|---|---|---|---|---|---|
| Animal Treatment ≈ Food Safety? | < | < | = | > | < | < |
| Animal Treatment ≈ Traceability? | >* | >*** | >*** | > | < | > |
| Food Safety ≈ Traceability? | >** | >*** | >*** | > | < | > |
| Combined Attributes ≈ Animal Treatment? | >*** | >*** | >*** | >** | >*** | >*** |
| Combined Attributes ≈ Food Safety? | >** | >*** | >*** | >*** | >** | >** |
| Combined Attributes ≈ Traceability? | >*** | >*** | >*** | >*** | >** | >*** |

*, **, *** denote significance for the two-tailed test at the .10, .05, and .01 levels, respectively. Friedman test assumes that average bids *across* different experiments are mutually independent but that average bids may be ranked (according to some criteria, such as WTP) across attribute types (see Conover, 1999, p. 369)

**TABLE 2: Random Effects Estimates**
Determinants of subject bids
(dependent variable=subject's average bid in final five auction rounds as a percentage of baseline sandwich value)

| **Variable** | Sample= **USA pork** Coef. (p-value) | Sample= **Canada pork** Coef. (p-value) | Sample= **Japan pork** Coef. (p-value) | Sample= **UK pork** Coef. (p-value) | Sample= **USA beef** Coef. (p-value) | Sample= **Canada beef** Coef. (p-value) |
|---|---|---|---|---|---|---|
| Market price | .130 (.00)*** | .081 (.00)*** | .001 (.00)*** | .224 (.00)*** | -.0001 (.79) | .090 (.00)*** |
| Animal Treatment | .050 (.01)*** | .039 (00)*** | .025 (.02)** | .014 (.09)* | .091 (.00)*** | .082 (.02)** |
| Meat Safety | .044 (.01)*** | .024 (.01)*** | .046 (.00)*** | -.003 (.67) | .132 (.00)*** | .076 (.03)** |
| Combined Attributes | .090 (.00)*** | .064 (.00)*** | .116 (.00)*** | .047 (.00)*** | .277 (.00)*** | .177 (.00)*** |
| Age | -.006 (.15) | .005 (.02)** | .005 (.05)** | .003 (.38) | .002 (.40) | -.001 (.79) |
| Income | .0000003 (.88) | -.000001 (.22) | -.00000002 (.01)*** | -.0000004 (.83) | -.000001 (.47) | -.00000006 (.76) |
| Education | .030 (.57) | .022 (.42) | -.007 (.90) | -.002 (.94) | -.043 (.26) | .047 (.39) |
| Articles | .001 (.81) | -.000 (.92) | -.002 (.13) | -- -- | .001 (.04)** | -.003 (.06)* |
| Constant | .124 (.44) | -.120 (.39) | .36 (.84) | -.092 (.57) | .072 (.58) | .105 (.64) |
| *R*-squared | .51 | .52 | .86 | .48 | .31 | .28 |

*,**,*** indicate significance at the .10, .05, and .01 level for the two-tailed test, respectively. Group dummy variables included in each case. *Articles* could not be included in the UK beef model due to negative estimates of the variance component for the random effects model. Sensitivity analysis of remaining coefficients with distinct combinations of demographic variables indicates that the results above are not sensitive to the omission of the *Articles* variable for the UK pork sample.