Consumers' Preferences for Farm Animal Welfare: the Case of Laying Hen

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Introduction

Animal-based food producers, consumers, and governments around the world have become increasingly mindful of farm animal welfare in recent years. European Union laws have already recognized that farm animals can feel, experience, and suffer, which serve as the basis of many animal welfare standards in a number of countries. The increasing awareness of farm animal welfare in the U.S. has also led to changes in state regulations and industry standards. For example, pregnant pig crates are now banned in Florida and Arizona (International Finance Corporation, 2006; Lusk *et al*., 2007). The United Egg Producers (UEP), representing nearly 90% of U.S. egg producers, launched the UEP Certified Program in 2002, which requires increasing stocking space for laying hens from 48 to 67-86 square inches per bird. By 2010, 80% of all eggs in the U.S. have been produced under the guideline. (United Egg Producers, 2010). Consumers appear to deem welfare issues differently for different farm animals. According to a Eurobarometer report, laying hens were considered to be in poorer living conditions compared to pigs and dairy cows, and laying hens and broilers were the animals that respondents preferred to improve their welfare the most (Special Eurobarometer, 2005).

U.S. consumers spend approximate $14.2 billion annually on eggs (USDA, 2005). A recent study conducted by the American Egg Board shows that majority of consumers believe eggs are healthy food, and the consumers' preferences are influenced by different attributes, such as price, health consciousness, food safety, and animal welfare, which has lately become an increasing concern (American Egg Board, 2009). To indicate different living conditions of laying hens, several animal-welfare related labels have been developed by various groups, referring to terms such as certified humane and cage-free.

The label “Animal Welfare Approved” developed by the Animal Welfare Institute, for example, requires cage-free condition and outdoor access for laying hens to perform their natural behaviors, including nesting, perching and dust bathing, and forbids forced molting and beak cutting (The Human Society of the United States, 2011).

Moreover, state and local governments are also playing an active role in improving laying hen’s well-being. In 2008, California passed the Prevention of Farm Animal Cruelty Act to ban confining hens in cages and require all the eggs sold in California to be cage-free by 2015. Michigan passed a similar law in 2009 to forbid battery cages. Similar regulations are being debated in other states, including Ohio and Oregon. Sumner *et al*. (2010) point out the new regulations would increase production costs of eggs, considerably reducing eggs produced within the state, and increasing egg shipments from other states. On the other hand, consumers appear to be willing to pay some premium for cage-free eggs (Sumner *et al*., 2011). Many restaurants, including Starbucks and Burger King, and universities now request for eggs produced from layer-friendly systems. As a result, higher layer welfare standards might help food producers realize new marketing opportunities with animal well-being concerned retailers and consumers (The Human Society of the United States, 2011).

This study aims to assess how consumers value various practices of managing laying hens that are related to their welfare to provide practical implications for U.S. egg producers and a more complete picture of consumer preferences on eggs. A survey was developed and administered online to about 1,000 randomly selected households nationwide. The respondents were asked to complete a choice experiment regarding eggs produced from layers under different management practices. The choice experiment

considered seven attributes: price, color of egg shells, availability of outdoor access for layers, cage confinement, stocking density, feed types, and practice of induced molting. The respondents were assigned randomly to two versions of the survey to assess whether information on environmental impacts of management practices would influence their valuation of factors. The choice experiment responses were analyzed using a random parameter logit model accounting for heterogeneity in consumer preferences. In addition to estimating consumer values towards various management practices, our analysis found that the majority of consumers are willing to pay an average premium ranged from $0.07 to $1.27 for egg produced under a welfare enhancing environment for layer hens.

Literature Review

U.S. egg consumptions had declined over the post-World War decades through the earlier 1990s, reflecting consumers' concerns regarding cholesterol and salmonella. The decline might also have been caused by the changes in people's lifestyle, where more food is consumed away from home (Brown and Schrader, 1990). In recent years, egg has become marketed as a healthy food product and a relatively cheap source of protein and minerals, stabilizing egg consumption (Thompson *et al*., 2011).

As part of the general trends in foods, the egg market has become highly differentiated in recent years. Sales of functional eggs, such as omega-3 enhanced and organic eggs, increased steadily recently and accounted for nearly 16% of the market in 2005 (Chang *et al*., 2010). Organic egg sales account for a small share of the overall U.S. egg market but has grown rapidly at an average annual rate of 19% from years 2000 to 2005 (Oberholtzer *et al*., 2006; USDA, 2005). Thus, several studies have investigated consumer preferences on differentiated eggs. Andersen (2011) studied the consumers'

willingness to pay for specific eggs using mixed multinomial logit models, and the results indicated that people were willing to pay a higher premium for organic eggs, which was attributed to consumers perceiving organic eggs as healthier food and feeling more familiar with the label. Asselin (2005) studied the consumption of eggs in Canada and found people were willing to pay positive premium for Omega-3 eggs. Baltzer (2004) used scanner data on weekly sales of eggs to estimate an almost ideal demand system (AIDS) model, and he found Danish consumers were willing to pay a significant premium for organic production methods and improvements in animal welfare.

With increasing concerns about animal welfare, the cage-free attribute has become one of the attributes commonly associated with hens' welfare. In the U.S., the majority of laying hens are confined in cages with limited space for each bird. The traditional housing systems are criticized by animal advocacy groups that hens cannot extend their wings and are unable to exhibit natural behaviors, such as nesting and dust bathing (The Human Society of the United States, 2011). Several studies have been conducted to assess consumers' attitude towards animal welfare and demand for related products. Fearne and Lavell (1996) conducted a survey involving 39 households to exam consumers' perceptions of eggs in the UK and found that people valued price and animal welfare as two key attributes of egg consumptions. Based on an auction experiment involving over 100 subjects, Norwood and Lusk (2011) found that people highly valued cage-free systems and were willing to pay a $0.95 premium for a dozen eggs raised in a cage-free system over a traditional caged system. On the other hand, Allender and Richards (2010) found only about 20% of households were willing to buy cage-free eggs at the average 2007-2008 prices. Chang *et al*. (2010) conducted a hedonic analysis using

scanner data from two regional markets and the U.S. market, and found that although people were willing to pay a significant premium on average for cage-free eggs, nearly half of the typically observed premium was attributed to egg color rather than better living conditions of hens. Thus, whether consumers would like to pay for eggs produced from animal friendly system remains debatable due to limited findings.

Furthermore, other important questions on animal welfare remain unanswered. One such question is how consumers value the tradeoff between improvement in animal welfare and environmental degradation. Xin *et al.* (2011) reported that cage-free systems or other systems allowing outdoor access generally generate more air and water pollutions placing heavier burden on the environment than traditional caged housing systems. Thompson *et al.* (2011) concluded that although hen manure is a valuable nutrient resource for crops, its handling can produce significant environmental burden on air and water quality. Moreover, Williams *et al*. (2006) found that these housing systems without cages use more feed and energy to keep optimal temperatures for layers due to smaller stocking densities, specifically that the free range egg production increases energy use by 15%. This tradeoff is seemingly an issue most consumers have not yet considered, and this study will evaluate how environmental concerns influence consumers' valuation of layer management practices.

Another question of interest pertains to the general consumers' perceptions of animal welfare. There are many factors to consider in assessing animal welfare, and people likely have different perceptions towards them. For example, traditional housing systems confining hens in cages provide clean shelters, comfortable temperatures, and reduce production costs. Also, hens' beaks are often trimmed to prevent them from

hurting fellow birds via harmful pecking. Although these management practices protect hens in some respects, they have usually been viewed as reductions of animal welfare by the public, since cutting beaks appear brutal, and caged hens cannot access outdoors and have no freedom to nest, perch, or even spread their wings. Lusk *et al*. (2007) found that people valued the opportunity for farm animals to exhibit natural behaviors and exercise outdoors more than protection from other animals and comfortable shelter. Thus, it is a goal of our study to identify what practices are perceived by consumers to indeed enhance welfare of layer hens.

Survey Instrument

The survey instrument was designed to obtain estimates of consumers' values of individual layer management practices and to examine the impact of the environmental factors of the commonly perceived welfare-enhancing practices, including screening questions, general questions, choice scenarios, and demographic questions. The screening questions pertained to shopping responsibilities of the respondent and frequencies of egg purchases by the household, which aimed to restrict our sample to practiced egg shoppers. The demographic information, including gender, age, educations, household annual income, and geographic areas were collected at the end of survey.

The general questions were designed to collect information on shopping behavior and perceptions of animal welfare as well as knowledge about environmental impacts of layer management. For example, respondents were asked to indicate the importance of attributes of egg products to them, such as price, product origins, animal welfare concerns, and environmental concerns. Also, they were asked to indicate their perceptions of important factors of hen's welfare, such as access to fresh food and water, opportunity to

exhibit natural behavior, and protection from injury. Additionally, respondents were asked to judge whether statements regarding relation between outdoor activities of hens and environmental degradation were true or not.

A choice experiment was designed to estimate marginal values of the following attributes of a dozen eggs: price ($1.99, $2.49, $2.99), shell color (white or brown), outdoor access (yes or no), confined in cages (yes or no), stocking density (high, medium, low), feed types (conventional, vegetarian, organic), and induced molting (yes or no). The lowest level of price was chosen based on current average market prices of conventional white eggs, while the middle level and highest level of prices were about 25% and 50% higher than the lowest price level, respectively. The three levels of stocking density were set at 67 square inches, 138 square inches, and 1.5 square feet or 216 square inches, where the highest density was chosen based on the UEP standards, the medium density was the average space for hens to fully stretch their wings, and the lowest density followed third-party authorized animal welfare standards, such as Certified Humane and Animal Welfare Approved (Animal Welfare Approved, 2011). The attributes and levels are summarized in table 1.

A full factorial design included 216 (=3×2×2×3×2×3) product profiles. After deleting two extreme profiles, i.e., the combination of practices that appear to be conventionally perceived as superior for hen's welfare (no cage with outdoor access and low stocking density) and organic feed associated with the lowest price, and the combination of practices with perceived lowest welfare conditions and conventional feed associated with the highest price, a macro in SAS 9.1 suggested 54 profiles for a fractional factorial design, which yielded a D-efficiency score over 99%. Eighteen

choice scenarios with three products each were generated and blocked into three sets of six choice scenarios to minimize response fatigue. The respondents were asked to choose from among three products with different attributes and a "Not buy any of the three" option for each choice scenario, and each respondent completed a set of six choice scenarios (figure 1).

To examine the information effect, there were two versions of the survey based on the availability of additional information on environmental aspects of non-cage systems and provision of outdoor access to layer hens. Some previous studies showed that negative messages would lower consumers' willingness to pay compared with produces with no or neural message (Borin *et al*.,2011; Napolltano *et al*., 2008). Thus, to make the statement objective, we explained potential environmental burden could be produced from both non-cage system and cage system. The complete statement found in the Appendix was presented to the respondents in the version with the additional information prior to the choice scenarios. In this paper, it was hypothesized that consumers with additional information would become more conflicted to related attributes and may value these attributes lower than those without additional information.

The Model

Stated preference methods are based on the theory of utility maximization. Respondents are assumed to choose the alternative with the combination of attributes that would provide them the highest level of utility, when they are presented with a choice task. When consumers choose egg products with similar attributes, it is naturally expected that consumer preferences towards various attributes are correlated and the Independence of Irrelevant Alternatives assumption of the multinomial logit model is

violated. A random parameters logit (RPL) model was used in this study to overcome this limitation of multinomial logit model and to examine heterogeneity of preferences within the population (Hensher and Greene, 2001; McFadden and Train, 2000).

The utility of an individual *i* derived from choosing alternative *j* can be written as:

$$U_{ij} = \beta_i X_{ij} + \varepsilon_{ij} \quad (1)$$

where X_{ij} is a vector of observed variables consist of attributes of the alternatives and individual characteristics. The parameter vector β_i is unobservable and varies across individuals with density $f(\beta|\theta)$, where θ is the parameter vector that define this distribution, and ε_{ij} represents the unobservable, random term that is assumed to be an independent and identically distributed (iid) extreme value. Following Hensher and Greene (2001), the choice probabilities are integrals of standard logit probabilities over the parameter densities and can be written as:

$$P_{ij}(\theta) = \int \left(\frac{e^{X_{ij}\beta_i}}{\sum_{k=0}^{J} e^{X_{ik}\beta_i}}\right) f(\beta|\theta) d\beta \quad (2)$$

The individual's utility was partitioned into choosing one of three egg products or "none of these three" option with price, product attributes variables and informational interaction terms, and it can be written as:

$$U_{ij} = \beta_{0i} + \beta_{1i} Price_j + \beta_{2i} Color_j + \beta_{3i} Organic_j + \beta_{4i} Vegetarian_j + \beta_{5i} Access_j + \beta_{6i} Cagefree_j + \beta_{7i} NoMolting_j + \beta_{8i} Density_j + \varepsilon_{ij} \quad (3)$$

where *Color, Organic*, *Vegetarian, Access, Cagefree*, and *NoMolting* are dummy variables representing egg product attributes. The *Density* variable assumed the values of stocking density in the experiment measured in 10.

The conditional means of parameters can be modeled as functions of individual characteristics, that is:

$$\beta_{ki} = \beta_k + \delta_k' z_i + \sigma_k v_i, \qquad k = 2, \ldots, 8 \tag{4}$$

where β_k is the population mean for the *k*th coefficient, δ and σ are parameters, z_i is a vector of observed individual characteristics, and v_i is an idd error term. Individual willingness-to-pay (WTP) estimates are then computed from individual-specific attribute parameters and the fixed price parameter as the negative ratio between the attribute and price parameters, which can be written as:

$$WTP_{ki} = -\frac{\beta_{ki}}{\beta_1} \tag{5}$$

where β_1 represents the price parameter.

Results

Sample Characteristics

The data were obtained through an online survey conducted in March of 2012, several weeks before Easter. The nationwide representative sample was provided by Research Now®. The respondents were screened to ensure that they were main shoppers of households that regularly purchased eggs. The survey was pre-tested with 60 respondents to ensure clarity of questions and balanced response across attribute levels for statistical reliance. Based on the pretest results where a large portion of the respondents chose the two lower price levels, the price intervals between the three price levels were reduced from an initial interval of $0.80 to $0.50, which was used in this study. Then, the research firm provided a sample of 1,049 respondents. After deleting incomplete responses and ones that were completed under seven minutes, a total of 924 responses were usable for this study. A total of 449 respondents completed the version without information on environmental aspects (version 1), while 475 respondents completed the version with information (version 2).

The demographic profile of the sample is compared to the national statistics in table 2. The respondent demographics were mostly comparable to those of the population, while our survey sample had higher proportions of female and individuals with bachelor's degree or higher). As respondents were screened to ensure that they were responsible for at least half of the household grocery shopping, it is reasonable to receive more responses from women. The educational attainment of the survey sample may be reflective of the fact that people with higher education have more interest in taking research surveys and expressing their perceptions about animal welfare. Each version of the survey included three sub-versions with different sets of choice scenarios. T-tests were conducted to examine if there were any differences in demographics of responses between the two versions and among three sub-versions in each version. The results showed no statistically significant differences in gender, education, ethnicity, household income, and regions. The only exception was age, where the average respondent of one sub-version of version 1 was older than those in the other two sub-versions, and the average respondent of one sub-version for version 2 was younger than the other two sub-versions in version 2. But, there was no statistical difference between versions 1 and 2.

The respondents were asked to rank seven items related to farm animal treatments in the order of importance to identify treatments of farm animals that are valued by consumers. The results showed the "Receive fresh and clean food and water" and "Are raised in ways to keep our food costs low" were considered as the most important factors by 38.5% and 23.7% of the respondents, respectively, which can be compared with "Receive treatment for injury and disease" and "Are allowed to exhibit natural behaviors" considered as the most important by about 8% of the respondents each (table 3).

As shown in table 4, over 75% of the respondents somewhat or completely agreed that food products produced in an animal friendly environment are of better quality, from happier and healthier farm animals, and they are healthier for humans, and over 60% of the respondents somewhat or completely agree that these products as better tasting and better for the environment. Regarding their perception of how various farming practices may impact the welfare of hens, approximately 50% of the respondents believed that housing hens in cages would somewhat or definitely worsen hens' welfare, while 22.4% of them believed that would somewhat or definitely improve hens' welfare. About 44% of the respondents believed that trimming hens' beaks would somewhat or definitely worsen their welfare, and over 62.5% of them believed that induced molting would somewhat or definitely worsen hens' welfare.

The respondents were also asked to judge the relationship between improving hen's welfare and environmental degradation, i.e., tradeoff between outdoor access and more air emissions or higher heat and feed utilizations (table 5). Over 40% of respondents were neutral with those questions, which may indicate that they lack of relative knowledge. Greater percentage of respondents were not aware of the tradeoff believing that a management practice that contributes to a higher level of hen's welfare also produces lower burden on environment. Moreover, approximately 50% of respondents were indifferent with the tradeoff between animal welfare and environmental degradation. These responses provide a basis for understanding the information effects we may find.

Random Parameter Logit Model

In equation (3), the price coefficient was specified as fixed across individuals to

simplify the computation of implicit values following convention. All non-price parameters were specified as normal with the conditional means dependent on demographics. The selected respondent characteristics in equation (4) included gender (a binary variable *Fem* equaling one for female), age (*Age*), household income (*Income*), education attainment (a binary variable *BPlus* equaling one for having a bachelor's degree or higher). The age variable assumed the midpoint in each age range; i.e., a response of 25-34 was given a value of 30, and the income variable assumed the midpoint in each income range measured in $10,000. Definitions and descriptive statistics of the variables in the analysis are reported in table 6.

In addition, the coefficients on attributes of welfare-related management practices, i.e., *Access*, *Cagefree*, *NoMolting*, and *Density*, were specified as functions of respondent's attitudes towards hen's welfare. The attitudes were measured by 11 questions that were based on similar scales, discussed above. A varimax rotation of an initial factor analysis of those 11 questions identified three factors, and a Chronbach's α test was conducted to test the reliability and acceptability of each factor (Cortina, 1993). As a result, two factors indicating that respondents' perceptions on quality of products produced in an animal friendly environment and respondents' perceived impacts of management practices on hen's welfare were usable with values of α greater than 0.70 (table 7). Responses to questions under each factor were averaged to generate two attitudinal variables *PQTY* and *PMGT*, respectively (see table 4 for descriptive statistics).

The random parameter logit model was estimated by maximum simulated likelihood using 100 Halton draws via NLOGIT 4.0 (Greene, 2007). To test the parameter equivalency between the samples with and without additional information, the model was

estimated using separate and combined samples to conduct the likelihood ratio test. The result of the likelihood ratio test showed that the parameters from the two versions were statistically different ($p = 0.002$). Given the similarity in demographic characteristics and attitudes towards animal welfare between the two samples, the test result can be interpreted as the impacts of additional information provided on consumers' preferences. Thus, results from the two versions are presented separately in table 8.

As expected, the coefficient for *Price* in each version was negative and statistically significant, indicating respondents obtain disutility from higher prices. Within version without additional environmental aspect information (version 1), the coefficients of attributes *Organic, Vegetarian, NoMolting,* and *Density* were positive and statistically significant, showing that on average respondents preferred eggs from hens raised with organic or vegetarian feed, relative to conventional feed, without induced molting, and lower stocking density. (Note, higher values for *Density* indicate more space per bird or lower stocking density.)

The heterogeneity-in-mean parameters measure the impacts of demographic and attitudinal variables on attribute parameters. In version 1, the values of heterogeneity-in-mean indicated that female respondents valued non-induced molting more than male respondents, while male respondents placed higher values on lower stocking density, organic-fed, and vegetarian-fed eggs. Younger respondents and those with higher education on average valued organic-fed eggs more than their counterparts. This finding, is consistent with Andersen (2008) that younger and those with higher education consumers are more familiar with organic eggs. Respondents with favorable perceptions of animal welfare friendly products placed higher values on the cage-free attribute, but

lower values on no induced molting. This may indicate that these respondents on average regard cage-free as the important factor influencing the quality of eggs. Respondents with perceptions that common management practices have negative impacts on animal welfare valued the no induced molting attribute more and lower density less than others, suggesting that these consumers likely perceive induced molting as a more brutal activity.

Comparing the results from the two samples shed some light on the impact of additional information about the environmental consequences of cage-free systems with outdoor access. Similar to those who received version 1 survey, respondents in version 2 also preferred eggs from hens raised with organic feed relative to conventional feed and in a lower stocking density. But they also on average preferred cage-free eggs, which was indicated via its positive and statistically significant coefficient. Heterogeneity-in-mean parameters indicated that different from version 1, male respondents and those believed animal welfare friendly products are better, on average, placed higher values on outdoor access. Younger respondents valued lower stocking density more than older respondents. Higher income household preferred organic-fed eggs, and this may be due to a commonly higher price for organic eggs than conventional ones. Similar as showed in version 1, those respondents perceived potential negative impacts of comment management practices on hen's welfare derived higher utility from eggs from hens without induced molting, but placed lower value on loose density.

The standard deviation estimates of all random coefficients were statistically significant in both versions, suggesting strong heterogeneity among preferences in addition to those captured by the heterogeneity-in-mean factors. Compared with version 1 without additional information, the standard deviation estimates for random coefficients

in version 2 were larger, except *Density*. This result indicated that consumers' responds were more varied when additional information provided.

The statistics of individual-specific WTPs for each version were displayed in table 9. From the version without additional information (version 1), we found that the average WTP for brown eggs over white ones was $0.01 per dozen, and only less than half respondents were willing to pay a positive premium for it, indicating that most of consumers were indifferent between brown eggs and white eggs. This result is different from some previous studies, for example, Fearne and Lavell (1996) reported that consumers preferred brown eggs over white ones in the UK, and Chang *et al*. (2010) found consumers were willing to pay an extra $0.73 for brown eggs. This result may be due to more consumers realized that the difference of colors is due to different breed and does not represent higher nutrition or better quality, which was stated for respondents before choice experiments. Also, as brown shells are commonly associated with organic-fed or cage-free in the marketing, the premium for brown shell may result from these attributes. Thus, analyses using data from retailers (e.g., Chang *et al*. 2010), may indicate a higher premium for brown eggs than those collected from our designed survey by not controlling for the organic-fed or cage-free attributes.

On average, respondents were willing to pay an over $0.80 premium for organic-fed or vegetarian-fed eggs over conventional eggs, and approximately 98% and 85% of consumers were willing to pay an extra for them, respectively. This is consistent with previous studies that found consumers were willing to pay a premium for organic eggs over conventional eggs, since organic eggs were perceived as healthier (Baltzer, 2004; Andersen, 2008). Approximately 100% of the respondents were willing to pay a

premium for outdoor access over no outdoor access, with the maximum estimated as $1.96 with a mean of $0.96. The average WTP for cage-free eggs relative to caged eggs was $1.27, and 95% of consumers were willing to a positive premium for it. This result is supported by other studies that found the majority of consumers preferred cage-free eggs over conventional eggs (Fearne and Lavell, 1996; Norwood and Lusk, 2011). Moreover, the premium of cage-free was the highest among these attributes, which may indicate that the consumers' familiarity and knowledge of cage-free eggs is generally increasing. In our sample, nearly 70% of the respondents rated that they were somewhat or very familiar with cage-free label, compared American Egg Board reported in 2010 that only nearly 30% of the consumers were familiar with cage-free attribute (American Egg Board, 2010). In addition, we found over 90% of the consumers also were willing to pay a positive premium for naturally molting over induced molting and lower stocking density. Respondents of version 1were willing to pay an average $0.93 for eggs from hens with non-induced molting and $0.07 for additional 10 square inches. Thus, average respondents were willing to pay an extra $0.50 for a dozen eggs from hens given 138 square inches each compared to the basic UEP standards of 67 square inches per bird and another $0.55 for further lowering the density to provide 1.5 square feet per bird.

Consistent with version 1, over half of the respondents in the version with additional information were not willing to pay a positive premium for brown shell. On average, approximately 88% of the respondents were willing to pay an extra $0.83 for organic-fed and nearly 85% of the respondents were willing to pay an average $0.91 premium for vegetarian-fed eggs over conventional eggs. Also, majority of the respondents were willing to pay a significant premium for animal welfare related

attributes, such as cage-free, outdoor access, not induced molting, and lower stocking density.

The differences in premia for these attributes between consumers with and without the additional information were distinct from our expectation. The average willingness to pay for animal welfare-related management practices increased when they were provided additional environmental aspect information, as well as their variability (expect for *Density* that did not change). A visual inspection of the individual WTP distributions reveal that the distributions for *Access, Cagefree,* and *Density* became more right skewed in version 2 compared with version 1. Thus, the information on environmental consequences did increase the differences in preferences, where respondents in general became more conflicted to pay for these attributes when they were given the information that different housing systems could have different environmental impacts, which was consistent with our hypothesis. But, consumers with an inclination to care about animal welfare seemingly harden their viewpoints in light of potential environmental issues, increasing the mean WTPs.

Conclusion

This study probed consumer perceptions and preferences regarding farm animal welfare in the case of layer hens. In terms of factors of importance for hens' welfare, we found that consumers in our sample valued the basic needs of "receiving fresh and clean food and water" and the human-side needs of being "raised in ways to keep lower costs" higher than other animal-friendly factors. Respondents are concerned food cost, which remains one of the most important factors influencing consumers' choice. Thus, providing eggs at a low price is critical for producers.

That said, the majority of the consumers (over 94%) were willing to pay a significant premium for improving hens' welfare attributes, including outdoor access ($0.96), cage-free ($1.27), non-induced molting ($0.93), and cage-free attribute was preferred with the highest average premium. According to Sumner *et al*. (2010), the cost for cage-free systems was $0.40 per dozen higher than the cost for cage systems, which is below our estimated premium that consumers were willing to pay, indicating a potentially profitable opportunity for producers to switch from caged systems to cage-free systems. If the other management practices, i.e., providing outdoor access or only relying on natural molting are not as costly as the estimated premia, producers could be better off incorporating these practices. Also, consumers were willing to pay $0.84 extra for organic-fed eggs and $0.86 extra for vegetarian-fed eggs per dozen relative to conventional eggs. Although functional eggs account for a relative small share in the market, the results indicated that consumers clearly preferred them and are willing to pay extra for these eggs.

The estimated impact of additional information on the environmental aspect of layer management practices was interesting. Approximately 50% of consumers felt indifferent about the tradeoff between animal welfare and environmental degradation. However, when provided the information that different housing systems could cause different environmental problems, consumers expressed conflict with related animal welfare friendly practices. Moreover, they were still willing to pay higher average premia for these attributes. This result suggests that animal welfare is an issue consumers of animal-based food products valued more than environmental impacts. Suitably designed educational campaigns could encourage consumers to seek out products from animal-

welfare friendly practices and provide incentives for producers to take advantage of such demand.

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Table 1. Attributes and Levels in the Choice Experiment

Variable	Definition
Attributes	
Price	$1.99, $2.49, $2.99
Color of Shell	Brown (*Color*), White
Feed	Organic (*Organic*), Vegetarian (*Vegetarian*), Conventional
Induced Molting	Not induced (*NoMolting*), Induced
Use of Cage	Cage-free (*Cagefree*), Caged
Outdoor Access	Yes (*Access*), None
Stocking Density	67 sq. inch, 138 sq. inch, 216 sq. inch

Table 2. Demographics of US Population and Survey Sample

		Survey Sample	U.S. Population
Gender	Male	41.45%	48.57%
	Female	58.55%	51.43%
Age	18-24	12.55%	12.83%
	25-34	19.59%	17.99%
	35-44	20.24%	17.23%
	45-54	21.97%	19.01%
	55-64	14.29%	16%
	65 or above	11.36%	16.95%
Education[a]	Graduate School	15.15%	9.61%
	Bachelor's degree	27.60%	18.14%
	Some college	37.34%	28.49%
	High school degree	18.72%	30.41%
	Lower than high school	1.19%	13.34%
Race/ Ethnicity	White	93.29%	76.07%
	Black/African American	3.57%	11.96%
	Hispanic[b]	4.87%	0.77%
	American Indian	0.54%	4.88%
	Asian	0.11%	0.15%
Household Income	$0-10,000	7.14%	7.78%
	$10,000-24,999	20.56%	17.91%
	$25,000-49,999	28.25%	24.72%
	$50,000-74,999	18.83%	17.74%
	$75,000-99,999	9.96%	11.43%
	$100,000-199,999	12.45%	16.52%
	$200,000 or above	2.81%	3.90%
Region	New England	6.39%	4.68%
	Mid-Atlantic	18.83%	13.24%
	East North Central	28.03%	15.04%
	West North Central	10.50%	6.64%
	South Atlantic	10.39%	19.36%
	East South Central	3.03%	5.97%
	West South Central	3.25%	11.77%
	Mountain	6.39%	7.15%
	Pacific	13.20%	16.16%

Source: U.S. Census Bureau, Annual Demographic Survey.

[a] Only counts those 18 years of age or more.

[b] Individuals can be listed as more than one ethnicities, so the ethnicity percentage do not have to sum to one.

Table 3. Items Related to the Treatments of Farm Animals

Items	% ranking as the most important
Receive fresh and clean food and water	38.5
Are raised in ways to keep our food costs low	23.7
Receive treatment for injury and diseases	8.7
Are allowed to exhibit natural behaviors	8.3
Are provided comfortable shelter	7.7
Are allowed to access outdoors	6.7
Are protected from being harmed by other animals	6.5

Table 4. Consumers' Attitudes on Animal Welfare

Questions	Average Score	Percentage
"I believe that food products produced in an animal friendly environment:" (1=completely disagree, 2=somewhat disagree, 3=neutral, 4=somewhat agree, 5=completely agree)		Somewhat/Completely Agree
Taste better.	3.79	59.13
Are of better quality.	4.10	75.69
Are better for the environment.	3.96	65.34
Are from happier farm animals.	4.19	77.47
Are from healthier farm animals.	4.34	83.56
Are healthier for humans.	4.20	77.39
Based on your understanding, how would the following activities affect the welfare of laying hens? (1=definitely improve, 2=somewhat improve, 3=no impact, 4=somewhat worsen, 5=definitely worsen)		Somewhat/Definitely Worsen
Hens are housed in cages, instead of not being caged.	3.42	49.76
Hens' beaks are trimmed.	3.43	43.87
Hens are withheld from feeding or given less nutritive diet so that they molt to regulate production of eggs.	3.78	62.47

Table 5. Perceptions Regarding Housing Systems and Environmental Impact

Please indicate the levels at which you agree or disagree with the following statements.		
Statements:	Mistakes%	Neutral%
Hens that are allowed outdoor access generate less air emissions (for example, ammonia emissions and dust level) than hens that are confined indoor.	49.19	41.66
Hens that are not caged use less heat and feed than hens that are confined in cages.	46.75	44.59
Hens that are allowed outdoor access use energy and land less efficiently than hens that are housed inside.	29.06	41.31
Statement:	Somewhat/Completely Agree%	Neutral%
"I would like to purchase animal welfare friendly products even if the procedure places a heavier burden on the environment."	27.08	48.25

Table 6. Descriptive Statistics

Variable	Definition	Mean	St. Dev.	Min	Max
Decision	1 if the alternative is chosen, 0 otherwise	0.25	0.43	0.00	1.00
Price	$1.99, $2.49, $2.99	1.87	1.13	0.00	2.99
Color	1 if brown, 0 otherwise	0.33	0.47	0.00	1.00
Access	1 if outdoor access, 0 otherwise	0.39	0.49	0.00	1.00
Cagefree	1 if cage-free, 0 otherwise	0.36	0.48	0.00	1.00
Organic	1 if organic, 0 otherwise	0.26	0.44	0.00	1.00
Vegetarian	1 if vegetarian, 0 otherwise	0.26	0.44	0.00	1.00
NoMolting	1 if not induced molting, 0 otherwise	0.42	0.49	0.00	1.00
Density	67 sq. inch, 138 sq. inch, 216 sq. inch in 10	10.53	8.04	0.00	21.6
Fem	1 if female, 0 otherwise	0.59	0.49	0.00	1.00
Age	Midpoint in age range 18-24, 25-34, 35-44, 45-54, 55-64, 65-84	44.26	16.07	21.00	74.50
Income	Midpoint in annual income range $5,000-10,000, $10,000-24,999, $25,000-49,999, $50,000-74,999, $75,000-99,999, $100,000-199,999, $200,000- 500,000 in $10,000	6.37	6.44	0.75	35.00
Bplus	1 if Bachelor's degree or higher, 0 otherwise	0.43	0.49	0.00	1.00
PQTY	Average of responds	4.10	0.76	1.00	5.00
PMNT	Average of responds	3.54	1.01	1.00	5.00

Table 7. Factor Analysis with Reliability Score

Questions & Chronbach's α	Factor Weight
Perceived Quality of Animal Welfare Friendly Products (PQTY) (α= 0.91)	
"I believe that food products produced in an animal friendly environment:" (from completely disagree to completely agree)	
Taste better.	0.716
Are of better quality.	0.820
Are better for the environment.	0.766
Are from happier farm animals.	0.773
Are from healthier farm animals.	0.800
Are healthier for humans.	0.797
Perceived Impacts of Management Practices on Hen Welfare (PMNT) (α= 0.82)	
Based on your understanding, how would the following activities affect the welfare of laying hens? (from definitely improve to definitely worsen)	
Hens are housed in cages, instead of not being caged.	0.772
Hens' beaks are trimmed.	0.804
Hens are withheld from feeding or given less nutritive diet so that they molt to regulate production of eggs.	0.810

Table 8 Estimated Random Parameter Logit Parameter Distributions

	Version 1		Version 2	
Variables/Statistics	Coefficient	Std.Error	Coefficient	Std.Error
Price (fixed)	-0.85***	0.05	-0.60***	0.05
Color (random)	-0.22	0.29	0.23	0.28
Standard deviation	1.08***	0.10	1.15***	0.07
Heterogeneity-in-mean				
Fem	0.04	0.17	-0.00	0.16
Age	0.01	0.01	-0.01	0.01
Income	-0.02	0.01	-0.02	0.01
Bplus	0.23	0.18	0.01	0.17
Organic (random)	1.27***	0.26	0.49*	0.25
Standard deviation	0.53***	0.13	0.67***	0.07
Heterogeneity-in-mean				
Fem	-0.39***	0.15	0.17	0.14
Age	-0.01**	0.00	-0.01	0.00
Income	-0.00	0.01	0.03**	0.01
Bplus	0.26*	0.16	-0.03	0.15
Vegetarian(random)	0.94***	0.31	0.34	0.27
Standard deviation	1.08***	0.10	1.20***	0.07
Heterogeneity-in-mean				
Fem	-0.37**	0.17	1.12	1.15
Age	-0.00	0.01	0.00	0.05
Income	0.01	0.01	0.02	0.01
Bplus	-0.04	0.19	-0.01	0.16
Access (random)	0.51	0.44	0.26	0.37
Standard deviation	0.55***	0.11	0.62***	0.08
Heterogeneity-in-mean				
Fem	-0.07	0.13	-0.24**	0.11
Age	0.00	0.00	0.01	0.00
Income	0.01	0.01	-0.01	0.01
Bplus	0.03	0.13	-0.14	0.12
PQTY	0.03	0.08	0.19***	0.07
PMNT	0.00	0.06	-0.02	0.05
Cagefree (random)	-0.72	0.53	0.75*	0.44
Standard deviation	0.94***	0.10	0.99***	0.06
Heterogeneity-in-mean				
Fem	0.20	0.15	-0.16	0.13
Age	0.00	0.00	-0.01	0.00

	Version 1		Version 2	
Variables/Statistics	Coefficient	Std.Error	Coefficient	Std.Error
Income	0.00	0.01	0.01	0.01
Bplus	0.09	0.16	-0.21	0.14
PQTY	0.29***	0.10	-0.04	0.08
PMNT	0.08	0.08	0.08	0.06
NoMolting (random)	0.77*	0.45	-0.03	0.42
Standard deviation	0.38***	0.11	0.52***	0.08
Heterogeneity-in-mean				
Fem	0.53***	0.13	0.13	0.13
Age	-0.01	0.00	-0.00	0.00
Income	-0.00	0.01	0.01	0.01
Bplus	-0.04	0.14	-0.08	0.13
PQTY	-0.16*	0.08	-0.01	0.08
PMNT	-0.16**	0.06	0.21***	0.06
Density (random)	0.19***	0.03	0.15***	0.03
Standard deviation	0.04***	0.01	0.00***	0.00
Heterogeneity-in-mean				
Fem	-0.019**	0.009	-0.001	0.008
Age	-0.000	0.000	-0.001***	0.000
Income	-0.000	0.001	-0.001	0.001
Bplus	-0.007	0.009	-0.001	0.008
PQTY	-0.006	0.006	-0.007	0.005
PMNT	-0.023***	0.004	-0.008**	0.004
Number of observations	2694		2850	
Log likelihood function	-3051.49		-3297.45	
McFadden Pseudo R-squared	0.18		0.17	
Akaike Information Criterion	2.30		2.35	

Note: single, double, and triple asterisks (*, **, ***) represent significant at the 10%, 5%, and 1% level.

Table 9 Statistics of Simulated WTP Distributions

Attribute	Mean	St. Dev.	Max	Min	Prob (<0)
Version 1					
Color	0.01	0.85	2.64	-2.49	0.52
Organic	0.84	0.43	2.06	-0.36	0.02
Vegetarian	0.86	0.89	3.22	-1.30	0.15
Access	0.96	0.33	1.96	-0.02	0.00
Cagefree	1.27	0.76	3.43	-0.78	0.05
NoMolting	0.93	0.45	1.90	-0.44	0.02
Density	0.07	0.04	0.18	-0.04	0.06
Version 2					
Color	-0.21	1.19	3.23	-4.01	0.58
Organic	0.83	0.72	3.21	-1.16	0.12
Vegetarian	0.91	0.91	3.23	-1.50	0.15
Access	1.34	0.47	2.83	-0.27	0.00
Cagefree	1.53	0.81	4.40	-0.29	0.02
NoMolting	1.06	0.66	3.10	-0.62	0.04
Density	0.09	0.04	0.18	-0.03	0.01

Please examine the products carefully. If the following 3 egg products were available, what would you do? Your options appear below the table.

	Product A	Product B	Product C
			
Price	$1.99	$2.49	$2.99
Feed	Conventional	Vegetarian	Organic
Induced Molting	Not induced	Not Induced	Induced
Use of Cage	Caged	Cage-free	Cage-free
Outdoor Access	Yes	None	Yes
Stocking Density	1.5 square feet	138 square inches	67 square inches

- **Buy product A**
- **Buy product B**
- **Buy product C**
- **Not buy any of the three**

Figure 1. Example Choice Scenario

Appendix: Additional statement that appeared in Version 2

Housing Systems and Environmental Impacts:

Cage-free systems and other housing systems that allow for outdoor access in egg production provide hens with more freedom to move. Lower stocking density (i.e., fewer birds per unit of space) allows hens to exhibit their natural behaviors. Some scientific studies have found that these systems generally contribute to poorer air quality with higher emission levels of ammonia and dust than conventional housing systems. Moreover, these systems require more feed and energy to maintain optimal temperatures. Thus, cage-free and other housing systems that allow for outdoor access likely contribute to larger environmental footprints with greater resource utilization. At the same time, some other studies indicate that traditional housing systems with higher stocking density generate higher levels of environmental degradation, particularly pertaining to waste-related pollution.