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Hedonic Analysis of Sustainable Food Products

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Abstract

This study aims to determine price premiums of sustainable attributes for fresh eggs by using hedonic analysis. The sustainable attributes defined include welfare-managed egg production and recyclable packaging attributes. Welfare-managed eggs have a price premium equal to 3.57 cents per egg; while the sustainable packaging variable was not found to be significant. The strategies for egg manufactures and retailers include offering organic or welfare-managed eggs independently until consumers perceive these attributes as being different, and using sustainable packaging for each specific region of the U.S. since each state has different laws and opportunities to recycle paper, plastic and Styrofoam products.

Keywords: hedonic, sustainable, sustainability, eggs, free-range, cage-free

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Introduction

Sustainability is one of the most important issues facing the global food supply chain. There are 9,450 new food and beverage products claimed to be ethically or environmentally produced¹ globally from February 2009 to January 2010 (Mintel 2010). This represents almost 10% of all new food and beverage products (Mintel 2010). This nebulous concept has the ability to change international trade patterns, make firms invest millions of dollars to change suppliers (i.e. McDonalds' sustainable supply chain (McDonald 2010), and change product components to minimize damage to brand name image.

There are four critical reasons why analyses need to be conducted on food manufacturers and retailers concerning sustainability. First, from the CIES survey² of the largest food supermarket retailers globally, corporate social responsibility emphasizing sustainability was the top issue that CEOs were concerned about in 2008 (CIES 2008). In the previous years, sustainability was ranked 5th in 2007 and 11th in 2006. One of the main reasons supermarket chains are concerned is that NGOs and customers are putting more pressure on them to source "Sustainably," and are being graded by certain NGOs, i.e., Greenpeace (Greenpeace 2009). CEOs realize the importance of sustainability to the competitiveness of their businesses, but they are not certain of which investments to make in order to strengthen their brands.

Second, companies are trying to improve their supply chain by reducing costs and carbon use simultaneously. The reduction in carbon emissions not only reduces the costs to the firm, but may also promote the firm's image and goodwill. For instance, in April 2008, Tesco announced the launch of "The Carbon Reduction Label," which focuses on energy usage and adopting the concept of "sustainability" policies to its retail center and its own private brand products (CarbonTrust 2008). Promoting energy saving is popular, for example, many companies began to use wind energy, and reclaim cooking oil and solar energy to substitute gas in their production processes (Weil 2008).

Third, consumers are becoming more aware of environmental problems and are interested in consuming products that are considered to be sustainably produced. This has led to a growing number of green consumers³. In the United States, the growth of consumers who are always or almost always green consumers increased from 12% in 2006 to 36% in 2007 (Mintel 2008). This implies more market opportunities for sustainable products since consumers are willing to pay for high quality products as well as products that help improve the environment.

Lastly, several standards and regulations were implemented to support environmental and sustainable policies. The examples of voluntary standards related to the environment are the ISO 14000 series. Also, there are several certifications for sustainable seafood products, such as, Marine Stewardship Council's fishery certification program and seafood eco-label, and dolphin

¹ Ethical categories include ethical-animal, ethical charity, and ethical-human categories. Moreover, Environmental categories include environmentally-friendly package, and environmentally-friendly product categories.

² The CIES survey is a survey of the Consumer Goods Forum which is an independent global parity-based Consumer Goods network. (www.ciesnet.com)

³ A green consumer is a person who is concerned about environmental or social issues constantly when deciding on purchasing products (Peattie 1992).

safe label. Governments have announced regulations to control pollution emissions from factories as well. These regulations are perceived to be increasing sustainable production, which includes animal welfare policies in Europe and in California (Proposition 2 of 2008)⁴.

Due to the pressure from retailers, consumers, legislation and competition, more sustainable food products are being launched (i.e. dolphin safe tuna products, cereal with recyclable packaging, and free range and other environmentally-friendly eggs). This study analyzes the value of sustainable attributes for fresh eggs by using hedonic price analysis and survey data of fresh egg prices in five city areas along the Eastern coast of the United States.

Sustainability has been defined by various organizations and companies and has led to a brand definition. Therefore, we will focus only on why two attributes in this study represent sustainable attributes. The first attribute is a welfare-managed attribute. In our study, welfare-managed eggs include free-range eggs and free-cage eggs⁵. To understand why the welfare-managed attribute represents a sustainable attribute, the concept of sustainable agriculture is introduced. According to the USDA, sustainable agriculture is defined as an integrated system of plant and animal production practices that has a site-specific application that will occur over the long term (USDA 2007b). Also, there are many approaches to define “animal welfare”. A well-known definition is that ‘welfare’ is the state of a being in relation to its environment (Broom 1991); (Blandford et al. 2002). The conventional process for raised hens is a battery cage system which provides space of 67 to 86 inches per bird (United Egg producers 2010); consequently, hens in battery cages do not have enough space for free movement. Welfare-managed systems including free range/cage free systems can improve animal welfare by allowing them to extend their limbs freely. Hence, the welfare-managed attribute represents one of the sustainable attributes as stated in Bennett (1998) “Consumers who are concerned about animal welfare prefer and are willing to pay more for methods of animal husbandry that allow hens to roam freely instead of being in cages”.

The second attribute representing a sustainable attribute is paper-pulp packaging since sustainability also includes an environmental dimension of recycling. For example, Spartan Stores and Wegmans changed their packaging of their store-brand eggs to be new recyclable and biodegradable molded fiber packaging to replace Styrofoam cartons that are not biodegradable (Progressivegrocer 2009); (Wegmans 2010). Therefore, paper-pulp packaging, which is recyclable and/or made from recycled material, is considered to be one of the sustainability attributes in this study.

Objectives

This study aims to determine price premiums for sustainable attributes of fresh eggs by using hedonic analysis. The sustainable attributes defined here include the free range/cage free

4 Proposition 2 entails improving animal production practices, such as, allowing animals to run around freely, lie down, stand up, and fully extend their limbs outside cages. This proposition will become operative on January 1, 2015 (Ballotpedia 2008).

⁵ There is no legal definition for free-range and free-cage eggs in the U.S.; however, according to the Egg Nutrition Center, free-range eggs are from hens that are either raised outdoors or can access outside. Free-cage eggs are from hens that live in indoor floor facilities, but do not necessarily have access to the outdoors.

attribute and recyclable attribute for packaging which is paper-pulp packaging. Furthermore, we will focus on the interaction between organic and sustainable attributes; that is, whether sustainable attributes of eggs have a higher value when eggs are organic.

This work is unique for several reasons. First, most of the literature focuses on analyzing the value of organic attributes more than sustainable attributes. Examples of papers that analyzed the price premiums of organic products are: Gil et al. 2000; Canavari et al. 2002; Soler et al. 2002; Ara 2003; Wang and Sun 2003; Batte et al. 2007; Griffith and Nesheim 2008. Second, most of the literature concerning price premiums for sustainable attributes used the contingent valuation approach (Loureiro et al. 2001); (Loureiro and Hine 2002); (Loureiro et al. 2002). Third, the unique data set was collected from five East coast U.S. cities and has not been analyzed for sustainable attributes for fresh eggs and the economic implications thereof. Moreover, there is no literature on price premiums for sustainable attributes of eggs in the U.S. Most egg literature studied specialty egg characteristics and the overall U.S. egg industry (Patterson et al. 2000); (Knudson 2004); (Oberholtzer et al. 2006); (Patterson et al. 2008). Lastly, recent studies suggest that eco-labels, an example of a sustainable attribute, should be added to complement other valued product attributes such as organic attribute in order to attract more consumer purchases (Johnston et al. 2001); (Arquitt and Cornwell 2007). Hence, this work also aims to test the hypothesis that multi-attribute eggs such as sustainable attributes and organic eggs are more valued.

Egg Industry

The egg industry is a great industry to better understand consumer evaluations of sustainable attributes of food products for several reasons. First, the fresh egg industry in the U.S. is a huge and important industry which had a market size equal to \$ 5.12 billion in 2007 (Mintel 2008). Second, quality survey data for egg prices and their attributes in key eastern U.S. cities are available. Third, eggs are not complicated food products and consumers can easily understand the marketing messages, and the sustainable attributes are easily included into our model. Fourth, organic eggs and free range/cage free are easily understood and well known attributes among egg consumers.⁶ Lastly, due to the vote for proposal 2 in California in 2008, the industry recognizes the importance of free range/cage free in the future to their market and the potential for this movement to spread across America.

There are two main segments for the egg market which are fresh shell eggs, and egg substitutes.⁷ In 2007, fresh eggs had a market share equal to 94.8%, while egg substitutes had a market share of only 5.2% (Mintel 2008). Hence, this study focuses only on the fresh egg market. There are two types of fresh eggs, which are regular eggs and specialty eggs. Examples of specialty eggs

⁶ Organic regulations require outdoor access for birds (Oberholtzer et al. 2006); therefore, organic eggs are a subset of free-range/cage-free eggs. However, we define organic and welfare-managed attributes separately because we are interested in the interaction between these two attributes. Egg manufactures sometimes label their organic eggs as cage-free eggs; while, others do not. Consumers might be confused whether organic eggs are welfare-managed eggs or not. The study is based on consumers' perception; therefore, we identify the attributes of each observation based on information on the label.

⁷ Breaker or breaker plant category is not in the scope of this study because our study focuses on consumer goods. Breakers are industrial goods which are not available in supermarkets but are used in restaurants, hospitals, schools, and other foodservice (USDA 2010).

are free-range eggs, organic eggs, eggs fortified with Omega-3 fatty acids, low-cholesterol eggs, and vegetarian-fed eggs.

Store brands⁸ dominate national brands and regional brands in the egg market. In 2007, store brands had a market share equal to 68.8%, while Eggland's Best, Rose Acre Farms, Land O'Lakes Inc, Cal Maine Foods, Dean Food Co., Michael Foods Inc., ConAgra Foods, Inc., and others had market shares equal to 7.9%, 2%, 1.4%, 1.2%, 1.1%, 0.9%, 0.9%, and 15.8%, respectively (Mintel 2008).

Methodology

Lancaster (1966) stated that a good does not give utility directly to a consumer, but it possesses characteristics or attributes which give utility to the consumer. Hedonic prices are defined as the implicit prices of attributes embodied in each good (Rosen 1974). Economic agents can determine hedonic prices of attributes by observing prices of differentiated products and specific amounts of attributes related to them (Rosen 1974). Examples of attributes are brand, packaging, color, taste, etc. If a good has a number of characteristics or attributes, z , equal to k , $z = (z_1, z_2, \dots, z_k)$, the price for a good is determined by a set of attributes or vector z , that is $price(z) = f(z_1, z_2, \dots, z_k)$. Hedonic pricing analysis and contingent valuation are the two main approaches used to calculate price premiums of unique attributes. The contingent valuation requires consumer survey data to determine if the premium of each attribute has value. Numerous papers have utilized this approach to address price premiums for food product attributes (Wessells et al. 1999); (Gil et al. 2000); (Loureiro et al. 2001); (Canavari et al. 2002); (Loureiro and Hine 2002); (Loureiro et al. 2002); (Ara 2003); (Cranfield and Magnusson 2003); (Batte et al. 2007). The weakness of this approach is that it only reflects consumers' intentions but not their actual actions in terms of purchasing behavior. Moreover, it is possible that the survey might create a bias in the sense that consumers might over-estimate their willingness to pay for sustainable products, which leads to the problem of over-estimating the price premium for sustainable attributes. Several papers analyzed or have referred to the biases of the contingent valuation approach (Diamond and Hausman 1994); (Blumenschein et al. 1998); (Aadland and Arthur 2003); (Ajzen et al. 2004); (Lockie et al. 2004); (Blumenschein et al. 2008).

Historically, hedonic analysis primarily has used scanner data⁹ or privately collected secondary data. Several authors used hedonic analysis for measuring a price premium of differentiated food product (wine, coffee, etc.) attributes (Nimon and Beghin 1999); (Combris et al. 2000); (Donnett et al. 2008); (Griffith and Nesheim 2008). The data for this study was collected from retailers who are concerned about consumer demand and maximize their profits by determining the optimal attributes, prices and quantities to offer (Steiner 2004); (Karipidis et al. 2005). The partial derivative of the hedonic price function with respect to a particular attribute is an implicit or shadow price at equilibrium that reflects both, the maximum price consumers are willing to pay for an additional attribute, and the minimum price for which suppliers are willing to sell

⁸ Store brand is interchangeable with private label.

⁹ Scanner data are "retail purchase information (such as price, brand, product size, amount purchased) gathered at the point of purchase by an electronic device that reads a coded ticket on the product through the use of an electronic reader over which the product passes." (www. Answer.com)

according to their costs (Sanjuan-Lopez et al. 2009). Moreover, consumers decide whether they should accept the price and purchase the eggs or not based on the retailers' offered price. Therefore, the price and attributes collected from retailers can be used to find the value of attributes by using hedonic analysis without ignoring the consumer side.

There are two advantages of using hedonic price analysis over contingent valuation. First, the hedonic price approach does not require joint consumption of goods within a group. Therefore, we can estimate the inverse demand of specific goods individually rather than modeling the whole system of demand and supply. Second, according to Butler (1982), since all estimates of hedonic price models are to some extent misspecified, models that use a small number of key variables generally suffice. Butler suggested that only those attributes that are costly to produce and yield utility are to be considered in the regression equation. Therefore, we need to use less attributes in our model so that we reduce the misspecification problem and increase the degrees of freedom.

Assume that an egg has k attributes plus sustainable attributes, organic attribute, and a sustainable and organic attribute. The egg price then depends on its attributes (Rosen, 1974) defined as follows:

$$price(\mathbf{x}) = f(x_1, x_2, \dots, x_k, \text{sustainable attribute, organic attribute, sustainable and organic attribute}),$$

where $price(\mathbf{x})$ represents the price of an egg, and vector \mathbf{x} represents attributes of the egg. Specifically, the model in our study is specified as the following:

$$\begin{aligned} priceperegg = & \beta_0 + \beta_1 o + \beta_2 wm + \beta_3 owm + \beta_4 vd + \beta_5 ne \\ & + \beta_6 regional + \beta_7 national + \beta_8 brown + \beta_9 AA \\ & + \beta_{10} plastic + \beta_{11} paper + \beta_{12} large + \beta_{13} extralarge + \beta_{14} jumbo \\ & + \beta_{15} acme + \beta_{16} giant + \beta_{17} pathmark + \beta_{18} safeway + \beta_{19} shopper \\ & + \beta_{20} shaws + \beta_{21} shoprite + \beta_{22} superfresh + \beta_{23} stopandshop \\ & + \beta_{24} wegmans + \beta_{25} weis \\ & + \beta_{26} shellable + \beta_{27} eggage + \beta_{28} unitsize + \varepsilon, \end{aligned}$$

where β 's represent the coefficient for the product attributes and ε is the error term. The definitions, minimums, maximums, and means of each variable are depicted in Table 1. In this model, the base variables for each category of dummy variable attributes are dropped in order to prevent perfect multicollinearity.

Data and Variable Description

The data used in our analysis are survey data of fresh egg prices and their attributes¹⁰. The data have 207 usable observations and were collected from retailers in five east coast cities (Baltimore, MD; Boston, MA; New York, NY; Philadelphia, PA; and Washington DC) in 2007. The data come from retail supermarkets (ACME, Giant, Pathmark, Safeway, Shoppers Food

¹⁰ We would like to thank Dr. Paul H. Patterson, from the Poultry Science Department at Penn State University for providing us with the data.

Warehouse, Shaw's, ShopRite, Super Fresh, Stop and Shop, Walmart, Wegmans, and Weis) in each of these cities.

From Table 1 (see Appendix), the first group of attributes is a group of specialty characteristics of the eggs which are regular, organic, vegetarian-fed, welfare-managed including free range and free cage, nutritionally enhanced¹¹, and a stacked attribute, organic and welfare-managed. The second group is categorized by brand. To preserve the degrees of freedom, we separate egg brands into three groups which are national, regional and store brands. The third group is categorized by colors which are white and brown. The fourth attribute is grouped by grades of eggs (grades A and AA), which reflect the quality and the freshness of the eggs, i.e., the firmness of the yolk, and the air cell in the egg. The fifth group is defined by packaging materials which are Styrofoam, paper pulp, and clear plastic. The sixth group is determined by egg sizes which are medium, large, extra large, and jumbo. The seventh group of attributes is determined by the retailers where consumers purchase eggs (ACME, Giant, Pathmark, Safeway, Shoppers Food Warehouse, Shaw's, ShopRite, Super Fresh, Stop and Shop, Walmart, Wegmans, and Weis). The eighth attribute is defined based on whether there is a label on the egg shell or not. The next variable is the age of the egg that is defined as the number of days from when an egg is laid until it is purchased at the store¹². The last attribute is an egg unit which is the number of eggs per package.

Credence Goods

The attributes can be categorized into three categories which are search, experience, and credence attributes (Caswell and Mojduszka 1996); (Bureau et al. 1998); (Loureiro et al. 2002); (Pelsmacker et al. 2005). Search attributes are those that consumers can observe immediately before purchase, i.e. color, size, and price. Experience attributes, such as taste, are attributes that consumers discover only after consumption. Credence attributes are attributes of which consumers can detect the quality neither before nor after buying the product. The ethical attribute, such as cage-free, is an example of a credence attribute. This leads to the problem of asymmetric information in the cage-free egg market.

Asymmetric information is addressed by manufacturers labeling their products; however, the credibility of manufactures is critical to getting price premiums and higher profits. Third Party Certification proof with high public trust can increase ethical label credibility (Loureiro et al. 2002); (Pelsmacker et al. 2005); however, there is no well-known certification for cage-free eggs in the U.S. market. Consequently, reputation of egg manufactures is the only signal for the cage-free attribute and U.S. consumers might be still confused and reluctant to trust cage-free labels, which could lead to low cage-free eggs purchasing.

¹¹ From our survey data, nutritionally-enhanced eggs are high-omega 3, high-vitamins, and low-cholesterol.

¹² Egg cartons with the USDA grade shield on them are regulated to display the "pack date" which is defined as the day that the eggs were washed, graded, and placed in the carton (USDA 2007a). We get the information about the age of the egg by using the pack date and assuming that eggs are packed the same day as they are laid.

Egg Packaging

There are three types of material for egg packaging which are paper pulp, clear plastic, and Styrofoam. Paper-pulp packaging is claimed to be recyclable and made from recycled paper. Clear plastic and Styrofoam are technically plastics and recyclable. Clear plastic packaging for eggs is made from polyolefins and defined as code 1 (Polyethylene terephthalate: PET) recyclable symbol. Styrofoam packaging is made from polystyrene (PS) and defined code 6 for its recyclable symbol (Marsh and Bugusu 2007).

Even though all materials for egg packaging are recyclable, paper and paperboard have the highest recycle rate. In 2007, 54.5% of paper and paperboard was recovered for recycling; while, plastics including Styrofoam had a recycle rate equal to 6.8% (United States Environmental Protection Agency 2008). Moreover, some egg manufactures marketed their eggs by changing material for their packaging from Styrofoam to paper pulp and claimed that their new packaging was more environmentally-friendly. For example, Spartan Store and Wegmans changed their egg packaging from Styrofoam packaging to paper-pulp packaging and claimed that their packaging is more sustainable or more environmentally-friendly (Progressivegrocer 2009); (Wegmans 2010). As a consequence, this study used paper-pulp packaging as its sustainable packaging attribute.

Results

Table 2 (see Appendix) presents hedonic prices of egg attributes from the estimation. The R-squared for the model shows that all egg attributes explain about 81.2% of the variation in the prices of eggs. The attributes that significantly affect the price of eggs are specialty characteristics, brands, grades, sizes, retailers (places where consumers buy eggs), and unit sizes. Signs of significant variables are as expected and the same as previous literature (Ness and Gerhardy 1994); (Fearne and Lavelle 1996); (Philippos et. al. 2005); (Goddard et. al. 2007) except the sign for the stacked variable attribute organic and welfare-managed (owm).

Most specialty characteristic coefficients which are organic attribute (o), welfare-managed attribute (wm), and nutritionally-enhanced attribute (ne) have positive values and are significant. Organic, welfare-managed, and nutritionally-enhanced eggs have price premiums over regular eggs equal to 16.50, 3.57, and 2.30 cents per egg, as shown in figure 1 respectively. This means that these attributes create value-added for the shell egg category. The coefficient for the vegetarian-fed attribute is a negative value, but not significant. Hence, it is ambiguous to conclude the value of the vegetarian-fed attribute.

The coefficient for the stacked variable attribute, organic and welfare-managed, equals -8.81 cents per egg and is significant. Therefore, an organic and welfare-managed egg has a premium over a regular egg equal to 11.26 cents which is less than the premium for an organic egg ($11.26 = 16.50 + 3.57 - 8.81$ cents representing the premium for organic, welfare-managed, and organic and welfare-managed attributes). The authors did not expect the negative sign for the stacked variable. We expected that welfare-managed eggs would get higher premiums when they are also marketed (labeled) as organic because consumers can easily associate the perceived animals health benefits and be willing to pay a premium for it. There are three hypotheses to explain this

result. First, consumers might be confused about the definition of eggs with these attributes and hence not be willing to pay more for the stacked attributes. Second, it might be possibly related to retailers' strategies (Greenblum¹³ 2009) to promote their store brands as sustainable brands; hence, offer promotions for the organic and welfare-managed products. Lastly, farmers might be able to share some production costs for the organic, free range and/or free cage methods; hence, the prices reflect supply and demand side effects. The prices of regular eggs and specialty eggs are compared in figure 1.

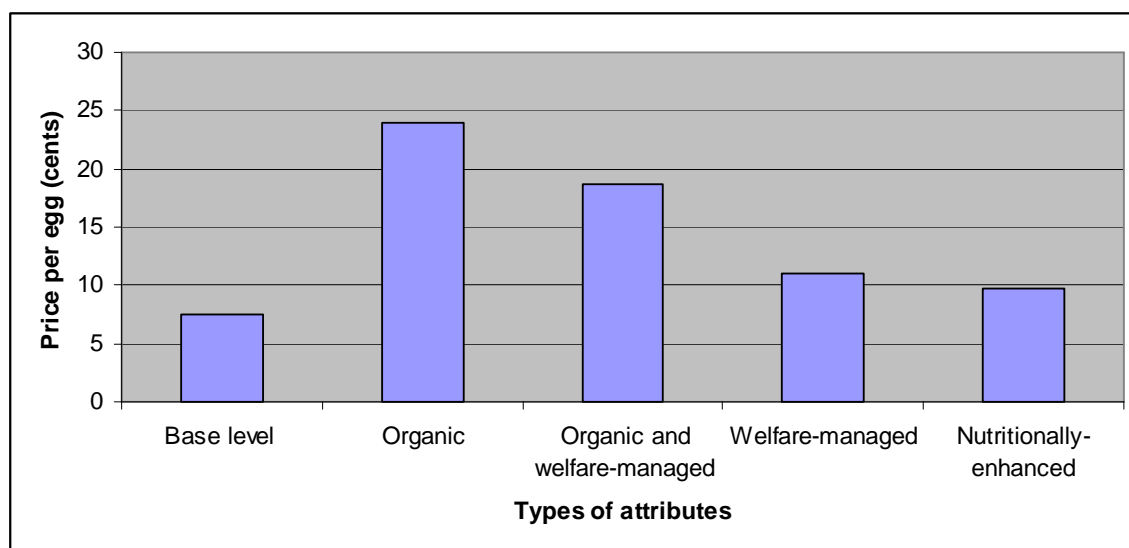


Figure 1. Prices of the base level and specialty eggs¹⁴ (cents per egg)

National brand eggs and regional brand eggs have price premiums equal to 5.33 cents and 3.95 cents compared to store brand eggs. Prices of grade AA eggs are significantly higher than prices for grade A eggs. Its price premium equals to 3.28 cents. All coefficients of sizes are significant. That is the larger size egg has a higher price premium. The coefficient for unit size is negative and significant. Therefore, the price per egg is lower when consumers buy eggs in bigger packages. Eggs from almost all retailers¹⁵ have significantly higher prices than the price of eggs from Walmart. Lastly, the coefficients of the rest of the variables which are various types of packaging, brown color, shell label and egg age are all insignificant.

Conclusion and Management Implications

We tested two attributes that we consider sustainable, welfare-managed, and paper-pulp packaging; only one was found to positively and significantly influence price. Welfare-managed eggs receive the price premium equals to 3.57 cents per egg as compared to regular egg. The

¹³ Ms. Greenblum is a senior director of Nutrition Education, Egg Nutrition Center.

¹⁴ Assuming that other attributes are the same, the base level egg for each category is defined as an egg with the following attributes: regular, store brand, white color, grade A, Styrofoam packaging, medium size, no shell label, egg age of 14 days, a dozen egg unit size, and Walmart is the base store. Specialty eggs have the same attributes as the base level eggs except they are not regular eggs.

¹⁵ From Table 2, these retailers are ACME, Giant, Pathmark, Safeway, Shoppers Food Warehouse, Shaw's, ShopRite, Super Fresh, Stop and Shop, Wegmans, and Weis.

attribute that has the greatest impact on price was the organic attribute which increase the price per egg by 16.50 cents. Interestingly, when organic and welfare-managed were combined the price premium was only 11.26 cents per egg. This implies that consumers are not willing to pay for both labeled attributes simultaneously, which has major implication for egg manufactures and retailers. In the short run, egg manufactures should maximize profit by offering and labeling either organic or welfare-managed eggs, and hence continue to segment the market until consumers perceive these attributes as being different.

Our results are ambiguous for the paper-pulp packaging attribute. Some egg manufacturers have claimed that their Styrofoam packaging and/or clear-plastic packaging are recyclable. A survey of consumers' perception about recyclable packaging might be helpful to answer this question; however, it is beyond the scope of this study. The best strategy for manufactures and retailers may be to market sustainable packaging for each specific region of the U.S. since each state has different laws and opportunities to recycle plastic and Styrofoam products.

References

- Aadland, David, and Caplan, Arthur J. 2003. Cheap talk revisited: new evidence from CVM. Selected paper presented at the annual meetings for the American Agricultural Economics Association, July 27-30, Montreal, Canada.
- Ajzen, Icek, Brown, Thomas C., and Carvajal, Franklin. 2004. Explaining the discrepancy between intentions and actions: the case of hypothetical bias in contingent valuation. *Personality and Social Psychology Bulletin* 30(9):1108–21.
- Alcalde, Nuria, Garces, Concepcion, Pedraja, Marta, and Rivera, Pilar. 2005. The recycling of container and packaging waste in the Spanish retail distribution sector. *Environment and Planning A* 37(8): 1461-1477.
- Ara, Shihomi. 2003. Consumer Willingness to Pay for Multiple Attributes of Organic Rice: A Case Study in the Philippines. Contributed paper selected for presentation at the 25th International Conference of Agricultural Economists, August 16-22, Durban, South Africa.
- Arquitt, Steven P., and Cornwell, T. Bettina. 2007. Micro-Macro Linking Using System Dynamics Modeling: An Examination of Eco-Labeling Effects for Farmed Shrimp. *Journal of Macromarketing* 27(3): 243-255.
- Ballotpedia. 2008. California Proposition 2 (2008). [http://ballotpedia.org/wiki/index.php/California_Proposition_2_\(2008\)](http://ballotpedia.org/wiki/index.php/California_Proposition_2_(2008)) (accessed June 1, 2010).
- Batte, Marvin T., Hooker, Neal H., Haab, Timothy C., and Beaverson, Jeremy. 2007. Putting their money where their mouths are: consumer willingness to pay for multi-ingredient, processed organic food products. *Food Policy* 32(2): 145-159.

- Bennett, R. 1998. Measuring Public Support for Animal Welfare Legislation: A Case Study of Cage Egg Production. *Animal Welfare* 7(1): 1–10.
- Bennett, R.M. 1997. Farm Animal Welfare and Food Policy. *Food Policy* 22(4): 281-288.
- Bennett, Richard M., and Blaney, Ralph J.P. 2003. Estimating the benefits of farm animal welfare legislation using the contingent valuation method. *Agricultural Economics* 29(1):85–98.
- Blandford, David, Bureau, Jean-Christophe, Fulponi, Linda, and Henson, Spencer. “Potential Implications of Animal Welfare Concerns and Public Policies in Industrialized Countries for International Trade.” In *Global Food Trade and Consumer Demand for Quality*. New York: Kluwer Academic/Plenum Publishers, 2002.
- Blumenschein, Karen, Blomquist, Glenn C., Johannesson, Magnus, Horn, Nancy, and Freeman, Patricia. 2008. Eliciting willingness to pay without bias: evidence from a field experiment. *Economic Journal* 118(525): 114–137.
- Blumenschein, Karen, Johannesson, Magnus, Blomquist, Glenn C., Liljas, Bengt, and O’Conor, Richard M. 1998. Experimental results on expressed certainty and hypothetical bias in contingent valuation. *Southern Economic Journal* 65(1): 169–177.
- Broom, D. M. 1991. Animal Welfare: Concepts and Measurement. *Journal of Animal Science* 69(10): 4167-4175.
- Bureau, Jean-Christophe, Marette, Stephan, and Schiavina, Alessandra. 1998. Non-Tariff Trade Barriers and Consumers' Information: The Case of the EU-US Trade Dispute over Beef. *European Review of Agricultural Economics* 25(4):437-462.
- Butler, Richard V. 1982. The specification of hedonic indexes for urban housing. *Land Economics* 58(1): 96-108.
- Canavari, Maurizio, Bazzani, Guido M., Spadoni, Roberta, Regazzi, Domenico. 2002. Food safety and organic fruit demand in Italy: a survey. *British Food Journal* 104(3/4/5): 220–232.
- CarbonTrust. 2008. Tesco and Carbon Trust join forces to drive forward carbon labeling. http://www.carbontrust.co.uk/news/news/archive/2008/Pages/29_04_08_Carbon_Label_Launch.aspx (accessed, June 1, 2010).
- Caswell, Julie A., Mojduszka, Eliza.M. 1996. Using informational labeling to influence the market for quality in food products. *American Journal of Agricultural Economics* 78(5): 1248-1253.
- CIES. 2008. Top of Mind Survey. <http://www.ciesnet.com/> (accessed June 1, 2010).

- Combris, Pierre, Lecocq, Sebastien, and Visser, Michael. 2000. Estimation of a Hedonic Price Equation for Burgundy Wine. *Applied Economics* 32(8): 961-967.
- Cranfield, J. A. L., and Magnusson, Erik. 2003. Canadian consumers' willingness-to-pay for pesticide free food products: an ordered probit analysis. *International Food and Agribusiness Management Review* 6(4): 13-30.
- Diamond, Peter A., and Hausman, Jerry A. 1994. Contingent valuation: is some number better than no number? *Journal of Economic Perspectives* 8(4): 45-64.
- Donnet, Laura M., Weatherspoon, Dave D., and Hoehn, John P. 2008. Price determinants in top-quality e-auctioned specialty coffees. *Agricultural Economics* 38 (3): 267-276.
- Dow Jones Sustainability Indexes. 2006. Dow Jones Sustainability World Indexes Guide. http://www.sustainability-index.com/djsi_pdf/publications/Guidebooks/DJSI_Guidebook_World_80.pdf (accessed June 1, 2010).
- EPA. 2010a. Air and Radiation – Regulations and Statutes. <http://www.epa.gov/air/oarregul.html> (accessed June 1, 2010).
- EPA. 2010b. Wastes – Laws & Regulations. <http://www.epa.gov/osw/laws-regs/index.htm> (accessed June 1, 2010).
- EPA. 2010c. Wastes – Non-Hazardous Waste – Industrial Waste. <http://www.epa.gov/osw/nonhaz/industrial/guide/chap6s.htm> (accessed June 1, 2010).
- Fearne, Andrew, and Lavelle, David. 1996. Perceptions of food “quality” and the power of marketing communication: results of consumer research on a branded-egg concept. *Journal of Product and Brand Management* 5(2): 29-42.
- Gil, J. M., Gracia, A., and Sanchez, M. 2000. Market segmentation and willingness to pay for organic products in Spain. *International Food and Agribusiness Management Review* 3(2): 207-226.
- Goddard, Ellen, Boxall, Peter, Emunu, John P., Boyd, Curtis, Asselin, Andre, and Neall, Amanda. 2007. “Consumer Attitudes, Willingness to Pay and Revealed Preferences for Different Egg Production Attributes: Analysis of Canadian Egg Consumers.” *Project Report* no. 07-03, Department of Rural Economy, University of Alberta, Canada, (July, 2007) <http://ageconsearch.umn.edu/bitstream/52087/2/PR%2007-03.pdf> (accessed June 1, 2010).
- Gore, Albert A. 2006. Al Gore Gives Policy Address at NYU on Solving the Climate Crisis. <http://www.nyu.edu/community/gore.html> (accessed November 1, 2009).
- Greenblum, Marcia D. Telephone interview. 18 Nov 2009.

- Greenpeace. 2009. More than Half of Leading U.S. Supermarkets Show Progress in Latest Greenpeace Sustainable Seafood Scorecard. (June 30, 2009) <http://www.greenpeace.org/usa/press-center/releases2/more-than-half-of-leading-u-s> (accessed June 1, 2010).
- Griffith, Rachel, and Nesheim, Lars. 2008. "Household willingness to pay for organic products." *cemmap working paper* CWP 18/08, The Institute for Fiscal Studies, Department of Economics, UCL, (July, 2008) <http://eprints.ucl.ac.uk/14668/1/14668.pdf> (accessed June 1, 2010).
- Hassan, Daniel, and Monier-Dilhan, Sylvette. 2006. National Brands and Store Brands: Competition through Public Quality Labels. *Agribusiness* 22(1): 21 – 30.
- Johnston, Robert J., Wessells, Cathy R., Donath, Holger, and Asche, Frank. 2001. Measuring Consumer Preferences for Ecolabeled Seafood: An International Comparison. *Journal of Agricultural and Resource Economics* 26(1): 20-39.
- Kaiser, Michel J. and Edwards-Jones, Gareth. 2006. The role of ecolabeling in fisheries management and conservation. *Conservation Biology* 20(2): 392–398.
- Karipidis, Philippos, Tsakiridou, Efthimia, Tabakis, Nikolaos, and Konstantinos, Mattas. 2005. Hedonic analysis of retail egg prices. *Journal of Food Distribution Research* 36(3): 68-73.
- Kassaye, W. Wossen, and Verma, Dharmendra. 1992. Balancing traditional packaging functions with the new green packaging concerns. *SAM Advanced Management Journal* 57(4): 15-23.
- Knudson, William A. 2004. "The Market for Organic and Fortified Eggs." *Working Paper* no. 2-0104, The Strategic Marketing Institute, MSU Product Center for Agriculture and Natural Resources, (January 2004) <http://www.productcenter.msu.edu/documents/Working/2-0104.pdf> (accessed November 1, 2009).
- Lancaster, Kelvin J. 1966. A New Approach to Consumer Theory. *The Journal of Political Economy* 74(2): 132-157.
- Laroche, Michel, Bergeron, Jasmin, Barbaro-Forleo, Guido. 2001. Targeting consumers who are willing to pay more for environmentally friendly products. *Journal of Consumer Marketing* 18(6): 503-20.
- Lewis, Helen 2005. Defining product stewardship and sustainability in the Australian packaging industry. *Environmental Science and Policy* 8(1): 45-55.

- Loureiro, Maria L., and Hine, Susan. 2002. Discovering Niche Markets: A Comparison of Consumer Willingness to Pay for Local (Colorado-Grown), Organic, and GMO-Free Products. *Journal of Agricultural and Applied Economics* 34(3):477-487.
- Loureiro, Maria L., McCluskey, Jill J., and Mittelhammer, Ron C. 2001. Assessing Consumers Preferences for Organic, Eco-labeled and Regular Apples. *Journal of Agricultural and Resource Economics* 26(2): 404-416.
- Loureiro, Maria L., McCluskey, Jill J., and Mittelhammer, Ron C. 2002. Will consumers pay a premium for eco-labeled apples? *The Journal of Consumer Affairs* 36(2): 203-219.
- McDonald. 2010. McDonald's Corporate Responsibility: Values in Practice Video. http://www.aboutmcdonalds.com/mcd/csr/video/sustainable_supply.10.html (accessed June 1, 2010).
- Marsh, Kenneth, and Bugusu, Betty. 2007. Food packaging: roles, materials, and environmental issues. *Journal of Food Science* 72(3): R39-R55.
- Mintel. 2008. "Green Living-US-February 2008." *Mintel/TechnoMetrica/SSI/Greenfield Online* http://academic.mintel.com.ezproxy0.ats.msu.edu/sinatra/oxygen_academic/search_results/show&/display/id=295904/displaytables/id=295904 (accessed June 1, 2010).
- Nerlove, Marc. 1995. Hedonic price functions and the measurement of preferences: The case of Swedish wine consumers. *European Economic Review* 39(9): 1697-1716.
- Ness, Mitchell R., and Gerhardy, Hubert. 1994. Consumer preferences for quality and freshness attributes of eggs. *British Food Journal* 96(3): 26-34.
- Nimon, Wesley, and Beghin, John. 1999. Are Eco-labels Valuable? Evidence from the Apparel Industry. *American Journal of Agricultural Economics* 81(4): 801-811.
- Oberholtzer, Lydia, Catherine, Greene, and Lopez, Enrique. 2006. "Organic poultry and eggs capture high price premiums and growing share of specialty markets." *Outlook Report*, U.S. Dept. of Agriculture, Economic Research Service, (December, 2006) <http://www.ers.usda.gov/Publications/LDP/2006/12Dec/LDPM15001/ldpm15001.pdf>. (accessed Oct 1, 2007).
- Patterson, P.H., Koelkebeck, K.W., Bell, D.D., Carey, J.B., Anderson, K.E., and Darre, M.J. 2001. Egg marketing in national supermarkets: Specialty eggs—Part 2. *Poultry Science* 80(4):390-395.
- Patterson, Thesmar, Reynnells, Darre, and Cravener. 2008. Specialty Eggs in North America.
- Peattie, Ken, and Charter, Martin. 1992. "Green marketing." Chap. 28 In *The M + E Handbook Series*, Longman, London.

- Pelsmacker, Patrick De, Driesen, Liesbeth, and Rayp, Glenn 2005. Do consumers care about ethics? Willingness to pay for fair-trade coffee. *The Journal of Consumer Affairs* 39(2): 363-385.
- Progressivegrocer. 2009. Spartan Store Brand Eggs Now in Green Packaging. (Jan 23, 2009) http://www.progressivegrocer.com/progressivegrocer/content_display/features/corporate-social-responsibility/e3i8e1f30d51da4f8e86906c7d215fef836 (accessed June 1, 2010).
- Rahn, Allan P. 2001. Caged Laying Hen Well-Being: An Economic Perspective. Prepared for inclusion in the proceedings and presentation at the 52nd North Central Avian Disease Conference and Symposium on The Science Behind Poultry Husbandry. September 30, Grand Rapids, Michigan.
- Rosen, Sherwin. 1974. Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy* 82(1): 34-55.
- Sanjuan-Lopez, A.I., Resano-Ezcaray, H., and Camarena-Gomez, D.M. 2009. Developing marketing strategies for Jiloca saffron: a price hedonic model. *Spanish Journal of Agricultural Research* 7(2): 305-314.
- Soler, Francisco, Gil, Jose M., and Sanchez, Mercedes. 2002. Consumers' acceptability of organic food in Spain Results from an experimental auction market. *British Food Journal* 104(8): 670-687.
- Supermarketnews. 2009. FreshDirect Offers New Environmentally Friendly Egg Packaging. (Aug 25, 2009) http://supermarketnews.com/news/freshdirect_packaging_0825/index.html (accessed June 1, 2010).
- United Egg producers. 2010. Housing, Space, Feed, and Water. <http://www.uepcertified.com/program/guidelines/categories/housing-space-feed-water> (accessed June 1, 2010).
- United States Environmental Protection Agency. 2008. Municipal Solid Waste in The United States 2007 Facts and Figures. (November, 2008) <http://www.epa.gov/osw/nonhaz/municipal/pubs/msw07-rpt.pdf> (accessed June 1, 2010).
- USDA. 2007a. Food Labeling. http://www.fsis.usda.gov/factsheets/food_product_dating/index.asp (accessed June 1, 2010).
- USDA. 2007b. Sustainable Agriculture: Definitions and Terms. <http://www.nal.usda.gov/afsic/pubs/terms/srb9902.shtml#toc2> (accessed June 1, 2010).

- USDA. 2010. Fact Sheets: Egg Products Preparation – Shell Eggs from Farm to Table. http://www.fsis.usda.gov/factsheets/focus_on_shell_eggs/index.asp (accessed June 1, 2010).
- Vermeir, Iris, and Verbeke, Wim. 2006. Sustainable Food Consumption: Exploring the Consumer “Attitude – Behavioral Intention” Gap. *Journal of Agricultural and Environmental Ethics* 19(2): 169-194.
- Walmart Watch. 2005. A Promise to the Environment Shedding Light on Walmart’s Environment Practices. <http://walmartwatch.com/environment> (accessed June 1, 2010).
- Wang, Qingbin, and Sun Junjie. 2003. “Consumer Preference and Demand for Organic Food: Evidence from a Vermont Survey.” Paper prepared for presentation at the American Agricultural Economics association Annual meeting, July 27-30, Montreal, Canada.
- Wegmans. 2010. The New Egg Cartons in Our Stores: How the Idea Was Hatched. (April 19, 2010) <http://www.wegmans.com/webapp/wcs/stores/servlet/PressReleaseDetailView?langId=-1&storeId=10052&catalogId=1&productId=690897> (accessed June 1, 2010).
- Weil, Marty. 2008. Consider alternative and renewable energy sources. (January 16, 2008) <http://www.foodprocessing.com/articles/2008/008.html?page=1> (accessed June 1, 2010).
- Wessells, Cathy R., Johnston, Robert J., and Donath, Holger. 1999. Assessing consumer preferences for ecolabeled seafood: The influence of species, certifier and household attributes. *American Journal of Agricultural Economics* 81(5): 1084–1089.

Appendix

Table 1. Definitions of the Variables and their Descriptive Statistics

Variables	Definition	Min (cent)	Max (cent)	Mean (cent)	Base Variables
Dependent variable					
<i>Price per egg</i>	A price per egg	0.06633	0.59667	0.23698	
Specialty Characteristics					
<i>r, o, wm, owm, vd, and ne</i>	DV* which is 1 for regular (<i>r</i>), organic (<i>o</i>), welfare-managed (<i>wm</i>), organic and welfare-managed (<i>owm</i>), vegetarian-fed (<i>vd</i>), and nutritionally-enhanced (<i>ne</i>) eggs, respectively and 0 otherwise	0	1	0.4198, 0.1481, 0.2305, 0.1111, 0.3868, and 0.2593	Regular (<i>r</i>)
Brands					
<i>store, regional, and national</i>	DV which is 1 for that type of brand, and 0 otherwise	0	1	0.4139, 0.2664, and 0.3197	Store brand (<i>store</i>)
Colors					
<i>white, and brown</i>	DV which is 1 for a white (brown) egg, and 0 for a brown (white) egg	0	1	0.4321, and 0.5679	White color (<i>white</i>)
Grades					
<i>A, and AA</i>	DV which is 1 for an egg is grade A (AA), and 0 if an egg is grade AA (A)	0	1	0.9508, and 0.0492	Grade A (<i>A</i>)
Types of Packaging					
<i>foam, plastic, and paper</i>	DV which is 1 for an egg package made from Styrofoam, plastic, and paper-pulp, respectively and 0 otherwise	0	1	0.2025, 0.4298, and 0.3678	Styrofoam (<i>foam</i>)
Size					
<i>Medium, large, extra large, and jumbo</i>	DV which is 1 for a medium, large, extra-large, and jumbo egg, respectively, and 0 otherwise	0	1	0.0459, 0.7156, 0.1651, and 0.0734	Medium size (<i>medium</i>)
Retailers					
<i>Acme, Giant, Pathmark, Safeway, Shopper, Shaws, Shoprite, Superfresh, Stop and Shop, Walmart, Wegmans, and Weis</i>	DV which is 1 for an egg sold by that retailers and 0 otherwise	0	1	0.0451, 0.0697, 0.1393, 0.1189, 0.0533, 0.0902, 0.0984, 0.0902, 0.0820, 0.0984, 0.0656, and 0.0492	Walmart (<i>walmart</i>)
Others					
<i>Shell able</i>	DV which is 1 for an egg with shell label, and 0 otherwise	0	1	0.1681	No shellable (<i>no shellable</i>)
<i>Egg age</i>	a number of days counted from when an egg is laid until it is bought at the store	1	41	14.02	
<i>Unit size</i>	a number of eggs per unit	6	60	12.45	

*Note: DV represents a dummy variable.

Table 2. Results for Hedonic Prices of Egg Attributes

Attributes	Coefficient (S.E.) Unit: Dollars	
Dependent variable	<i>Price per egg</i>	
Specialty Characteristics		
o	0.165***	(-0.023)
wm	0.0357***	(-0.0122)
owm	-0.0881***	(-0.0267)
vd	-0.0065	(-0.0089)
ne	0.0230***	(-0.00877)
Brands		
regional	0.0395***	(-0.0125)
national	0.0533***	(-0.00939)
Colors		
brown	0.00186	(-0.00834)
Grades		
AA	0.0328**	(-0.0127)
Types of packaging		
plastic	0.0106	(-0.0114)
pulp	-0.00306	(-0.00936)
Sizes of eggs		
large	0.0456***	(-0.0119)
extra large	0.0575***	(-0.0119)
jumbo	0.0715***	(-0.0135)
Retailers		
Shaws	0.0601***	(-0.0116)
Stop and shop	0.0540***	(-0.0167)
Giant	0.0597***	(-0.0117)
Safeway	0.116***	(-0.0149)
Wegmans	0.00609	(-0.0145)
Weis	0.0393**	(-0.0189)
Shopper	-0.0125	(-0.0124)
Pathmark	0.0775***	(-0.0133)
Shoprite	0.0634***	(-0.0128)
Superf resh	0.0502***	(-0.013)
Acme	0.0645***	(-0.0146)
Others		
shell label	0.00425	(-0.0121)
egg age	0.000214	(-0.000371)
unit size	-0.00149**	(-0.000728)
Constant	0.0897***	(-0.0174)
Observations	207	
R-squared	0.812	

Note: * significant at 10%; ** significant at 5%; *** significant at 1%