Assessing Consumers' Willingness to Pay for Different Units of Organic Milk: Evidence from Multiunit Auctions

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Experimental auctions are normally conducted using single-unit auctions. In this paper, we use the multiunit Vickrey auction to assess the determinants of consumers' willingness to pay (WTP) for organic milk in a multiunit shopping scenario. We also analyze the effect of positive and negative information about organic farming on WTP. Our results suggest that consumers are willing to pay a premium for organic milk but that this WTP decreases with the number of units purchased. Results also suggest that health issues, high price of organic foods, taste, and lack of information on organic foods are factors that influence WTP for organic milk. The type of information provided also plays a relevant role. Specifically, we found that subjects' WTP responds positively to positive information about organic farming and responds negatively to negative information. The provision of both positive and negative information does not affect WTP.

Les enchères expérimentales sont en règle générale effectuées sous un cadre d'enchères de Vickrey à une seule unité. Dans le présent article, nous avons utilisé l'enchère de Vickrey à unités multiples pour évaluer les déterminants du consentement à payer (CAP) des consommateurs pour du lait biologique dans un contexte d'achats multiples. Nous avons également examiné les répercussions que l'information positive et négative à l'égard de l'agriculture biologique a sur le CAP. Nos résultats autorisent à penser que les consommateurs sont prêts à payer un prix plus élevé pour obtenir du lait biologique, mais que ce CAP diminue avec le nombre d'unités achetées. Nos résultats autorisent aussi à penser que les aspects liés à la santé, le prix élevé des aliments biologiques, le goût et le manque d'information sur ces aliments sont des facteurs qui influencent le CAP pour du lait biologique. Le type d'information joue également un rôle important. Nous avons observé que le CAP réagit favorablement à de l'information positive sur l'agriculture biologique et défavorablement à de l'information négative. La diffusion simultanée d'information positive et négative n'influence pas le CAP.

INTRODUCTION

The interest in organic foods has grown considerably in the last decade in response to increasing concerns regarding the negative externalities associated with the effects of intensive farming systems on both human health and the environment (e.g., the contamination of food, land, and ground water by pesticide residues, etc.). This interest has

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also been stimulated by increasing consumer anxiety about numerous food scares such as the mad cow disease, avian influenza, and the Belgian dioxin scare (Miles and Frewer 2001). From the production side, governmental subsidies provided to organic producers in developed countries have helped promote a certain degree of substitution between conventional and organic farming (Soler et al 2002).

Organic farming arose in northern Europe in the beginning of the 20th century. Since then, organic farming and the market for organic food products have experienced significant growth, especially in the last couple of decades. While organic farming occupied about 11 million hectares globally in 1999, it covered 37 million hectares in 2009. Sales of organic food products reached about US$55 billion in 2009 (Willer and Kilcher 2011).

One of the largest producers and markets for organic foods is North America, with about 2.7 million hectares (compared to only 700,000 hectares in 1999) devoted to organic agriculture, representing approximately 7% of the world's organic agricultural land. In 2009, the organic foods market in the United States and Canada was valued at about US$28.6 billion, accounting for 52% of global revenues. Fruits and vegetables occupy the largest segment of the organic foods market, followed by dairy products and beverages (Willer and Kilcher 2011).

Despite the significant growth in the demand for organic foods, many farmers are still hesitant to adopt organic farming due to the lack of accurate information on market demand and consumers' willingness to pay (WTP) for organic food products. While a number of studies have been conducted to assess consumer preferences and WTP for organic products, most of these studies have used stated preference methods (see Table 1). In general, three stated preference methods have been used: hedonic prices, contingent valuation, and conjoint analysis/choice experiments. In spite of the useful information these methods provide, their main limitation is that they do not provide subjects an incentive to spend cognitive effort in evaluating the product as they do in real market situations. Hence, subjects do not have an incentive to reveal their true WTP values. In contrast to the studies exhibited in Table 1, we utilize experimental auctions, a revealed preference method, to estimate consumers' WTP for an organic product (i.e., organic milk) in Spain. Organic milk is still quite a relatively novel product in Spain and many other places including North America so results from our study can be used as a guide in making production, product adoption, and pricing decisions. We use experimental auctions since it is a nonhypothetical and a demand revealing method that can provide more accurate WTP values for organic food products.

Several studies have used experimental auctions to determine consumers' WTP for novel food products and attributes (McAfee and McMillan 1987; Dickinson and Bailey 2002; Fox et al 2002; Soler et al 2002; Lusk et al 2004b; Kassardjian et al 2005; Rousu et al 2005, 2008; Nayga et al 2006; Shaw et al 2006; Alfnes 2009). A vast majority of these studies use single-unit auctions to assess consumers' valuation of a single unit of a food product. Consumers, however, can be interested in purchasing not just one but multiple units of this type of product. Also, due to time constraints, many consumers are becoming increasingly concerned about optimizing shopping efficiency by purchasing multiple units of products to save several trips to the store. Hence, the usefulness of single-unit auctions to assess consumer behavior in multiunit shopping scenario is limited and can lead to biased inferences if the analyst assumes that results obtained from an auction of a single unit are also applicable to any additional unit beyond the first unit. Consequently, in

Table 1. Studies that examined the factors affecting WTP for organic food

Authors	Country	Purchase motivations of organic food	Purchase disincentives of organic food
Magnusson et al (2001)	Sweden	Better taste Better for the health Better aspect Freshness Better aspect	Price (expensive) Unavailability of organic food in habitual shopping area
Soler et al (2002)	Spain	Better for the environment More healthy More nutritious High reference prices of conventional food	Price (expensive)
Fotopoulos and Krystallis (2002)	Greece	More healthy Better quality High education High income Place of residence (near from the production area)	Low availability Expensive
O'Donovan and McCarthy (2002)	Ireland	Better for the environment More healthy Better quality High socio-economic level	High price of organic food Low availability

(*Continued*)

Table 1. Continued

Authors	Country	Purchase motivations of organic food	Purchase disincentives of organic food
Makatouni (2002)	UK	Organic food is healthier Better for the environment High level of animal welfare	
Chen (2007)	Taiwan	Environment protection Animal welfare Health Political values Natural content Family and friends (if they prefer organic food)	Convenience
Roitner-Schobesberger et al (2008)	Thailand	Health concerns Environmental concerns High income High educational level	Lack of knowledge/information; Confusion with other safe product label; Competitiveness with other safe product; Expensive; Lack of trust in the label; Lack of availability
Onyango et al (2007)	USA	Food naturalness vegetarian-vegan identity Preference for U.S. production Female Young Moderately religious High level of education	Food familiarity (consumer prefers familiar brand)

this paper, we propose the use of a multiunit auction to measure consumers' WTP for multiple units of organic milk and estimate the factors affecting consumers' WTP for each additional unit beyond the first unit. The use of multiunit auctions also allows us to derive the demand curve for the product being auctioned for each individual and the market. Hence, demand elasticities and consumer surplus measures can be derived, which can then be used, among others, in evaluating consumer demand and welfare implications of policy interventions (e.g., product taxes, price ceilings, price floors). While scanner data from supermarkets can be used to derive these measures, these data cannot be used for new products that have not been in the market for a specific period of time. Scanner data are also quite expensive to acquire and may not always include information about customers' socio-economic and demographic characteristics.

The price that consumers are willing to pay for an organic product can depend on the type of information that is provided to them. Specifically, results from previous empirical studies (see Table 1) on consumers' acceptance of organic food showed that the majority of subjects think of organic products as being healthier and more nutritious than conventional products. However, in the last few years, some unfavorable information about organic farming has been published claiming the nonexistence of these differences between organic products and their conventional counterparts.[1] Hence, another objective of our paper is to test the effect on WTP of three types of information about organic farming: (1) positive information; (2) negative information; and (3) both types of information.[2]

Our paper is structured into four sections. In the next section, we describe how the multiunit auction mechanism works, followed by our experimental design. We then discuss the results in the fourth section and then draw some concluding remarks in the last section of the paper.

MULTIUNIT VICKREY AUCTION

In our experiment, we used an incentive compatible multiunit auction mechanism, the so-called multiunit Vickrey auction, which is a generalization of the second price auction. Each participant is asked to bid on multiple units of the same product and the winner pays an amount corresponding to the sum of the bids (excluding his or her own bids) that are displaced by his or her successful bids (Krishna 2010). For a better understanding of the auction mechanism, consider three bidders and three identical units of the same product to be auctioned. Each bidder reports a bid of three values (i.e., one value for each unit). Let's say that bidder 1's bid is (10, 7, 4), bidder 2's bid is (9, 8, 5), and bidder 3 bids (11, 6, 0). If we rank the nine values, we obtain (11, 10, 9, 8, 7, 6, 5, 4, 0). The pricing rule dictates that the owner(s) of the three highest bids is (are) declared the winner(s). In this particular

[1] For example: There is no evidence that organically produced foods are nutritionally superior to conventionally produced foodstuffs (Dangour et al 2009); there is no evidence to support the argument that organic food is better than food grown with the use of pesticides and chemicals (Society of Chemical Industry 2008); Organically grown wheat may have different labeling and have a higher price in stores, but it contains essentially the same profile of amino acids, sugars, and other metabolic substances as wheat grown with conventional farming (Zörb et al 2006).

[2] The information provided came from scientific papers and from papers published in public bodies' websites such as the USDA website.

example, the owners of the bids 11, 10, and 9 (i.e., bidder 3, bidder 1, and bidder 2) are the winners. The price that each winner has to pay (i.e., clearing price) is determined as follows. First, the common set of rejected values (i.e., the values that do not make their owners winners of the auctioned product) is determined. In our example the common set of rejected values is {8, 7, 6, 5, 4, 0}. Second, for each winner, an individual set of rejected values consisting of the common set of rejected values without the winner's own values, is determined. In our particular example, the individual set of rejected values for bidder 1, bidder 2, and bidder 3 are {8, 6, 5, 0}, {7, 6, 4, 0}, and {8, 7, 5, 4}, respectively. Third, if the winner wins one unit, he/she pays a price equal to the first highest value in his/her individual set of rejected values. If the winner wins two units, he/she pays a price equal to the sum of the first and the second highest value in his/her individual set of rejected values and so on. In our particular example, bidder 1, bidder 2, and bidder 3 each pays a price equal to 8, 7, and 8, respectively. Now suppose that bidder 3 provided a bid equal to (13, 11, 6) so the ranking of values is now (13, 11, 10, 9, 8, 7, 6, 5, 4). Hence, bidder 1 wins one unit, bidder 2 does not win any unit, and bidder 3 wins two units. The individual set of rejected values for bidder 1 and bidder 3 are {9, 8, 6, 5} and {9, 8, 5, 4}, respectively. So, bidder 1 pays 9 and bidder 3 pays 9 for the first unit and 8 for the second unit. Since the price that the winner has to pay is not based on the winner's bid but on the bids of the other participants, bidding truthfully is a dominant strategy in the multiunit Vickrey auction (Engelbrecht-Wiggans and Kahn 1998).

EXPERIMENTAL DESIGN

According to Lusk and Shogren (2007), over 100 academic studies have utilized single-unit experimental auctions to examine consumers' valuation of different products. Some of these studies focused on the valuation of food safety and health attributes (e.g., Buhr et al 1993; Hayes et al 1995; Noussair et al 2004; Rousu et al 2004) while others assessed the factors affecting consumers' WTP for new food products (e.g., Masters and Sanogo 2002; Lusk et al 2004a; Hobbs et al 2006; Alfnes 2007). In our study, we also used experimental auctions (i.e., multiunit Vickrey auction) to (1) analyze the main determinants of consumers' WTP for organic milk and (2) investigate the sensitivity of WTP values to different types of information about organic farming (i.e., positive, negative, and both).

To recruit participants, we contracted with a company that carries out market studies and sensory analysis. This company randomly selected the participants from a list of people who were responsible for food shopping in their household, using a quota system to guarantee that the sample represented the appropriate population age distribution. In total, 80 subjects[3] participated in the experiment without having prior information on the objective of the study, the product studied, and the conditions of our study. These subjects were then randomly assigned to four treatments (see Table 2). Sessions were conducted in groups of 10 subjects with each treatment consisting of two sessions. Participants in the first treatment did not receive any information about organic foods. Participants in the second treatment were provided positive information while those in the third treatment were provided negative information. The participants in the fourth treatment were given

[3] In the analysis, we only considered the data obtained from 78 participants due to missing data from two participants.

Table 2. Experimental design

Treatments	Number of sessions	Participants by session	Total number of participants
Positive information	2	10	20
Negative information	2	10	20
Both types of information	2	10	20
Without information	2	10	20

both positive and negative information about organic foods. Table 3 shows the socio-demographic and economic characteristics of participants in the experiment.

The auctioned product was a "six-pack" (i.e., six identical items in the same package) of organic milk. Each unit contains 1 L of organic milk. "Six-pack" is the packaging form popularly used in Spain for products such as soda, juice, water, beer, and milk. These products are typically bought by consumers in multiple units during the same shopping trip in Spain. While a "six-pack" consists of six identical units of the same product together in a bundle, *consumers in retail stores are not forced to buy the entire bundle*—that is they can purchase less than six units by just opening the package and taking the number of units they want to buy. This handling flexibility makes the product available to all types of consumers (e.g., regular and occasional buyers).[4] Since the fat content of the milk can potentially influence consumer preferences, we used semi-skimmed organic milk which is more likely to be accepted by either whole or skimmed milk consumers.[5] In our sample, 62%, 45%, and 24% of the participants declared being consumers of semi-skimmed milk, whole milk, and skimmed milk, respectively. Unlike milk typically sold in North America, the Spanish milk has a long shelf life and can be stored unrefrigerated since it is ultra pasteurized (using UHT method). Finally, it is important to note that in Spain multiunit pack products (e.g., soft drink, milk, etc.) are often accompanied with multiunit price promotions such as "buy 2 and pay 1," "buy 6 and pay the price of 5," "buy 6 units for $6 and save $1," etc. Research has shown that multiunit price promotions can stimulate consumers to buy and stock higher quantities of a product than they usually would use and stock (Blattberg and Neslin 1990; Wansink et al 1998; Manning and Sprott 2007).

The experiment was performed in a room equipped with 10 computers. We used the Z-Tree software (Fischbacher 2007)[6] to collect bids and to determine the winner and the clearing price. The participants also had to complete a questionnaire on various aspects

[4] Otherwise, only consumers who need to buy the entire bundle will be able to purchase the product and, as a result, sellers can incur losses by ignoring buyers of few units.

[5] In each session, before starting the auction, we informed participants of fat content in the milk and we asked them if anyone has any objections to bidding for semi-skimmed milk. None of the participants showed any objections. They were, however, specifically told that they could bid zero if they do not want semi-skimmed milk.

[6] Z-Tree (Zurich Toolbox for Readymade Economic Experiments) is a software developed by Urs Fischbacher to help researchers design and carry out economic experiments. It can be downloaded from http://www.iew.uzh.ch/ztree/index.php.

Table 3. Sample socio-demographic and economic characteristics

Variables	Categories	Percent sample
Gender	Female	56
	Male	44
Age	18–34 years old	27
	35–49 years old	42
	50–66 years old	31
Education	High education	38
	Medium education	55
	Low education	07
Family income (per month)	<1,500€ (2,000 CAD)	15
	1,501€–2,500€ (2,001 CAD–3,332 CAD)	43
	2,501€–4,000€ (3,333 CAD–5,331 CAD)	30
	>4,000€ (5,331 CAD)	12

related to organic products, in general, and organic milk, in particular. We carried out the experiment in four steps. In step 1, each subject sat in a table separated from the rest of the participants to minimize any possible interactions and to allow anonymous bidding. After taking a seat, each participant received an envelope which contained 15€ (20 Canadian dollars [CAD]) as compensation for their participation, his or her identification number (to be held in secret during the process), and a questionnaire. Also, we endowed participants with six items of conventional milk (same brand and same fat content).[7] To avoid brand effects, we covered all the milk items with white paper. We then asked participants to complete the questionnaire.

In step 2, once the questionnaire was completed,[8] the actual experiment began. One of the main determinants of success in experimental auctions is a good understanding by the participants of the operating procedures used in the auction mechanism. To achieve this goal, we gave each participant a printed material that included a detailed explanation of how the specific auction works and some examples to illustrate the auction. The participants were given the opportunity to ask questions to dissipate any doubts about the auction mechanism. Given the importance of this step, we informed participants that it is very important that they fully understand the auction mechanism. We also demonstrated to them how they could lose money if they deviate from their true valuations.

Finally, to permit a better understanding and familiarity of the auction mechanism and the software, we carried out a training session by auctioning six identical items of

[7] Lusk and Shogren (2007, pp. 65–68) argue that if there are perfect field substitutes to products offered in the full bidding approach, then the bids for each of the products will be censored at the market price of the products and the differences in optimal bids might differ from the measure of real interest, the differences in value. As a result, they recommended the use of the endow-upgrade approach, since bids cannot be affected by such bias.

[8] The questionnaire was given before the experiment since we wanted to get information about their baseline attitudes toward organic production and organic food prior to testing the effect of information during the auctions.

organic milk and informed participants that no actual economic exchange would take place at the end of the training session. In this session, we asked participants to bid the amount they are willing to pay to exchange each item of their conventional milk with a unit of organic milk. Therefore, for each unit won, the winner gets a unit of organic milk in exchange for one of the endowed units of conventional milk plus the clearing price. We informed the participants that the only difference between the milk they already have and the product to be auctioned was the organic attribute. Once all participants reported their bids through the computer, the computer software identified the winner(s) and the price to be paid (i.e., clearing price). To avoid the problem of bid affiliation and to carry out a clean assessment of the information effect, we did not post the clearing price after each round (Corrigan and Rousu 2006).

In step 3, once the participants became familiar with the procedure, we announced the start of the organic milk auction. Each participant had to submit, again through the computer, how much more he or she was willing to pay to exchange each unit of conventional milk with a unit of organic milk. The same process was repeated with three additional rounds of auction. In step 4, we provided participants with different types of information. Depending on the treatment, participants in treatment 2, 3, and 4 were provided positive information, negative information, and both types of information about organic food, respectively (see Table A1). In treatment 4, the positive and negative information were printed using both sides of a paper and were randomly presented to the subjects. To serve as the control group, participants in treatment 1 were given no additional information. For this control group, the experiment was conducted as laid out in step 3, with a total of six rounds. In the other three cases, the additional information was provided after the fourth round. Hence, two more rounds were carried out after the provision of the additional information. At the end of the six rounds, one round was chosen randomly to determine the binding round. The winner(s) in the binding round was (were) appointed as the winner(s) of the auction. Once the results were announced, the experiment ended by handing the product to the winner(s) who had to pay the corresponding market-clearing price and the corresponding number of units of the endowed milk (e.g., if the winner wins two units of organic milk, he has to give the experimenter two units of conventional milk and pay the corresponding clearing price).

RESULTS

This section is organized into four subsections. In the first subsection, we outline some background information about our sample's purchasing habits and attitudes toward organic food, in general, and organic milk, in particular. In the second subsection, we analyze consumers' WTP for multiple units of organic milk. In the third subsection, we discuss the factors affecting the WTP for each unit of organic milk. Finally, in the fourth subsection, we assess the effect of the provision of different types of information about organic foods on consumers' WTP for organic milk.

Sample's Purchasing Habits and Attitudes toward Organic Milk

About 77% of our participants purchase milk once per week. Sixty-two percent of participants buy semi-skimmed milk and 43% buy milk in a package of six units. In relation to organic foods, 56% of participants considered themselves to be regular or occasional

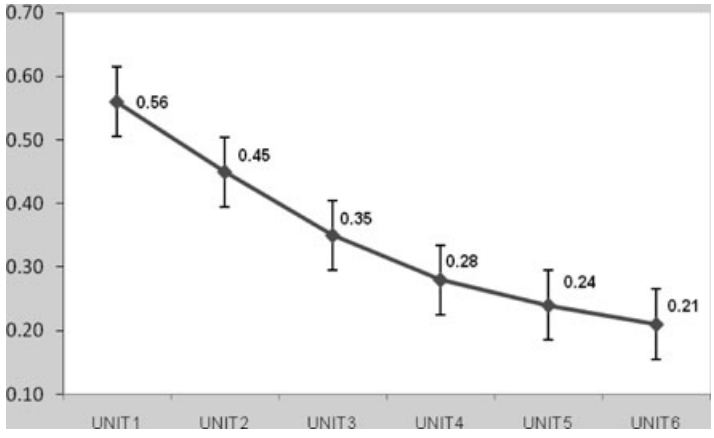

Figure 1. Price premium (€) for multiple units of organic milk

buyers of organic products. Vegetables, fruits, eggs, and honey are the organic foods that are purchased the most. Specialized food stores are the shopping places most frequented by organic food buyers. Only 31% of participants have purchased organic milk in the past. The main reasons provided for not buying organic milk are high price, unavailability, and lack of information on characteristics of organic milk. Finally, 66% of subjects revealed having a favorable attitude toward organic milk and 55% declared that they need more time and more information about organic milk before they could switch from purchasing conventional milk to organic milk.

Consumers' WTP for Organic Milk

One of the advantages of using the multiunit Vickrey auction is that we can obtain consumers' WTP for multiple units of the good, which then allows us to construct the demand curve of the product. Figure 1 exhibits the demand curve of organic milk.[9] As predicted by theory, we found that the average price premium consumers are willing to pay for organic milk is decreasing as the number of units being auctioned increases. For example, our results show that consumers on average are willing to pay 62% more for the first unit, 50% more for the second unit, 39% more for the third unit, 31% more for the fourth unit, 27% more for the fifth unit, and 23% more for the sixth unit.[10] This finding implies that to increase sales, food marketers could adopt price discount strategies as the number of units purchased increases (e.g., "buy 6 and pay 5," "buy 6 for 6€ (8 CAD) and save 1€ (1.33 CAD)," etc.). Our results also show that only 5% of the participants revealed that they were not willing to pay a price premium for any unit of organic milk.

[9] The values shown in Figure 1 are the average (over subjects) of participants' price premium in the first four rounds. Also, we found that the difference between the price premium for the different units is statistically significant at 1% level except for the difference between the price premium for the fourth unit and the fifth unit and between the price premium for the fifth unit and the sixth unit.

[10] These percentages were calculated with respect to an estimated average of the prices of the different brands of conventional milk available in the market, which is equal to 0.90€ (1.20 CAD).

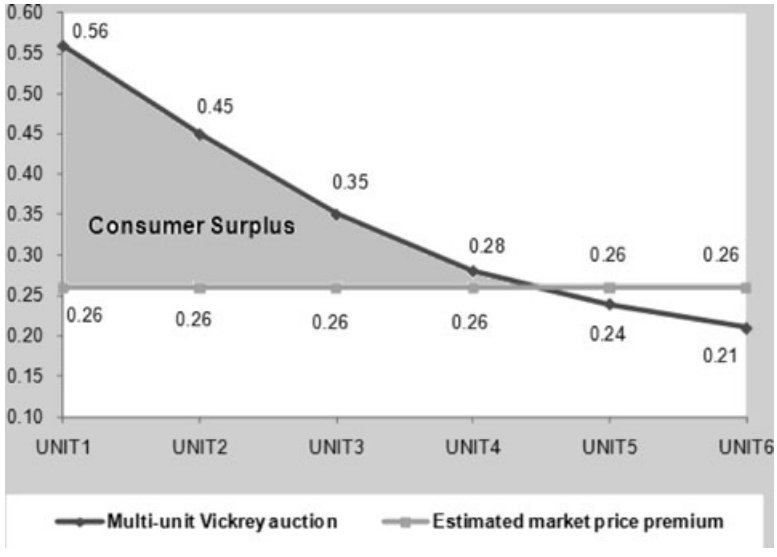

Figure 2. Consumer surplus

However, 9%, 13%, 8%, 4%, 6%, and 55% of the participants reported a WTP a price premium for the quantities of 1 unit, 2 units, 3 units, 4 units, 5 units, and 6 units of organic milk, respectively.

Consumer surplus analysis is also a useful tool for studying consumer behavior in a multiunit setting. In Figure 2, the level of consumer surplus is shown by the area under the demand curve and above the market price premium. Concerning the determination of the market price premium, there was an attempt by a retailer of high quality foods in Barcelona to introduce its own brand of organic milk with a market price of 1.04€/unit (1.40 CAD/unit). Also the manufacturer who provided the organic milk used in our experiment had the intention to sell his product at a price of 1.28€/unit (1.70 CAD/unit). Since the auctioned units of organic milk used in our experiment were covered (hence the consumer cannot determine if the product is a retailer or private brand), we estimated the market price premium by subtracting the average price of conventional milk (0.90€ [1.20 CAD]) from the average of the prices of the two mentioned brands (i.e., $0.26 = (1.04 + 1.28)/2 - 0.90$). We can see that on *average,* participants can benefit from purchasing a bundle of four units of the auctioned organic milk during the same shopping trip since their consumer surplus from buying these units is positive. Also, this result suggests that organic milk could be introduced into the market in package sizes of up to four units since we found that 38% of participants are willing to buy a bundle of four units of organic milk at a price premium of 0.26€/unit (0.35 CAD). In addition, based on results from the calculation of the individual consumer surplus, other package sizes can also be considered. In fact, we found that 76%, 64%, 47%, 33%, and 27% of participants are willing to buy a package of 1 unit, 2 units, 3 units, 5 units, and 6 units of organic milk, respectively (i.e., their consumer surplus is positive for these bundles).

Factors Affecting Consumers' WTP for Organic Milk

As mentioned in the introduction, we are also interested in analyzing the factors affecting consumers' WTP for multiple units of organic milk. Since subjects' bids are censored at zero, we estimated six robust Tobit models.[11] To perform the analysis, we estimated six (robust) Tobit regression models (one for each auctioned unit of organic milk) using the following specification (Amemiya 1984):

$$y_{ij} = \begin{cases} y_{ij}^{*} & si \quad y_{ij}^{*} > 0 \\ 0 & si \quad y_{ij}^{*} \leq 0 \end{cases} \tag{1}$$

$$y_{ij}^{*} = x_{ij}\beta_j + \varepsilon_{ij} \quad \forall i = 1, \ldots N \quad \text{and} \quad j = 1, \ldots, 6$$

where j indexes the jth auctioned unit in the experiment (i.e., this equation is estimated six separate times, once for each unit of organic milk under analysis) and i indexes cross-section units such that $i = 1, 2, \ldots, \mathrm{N}$ (N is the number of participants). The matrix $\boldsymbol{X}_{ij}$ is of dimension $(\mathrm{N} \times \mathrm{K})$ and contains data on the observable explanatory variables of the model for the six auctioned units. Y_{ij} is the price premium subject i is willing to pay to exchange a unit of conventional milk with a unit j of organic milk. $\beta_j = (\beta_{j,1} \ldots \beta_{j,k_j})' \in \boldsymbol{R}^{k_j}$ are vectors of parameters to be estimated. ε_{ij} captures the stochastic disturbances of the model for the six auctioned units.

The dependent variables are BID_j, where $j = 1$ to 6 indexes the price premium for the jth auctioned unit. Taking into account the information obtained from the survey, the explanatory variables can be grouped into three main categories. The first category includes variables that capture purchasing and consumption habits related to organic foods in general, and organic milk in particular, such as frequency of purchasing and consuming organic foods, purchased quantity of milk, and weekly expenditure of organic foods. We included these variables in the analysis not only to assess their effect on consumers' WTP but also to help control for some unobservable factors such as inventory effects. The second category of explanatory variables reflects information regarding the attitudes that participants have toward various aspects related to organic milk. Several empirical studies (see Table 1) showed a strong relationship between consumers' WTP for organic foods and variables such as environmental issues, health concerns, availability, trust in information sources, etc. The third category includes variables that represent the socio-demographic and economic characteristics of participants (gender, age, marital status, employment, income, etc.) and their lifestyles (health, eating habits, sports, etc.). Table A2 exhibits the description of the variables considered in the estimation.

[11] Since the results from the estimation of the random effect Tobit models using data from the first four rounds (i.e., panel data) and the results from the estimation of Tobit models using just the data from the first unit were quite similar, we decided to consider the results from the Tobit models. By doing this, we were able to avoid the problem of autocorrelation between rounds that was found to be significant at 5% using the Wooldridge test for autocorrelation in panel data. Also we estimated robust Tobit models instead of Tobit models to remove any bias generated by the presence of heteroskedasticity. Furthermore, our analysis showed the absence of multicollinearity since the Value Inflation Factor for all the explanatory variables was found to be lower than 2 and all the simple correlation coefficients were lower than 0.4.

Table 4. Results from robust Tobit models

Variables	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
Constant	0.380**	0.472**	0.274	0.114	0.125	0.037
Price	0.188	−0.084	−0.018	0.088	0.046	0.102
Informed	−0.080	−0.079	−0.079	−0.134	−0.147	−0.104
Consume	0.080	0.082	−0.134	−0.126	−0.136	−0.148
Income	−0.197*	−0.161	0.014	0.017	0.034	−0.023
Education	0.003	0.070	0.102	−0.018	−0.100	−0.082
Environment	0.077*	0.004	−0.037	−0.019	−0.043	−0.045
Healthy	0.056	0.101**	0.160***	0.136**	0.126***	0.117**
No_Information	−0.070*	−0.087**	−0.105**	−0.095**	−0.107***	−0.110***
Unavailability	−0.037	−0.023	−0.017	−0.005	−0.022	−0.030
Expensive	−0.062	−0.107*	−0.150***	−0.199***	−0.211***	−0.208***
Certification	0.071	0.083*	0.094**	0.078	0.067	0.046
Welfare	−0.031	0.028	0.033	0.036	0.043	0.029
Taste	−0.098*	−0.104**	−0.127***	−0.117**	−0.099*	−0.087*
Loglike	−34.46	−39.61	−37.39	−41.91	−40.21	−38.22
LR $Chi^2(13)$	23.27	20.85	33.06	25.30	27.66	24.29
Prob > Chi^2	0.04	0.08	0.00	0.02	0.01	0.03
Number of obs.	78	78	78	78	78	78

Notes: LR, likelihood ratio; (13), number of independent variables from Price to Taste.
***, **, * Statistically significant at the 1%, 5%, and 10% level, respectively.

In order to keep the estimated model as simple and manageable as possible, we reduced using factor analysis (see Table A3) the information on participants' attitudes toward organic foods (that were measured using a 17-item Likert scale[12] shown in the first column of Table A3) into nine factors. These nine factors explain 85.21% of the total information provided by the original 17 variables. Cronbach's alpha[13] is equal to 0.80. Each column in Table A3 represents each of the nine factors. Numbers in each column represent the correlation between factors and each of the original variables. The bold numbers indicate that correlations were higher than 0.6. We then utilized these numbers to name a few factors. For instance, we constructed the second factor named HEALTHY from two items: (1) organic foods are healthier for children; and (2) organic foods are adequate for a safe diet.

To specify the econometric model, we relied on theory and the results of previous studies on consumers' WTP for organic food. Our investigation showed that factors such as health, environment, and animal welfare issues as well as participants' income and education, unavailability of organic food in conventional stores, and the lack of

[12] The Likert scale is a type of psychometric scale frequently used in psychology questionnaires. It was developed by and named after organizational psychologist Rensis Likert. It is an ordered, one-dimensional scale from which respondents choose one option that best represents their view.

[13] Cronbach's alpha is commonly used as a measure of internal consistency or reliability of a psychometric instrument. In other words, it measures how well a set of variables or items measures a single, one-dimensional latent aspect of individuals. An internal consistency is acceptable if Cronbach's alpha is greater than or equal to 0.7.

information on characteristics of organic foods are key factors influencing consumers' WTP for organic food products.

Results from the estimation of the six robust Tobit models using STATA are shown in Table 4. In general, some of the determinants of consumers' WTP differ from one unit to another while some are common across all units. Also, in cases where the effect is significant for more than one unit, the magnitude of the effects differs between units. In this section, we start by discussing the factors that positively affect consumers' WTP. We then focus on those factors that negatively affect consumers' WTP for organic milk.

As exhibited in Table 4, the health issue (i.e., the variable HEALTHY) was a key factor that positively influenced consumers' WTP for organic milk. In fact, subjects who considered organic milk as healthier and more nutritious were willing to pay a price premium of 10.1 cents (0.13 CAD), 16.0 cents (0.21 CAD), 13.6 cents (0.18 CAD), 12.6 cents (0.17 CAD), and 11.7 cents (0.16 CAD) for the second, third, fourth, fifth, and sixth unit, respectively. Consistent with previous studies, we found that participants who agreed with the statement that "the production of organic milk improves the sustainability of the environment and reduces the contamination of water and soil" reported a WTP a price premium of 7.7 cents (0.10 CAD) for the first unit of organic milk. However, this variable seems to be a minor determinant of WTP for organic milk since it significantly affects the WTP for only the first unit. We also found that those who trust organic milk because it is certified by public organizations or it has an organic food certification were willing to pay a price premium for organic milk. These effects are however statistically significant only for the second and the third units.

Subjects who claimed to have a lack of information on organic food benefits and certifications reported a lower WTP that ranges from 7.0 cents (9.3 CAD) on the first unit to 11.0 cents (14.6 CAD) on the sixth unit. Hence, more effort by producers and retailers in promoting the benefits of organic food might be useful to increase the market potential of organic products. As expected, our results indicate that subjects who thought of organic foods as expensive products reported a significantly lower WTP for all the units of organic milk except the first unit. The decrease in the WTP ranges from 10.7 cents (0.14 CAD) on the second unit to 21.1 cents (0.28 CAD) on the fifth unit. Interestingly, those who think that organic products have an intense taste are less willing to pay a premium for organic milk.

We conclude this section by pointing out two issues. First, it is clear that one cannot generally utilize the results for a single unit to assess consumer behavior in a multiunit shopping scenario since this could lead to incomplete and even biased conclusions. For example, if we only consider the results corresponding to the first unit, we would have mistakenly concluded that the environmental issue, the lack of information on organic foods' characteristics, and taste are the only key determinants of consumers' WTP for organic milk and that health and the high price of organic foods are irrelevant factors. On the contrary, our results show that the health issue and the high price of organic foods are important factors that influence WTP for various units of organic milk and that the environmental factor is a determinant of the WTP for the first unit only. Second, in accordance with the results of previous studies that were carried out in different countries (Table 1), consumers' WTP for organic foods is more influenced by attitudinal factors such as health and taste than by socio-demographic factors.

Sensitivity of Consumers' WTP to Controversial Information on Organic Farming

As discussed above, health is one of the most important factors that positively influence consumers' WTP for organic milk. The majority of the participants in our experiment considered organic milk to be healthier and more nutritious than ordinary milk. However, during the last few years, a number of scientific papers (e.g., Zörb et al 2006; Dangour et al 2009) have been published showing that there are no significant differences between organic foods and their conventional counterparts in terms of safety or nutritional content. This research also claims that if some differences were found, they were related to the place and the conditions of the setting in which the experiments had taken place and, therefore, conclusions could not be generalized. Since consumers' positive attitudes toward organic food could be mainly based on subjective perceptions (Tarkiainen and Sundqvist 2005; Lobb et al 2007), we also analyzed the effect of "nonpositive" information about organic food on consumers' WTP for organic milk by providing participants in our experiment with three types of information about organic farming (i.e., positive, negative, and both types of information).

In this context, we carried out two types of analysis: within subjects and between subjects. In the within-subjects analysis, since participants received the corresponding information on organic farming after the fourth round, we compared the average WTP before (first four rounds) and after (last two rounds) the provision of information. Results exhibited in Figure 3 show that while the introduction of positive information increases consumers' WTP, the introduction of negative information has the opposite effect. The provision of both types of information does not seem to have an effect on the average WTP.[14] These effects, however, are only weakly statistically significant, although economically the difference can be important since on average, the positive information increases the WTP by 46% while the negative information decreases the WTP by 20%.

To carry out the between-subjects analysis, we analyzed the change in bids of subjects who received information in comparison with subjects who did not receive information (i.e., the control group). For each subject, we calculated the average of his/her price premium in the first four rounds (i.e., before receiving information) and the average of his/her price premium in the fifth and sixth rounds. We then calculated the difference of the average price premium in the first four rounds and the average price premium in the last two rounds for each subject. Hence, we obtained a cross-sectional data (i.e., an observation for each subject) and used dummy variables for the different groups to assess the effect of information. To carry out this analysis, we estimated six regressions with robust standard error (i.e., a regression for each auctioned unit of organic milk).[15] We

[14] The *t*-test results (within analysis) showed that the provision of positive information significantly increases participants' WTP by a range of 11.2 cents (0.15 CAD) on the sixth unit to 39.7 cents (0.53 CAD) on the first unit. However, the provision of negative information decreases participants' WTP by a range of 2.1 cents (0.03 CAD) on the sixth unit to 5.1 cents (0.07 CAD) on the first unit. The provision of both types of information increases participants' WTP by a range of 2.0 cents (0.03 CAD) on the first unit to 6.7 cents (0.09 CAD) on the fourth unit. The results show that only the effect of providing positive information is statistically significant.

[15] We estimated standard linear regressions instead of censored models because some of the calculated values are negative.

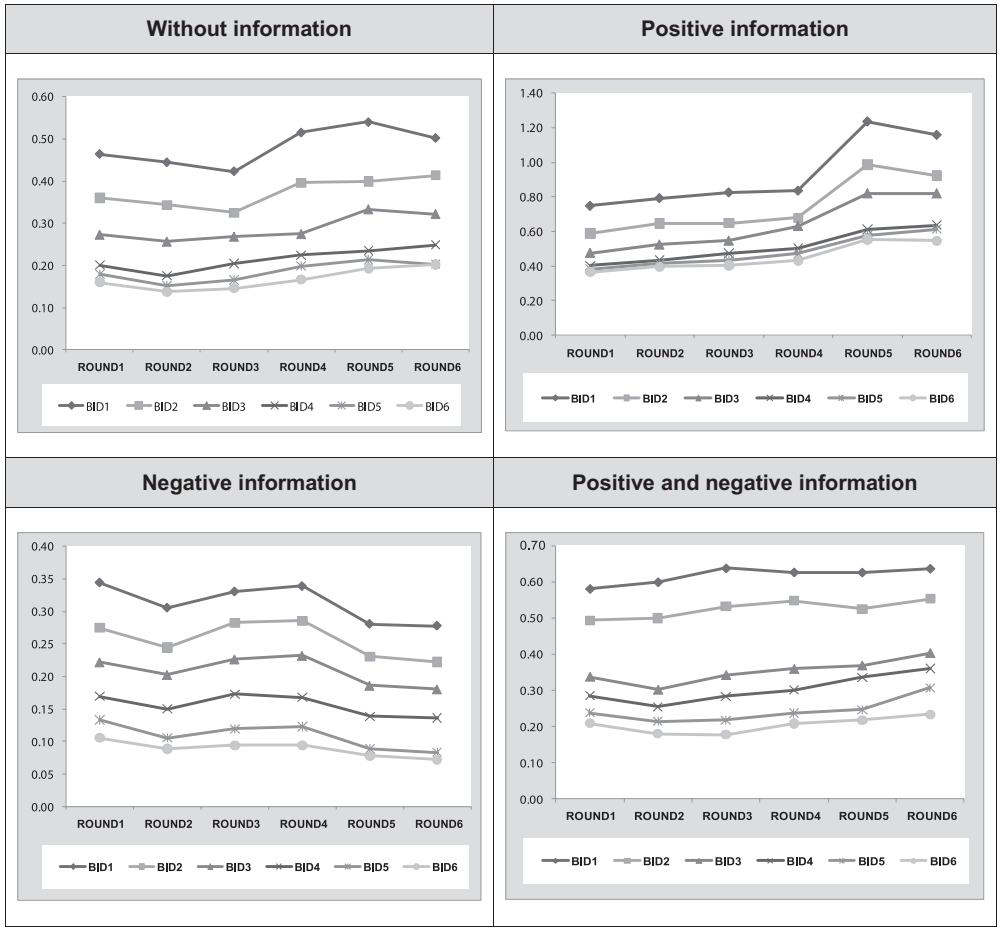

Figure 3. The effect of providing information on WTP

specified the six regression models as follows:

$$y_{ij} = x_{ij}\beta_j + \varepsilon_{ij} \quad \forall i = 1, \ldots \mathrm{N} \quad \text{and} \quad j = 1, \ldots, 6 \tag{2}$$

where j indexes the jth auctioned unit in the experiment (i.e., this equation is estimated six separate times, once for each of the unit of organic milk under analysis) and i indexes cross-section units such that $i = 1, 2, \ldots, \mathrm{N}$ (N is the number of participants). The matrix $\boldsymbol{X}_{ij}$ is of dimension (N × K) and contains data on the observable explanatory variables of the model for the six auctioned units. Y_{ij} is the difference between the mean of the price premium in the first four rounds and the mean of the price premium in the two last rounds. $\beta_j = (\beta_{j,1} \ldots \beta_{j,k_j})' \in R^{k_j}$ are vectors of parameters to estimate. ε_{ij} capture the stochastic disturbances of the model for the six auctioned units. Results are shown in Table 5.

Table 5. Results from regression estimation with robust standard error (information effect)

Variables	UNIT1	UNIT2	UNIT3	UNIT4	UNIT5	UNIT6
Constant	0.037	0.003	0.029	0.015	0.043	0.068
P_Information	0.114*	0.354***	0.235**	0.200**	0.112	0.080
N_Information	−0.110***	−0.092**	−0.117***	−0.074*	−0.083*	−0.090**
PN_Information	−0.022	−0.011	−0.010	0.044	0.016	−0.014
Consume	−0.033	0.031	0.018	−0.053	−0.074	−0.109**
Education	0.080	0.123	0.109	0.106	0.048	0.031
Environment	0.011	0.008	−0.002	−0.005	−0.006	0.000
Healthy	0.002	−0.008	−0.020	0.011	0.018	0.020
Expensive	−0.023	−0.043	−0.051	−0.043	−0.060	−0.060
Taste	−0.042**	−0.052*	−0.033	−0.052**	−0.032*	−0.021
R^2	0.26	0.41	0.30	0.24	0.23	0.21
Number of obs.	78	78	78	78	78	78

Note: ***, **, * Statistically significant at the 1%, 5%, and 10% level, respectively.

As expected, we found that provision of positive information increases the price premium participants are willing to pay to exchange the conventional milk with the organic milk by a range of 11.4 cents (0.15 CAD) on the first unit to 35.4 cents (0.47 CAD) on the second unit. Conversely, the provision of negative information decreases participants' WTP for organic milk by a range of 7.4 cents (0.10 CAD) on the fourth unit to 11.7 cents (0.16 CAD) on the third unit. Finally, consistent with the results we found that in the within-subjects analysis, the WTP of participants who received both types of information and the WTP of participants who did not receive any type of information are not significantly different from each other.[16]

CONCLUSIONS

Food consumption habits and consumer lifestyles around the world are changing. Interest in and knowledge about health and nutrition is growing and this is reflected by the increasing demand for food quality. At the same time, with increasing opportunity cost of time, people are busier which increases the incentive to optimize food shopping or limit the number of trips to food stores by purchasing multiple units of products per shopping visit. In this paper, we conducted an experiment to analyze Spanish consumers' WTP for organic milk. Unlike previous studies, however, we examined consumers' WTP for organic milk using a multiunit auction instead of the commonly used single-unit auction. With a multiunit auction, we were then able to estimate the demand, consumer surplus, and the determinants of consumers' WTP for various units of organic milk. In addition,

[16] The *t*-test results (between analyses) showed that the provision of positive information significantly increases participants' WTP by a range of 36.1 cents (0.48 CAD) on the sixth unit to 69.6 cents (0.93 CAD) on the first unit. However, the provision of negative information significantly decreases participants' WTP by a range of 9.6 cents (0.13 CAD) on the fourth unit to 25.9 cents (0.35 CAD) on the first unit. The provision of both types of information increases participants' WTP by a range of 2.5 cents (0.03 CAD) on the sixth unit to 12.6 cents (0.17 CAD) on the second unit; however, this effect is not statistically significant.

we also examined the effect of different types of information (positive, negative, both) on WTP for organic milk.

Our results based on Spanish data suggest that modern consumers may be willing to pay a premium for organic milk but that this WTP could decrease with the number of units purchased. Results also suggest that health issues, high price of organic foods, taste, and lack of information on organic foods are factors that could influence WTP for organic milk. Another interesting finding of our research is the sensitivity of consumers' WTP to the nature of information participants received. We found that subjects' WTP responds positively to positive information about organic farming and responds negatively to negative information. Interestingly, WTP does not seem to be affected when both types of information are provided. Hence, these results imply that propagation of negative information can dramatically affect consumer preferences toward organic products and can slow down the growth of the organic product market. However, our results also suggest that negative information can be neutralized by positive information about organic farming.

Given the increasing interest in organic foods and specifically in organic milk not only in Europe but also in North America, the results of our study can be used as a guide in making production, product adoption, and pricing decisions. The findings suggest that people may be willing to pay a premium for organic milk. If this price exceeds the cost of selling the product, then there would be an incentive for organic milk producers and retailers to produce and sell organic milk. Results of this study can also be used for promotion or marketing purposes since we have determined the factors that affect WTP for organic milk in a multiunit setting and the potential effects of introduction of different types of information to consumers. Future studies should attempt to test the robustness of our findings in other countries or settings. While the results of these studies across countries could depend upon regional social attitudes toward organic foods, they could serve as the foundation for future research.

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APPENDIX

Table A1. Positive and negative information on organic food provided to subjects

Positive information	Negative information
Organic farming can be defined easily as a compendium of agricultural techniques that would normally exclude the use in agriculture of synthetic chemicals such as fertilizers, pesticides and antibiotics, in order to preserve the environment, maintain or increase soil fertility and provide foods with all its natural properties. *Spanish Ministry of Environment and Agriculture 2009*	USDA makes no claims that organically produced food is safer or more nutritious than conventionally produced food. Organic food differs from conventionally produced food in the way it is grown, handled, and processed. *ProCon.org 2009—United States Department of Agriculture (USDA) 2007*
Organic milk comes from cows, sheep and goats living in a welfare-oriented animal husbandry: outdoors in summer with access to pasture and indoors in winter when the climate is rough, with organic forage and regular exercise. *European Commission of Agriculture and Rural Development 2009*	Because of its low productivity level, organic products are incapable of feeding the world population in general and the populations of poor countries, in particular, as presented as alternative to conventional products. *Carlisle 2000—National Center for Public Policy Research: USA*
Organic milk contains 60% more of omega-3s (which help to fight serious heart and arthritis problems) and 30% more beta carotene (which reduces the chance of heart attacks and increases the efficiency of the immune system). *Butler et al 2008—Journal of the Science of Food and Agriculture*	Under the new regulation of the European commission of agriculture and rural development, organic foods can contain up to 0.9% genetically modified material. *European Commission of Agriculture and Rural Development 2007*
The review of 29 scientific studies shows that organic foods are superior in terms of food security and nutritional content than conventional foods. *Heaton 2001—Soil Association: UK*	Organic farming practices are inadequate to control soil erosion because organic farmers cannot use modern conservation tillage techniques that have been extraordinarily successful in reducing soil erosion. *Trimble 1999—University of California*

Table A2. The independent variables used in the estimation

Label of independent variables	Name	Description
Price of conventional milk	Price	Continuous variable: the price at which participant used to buying 1 L of conventional milk
Information level on organic foods	Informed	Dummy variable that takes the value 1 if the participant declared to be informed on organic milk; and 0 otherwise
Consumption of organic milk	Consume	Dummy variable that takes the value 1 if the participant declared to habitual/occasional consumer of organic milk; and 0 otherwise
Income level	Income	Dummy variable that takes the value 1 if the household's income is more than 4,000€/month (5,331 CAD/month); and 0 otherwise
Organic foods are healthy	Healthy	Continuous variable. Factor analysis carried out on a 17-item Likert scale to measure participants' attitudes to organic food
Lack of information on organic food	No_Information	Continuous variable. Factor analysis carried out on a 17-item Likert scale to measure participants' attitudes to organic food
Unavailability of organic foods	Unavailable	Continuous variable. Factor analysis carried out on a 17-item Likert scale to measure participants' attitudes to organic food
Organic foods are expensive	Expensive	Continuous variable. Factor analysis carried out on a 17-item Likert scale to measure participants' attitudes to organic food
Certified organic foods are trustworthy	Certification	Continuous variable. Factor analysis carried out on a 17-item Likert scale to measure participants' attitudes to organic food
Producing organic milk improves animal welfare	Welfare	Continuous variable. Factor analysis carried out on a 17-item Likert scale to measure participants' attitudes to organic food
Organic milk has an intense taste	Taste	Continuous variable. Factor analysis carried out on a 17-item Likert scale to measure participants' attitudes to organic food
Positive information	P_Information	Dummy variable that takes the value 1 if the participant received positive information on organic farming; and 0 otherwise
Negative information	N_Information	Dummy variable that takes the value 1 if the participant received negative information on organic farming; and 0 otherwise

(*Continued*)

Table A2. Continued

Label of independent variables	Name	Description
Positive and negative information	PN_Information	Dummy variable that takes the value 1 if the participant received positive and negative information on organic farming; and 0 otherwise
Without information	W_Information	Dummy variable that takes the value 1 if the participant did not receive any kind of information on organic farming; and 0 otherwise

Table A3. Results from factor analysis on consumers' attitudes toward organic foods

Items	Environment	Healthy	No_Information	Unavailable	Expensive	Certification	Confusion	Welfare	Taste	Communalities
OF (organic foods) are healthier for kids	0.149	**0.873**	0.082	0.080	0.087	0.191	0.067	0.227	−0.093	0.906
OF are adequate for a safe diet	0.267	**0.853**	0.039	−0.011	0.167	0.158	0.025	0.036	−0.084	0.862
OF reduce the contamination of water and soil	**0.930**	0.121	−0.082	0.065	0.016	0.182	0.080	−0.048	0.019	0.932
OF improve the sustainability of the environment	**0.927**	0.235	−0.053	0.065	−0.006	0.140	0.021	0.036	−0.051	0.946
Organic milk production requires a high level of animal welfare	0.100	0.130	0.036	0.071	0.093	0.357	−0.069	**0.586**	−0.549	0.819
Organic milk production prohibits the use of synthetic hormones	−0.039	0.157	0.036	−0.076	−0.023	−0.020	−0.042	**0.920**	0.080	0.889
I trust in organic milk because it has an organic food certification	0.066	0.400	−0.058	0.046	0.142	**0.814**	−0.064	−0.017	0.022	0.856
I trust in organic milk because it is certified by public organisms	0.377	0.034	−0.145	0.055	0.060	**0.795**	0.048	0.094	0.040	0.816
OF are expensive	0.049	0.129	0.046	0.200	**0.873**	0.123	−0.058	0.005	0.001	0.842
The difference between conventional and organic foods in terms of price is exaggerated	−0.011	−0.055	0.018	0.035	**0.925**	0.030	0.132	−0.043	−0.041	0.882

(*Continued*)

Table A3. Continued

Items	Environment	Healthy	No_Information	Unavailable	Expensive	Certification	Confusion	Welfare	Taste	Communalities
OF are not available in habitual shopping places	0.097	0.140	−0.033	**0.826**	0.239	0.148	0.110	0.007	0.296	0.892
Looking for OF takes a lot of time	0.059	−0.025	0.063	**0.887**	0.208	−0.030	0.183	−0.071	0.000	0.877
I am confused by different labels of organic milk	0.060	0.024	0.100	0.045	0.106	0.065	**0.845**	0.044	0.253	0.811
I am confused between organic and functional milk	0.045	0.086	0.132	0.250	−0.025	−0.067	**0.792**	−0.115	−0.011	0.735
There is a lack of information on organic food benefits	−0.052	0.106	**0.961**	0.003	0.001	−0.029	0.022	−0.012	0.017	0.940
There is a lack of information on organic food certifications	−0.088	−0.006	**0.902**	0.050	0.116	−0.136	0.212	0.072	0.092	0.914
The taste of organic milk is intense	−0.004	−0.131	0.131	0.288	0.080	0.121	0.231	0.075	**0.779**	0.805
Eigen value	2.007	2.113	1.848	1.877	2.545	1.640	1.677	1.300	1.183	
Variance (%)	10.564	11.121	9.726	9.878	13.393	8.632	8.827	6.844	6.226	
Cumulative variance (%)	10.564	21.69	31.41	41.29	54.68	63.31	72.14	78.98	**85.21**	
Cronbach's alpha	0.80									
Kaiser-Meyer-Oklin	0.65									
Bartlett's test (significance)	0.00									

Note: Bold numbers indicate that correlations were higher than 0.6.