



RESEARCH ARTICLE

OPEN ACCESS

Comparing hypothetical versus non-hypothetical methods for measuring willingness to pay in a food context

Laura Martínez-Carrasco¹, Margarita Brugarolas¹, Africa Martínez-Poveda¹ and Juan J. Ruiz-Martínez²

¹ University Miguel Hernández. Department of Agroenvironmental Economics. Ctra. Beniel, km. 3,2. 03312 Orihuela (Alicante), Spain.

² University Miguel Hernández. Department of Applied Biology. Ctra. Beniel, km. 3,2. 03312 Orihuela (Alicante), Spain

Abstract

Choosing a valid procedure to measure willingness to pay (WTP) is crucial for designating optimum price policies or for evaluating the demand for new products. This study compares two methods for obtaining WTP in a food context: a random n^{th} price auction and an open-ended contingent valuation (CV) question. Participants were regular salad tomato buyers of Alicante and they were randomly assigned to one of the two treatments. The products about which they would show their WTP were traditional tomato varieties. Both treatments were divided into three stages: in the first stage the only available information was a reference price for the tomatoes. In stages 2 and 3 we revealed the local origin and the organic grown of the tomatoes respectively. Our results show that in the auction the percentage of participants willing to pay the same or more than the reference price was between 20 and 30%. In the CV method this percentage was between 40 and 65%. The mean WTP in the auction, considering the whole of the individuals, was situated between 1.90 and 2.13 €/kg. These same results obtained through the CV were situated between 2.54 and 3.21 €/kg. The results confirmed the findings of previous papers in which the hypothetical bias of CV was clarified because it yields higher values for WTP than the auction, especially when referring to the number of individuals willing to pay more. Additionally, hedonic price models were estimated for the prices obtained by both methods with the result that in all the models, WTP was directly related to the price paid for the latest purchase of tomatoes.

Additional key words: experimental auction; contingent valuation; traditional varieties; hedonic prices; consumer preferences; fresh tomatoes.

Abbreviations used: BDM (Becker, De Groot and Marscak's); CV (contingent valuation); EA (experimental auction); WTP (willingness to pay).

Citation: Martínez-Carrasco, L.; Brugarolas, M.; Martínez-Poveda, A.; Ruiz-Martínez, J. J. (2015). Comparing hypothetical versus non-hypothetical methods for measuring willingness to pay in a food context. Spanish Journal of Agricultural Research, Volume 13, Issue 4, e0109, 12 pages. <http://dx.doi.org/10.5424/sjar/2015134-8233>.

Received: 01 Jul 2015 **Accepted:** 12 Nov 2015

Copyright © 2015 INIA. This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial (by-nc) Spain 3.0 Licence, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Funding: Spanish Ministry of Science and Innovation (project AGL2008-03822/AGR).

Competing interests: The authors have declared that no competing interests exist.

Correspondence should be addressed to Laura Martínez-Carrasco: lmartinez@umh.es

Introduction

Many commercial decisions such as setting prices or launching new products require an adequate knowledge of how consumers value those products. One way to measure the value that consumers place on a product is through their willingness to pay (WTP). WTP indicates the maximum quantity of money that consumers would pay for a certain quantity of the product (Kalish & Nelson, 1991). Therefore, choosing a valid procedure to measure WTP is crucial for designating optimum price policies or for evaluating the demand for new products. In the food context, the WTP measurement is broadly used to face different problems, for example, to examine

the influence of different quality brands on the consumers' WTP such as the halal quality label (Verbeke *et al.*, 2013) or the country-of-origin label (Lim *et al.*, 2013); to explore different aspects of food sustainability by measuring consumer's WTP for fair trade coffee (Lange *et al.*, 2015) or for chocolate bars (Vecchio & Annunziata, 2015); or simply to identify sensory properties that influence consumers' WTP (Gabrielyan *et al.*, 2014).

The choice of the most appropriate method for measuring WTP is a complex task, since true consumer WTP is an unobservable construct. Consequently, each method for measuring WTP only represents an attempt to come as close as possible to true consumer valuation (Voelckner, 2006).

In this paper, two commonly used elicitation mechanisms will be compared to measure WTP: contingent valuation (CV) and the experimental auctions (EA). The former belongs to the so-called hypothetical methods which do not require a monetary commitment by the participants; and the latter, to the methods that measure actual WTP, which do require it. The product chosen was traditional tomato varieties, with the desire to expand the studies that compare WTP methods in a food context, and specifically in the fresh fruit and vegetable sector.

Food/agribusiness managers and researchers can use the outcomes of our study to better understand how choice of WTP elicitation mechanisms can significantly influence WTP estimates, which can then be used to make informed product adoption and optimal pricing decision.

The general objective was to compare WTP results from a CV survey to an experimental auction. Therefore, a series of indicators were determined: (1) the percentage of individuals willing to pay the same as the reference price or more, (2) the mean price obtained for the whole of individuals as well as for the segment that is willing to pay the same as the reference price or more and (3) several hedonic price functions that relate the obtained price to various socioeconomic characteristics of the participants. These indicators were determined for traditional tomatoes after tasting, and under the assumptions that have been grown locally and organically.

Material and methods

An overview of willingness to pay measurement methods

An initial classification of the methods for measuring WTP is whether they do so directly or indirectly. Direct methods directly ask consumers their WTP for a product, as for example in CV. Direct methods are commonly criticized because of the hypothetical nature of the questions and the fact that the actual behaviour is not observed. Literature on preference evaluation usually refers to these methods as stated preference techniques (Adamowick *et al.*, 1994). In the indirect or revealed preference methods, as for example the conjoint analysis, WTP is calculated from consumer choices among several product alternatives (Miller *et al.*, 2011).

Another usual classification of the methods for determining consumer WTP depends on whether a real economic commitment is required of the participants, for example with real purchases (real WTP), or

whether such a commitment is not required (hypothetical WTP). The former requires consumers to pay the declared price or the price of the chosen product. Experimental auctions are typical examples. Regarding the latter, there is no financial consequence for the participants. Consumers who declare their WTP in a hypothetical context avoid any obligation to purchase. The most popular methods for measuring hypothetical WTP are CV and conjoint analysis (Voelecker, 2006).

Whatever the chosen technique is for measuring WTP, the primary objective is for it to be incentive compatible. That is to say, its dominant strategy would truthfully reveal the real value that the product has for the consumer. In this sense, one of the greatest concerns regarding CV is its lack of incentive compatibility in the sense that there is not a dominant strategy to bid truthfully (Werthenbroch & Skiera, 2002). On the contrary, experimental auctions are considered incentive compatible since the commitment to pay real money creates an incentive to truly reveal the reservation price.

However, no method is completely precise. Many studies have shown that both direct and indirect approaches can generate inaccurate results for various psychological and technical reasons (*e.g.*, Miller *et al.*, 2011). According to these authors, both approaches measure consumers' hypothetical, rather than actual, WTP and thus can generate a hypothetical bias, which economics literature defines as the bias induced by the hypothetical nature of a task.

Studies carried out until now supply evidence that hypothetical WTP is substantially greater than actual WTP (Neill *et al.*, 1994). For example, List & Gallet (2001) used evidence from a meta-analysis and found that on average subjects overstate their preferences by a factor of about 3 in hypothetical settings. In contrast, Murphy *et al.* (2005) found a median ratio of hypothetical to actual value of only 1.35. Concretely, CV has been criticised for overestimating WTP and consequently the demand for new products (Blumenschein *et al.*, 1998); many times the prices and levels of demand subsequently obtained have been considerably lower than the ones predicted (Grunert *et al.*, 2009). In this sense, experimental auctions, although not problem-free (we will discuss in more detail later), are preferred by some researchers since they use real money and therefore, they overcome the hypothetical bias of the CV.

In the specific context of food literature some papers compare WTP methods: Johannesson *et al.* (1997) compared an open-ended hypothetical WTP question and a second-price auction for a box of chocolate and they could not reject the null hypothesis of no difference in the mean WTP between the groups. Werthen-

broch & Skiera (2002) compared the Becker, De Groot and Marschak's (BDM) incentive-compatible auction with two non-incentive compatible methods such as open-ended and double-bounded CV in specific point of purchase contexts. They found that consumers reported substantially lower WTP under BDM than under hypothetical response formats. The same BDM mechanism is compared with the conjoint analysis by Silva *et al.* (2007) to measure consumers' WTP for novel products (grapefruit), reporting that the hypothetical WTP values are significantly higher than the non-hypothetical WTP values.

Ding *et al.* (2005) conducted a study to compare hypothetical choice conjoint, hypothetical CV, or stated-price method; and their corresponding incentive-aligned versions. The context they used was Chinese dinners and they found strong evidence in favor of incentive-aligned choice conjoint analysis and therefore suggest conjoint practitioners to consider conducting studies in realistic settings using incentive structures.

However, Grunert *et al.* (2009) did not find differences between the use of CV and experimental auction, and between the use of real vs. game money. They hypothesized that dealing with a low-priced consumer good may play a role in these results.

More recently, Pomarici & Vecchio (2014) compared hypothetical and non-hypothetical auctions to obtain wine drinkers' WTP and they found that WTP in the hypothetical auctions range from 58% to 63% more than WTP in non-hypothetical auctions.

Experimental auctions

Experimental auctions have become an important technique to determine consumers' WTP as an alternative to CV methods, which have been criticised for hypothetical bias (List, 2003), although they are also important to identify consumers' preferences (Noussair *et al.*, 2004; Poole *et al.*, 2007). The principal advantage of experimental auctions is that a real product and real money are used. Therefore, the dominant strategy of truthful bidding and the commitment of real money create an incentive to truthfully reveal reservation prices (Voelckner, 2006).

However, this method also bears disadvantages, such as higher costs than CV, geographical or regional restrictions on samples and, thereby, non-representativeness of the sample, bias caused by participation payments, artificial settings of experiments that induce discrepancies between behaviours in the lab and in real life and the gambling behaviour developed by respondents competing and trying to win the auction (Lee & Hatcher, 2001; Voelckner, 2006).

Another critical point is the difficulty in understanding the auction procedure (Kagel & Levin, 1993). Staging a trial auction with a product not belonging to the experiment attempts to solve this (Umberger *et al.*, 2002; Alfnes & Rickertsen, 2003; Martínez-Carrasco *et al.*, 2006).

There are several auction mechanisms, all with advantages and inconveniences (Lusk *et al.*, 2004). In agricultural economics the applications of experimental auctions to various problems are increasing (Jaeger *et al.*, 2004). In Brugarolas *et al.* (2009), there is a compilation of several applications of experimental auctions to food products. Some research papers compare different auction mechanism in a food context. For example, De Groote *et al.* (2011) used both Vickrey and BDM auctions to quantify maize consumers' preference for fortified maize in Western Kenya; Elbakidze *et al.* (2013) used three types of auction mechanism: second-price, random n^{th} , and incremental second-price auctions to elicit WTP for humane animal care-certified dairy products; Depositario *et al.* (2014) examined the effect of the cash endowment level on bidding behavior under the second price auction and the random n^{th} price auction. In the specific case of tomatoes, Chen *et al.* (2015) develop recently a BDM auction experiment to determine consumers' WTP for tomatoes carrying different organic labels.

The contingent valuation method

Contingent valuation is a survey-based approach that attempts to create a hypothetical market for a good or service by constructing a scenario in which survey respondents indicate the amount of money they would pay to hypothetically acquire the good or service described in the questionnaire (Mitchel & Carson, 1989). Although the CV method has been traditionally used to determine the value of goods that have no established private market, such as environmental goods, its use has been extended to other applications, such as to analyse WTP a premium price for an added value feature of a product, such as organic food (Loureiro & Hine, 2002; Batte *et al.*, 2007; Mesías *et al.*, 2012), and to avoid the potential risk from the consumption of certain foods (Weaver *et al.*, 1992; Buzby *et al.*, 1995). It is one of the most used method to measure WTP in empirical studies because it is an inexpensive, flexible tool and easier to implement than other experimental methods. But it also has downsides, such as overestimation of true WTP, large differences between WTP and willingness to accept, discrepancy depending on the familiarity with the good, inconsistencies between closed-ended and open-ended responses, and vulnerability to sample and question format bias (Lee & Hatcher, 2001; Hausman, 2012).

Research design and data collection

The population that was the object of the study has been “regular salad tomato buyers, adults and residents of the province of Alicante (Eastern, Spain)” The choice of the sample was made following the non-probability convenience sampling procedure called snowball sampling (Bailey, 1994). To recruit participants, an email was sent to all staff of the University Miguel Hernández (Elche, Eastern Spain), including students, administration and services staff, lecturers and researchers, while urging to invite family and friends with the aim of obtaining a sample as much heterogeneous as possible. Two were the eligible criteria to participate: to reside in the province of Alicante and be tomato buyer. Participation in the sessions was gratified with 10 €.

Sessions were conducted in the month of July, 2010 in four different locations around the province of Alicante. A total of 210 participants were recruited who were randomly assigned to the auction or the CV experiment. A total of 20 group sessions were carried out with a number of participants per session between 8 to 12 and lasting from 20 to 45 minutes. Two varieties of tomato were used: ‘Muchamiel’ and ‘De la Pera’. Both are traditional landraces originated in Alicante (Eastern of Spain), that is, in the area of studio. For each of the varieties two types of tomato were available: tomatoes purchased in traditional stores, and tomatoes grown *ad hoc* for a breeding project. The tomatoes we used as reference were store-bought tomatoes and tomatoes for which participants had to bid were grown tomatoes.

Unidentified tomatoes were shown to the participants in both types of sessions. The only information offered in stage 1 was a reference price for the reference tomatoes varying from 2.80 €/kg to 3 €/kg. These prices were obtained through commercial observation at several usual shopping establishments for fruit and vegetables during the week that the experiments were conducted. The tomatoes were available both in whole fruits and pieces for tasting and participants could touch, smell and taste the product before submitting their WTP. Thus, one of the requisites of CV was satisfied that requires interviewees to be familiarised with the product (Cummings *et al.*, 1986; Bateman & Turner, 1993). Because of its nature, the auction also requires the presence of the real product. In stages 2 and 3 we revealed the local origin and the organic grown of the tomatoes respectively. Next, both experimental procedures are specified in detail.

The auction chosen for this study was the random n^{th} price auction whose advantage as opposed to others is that it involves *off-margin* bidders, that is, those whose preferences are relatively low or moderate, who

hardly feel attracted to auctions in which they have no possibility of winning (Shogren *et al.*, 2001). An n^{th} price auction is run as follows: participants make their bids anonymously and secretly. The auctioneer collects them and puts them in order from the highest to the lowest, assigning them a number in order from 1 to n , where n is the number of participants. To choose the winner of the auction, the auctioneer extracts a number from 1 to $n-1$ at random. The number (k) extracted indicates the price at which the product will be auctioned. Winners of the auction are all the participants who had made a bid higher than k . By determining the winner through a random number, the winner is disconnected from his bid, so that bidders with low or moderate evaluations also have a good chance of obtaining the product.

Due to dealing with a quite complex procedure, a trial auction was carried out with a different product other than the key product of the experiment. The trial auction was conducted with a small bottle of water. Before the auction began, participants had to commit to purchase the product in the event of winning the auction, for which they signed a purchase contract. Once the auction began, participants had to bid for tomatoes after tasting and manipulating them (touching, smelling, etc.). This was round 1. Then it was revealed that the tomatoes were produced locally (round 2). Finally the participants were informed that the tomatoes had been produced organically (round 3).

For the CV question a mixed format was chosen which began with a discrete question (binary or referendum) followed by an open-ended or continuous question. In the binary question they were asked whether or not they were willing to pay a determined premium price for one good in comparison with another. Independently of whether the answer was affirmative or negative, the second question asked what their maximum WTP for the good would be. In our case, this second question was followed by two more which asked what the maximum WTP would be if the tomato were of local origin (stage 2) and if the tomato were farmed organically (stage 3). The advantage of this formula lies in it being somewhat simpler for the respondent, even though it shares the majority of inconveniences of the starting point price. This price conditions the respondent who finally opts for a value (influenced by the one indicated in the question) which is not really the one he is thinking (Herriges & Shogren, 1996). This case sometimes happens from trying to please the interviewer. To minimize the starting point bias, the sample was divided into four subsamples. A different starting point price was offered to each of the four. These guide prices came from applying a percentage (+10%, +25%, +50%, +100%) to the

reference price. Once the results were obtained, the inexistence of bias in the guide price was verified through several parametric and non-parametric tests for comparing means, so that the data from the four subsamples could be considered aggregated.

After finishing each session, respondents filled out a questionnaire which asked for their socioeconomic data and some questions about their tomato purchasing and consumption habits.

Results

Profile of the sample

Tables 1 and 2 show the profile of the participants from both experiments according to their socioeconomic traits and tomato purchasing habits.

As mentioned above, participants were randomly assigned to one of the experiments without knowing a

priori in which type of experiment they were going to participate. As can be seen on Tables 1 and 2, the profiles of both samples were very similar. Although the mere observation of the data seems to indicate some differences, a one-way ANOVA test determined that they were insignificant. Only two variables were significantly different between both samples. In the auction experiment there was a significantly higher percentage of individuals who buy tomatoes in traditional vegetable shops and the price paid for the latest purchase of tomatoes was significantly higher among participants of the CV experiment.

Direct results on willingness to pay

In the first place, the percentage of participants who were willing to pay at least the reference price in each of the experimental conditions was determined. The results are shown on Table 3. In the case of the auction,

Table 1. Sample characteristics (%)

Variable	Category	CV ^a	EA ^b	Alicante ^c	Spain ^c
Gender	Women	65.4	63.7	50.6	50.0
	Men	34.6	36.3	49.4	49.0
Age (years)	18-24	13.9	15.5	23.5	23.1
	25-34	19.4	25.2	29.1	28.9
	35-49	37.0	28.2	27.5	27.2
	50-64	21.3	19.4	19.9	20.8
	> 64	8.3	11.7		
Activity	Housewife	11.1	11.7	11.7	11.9
	Student	15.7	23.3	20.6	20.2
	Employee	40.7	35.0		
	Self-employed	1.9	0.0	40.2 ^d	40.2 ^d
	Entrepreneur	2.8	1.0		
	Retired	6.5	8.7	17.7	17.3
	Unemployed	4.6	4.9	5.6	6.6
	Other	16.7	15.5	3.7	4.3
Monthly household income (EUR)	< 1000	15.8	16.7	—	22.7
	1001 - 2000	39.6	29.4	—	40.0
	2000 - 3000	22.8	27.5	—	22.1
	3000 - 4000	16.8	16.7	—	
	> 4000	5.0	9.8	—	15.1 ^e
Education	Primary	20.8	18.6	—	47.0
	Secondary	26.4	19.6	—	22.0
	University	52.8	61.8	—	31.0

^a CV, contingent valuation. ^b EA, experimental auction. ^c Data source of Alicante and Spain: Instituto Nacional de Estadística (www.ine.es) and MECD (2013). ^d It comprises employee, self-employed and entrepreneur; ^e > €3000; —, no data.

Table 2. Purchasing habits and consumption of the sample tomato

Variable	Category	CV	EA
Place of purchase ^a	Market	69.8	65.0
	Vegetable shop	49.1	62.1
	Super/hypermarket	48.1	56.3
	Street market	66.0	66.0
	Other	95.3	92.2
Weekly per capita consumption (kg)	< 0.5	26.9	15.5
	0.5 - 1	57.4	65.0
	> 1	15.7	19.4
Price paid in the latest purchase of tomato ^b	Minimum	0.90	0.40
	Maximum	5.80	5.80
	Mean	2.13	1.84
	Standard deviation	0.84	0.85

^a Several options could be marked in this question, so that the aggregated data exceeds 100%. ^b The basic statistics have been calculated given the continuous nature of this variable.

Table 3. Percentage of participants willing to pay the same or more than the reference price

Stage	EA		CV	
	Muchamiel	De la Pera	Muchamiel	De la Pera
1	21.4	20.4	41.5	37.0
2	19.4	23.3	47.3	40.8
3	30.1	26.2	64.8	55.5

Table 4. Mean willingness to pay for each type of tomato (€/kg)

Stage	EA				CV			
	All		WTP same or more		All		WTP same or more	
	Much	Pera	Much	Pera	Much	Pera	Much	Pera
1	1.90	1.91	3.06	3.11	2.61	2.54	3.58	3.56
2	1.93	1.93	3.06	3.11	2.72	2.66	3.57	3.67
3	2.11	2.13	3.12	3.29	3.21	3.09	3.77	3.88

the percentage of participants willing to pay the same or more than the reference price was around 20% in the first two stages, increasing to 30% and to 26% respectively when informed that both the Muchamiel and the De la Pera cultivars were organic. These percentages were much higher in the case of the CV. In the first two stages, they were situated around 40% and up to 47% in the case of the Muchamiel of local origin and increased to 65 and 55% respectively when the organic characteristic of the tomatoes was revealed. That is, the CV method shows between 16 and 35% more individuals willing to pay a premium price.

On Table 4 the mean WTP is shown in the three stages for each experiment. The results were calculated for the whole of the individuals on the one hand and for the segment that is willing to pay at least the reference price on the other. The mean WTP in the auction, considering the whole of the individuals, was situated between 1.90 and 2.13 €/kg (depending on which tomato and on the stage). These same results obtained through the CV were situated between 2.54 and 3.21 €/kg. In all the cases, the mean differences were statistically significant. This test was performed through one-way ANOVA. When the segment willing

to pay at least the reference price was considered by itself, the mean WTP in the auction varied between 3.06 and 3.29 €/kg. In the case of the CV this mean WTP varied between 3.56 and 3.88 €/kg. Again, the mean differences were statistically significant. Nonetheless, it must be taken into consideration that the price paid in the latest tomato purchase by those who participated in the CV was significantly higher than by those who participated in the auction, which may have influenced these results.

Hedonic price analysis

Lastly, several hedonic price models were estimated for WTP obtained by both types of tomato in each stage and in each experimental condition according to a series of socioeconomic variables and tomato consumption habits asked in the survey. Definitions of the dependent variables are shown on Table 5.

Table 6 shows the codification of the independent variables that were used in the hedonic price equation. The “price paid for the latest purchase” is a continuous variable and is measured in €/kg. The other variables are dummy variables codified as 0 and 1 where 1 represents the case under consideration and 0, any other case. The stepwise method was used to estimate the regression. This method directly includes the variables that have a coefficient of significance below 0.05 or 0.10.

The coefficients and the goodness of fit obtained for each model are shown on Table 7 for Muchamiel tomato and on Table 8 for De la Pera tomato.

In the models estimated for the Muchamiel variety, the price paid for 1 kg of tomatoes in the latest purchase was a significant variable and directly proportional to WTP. In all of them, the coefficient of this predictor varied between 0.3 and 0.5.

Another significant variable in all the models was the student variable. Nevertheless, the fact is conspicuous that in the models obtained from the CV, this variable has a positive coefficient, while in the ones obtained from the auction, the coefficient has a negative sign. Perhaps this fact can be explained by the hypothetical or non-hypothetical characteristic of the techniques used.

One variable that seemed significant in the models obtained from the CV was income. In the first case, the fact of having incomes lower than 1000 € was negatively related to WTP for the Muchamiel tomato. In the next two cases, the fact of having incomes between 1000 and 2000 € was positively related to WTP for the local and for the organic tomato.

In the case of the auction, the fact of having a primary education was negatively related to WTP for the Muchamiel tomato of local origin and from organic farming.

In the De la Pera tomato (Table 8), the price paid for 1 kg of tomatoes in the latest purchase was also a significant variable and directly proportional to WTP. It might be pointed out that the coefficient assigned to this variable is very similar in all the equations, around 0.4.

In the three models obtained from the CV, incomes between 1000 and 2000 € were positively related to WTP. In the first of these models, besides, the fact of

Table 5. Description of the dependent variables

Variable	Description
EA1 Much	Mean WTP obtained in stage 1 of the EA for Muchamiel tomato
EA2 Much	Mean WTP obtained in stage 2 of the EA for Muchamiel tomato
EA3 Much	Mean WTP obtained in stage 3 of the EA for Muchamiel tomato
CV1 Much	Mean WTP obtained in stage 1 of the CV for Muchamiel tomato
CV2 Much	Mean WTP obtained in stage 2 of the CV for Muchamiel tomato
CV3 Much	Mean WTP obtained in stage 3 of the CV for Muchamiel tomato
EA1 Pera	Mean WTP obtained in stage 1 of the EA for De la Pera tomato
EA2 Pera	Mean WTP obtained in stage 2 of the EA for De la Pera tomato
EA3 Pera	Mean WTP obtained in stage 3 of the EA for De la Pera tomato
CV1 Pera	Mean WTP obtained in stage 1 of the CV for De la Pera tomato
CV2 Pera	Mean WTP obtained in stage 2 of the CV for De la Pera tomato
CV3 Pera	Mean WTP obtained in stage 3 of the CV for De la Pera tomato

Table 6. Independent variables used in hedonic price functions

Variable	Values
<i>Gender</i>	1= woman; 0= man
<i>Age</i>	
Age1	1= 18 to 24 years old; 0= anything else
Age 2	1= 25 to 34 years old; 0= anything else
Age 3	1= 35 to 49 years old; 0= anything else
Age 4	1= 50 to 64 years old; 0= anything else
<i>Activity</i>	
Act1	1= Housewife; 0= anything else
Act2	1= Employee; 0= anything else
Act3	1= Student; 0= anything else
Act5	1= Self-employed; 0= anything else
Act6	1= Retiree; 0= anything else
Act7	1= Unemployed; 0= anything else
<i>Monthly household income</i>	
Income1	1= < €1000; 0= anything else
Income2	1= €1000-2000; 0= anything else
Income3	1= €2000-3000; 0= anything else
Income4	1= €3000-4000; 0= anything else
<i>Education</i>	
Edu1	1= primary education; 0= anything else
Edu2	1= secondary education; 0= anything else
<i>Place of purchase</i>	
PP1	1= market; 0= anywhere else
PP2	1= vegetable shop; 0= anywhere else
PP3	1= super/hypermarket; 0= anywhere else
PP4	1= street market; 0= anywhere else
<i>Consumption per capita</i>	
Conspercap1	1= < 0.5 kg; 0= anything else
Conspercap2	1= 0.5-1 kg; 0= anything else
<i>Price paid for 1 kg of tomatoes in latest purchase (€/kg)</i>	
Latestprice	Continuous variable

having a secondary education was positively related to WTP for De la Pera tomato. And WTP for organic De la Pera tomato was negatively related to purchasing tomato at street markets.

In the auctions only one additional significant variable emerged. This variable turned out to be that of the student, which was negatively related to WTP, similarly to what happened with the Muchamiel tomato.

Discussion

The choice of the most adequate method to determine consumer WTP and therefore to discover the true valuation that they confer to products can guide business managers in making optimal pricing decisions. This paper aims to contribute empirical results by comparing two methods that measure consumer WTP in a food context.

Table 7. Hedonic price models for Muchamiel tomato.

Dependent variable	Predictor variables	Non-standardized coefficients		Typified coefficients Beta	t value	R ²
		B	Typical error			
EA 1 Much	(Constant)	1.161	0.198		5.863	0.288
	Latestprice	0.441	0.094	0.470	4.680	
	Act3	-0.434	0.198	-0.221	-2.194	
EA2 Much	(Constant)	1.421	0.191		7.429	0.419
	Latestprice	0.438	0.087	0.463	5.042	
	Act3	-0.683	0.188	-0.343	-3.638	
	Edu1	-0.624	0.192	-0.306	-3.244	
EA3 Much	(Constant)	1.505	0.206		7.307	0.410
	Latestprice	0.489	0.094	0.483	5.222	
	Act3	-0.657	0.202	-0.309	-3.251	
	Edu1	-0.620	0.207	-0.284	-2.992	
CV 1	(Constant)	1.577	0.282		5.602	0.304
	Latestprice	0.429	0.122	0.377	3.526	
	Income1	-0.932	0.300	-0.336	-3.110	
	Act3	0.814	0.334	0.263	2.439	
CV2	(Constant)	1.405	0.288		4.882	0.266
	Latestprice	0.393	0.123	0.351	3.204	
	Income2	0.487	0.208	0.257	2.345	
	Act3	0.743	0.333	0.242	2.227	
CV3	(Constant)	1.958	0.287		6.813	0.269
	Income2	0.647	0.207	0.341	3.119	
	Latestprice	0.307	0.123	0.274	2.503	
	Act3	0.746	0.333	0.243	2.242	

Table 8. Hedonic price models for De la Pera tomato.

Dependent variable	Predictor variables	Non-standardized coefficients		Typified coefficients Beta	t value	R ²
		B	Typical error			
EA1 Pera	(Constant)	1.074	0.214		5.010	0.199
	Latestprice	0.444	0.106	0.446	4.200	
EA2 Pera	(Constant)	1.242	0.241		5.153	0.211
	Latestprice	0.423	0.115	0.390	3.681	
	Act3	-0.482	0.241	-0.211	-1.996	
EA3 Pera	(Constant)	1.295	0.256		5.055	0.155
	Latestprice	0.460	0.127	0.394	3.633	
CV1 Pera	(Constant)	1.303	0.256		5.085	0.282
	Latestprice	0.444	0.113	0.426	3.948	
	Edu2	0.496	0.204	0.263	2.437	
	Income 2	0.377	0.184	0.215	2.053	
CV2 Pera	(Constant)	1.330	0.272		4.899	0.279
	Latestprice	0.468	0.117	0.431	4.000	
	Income2	0.474	0.198	0.258	2.398	
CV3 Pera	(Constant)	2.070	0.310		6.679	0.301
	Latestprice	0.392	0.126	0.334	3.113	
	PP2	-0.572	0.214	-0.284	-2.671	
	Income2	0.538	0.213	0.271	2.529	

Our results seem to confirm previous studies which state that a hypothetical method such as CV gives higher results about WTP than a method that requires a real commitment to purchase the product, like the experimental auction (Neill *et al.*, 1994; Voelckner, 2006). In our case, WTP in the CV method range from 17% to 50% more than WTP in the experimental auction. Other authors have found wider ranges such as Pomarici & Vecchio (2014) who found that WTP in hypothetical auctions range from 58% to 63% more than WTP in non-hypothetical auctions. Kaneko & Chern (2004) also found evidence about a large hypothetical bias of more than 50%. Burchardi *et al.* (2005) concluded that WTP from a hypothetical CV setting is biased upwards when compared with the experimental setting and they suggested designing surveys which allow for an identification of subjects who are more prone to be affected by hypothetical bias than others.

In our work, the hypothetical bias is particularly relevant in reference to the percentage of individuals willing to pay a premium price, which is quite higher in the CV. Nevertheless, we must be more cautious in reference to the differences found in the WTP obtained through one method or the other since the samples differed in the price paid for the latest purchase of tomato.

In the estimated hedonic price functions, the price paid for tomatoes in the latest purchase was a significant variable, directly related to WTP and having similar weight in all the models, those obtained from the auction as well as those obtained from CV. The most important difference found between the models obtained from auctions and those obtained from CV was that in the latter, average household incomes appeared as a significant variable which were positively related to WTP with the exception of CV1 for Muchmiel tomato.

Another variable that had prominence in the models obtained in Muchmiel tomato was the student variable, since it is directly related to WTP in CV and indirectly in auctions. The explanation found for this fact perhaps lies in the hypothetical vs. the real characteristic of the methods. For, when WTP is attempted to be manifested without any monetary commitment, students bid high, while when a real commitment to purchase is required, they preferred to bid low.

Besides, it could be seen through the estimated hedonic price models that this variable directly influences consumer WTP. In fact, if this were the only influential variable, we could consider both techniques as comparable and could explain the different mean WTPs obtained in our results.

Nevertheless, the estimated hedonic price functions have revealed that other variables can have an influence

on WTP, such as income and work activity, concretely the situation of the student. They would be the variables to control in these studies since they would provide important changes in the mean price obtained, depending on the method used. This is important in the case of the second variables, since much research uses students for samples due to ease of access.

The paper identifies several variables which are related to WTP for tomatoes, such as the price paid for 1 kg of tomatoes in the participants' most recent purchase, income or being a student or not. Some practitioners might be able to make inferences from that.

The R^2 statistic is somewhat low in some models, especially in those obtained for De la Pera tomato from the auctions. However, R^2 s close to 0.3 or higher are similar to those obtained in other hedonic price models for fresh products (Melton *et al.*, 1996; McConnell & Strand, 2000; Huang & Lin, 2007). Nevertheless, the purpose of this study is not so much to find variables that explain willingness to pay as to compare the results obtained by both techniques. However, our study has certain limitations when generalising results due to the non-probabilistic sampling. Therefore it is necessary to continue researching in this field with the purpose of developing adequate methods for measuring willingness to pay.

References

- Adamowick W, Louviere J, Williams M, 1994. Combining revealed and stated preference methods for valuing environmental amenities. *J Environ Econ Manage* 26: 271-292. <http://dx.doi.org/10.1006/jeem.1994.1017>
- Alfnes F, Rickertsen K, 2003. European consumers' willingness to pay for U.S. beef in experimental auction markets. *Am J Agr Econ* 85 (2): 396-405. <http://dx.doi.org/10.1111/1467-8276.t01-1-00128>
- Bailey K, 1994. *Methods of Social Research*. 4th Edition. The Free Press. New York.
- Bateman IJ, Turner RK, 1993. Valuation of environment, methods and techniques: the contingent valuation method. In: *Sustainable environmental economics and management: principles and practice*; Kerry Turner R (ed). pp: 91-120. Belhaven Press, London.
- Batte MT, Hooker N, Haab T, Beaverson, J, 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. <http://dx.doi.org/10.1016/j.foodpol.2006.05.003>
- Blumenschein K, Johannesson M, Blomquist G C, Liljas B, O'Connor RM, 1998. Experimental results on expressed certainty and hypothetical bias in contingent valuation. *Southern Econ J* 656 (1): 169-177. <http://dx.doi.org/10.2307/1061360>

- Brugarolas M, Martínez-Carrasco L, Martínez-Poveda A, Ruiz JJ, 2009. A competitive strategy for vegetable products: traditional varieties of tomato in the local market. *Span J Agric Res* 7(2): 294-304. <http://dx.doi.org/10.5424/sjar/2009072-420>
- Burchardi H, Schröder C, Thiele HD, 2005. Willingness-to-pay for food of the own region: empirical estimates from hypothetical and incentive compatible settings. *American Agricultural Economics Association Annual Meeting*, Providence, RI, USA, July 24-27.
- Buzby J, Skees J, Ready R, 1995. Using contingent valuation to value food safety: a case study of grapefruit and pesticide residues. In: *Valuing food safety and nutrition*; Caswell JA (ed), pp: 219-256. Westview Press, Boulder, CO, USA.
- Chen M, Yin S, Xu Y, Wang Z', 2015. Consumers' willingness to pay for tomatoes carrying different organic labels: Evidence from auction experiments. *Brit Food J* 117(11). <http://dx.doi.org/10.1108/BFJ-12-2014-0415>
- Cummings RG, Brookshire DS, Schulze WD (eds.), 1986. *Valuing environmental goods: a state of the arts assessment of the contingent valuation method*. Rowman and Allanheld. Totowa, NJ, USA. 326 p.
- De Groote H, Kimenju SC, Morawetz UB, 2011. Estimating consumer willingness to pay for food quality with experimental auctions: the case of yellow versus fortified maize meal in Kenya. *Agr Econ* 42(1): 1-16. <http://dx.doi.org/10.1111/j.1574-0862.2010.00466.x>
- Depositario, DPT, Nayga RM, Zhang YY, Mariano, RDE, 2014. Revisiting cash endowment and house money effects in an experimental auction of a novel agri-food product in the Philippines. *Asian Econ J* 28(2): 201-215. <http://dx.doi.org/10.1111/asej.12033>
- Ding M, Grewal R, Liechty J, 2005. Incentive-aligned conjoint analysis. *J Mark Res* 42(1): 67-82. <http://dx.doi.org/10.1509/jmkr.42.1.67.56890>
- Elbakidze L, Nayga R M, Li H, 2013. Willingness to pay for multiple quantities of animal welfare dairy products: results from random nth-, second-price, and incremental second-price auctions. *Can J Agr Econ* 61: 417-438. <http://dx.doi.org/10.1111/j.1744-7976.2012.01263.x>
- Gabrielyan G, McCluskey JJ, Marsh TL, Ross CF, 2014. Willingness to pay for sensory attributes in beer. *Agric Res Econ Rev* 43(1): 125-139.
- Grunert KG, Juhl H, Esbjerg L, Jensen BB, Bech-Larsen T, Brunsø K, Madsen CO, 2009. Comparing methods for measuring consumer willingness to pay for a basic and an improved ready made soup product. *Food Qual Prefer* 20: 607-619. <http://dx.doi.org/10.1016/j.foodqual.2009.07.006>
- Hausman J, 2012. Contingent valuation: fromo dubious to hopeless. *J Econ Perspect* 26 (4): 43-56. <http://dx.doi.org/10.1257/jep.26.4.43>
- Herriges JA, Shogren JF, 1996. Starting point bias in dichotomous choice valuation with follow-up questioning. *J Environ Econ Manag* 30: 112-131. <http://dx.doi.org/10.1006/jeem.1996.0008>
- Huang CL, Lin BH, 2007. A hedonic analysis of fresh tomato prices among regional markets. *Appl Econ Perspect Policy* 29(4): 783-800. <http://dx.doi.org/10.1111/j.1467-9353.2007.00387.x>
- Jaeger SR, Lusk JL, House LO, Valli C, Moore M, Morrow B, Traill W.B, 2004. The use of non-hypothetical experimental markets for measuring the acceptance of genetically modified foods. *Food Qual Prefer* 15 (7-8): 701-714. <http://dx.doi.org/10.1016/j.foodqual.2004.04.002>
- Johannesson M, Liljas B, O'Connor RM, 1997. Hypothetical versus real willingness to pay: Some experimental results. *Appl Econ Lett* 4: 149-151. <http://dx.doi.org/10.1080/135048597355401>
- Kagel JH, Levin D, 1993. Independent private value auctions: Bidder behavior in first-, second- and third-price auctions with varying numbers of bidders. *Econ J* 103: 868-879. <http://dx.doi.org/10.2307/2234706>
- Kalish S, Nelson P, 1991. A comparison of ranking, rating and reservation price measurement in conjoint analysis. *Market Lett* 2(4): 327-335. <http://dx.doi.org/10.1007/BF00664219>
- Kaneko N, Chern WS, 2004. Willingness to pay for non-genetically modified food: Evidence of hypothetical bias from an auction experiment in Japan. In: *American Agricultural Economics Association Annual Meeting*, Denver, CO, USA. Aug 1-4. <http://ageconsearch.umn.edu/bitstream/20305/1/sp04ka04.pdf>
- Lange C, Combris P, Issanchou S, Schlich P, 2015. Impact of information and in-home sensory exposure on liking and willingness to pay: The beginning of Fairtrade labeled coffee in France. *Food Res Int* 76 (3): 317-324. <http://dx.doi.org/10.1016/j.foodres.2015.06.017>
- Lee K, Hatcher CB, 2001. Willingness to pay for information: an analyst's guide. *J Consum Aff* 35(1): 120-140. <http://dx.doi.org/10.1111/j.1745-6606.2001.tb00105.x>
- Lim KH, Hu W, Maynard LJ, Goddard E (2013). US consumers' preference and willingness to pay for country-of-origin-labeled beef steak and food safety enhancements. *Can J Agr Econ* 61(1): 93-118. <http://dx.doi.org/10.1111/j.1744-7976.2012.01260.x>
- List JA, 2003. Using random n-th price auctions to value non-market goods and services. *J Regul Econ* 23 (2): 193-205. <http://dx.doi.org/10.1023/A:1022259014448>
- List JA, Gallet CA, 2001. What experimental protocol influence disparities between actual and hypothetical stated values? *Environ Resour Econ* 20: 241-254. <http://dx.doi.org/10.1023/A:1012791822804>
- Loureiro ML, Hine S, 2002. Discovering niche markets: A comparison of consumer willingness to pay for local (Colorado grown), organic, and GMO-free products. *J Agric App Econ* 34 (3): 477-488.
- Lusk JL, Feldkamp T, Schroeder TC, 2004. Experimental auction procedure: impact on valuation of quality differentiated goods. *Am J Agr Econ* 86 (2): 389-405. <http://dx.doi.org/10.1111/j.0092-5853.2004.00586.x>
- Martínez-Carrasco L, Vidal F, Poole N, 2006. Evaluación de preferencias hacia las mandarinas en el mercado británico. *Aplicación de las subastas Vickrey*. *Econ Agrar Recur Nat* 6 (11): 157-175.
- McConnell KE, Strand IE, 2000. Hedonic prices for fish: tuna prices in Hawaii. *Am J Agr Econ* 82(1): 133-144. <http://dx.doi.org/10.1111/0002-9092.00011>

- MECD, 2013. Panorama de la educación. Indicadores de la OCDE 2013. Panorama español. Ministerio de Educación, Cultura y Deporte, Gobierno de España. <http://www.mecd.gob.es/inee>.
- Melton BE, Huffman WE, Shogren JF, 1996. Economic values of pork attributes: Hedonic price analysis of experimental auction data. *Rev Agr Econ* 18: 613-627. <http://dx.doi.org/10.2307/1349594>
- Mesías F J, Martínez-Carrasco F, Martínez Paz JM, Gaspar P, 2012. Consumer knowledge, consumption, and willingness to pay for organic tomatoes. *Brit Food J* 114(3): 318-334. <http://dx.doi.org/10.1108/00070701211213447>
- Miller KM, Hofstetter R, Krohmer H, Zhang ZJ, 2011. How should consumers' willingness to pay be measured? An empirical comparison of state-of-the-art approaches. *J Mark Res XLVIII*: 172-184. <http://dx.doi.org/10.1509/jmkr.48.1.172>
- Mitchell R, Carson R, 1989. Using surveys to value public goods. The contingent valuation method. Johns Hopkins University Press, Baltimore, MD, USA.
- Murphy J, Allen G, Stevens T, Weatherhead D. 2005. A meta-analysis of hypothetical bias in stated preference valuation. *Environ Res Econ* 30: 313-325. <http://dx.doi.org/10.1007/s10640-004-3332-z>
- Neill HR, Cummings RG, Ganderton PT, Harrison GW, McGuckin T, 1994. Hypothetical surveys, provision rules, and real economics commitments. *Land Econ* 70: 145-154. <http://dx.doi.org/10.2307/3146318>
- Noussair C, Robin S, Bernard R, 2004. A comparison of hedonic rating and demand-revealing auctions. *Food Qual Prefer* 15: 393-402. [http://dx.doi.org/10.1016/S0950-3293\(03\)00086-7](http://dx.doi.org/10.1016/S0950-3293(03)00086-7)
- Pomarici E, Vecchio R, 2014. Exploring factors effecting willingness-to-pay for sustainable wine through hypothetical and non-hypothetical experimental auctions. *Proc. 50th SIDEA Conf., Sustainability of the Agri-Food System: Strategies and Performances*. Lecce, Chiostro dei Domenicani, 26-28 September.
- Poole N, Martínez-Carrasco L, Vidal F, 2007. Quality perceptions under evolving information conditions: Implications for diet, health and consumer satisfaction. *Food Policy* 32: 175-188. <http://dx.doi.org/10.1016/j.foodpol.2006.05.004>
- Silva A, Nayga Jr RM, Campbell BL, Park J, 2007. On the use of valuation mechanisms to measure consumers' willingness to pay for novel products: A comparison of hypothetical and non-hypothetical values. *Int Food Agribus Man* 10(2): 165-180.
- Shogren JF, Margolis M, Koo C, List JA, 2001. A random nth-price auction. *J Econ Behav Organ* 46: 409-421. [http://dx.doi.org/10.1016/S0167-2681\(01\)00165-2](http://dx.doi.org/10.1016/S0167-2681(01)00165-2)
- Umberger W, Feu D, Calkins C, Killinger-Mann K, 2002. U.S. consumer preference and willingness-to-pay for domestic corn-fed beef versus international grass-fed beef measured through an experimental auction. *Agribusiness* 18 (4): 491-504. <http://dx.doi.org/10.1002/agr.10034>
- Vecchio R, Annunziata A, 2015. Willingness-to-pay for sustainability-labelled chocolate: an experimental auction approach. *J Clean Prod* 86: 335-342. <http://dx.doi.org/10.1016/j.jclepro.2014.08.006>
- Verbeke W, Rutsaert P, Bonne K, Vermeir I, 2013. Credence quality coordination and consumers' willingness-to-pay for certified Halal labelled meat. *Meat Sci* 95(4): 790-797. <http://dx.doi.org/10.1016/j.meatsci.2013.04.042>
- Voelckner F, 2006. An empirical comparison of methods for measuring consumers' willingness to pay. *Mark Lett* 17: 137-149. <http://dx.doi.org/10.1007/s11002-006-5147-x>
- Weaver RD, Evans DJ, Luloff, A, 1992. Pesticide use in tomato production: consumer concerns and willingness to pay. *Agribusiness* 8 (2): 131-142.
- Wertenbroch K, Skiera B, 2002. Measuring consumers' willingness to pay at the point of purchase. *J Mark Res* 39: 228-241. <http://dx.doi.org/10.1509/jmkr.39.2.228.19086>