THE ROLE OF PRODUCTION METHODS IN FRUIT PURCHASING BEHAVIOUR: HYPOTHETICAL VS ACTUAL CONSUMERS' PREFERENCES AND STATED MINIMUM REQUIREMENTS

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Abstract

In recent years, concerns for potential risks on human health related to the overuse of chemical pesticides have encouraged research of alternatives production methods as integrated pest management (IPM) and organic agriculture.

Consumer preferences for these practices or for new product characteristics often have been evaluated using stated preference techniques such as Choice Experiment (CE). Nevertheless, it has been found that in these surveys respondents generally report higher hypothetical than real willingness to pay, providing the existence of the so-called "hypothetical bias". While the presence of this bias has been widely reported in Contingent Valuation, its investigation in CE is still at the beginning. Moreover, in most of the cases, the comparison between hypothetical and real payments treatments has been performed in laboratory settings, employing within-sample approach and providing an initial endowment of money to respondents.

This paper contributes to the current literature by presenting an empirical CE study on apples performed in the field (in supermarkets) comparing a hypothetical and a real payment treatment. The latter is done without providing any initial endowment to respondents but asking them to use their own money, that is to pay out of their own pocket.

The focus of the survey is to investigate consumers' preferences for alternative production systems that employ different mixtures of chemicals, natural substances and beneficial microorganisms providing a progressive healthier and safer product. We moved from a conventional to an organic production, passing through an IPM and an innovative technique that employs biocontrol agents. Other investigated attributes are appearance, origin, climate change mitigation practices and price. Moreover, we asked respondents to state their minimum requirements for the attributes' levels (cut-offs) and to rank the attributes' importance.

Our split sample CE to evaluate apple preferences includes two treatments (hypothetical and real payment) with 96 respondents each. Data were collected in Trentino Province (Italy) during the fall of 2009 by means of a touch-screen computer-assisted self-interviewing system.

The results show that consumers' behavior is significantly different in hypothetical and real treatments, having some parameters a different effect on the probability of purchase in the two treatments. As expected, the price has more influence on the real purchase decision, while alternative methods and the issues of climate change seem weight more heavily in the hypothetical scenarios. Moreover, the coefficient associated to the alternative method that integrates microorganisms into IMP is not statistically significant in both treatments.

Regarding the order of attribute importance, the pairwise comparison between the two treatments (hypothetical vs real) indicates that only for the most important attribute (rank 1) the distribution of preferences is statistically different. In any cases, in both treatments the origin is ranked first by the majority of the respondents.

Finally, most of interviewed people stated to have cut-offs values in mind when purchasing apples. Regarding methods of production, however, results show that in a real purchasing situation 42% of respondents do not look at the method of production employed at all (with respect to 28% in the hypothetical setting) and, that among those who stated a minimum requirement, 89% violated them. These findings suggest that consumers, besides preferring organic production among other methods, seem to not give much importance on production attribute at the purchasing stage. Furthermore, they do not yet have in mind a clear frame of the other different production methods and their impact on health related aspects.

Keywords: fruit purchasing behaviour, production methods, mitigation practices, hypothetical bias, real choice experiment,

JEL codes C35 Q18 D12 C93

1. Introduction

In recent years, increasing concerns over the effects and potential risks related to the use of chemical pesticides on the environment and human health (Donald et al., 2004) have encouraged and promoted research for alternatives production methods and agricultural management practices more environmentally sound that the conventional ones.

Organic agriculture is known as a method of production which refrains from the use of chemosynthetic fertilizers, pesticides and pharmaceutical (Ghorbani et al. 2010), placing the highest emphasis on protecting and enhancing the environmental and minimizing pollution (Liebhardt, 2003). But organic agriculture is not the only alternative aiming to achieve sustainable agriculture (Wu and Sardo, 2010). Integrated pest management[1] (IMP) is now widely accepted as plant protection strategy for sustainable farming[2] in all of Europe and is considered to be a standard procedure in perennial crops (Freier and Boller, 2009). In Italy, 75-78% of the sales of Apo Conepro - the biggest Italian producers' consortium producing more than a million of tons of fruits and vegetables – and 80% of the production of the biggest fruit producers' organization in Trentino Alto-Adige is produced according to the principles of IPM (Elia et al., 2008). Unfortunately IPM is not regulated at the European level yet and according to the mixture of tools employed, the externalities produced, both in terms of residues and environmental effects, can be quite different. One promising plant protection tool integrable into IPM is biological control. Biocontrol agents are living organisms capable of suppressing and/or controlling the population or impact of pests (Eilenberg et al., 2001). Thanks to their generally minimal effects on soil fertility and local water quality (Hokkanen and Lynch, 2003) and the absence of chemical residues in the final product, they assure remarkable benefits for consumers, growers and the environment. Unfortunately, at this stage of their development, they cannot completely substitute chemicals pesticides but they can be used successfully in IMP strategies (Moser et al., 2008a).

In the most recent years, given the growing concern about climate change, there has been also an increasing interest in studying the effect of agriculture on climate change (Desjardins et al., 2007). Farmers can influence greenhouses gas emissions through decisions on their production system (crops and/or livestock systems and/or alternative productions like energy cropping, biofuels, and biogas), on which type of production method to adopt (conventional, IPM, organic), on the choice of variety, level of mechanization, irrigation, fertilization schedules, etc. (Seguin et al., 2007). So, among the several mitigation practices which can help agriculture to reduce gas

[1] In the 1987 German Plan Protection Act IPM was defined as a "combination of methods in which primary attention is paid to biological, biotechnical, plant-breeding and cultivation techniques, and in which the use of chemical pesticides is limited to necessary amount" (Freier and Boller, 2009).

[2] Studies have shown that IPM systems yield greater biodiversity and reduce pesticide use by at least approximately 20% compared to conventional farming (Freier and Boller, 2009).

emissions (Johnson et al., 2007), some of them can be applied independently of the chosen production method.

Looking at the different production methods form the consumer side, while preferences to organic food have been extensively studied research into consumer response towards IPM or other sustainable production is currently scarce in the literature (Govindasamy and Italia, 1998; Louriero et al. 2001, Scarpa et al., 2005). The investigation on consumers' sensibility to low carbon emission products is still at its beginning. A recent market research on 300 Italian consumers (Det Norske Veritas -DNV, 2009), revealed that 83% of interviewees consider important (quite or very important) to buy food products with low CO_2 emission, even if terms such as "carbon free" or "carbon neutral" are unknown for 94% of the interviewees. At the European level, the recent Special Eurobarometer survey (TNS Opinion & Social, 2010), suggests that Europeans are ready to pay their share to contribute to emission reduction. About six out of ten respondents (58%) responded affirmatively about their willingness to pay 10% more for agricultural products if they are produced in a way that does not increase climate change. These responses skew more to 'tend to agree' (37%) rather than 'totally agree' (21%), and this skewness is even stronger for Italy where 40% of interviewees 'tend to agree' and 19% 'totally agree'.

Stated preferences techniques such as Choice Experiment (CE) allow the researcher to evaluate consumer' preferences for products attributes and their willingness to pay in a more rigorous way. Nevertheless, it has been found that in these surveys respondents generally report higher hypothetical than real willingness to pay, providing the existence of the so-called "hypothetical bias". This bias has been widely reported in Contingent Valuation, while its investigation in CE is still at the beginning. Moreover, these studies have been done in laboratory settings, employing within-sample approach and providing an initial endowment of money to respondent.

In this study we present a Choice Experiment carried out to understand apple consumers' preference for the use of alternative production systems besides the common ones. In addition to conventional and organic production, we scrutinized preference for IPM and a more innovative IPM technique that employs biocontrol agents extensively and for the adoption of mitigation practices aiming at reducing greenhouses gas emission. Other investigated attributes were appearance, origin, and price. Additionally, we asked respondents to rank attributes presented in CE in order of importance and to state if they have some minimum requirements for the attributes' levels in mind when they decide to buy. We scrutinized preferences about apples because in Italy they are staple fruit with an average annual purchase per household in 2008/2009 equal to 39 kg (CSO, 2009). In Trentino province (Italy) they represent the main crop, along with wine grapes. With a production

over 450 thousands of tons of apples, this small province is the second major production area in Italy (PAT, 2010).

From a methodological point of view, this is the first CE study - to our knowledge - investigating hypothetical bias in the field (in supermarkets) without providing any initial endowment to respondents but asking respondents to use their own money, that is to pay out of his/her own pocket. Our sample design includes two treatments with 96 respondents each: a hypothetical treatment and a real payment treatment. Data were collected in Trentino Province (Italy) during the fall of 2009. A between sample approach was used to avoid the cognitive dissonance and to control for non-response rate due to time burden if people had to answer both the hypothetical and the real questionnaire.

The paper is structured as follows: Section 2 provides a literature review on hypothetical bias; Section 3 describes the use of incentive compatible mechanisms in CE to induce respondents to state or reveal their real preferences; Section 4 describes the CE mechanism, the survey and experimental design, the data and the estimation method; Section 5 presents the results; and Section 6 summarizes the findings and draws practical implication for further research.

2. Hypothetical vs actual consumers' preferences

In literature, particular attention has been devoted to the difference between hypothetical and real values – the so called hypothetical bias – since it leads most often to an overestimation of the WTP estimates (for a review and meta studies see List and Gallet, 2001; Little and Berrens, 2003; Murphy et al., 2005; and Harrison, 2006).

Several studies have addressed hypothetical bias in CV (Champ et al., 2009) but the literature that compares actual and hypothetical payments in CE is still rather restricted and limited to experimental setting. In fact, most of these studies are performed in a laboratory setting and employed within-sample approach.

Lusk and Schroeder (2004) found that hypothetical responses predicted higher probabilities of purchasing than the real ones and a higher total hypothetical WTP for beef steaks while the marginal WTP was not statistically different. Alfnes et al. (2006, 2009) observed a significantly lower actual WTP for the colour of salmon than the hypothetical one. Johansson-Stenman and Svedsäter (2008) conducted both within-subject and between-subject tests of hypothetical bias on public good donation - two environmental campaigns run by the World Wildlife Fund - founding a largest WTP estimate in the hypothetical CE than in the real one. Chang et al. (2009) compared CE, real CE and non hypothetical conjoint ranking results with market behaviour showing that the real approaches did better than the hypothetical CE in predicting retail sales of ground beef, wheat flour

and dishwashing liquid. Corrigan et al. (2009) compared the performances of Open-Ended Non-hypothetical CE and Experimental Auctions to estimate consumer demand for genetically modified golden rice, finding WTP estimates from CE more reliable in terms of stability across rounds and equivalence to the final auction round estimates. As far as we know the only study carried out on field is Chowdhury et al. (2009) who explored CE hypothetical bias in the field, investigating consumer WTP for biofortified foods in a developing country. They founded that respondents overstated their hypothetical WTP by a factor over than 2.

As common practice in experimental research all the above mentioned studies provided respondents with an initial endowment. There are though some empirical evidences that giving respondents initial money might create a "house money effect" leading people to spend or invest more money. People are going to treat the money received unexpectedly ("windfall money") in a different way with respect to their regular income (Keeler et al., 1985; Battalio et al., 1990; Thaler and Johnson, 1990; Arkes et al., 1994; Keasy and Moon, 1996; Carlsonn et al., 2009). In experimental settings, this effect has been investigated in public good contributions (Clark, 2002; Cherry et al., 2005), capital expenditure decision (Soman and Cheema, 2001) and trading sector (Brown et al., 2005; Frino et al., 2008). Results are different: some studies found this effect (as Carlsson et al., 2009), while other do not (Clark, 2002). To avoid the house money effect we did not provide respondents with an initial endowment but they had to pay out of their own pocket to buy the selected product. However, applying such approach may reduce participation rates or underestimate consumers' WTP (Lusk et al., 2008).

3. Methods

In order to test the presence of hypothetical bias we designed and carried out a split sample Choice Experiment including two different treatments: a hypothetical treatment and a real payment treatment, with 96 respondents each. In the hypothetical treatment a short cheap talk was employed as common practice after Cummings and Taylor (1999).

In the real treatment respondents were informed - before starting the survey- that one of the choice cards was going to be randomly selected at the end of the CE and that they had to buy the chosen product indicated in the card, if they had selected one. Moreover, a short reminder was also provided in the survey before showing the choice cards. They were told that since each choice card had the same probability to be selected, they had to carefully answer as if each choice can subsequently be a real choice, involving real money payout.

This type of mechanism, where a randomly selected choice scenario becomes effective at the end of the experiment, has been used in CE's by Johansson-Stenman and Svedsäter (2008), Lusk et

and Schroeder, (2004), Ding et al. (2005), Alfnes et al. (2006) and Lusk et al. (2008). This mechanism is incentive compatible (IC) because it is in participants' best interest to reveal their real preferences. If they choose the none-of-these option, they could loose an opportunity to get the product at a really interesting price, while if they choose a product with a high price, then they risk paying more than they would have paid for. Moreover, in a CE, since respondents do not know the cards that will be presented, they are incentivized to respond to all choice cards truthfully.

Since a real CE requires the availability of all product profiles (Ding et al., 2009), a new issues has to be deal with when a new product or a product with new characteristics is under investigation. Our case reflects exactly this type of situation. At the time of the survey, some apples with certain attributes were difficult to find on supermarkets and surrounding area, mainly due to the fact that some products were still in an experimental phase. Actually, using a random mechanism to extract the binding choice may result in a product that could be not available to the respondent. To solve this problem the following mechanism was implemented, similar to that used by Lusk et al. (2008). At the end of the interview, substitutes of the products presented in the cards but not available were proposed at a discounted price to respondent who could decide to accept or not the substitution. 20 cent discount was applied to the original price when substitution occurred for one attribute, while 40 cent when there were two. The only purpose of the discount was to compensate the respondent for the missing attributes. In case of acceptance, the substitute entered in the lottery box together with other available products and the balls representing the "none of these" alternative, otherwise balls corresponding to not available products would not be entered in the box. A close substitution was possible only for certain attributes and for certain levels.

Finally, in order to avoid pro-social behaviour, we decided to perform the experiment in a natural setting (in store) and not in a laboratory. Evidence shows that this behaviour disappears when subjects are in a natural occurring market place (List, 2006). We used a between-sample approach to avoid disadvantages of within-subject design such as the influence of hypothetical treatment on the real treatment (or vice-versa) - a type of bias due to cognitive dissonance. Moreover this approach allowed us to avoid a low response rate due to time burden when people are exposed to two treatments.

In order to gain many insights into consumers' preference, we asked respondents to rank the attributes according to their importance and if they had some minimum requirements for the attributes' levels when they decided to buy.

In the literature, minimum requirements or threshold values (cut-offs) have been investigated and recognized as heuristics used by the consumers in purchasing behaviour (Svenson, 1996, Swait, 2001). In 2001, Swait defined two types of cut-off: hard and soft cut-offs. Hard cut-

offs are attribute levels that must be reached, or alternatively not reached, before a choice is allowed (lexicographic preferences represent the extreme case) (Tversky, 1972; Manrai and Sinha, 1989). Since it has been demonstrated that respondents often violate their stated cut-offs, (Huber and Klein, 1991; Green et al., 1988; Swait, 2001), the concept of "soft cut-offs" tries to solve the issue of the cut-off violation. According to Swait (2001) respondents may violate the stated or self reported cut-off for single attributes because he/she evaluates the benefits associated to the bundle of attributes represented in that particular alternative. Put in another way, individual prefers to suffer a potential cost associated to cut-offs violation (penalty) rather than give up to that particular alternative. The application of the Swait soft cut-offs approach goes beyond the scope of the present contribution. The stated minimum requirements are here analysed in a qualitative manner along with the results of the ranking task.

4. Survey design, data description and model specification

Survey design followed the recommended five steps for a CE: selection of attributes, definition of levels, choice of the experimental design, construction of choice sets, and measurement of preferences.

Given the increasing importance of the climate change issue, we added climate change mitigation practices to the list of attributes identified in the literature as relevant for the fruit purchasing behaviour (Moser et al., 2008b). From this extended set of attributes participants in the focus groups selected four, other than price, as being important for apples: 1) production's method 2) visual aspect 3) origin 4) presence of climate change mitigation practices. Levels of non-monetary attributes and their description to the respondents were defined with the help of specialists. Four types of production method were identified: Conventional, Integrated, Innovative and Organic.[3] For visual aspect (appearance) the identified levels were three: good, mediocre and bad; for origin were Trentino region (local), Italy, abroad; and for climate change mitigation practices were presence or absence in apple cultivation.

Price levels reflect the range of the market prices registered in the local supermarkets and grocery stores during the year. They were selected to be wide enough to cover the potential WTP (Hensher, 2004, 2006). Six price levels were identified and they vary from € 0.9 to € 2.9 per kilo

[3] The following description of production methods was provided to respondent in the survey instrument. The conventional control refers to a pest management strategy that employs pesticides (chemicals) to reduce pest and disease. IPM is a pest control strategy that integrates chemicals with biological agents (insects, microorganisms and natural enemies), agronomic techniques and cultural methods and implies a reduction of chemicals with respect to conventional control. The "innovative" method is a IPM that intensify the use of biocontrol agents and agronomic techniques as much as possible till reaching a further reduction of the number of chemical treatments with respect to IPM control. The organic farming excludes or strictly limits the use of synthetic fertilizers and synthetic pesticides, and that maintains, promotes and enhances biodiversity, biological cycles, and soil productivity.

(Table 1). The apples' varieties Golden, Stark, and Fuji were selected because of their market importance and their year long presence on the supermarkets' shelves. A "none-of-these" option was also added to meet the property of exhaustiveness (Train, 2009), and to give more realism to the questionnaire (Johnson and Orme, 1996). The "none of these" option is the base from which other alternatives are compared (Louviere, 1988).

Table 1: Attributes and levels employed in the CE

Attribute	Level
Method of production	Conventional
	Integrated Pest Management
	Innovative (IPM + biocontrol agents)
	Organic
Appearance	Bad
	Mediocre
	Good
Origin	Abroad
	Italy
	Trentino
Low emission practices	Yes
	No
Price	0.90, 1.30, 1.70, 2.10, 2.50, 2.90

4.1 Experimental design

In the present study, we employed a Bayesian D-efficient design. The procedure was the usual one. Since alternatives were labeled, the full factorial structure was equal to L^{MA}, where L is the number of attribute levels, A the number of total attributes and M the number of alternatives (Louviere et al., 2000). Due to this large amount of choice sets, we employed a computer generated orthogonal fractional factorial design that generated 36 profiles. We divided the design into 4 equal blocks of 9 choices sets each.

We decide to present 9 choice cards to each respondent taking into account the results of previous studies on both the learning and fatigue effects. Evidences show that there is an increase in efficiency, a decrease in error variance and a change of focus as the respondent moves through successive choice cards (Johnson and Orme, 1996; Allenby et al., 2005; Caussade et al., 2005). Nevertheless, increasing the number of choice cards to present may induce fatigue or boredom (Savage and Waldman, 2008), reducing the quality of the data. More specifically, Caussade et al. (2005) founded that error variance decreases moving from one up to nine choice cards and Scarpa et al. (2009) indicated that the scale increases gradually from the first to the 11^{th} rank-order task, and then declines quite rapidly for ranking tasks 14-16.

A preliminary pilot study (72 interviews) was carried out in different stores to test the questionnaire and to have data to calculate prior estimates for the experimental design. Coefficients'

estimates obtained in the pilot using multinomial logit (MNL) model were employed to create a Bayesian D-efficient block design. The final design was generated using Ngene software. The design had a Bayesian D-error of 0.2648 and was attribute-level balanced.

4.2 Structure of the questionnaire

The questionnaire consists in six sections described here below in detail.

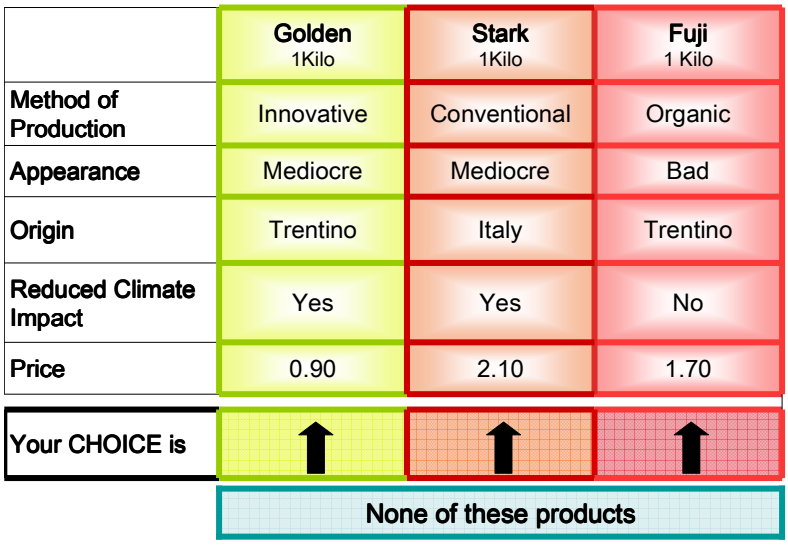
The first part involves consumption and attitudinal questions and it aims to collect data on apple purchasing habits of respondents. Respondents were also asked if they acquire or ask information about the origin and the method of production of fresh fruit ad if they purchase local products. To elicit which factors lead respondent to buy local products, respondent were asked to provide an opinion on several factors through a five-point Likert scale (from unimportant to important).

The second part (concepts definition) aims to provide the same information to each respondent about method of production (from conventional to organic), different levels of fruit appearance (visual quality) and about low emission production. Moreover, it helped respondent to familiarize with the attributes and their levels.

The third part aims at eliciting respondents' minimum requirements (cut-offs) in purchasing behaviour. According to both Swait (2001) and Hu (2008) importance rating and cut-off reporting should be collected before choice tasks so they are free of contextual experience and are based on past experience and not on information provided in the choice experiment (attribute levels) itself. For the method of production, the origin, and appearance, respondent were asked to select the level of each attribute they consider to be the minimum requirement for purchasing apples. To facilitate the understanding of this task, an example was provided to respondent. After this, moreover, respondents were asked to rank the five attributes in order of importance they have in influencing their purchase decision. Regarding ranking we asked respondent to rank before and after the CE in order to investigate 1) the choice consistency of respondent and 2) to assess the best place to position the rank in future CE.

In the central part of the questionnaire we proposed the 9 choice cards aiming at eliciting respondents' preferences for the five apples' attributes. Each choice card (Figure 1) presents four alternatives (three products and the none-of-these option).

Figure 1: Example of choice card



In order to control for the three types of ordering effects[4] described by Chrzan (1994), a mechanism that automatically randomizes rows and columns of the choice cards and the cards sequence was employed. This has been made also for price, even if it may fit more logically at the beginning or end of a profile than somewhere in between (Chrzan, 1994).

The final section is devoted to collecting the usual basic socioeconomic and demographic characteristic of the respondents as gender, age, marital status, marital status, household composition, where they live, monthly household net income, affiliation to environmental association and practice of agricultural activities.

4.3 Survey submission

To collect data, we used a touch-screen computer-assisted self-interviewing system, or touch screen CASI, that is a laptop personal computer equipped with a touch-sensitive video monitor and a specific touch-screen pen. This recently developed method has many benefits with respect to the traditional paper-and-pencil method. It allows researcher to standardize question administration (Metzger et al., 2000), to generate a large sample size quickly reducing the interviewing time (Brown et al., 2008), to reduce the respondent's predilection to modify or change answers (Cooley et al., 2001), to reduce time devoted to data entry and to obtained clean data files (Metzger et al., 2000). Nevertheless, this method has been found to attract more likely respondents who are more familiar with computer (Couper and Rowe, 1996; Brown et al., 2008) introducing therefore potential bias to the survey. Our pilot study reassured us about this concern. Respondents generally

[4] They are: (1) choice set order (the sequence of cards), (2) order of alternatives within choice sets and (3) attribute order within alternatives (Chrzan, 1994: p.166).

did not signal to have problems, but they showed rather interest, facing this new technology. However, an interviewer was always present to guide respondents as needed. Purpose-built software was developed with the language Borland Delphi to administer the survey. Moreover, the software allowed us to randomize columns and rows of choice card and to keep track of elapsed time of respondents on each question. A mechanism was also elaborated to ensure that the four blocks of nine choice situations that composed the design was presented the same number of times.

Data for the final survey were collected during November and December 2009 by three trained interviewers in four supermarkets located in four different areas of Trentino. To capture all types of grocery shoppers, interviews were conducted from weekdays to weekends and from the morning to evenings. Interviewers randomly selected shoppers at the entrance of each supermarket and, after explaining the aim of the research, asked their availability to participate at the survey. Eligibility to participate required a respondent to answer affirmatively to two screening questions: i) being a primary food shopper in their household (make at least 50% of food purchases) and ii) eating and buying apples. Once participants passed the screening questions, they were invited to answer the entire questionnaire. Each respondent was randomly assigned to one treatment - hypothetical and real - each treatment having 96 subjects. The final sample usable for estimation resulted in 192 completed questionnaires.

We analysed the choices using a mixed logit model (Random parameter logit model, RPL), where the choice probabilities can be expressed as (Train, 2009):

$$P_{ni} = \int L_{ni}(\beta) f(\beta) d\beta$$

where:

$$L_{ni}(\beta) = \frac{e^{\beta' x_{ni}}}{\sum_{j=1}^{J} e^{\beta' x_{nj}}}.$$

In estimating the mixed logit model, we assumed the alternative-specific constants and some coefficients to be independent normally distributed, while other coefficients including price to be fixed in the population. For random parameters, we used sequences of Halton numbers (R = 150), as is common practice (Train, 2009). All models were estimated using Limdep Nlogit (version 4.0) (Econometric Software Inc., www.limdep.com).

5. Results

The two treatments showed similar response rate, even if in the real one the response rate was slightly lower. We observed a 65% for the hypothetical treatment, while a 55% response rate for the real one. A summary of samples' socioeconomic characteristics for the two treatments is provided in Table 2. According to the Kolmogorov-Smirnov test, the null hypothesis of equality of

means across treatments cannot be rejected with the exception of Gender and Agricultural experience for the hypothetical treatment versus the real one.

Table 2: Summary statistic of socio-demographics by treatment.

Characteristics	Variable specification	Treatments	
		Hypothetical	Real
Age	years	46.1 (11.5)	46.2 (12.5)
Gender	1=Female	0.87 (0.33)	0.75 (0.43)
Citizen [c]	1= Italian, 2 = UE country, 3=extra UE	1.03 (0.23)	1.04 (0.25)
Status	1=Single; 2=Married\Live-in partner 3=Separated\divorced; 4= Widowed	2.02 (0.58)	2.06 (0.79)
Household members	children <14	0.54 (0.78)	0.47 (0.78)
	with people15-19	0.20 (0.42)	0.12 (0.39)
	with people 20-64	1.34 (0.99)	1.39 (0.98)
	with people >64	0.14 (0.41)	0.14 (0.38)
Household food expenditure	Euro/week	98.3 (48.6)	99.9 (48.9)
Practice of agricultural activities	1= yes	0.44 (0.50)	0.27 (0.45)
Consider himself an environmentalist	1=yes , 2=no , 3=I do not know	1.56 (0.83)	1.81 (0.92)
Belong to an environmental association	1=yes	0.04 (0.20)	0.12 (0.33)
Education [b]	Elementary school	1.0	1.0
	Middle school	16.7	25.0
	3 year diploma	12.5	11.5
	High school diploma	45.8	36.5
	College/university degree	34.0	26.0
	Post university education	0.0	0.0
Occupation [b]	Entrepreneur\ self-employed	7.3	10.4
	Executive	2.1	5.2
	Office worker\Teacher	52.1	41.7
	Worker	7.3	6.3
	Housewife	14.6	15.6
	Actually unemployed	2.1	4.2
	Fixed-term\project contract	1.0	0.0
	Student	2.1	2.1
	Pensioner	11.5	14.5
Household net income (Euro/ month)[b]	<1000	6.2	5.2
	1000-2000	30.2	29.2
	2000-3000	30.2	18.7
	3000-4000	13.5	14.6
	>4000	6.2	8.3
	I don't know	5.2	5.2
	I don't answer	8.3	18.8
Respondents living in [b]:	City centers	25.0	15.6
	Suburban/surrounding areas	18.7	32.3
	Villages\small villages	47.9	49.0
	Isolated areas	8.3	3.1
Number of respondents		96	96

[a] standard deviation in parentheses
[b] percentage of sample with the specific characteristic

Table 3 provides the definition of the variables used in the model, while Table 4 reports parameter estimates for the two individual samples and full sample by random parameter logit models.

Table 3: Variables definitions used in the models

Variable	Definition
Pint	Production with an integrated pest management (IPM)
Pinn	Production with an IPM + biocontrol agent management
Pbio	Organic production
Qm	Mediocre Appearance
Qh	Good appearance
Zit	Italian Origin
Ztn	Trentino Origin
CC	Climate change mitigation practices
Pr	Price
ASC_Golden	Constant for Golden
ASC_Stark	Constant for Stark
ASC_Fuji	Constant for Fuji

Table 4: Parameter Estimates from random parameters[a] logit models

	Hypothetical	Real	Pooled data
Attribute parameters	Coeff. (t-stat)	Coeff. (t-stat)	Coeff. (t-stat)
Pint	-0.169 (-0.91)	-0.204 (-1.35)	-0.172 (-1.73)*
Pinn	0.011 (0.07)	0.208 (1.28)	0.790 (0.85)
Pbio	0.483 (2.89)***	0.586 (2.71)***	0.463 (5.26)***
Qm	0.242 (2.09)**	0.456 (2.92)***	0.306 (3.89)***
Qh	0.417 (2.75)***	0.530 (2.76)***	0.502 (5.57)***
Zit	0.441 (2.82)***	0.481 (1.90)*	0.535 (3.66)***
Ztn	1.221 (7.37)***	1.348 (5.39)***	1.310 (10.0)***
CC	0.202 (2.23)**	0.166 (1.72)*	0.173 (3.38)***
Pr	-0.809 (-7.00)***	-1.473 (-10.2)***	-1.046 (-14.7)***
ASC_Golden	1.517 (3.73)***	2.407 (4.76)***	1.591 (5.61)***
ASC_Stark	0.446 (1.07)	0.899 (1.69)*	0.537 (1.75)*
ASC_Fuji	0.216 (0.48)	1.240 (2.23)**	0.481 (1.35)
Standard deviation parameters			
Sd Pint	-	-	-
Sd Pinn	-	-	-
Sd Pbio	0.169 (1.13)	0.601 (1.88)*	0.067 (0.73)
Sd Qm	-	-	-
Sd Qh	0.603 (31.95)*	0.971 (3.55)***	0.642 (5.19)***
Sd Zit	0.528 (2.91)***	0.772 (2.28)**	0.633 (3.35)***
Sd Ztn	0.730 (2.97)***	1.081 (3.72)***	0.837 (4.41)***
Sd CC	-	-	-
Sd Pr	-	-	-
Sd GoldASC	2.348 (3.46)***	2.598 (5.90)***	2.457 (6.85)***
Sd StarkASC	2.444 (3.02)***	2.914 (4.42)***	2.704 (8.21)***
Sd FujiASc	2.494 (2.85)***	3.234 (5.27)***	3.01 (8.88)***
LL funct	**-807.31**	**-765.52**	**-2386.51**
R-sq Adj Const. only	0.2808	0.3293	0.3032
# parameter	40	40	40
I Crit. AIC	1.961	1.865	1.906
# observation	864	864	1728

*** significant at 1% level, **significant at 5% level,* significant at 10% level

[a] Parameter estimation performed by simulated maximum likelihood using R=150 replications

The null hypothesis of preference equality across treatments was tested with the Likelihood ratio test, $-2\left(LL_J - \sum LL_i\right)$ distributed χ^2 with $K(M-1)$ degree of freedom, where LL_J is the log likelihood value for the pooled model, LL_i are the log likelihood values for the individual models,

K is the number of restrictions (40), and M the number of treatments (2) (Lusk and Schroeder, 2004). The hypothesis of preference equality is rejected (χ^2 =68.79; $p < 0.05$).

The best fitting model is the one for the real treatment. Moving from the hypothetical treatment to the real one, the coefficients do not change sings but there are some changes in magnitude and statistical significance. This implies a difference in the consumer behaviour in the hypothetical and real treatments.

As expected in the real treatment the price has more influence on the purchase decision with respect to the hypothetical scenario. In general, the probability of purchase is higher for high quality organic Golden apples locally produced. Organic apples are always strongly preferred than apples produced with other methods. Coefficients for IPM and innovative production are not statistically significant. This suggests that consumers seem to not perceive the difference with respect to conventional production. More surprisingly, the presence of climate change mitigation practices is statistically significant and exerts a positive effect on the probability of purchasing. Visual appearance is clearly significant in both treatments. Local origin (Trentino) presents the biggest coefficient and significant in both treatments whereas the Italian origin, that results significant in the hypothetical treatments, is less significant in the real one. This may indicate that, in purchasing decisions of a staple fruit as apples, consumers are more open to consider other origins in hypothetical settings, while in fact they show a strong attachment to the origin of the product, and in particular to the local one.

The alternative specific constants, indicating the utility of each option in relation to the "none of these" option, are always positive but only for the Golden variety the coefficient is highly significant in both treatments. This may reflect the fact that Golden is the most well-known variety of apples to Trentino consumers and owns the highest market share. Stark and Fuji gave mixed results, even if the coefficient of Stark is almost not statistically significant. The probability to buy the Fuji variety is positive in the real scenario while in the hypothetical is not statistically significant.

The comparison of WTPs across hypothetical and real treatments (Table 5) confirms the direction of hypothetical bias of extant literature for all significant parameters. WTP for random parameters were constructed as suggested by Hensher et al. (2005). The reported WTPs are referred to one kilo of apples.

Table 5: Willingness-to-Pay (WTP) for apples (Euro/Kilo) by treatments

Attributes	Hypothetical	Real
Pint	-0.42	-0.28
Pinn	0.03	0.28
Pbio	1.24***	0.86***
Qm	0.60**	0.62***
Qh	1.08***	0.76***
Zit	1.06***	0.62*
Ztn	2.74***	1.60***
CC	0.50**	0.23*

***significant at 1% level, **significant at 5% level

As expected, subjects overstate their WTPs in the hypothetical scenario compared to the real one. Hypothetical WTPs calculated only on significant parameters are bigger than the real ones by a mean factor equal to 1.57. This outcome lies between the result of Murphy's meta-analysis which reports a median ratio of hypothetical to real valuations to be equal to 1.35 and the factor over than 2 estimated by Chowdhury et al. (2009).

Regarding the order of attribute importance (Table 6), the pairwise comparison between the two treatments indicates that two rankings are found to be statistically different only for the first position but not for the remaining ones. In the hypothetical treatment respondents evaluated origin and production method as most important followed by appearance and price, while in the real treatment they ranked first mainly origin and appearance, followed by price and method of production. Climate change mitigation practices are generally ranked as last.

Table 6: Attribute position in ranking in the two treatments expressed in % (N=96)

Rank position/ Attribute	Hypothetical					Real				
	Appearance	Price	Origin	Production	Climate change	Appearance	Price	Origin	Production	Climate change
1st	13.5	8.3	46.9	30.2	1.0	22.9	13.5	51.0	11.5	1.0
2nd	16.7	19.8	29.2	26.0	8.3	18.8	15.6	32.3	20.8	12.5
3rd	22.9	17.7	17.7	18.8	22.9	17.7	30.2	15.6	19.8	16.7
4th	22.9	28.1	4.2	19.8	25.0	17.7	24.0	1.0	37.5	19.8
5th	24.0	26.0	2.1	5.2	42.7	22.9	16.7	0.0	10.4	50.0
Tot	100	100	100	100	100	100	100	100	100	100

Looking at the stated minimum requirements, results indicate that most people seem to have specific requirements in mind when buying apples and they are not the same for the different cultivars.

Respondent's stated minimum requirements are showed in Table 7.

Table 7: Respondents stating minimum requirements for attribute levels by treatment and cultivar and as percentage of total respondents (N=96)

Treatments	Hypothetical					Real				
Cultivar / Level	Golden	Stark	Fuji	Average	% of resp.	Golden	Stark	Fuji	Average	% of resp.
Method of production										
Does not matter	21	27	34	**27**	**28,1%**	35	42	44	**40**	**41,7%**
Stated cut-off				**69**	**71,9%**				**56**	**58,3%**
Integrated	*22*	*17*	*17*	***19***	***19,8%***	*20*	*16*	*17*	***18***	***18,8%***
Innovative	*19*	*20*	*16*	***18***	***18,8%***	*23*	*23*	*18*	***21***	***21,9%***
Organic	*34*	*32*	*29*	***32***	***33,3%***	*18*	*15*	*17*	***17***	***17,7%***
Origin										
Does not matter	1	1	4	**2**	**2,1%**	1	3	5	**3**	**3,1%**
Stated cut-off				**94**	**97,9%**				**93**	**96,9%**
Italy	*25*	*25*	*27*	***26***	***27,1%***	*21*	*22*	*20*	***21***	***21,9%***
Trentino	*70*	*70*	*65*	***68***	***70,8%***	*74*	*71*	*71*	***72***	***75,0%***
Appearance										
Does not matter	13	15	16	**14**	**14,6%**	17	20	23	**20**	**20,8%**
Stated cut-off				**82**	**85,4%**				**76**	**79,2%**
Mediocre	*30*	*28*	*25*	***28***	***29,2%***	*39*	*40*	*37*	***39***	***40,6%***
Good	*53*	*53*	*55*	***54***	***56,3%***	*40*	*36*	*36*	***37***	***38,5%***
Price										
Does not matter	25	24	30	**26**	**27,1%**	16	20	22	**19**	**19,8%**
Stated cut-off				**70**	**72,9%**				**77**	**80,2%**

Almost all respondents stated a minimum requirement for origin (about 97% in both treatments) and the local origin (Trentino) is the most frequently stated requirement in both treatments.

Clear differences between treatments emerge for other attributes and levels: organic is the most frequently stated threshold level for production methods in the hypothetical treatment but become the less stated in the real one. The same happens to the good appearance which captures most of the preference in the hypothetical treatment whereas is surpassed by the mediocre appearance in the real treatment.

Except for the origin, a downward revision of minimum requirements seems to affect respondents when comparing the hypothetical treatment to the real one. As expected, price minimum requirements become more important in the real treatment than in the hypothetical one.

Looking at the production methods, results show that 42% of respondents (with respect to 28% in the hypothetical setting) do not have clear production requirements in mind when they enter the supermarket.

Moreover, comparing actual choices made by respondent in the CE with their individually-stated minimum requirements, we found that the greatest number of violations occurred for the method of production both in the hypothetical and real setting.

The number of respondents who violated their stated minimum requirements at least once in the nine choices is reported in Table 8.

Table 8: N° of respondents stating and violating minimum requirements for attributes level by treatment

Treatments	Hypothetical		Real	
Level	N° of respondents stating minimum requirements	N° of respondents violating stated minimum requirements	N° of respondents stating minimum requirements	N° of respondents violating stated minimum requirements
Method of production	69	62 (89.8%)	56	50 (89.2%)
Integrated		48		37
Innovative		46		36
Organic		31		18
Origin	94	70 (74.4%)	93	73 (78.5%)
Italy		31		32
Trentino		65		65
Appearance	82	65 (79.2%)	76	63 (82.8%)
Mediocre		49		43
Good		48		38
Price	70	53 (75.7%)	77	59 (76.6%)

It is interesting to note that organic production is the less violated minimum requirement suggesting that people who state that requirement tend to be more coherent in their choices and consider it as a real binding requirement for purchasing apple. The absence of this requirement seems to be hardly compensated by other attributes. On the contrary, the strong preference for local production according to the stated minimum requirement is mostly violated in the choices. More in general, stated minimum requirements are violated by the great majority of respondents: only 9 respondents in the hypothetical treatment and 3 in the real one were strictly coherent and did not violate their stated minimum requirements in all nine choice cards. This confirms the Swait's idea of minimum requirements as soft and not hard cut-offs.

6. Conclusions

We investigated the hypothetical bias in CE comparing probability of purchase and WTP for three different apples varieties estimated on data collected in two treatments: a hypothetical and real one. We carried out the CE in natural setting, that is a market environment (supermarket) which is more familiar to participants than the laboratory. Unlike most real payment treatments, we did not provide respondents with an initial endowment but they had to use their own money to buy the product. To our knowledge this is the first investigation of hypothetical bias in CE in the field by using respondents' own money.

Our findings confirm the presence of hypothetical bias described in literature. Consumer behaviour is significantly different in hypothetical and real treatment, having some parameters a different effect on the probability of purchase in the two treatments. While the price has more influence on the real purchase decision, the issue of climate change mitigation practices and the

organic characteristic seem to weight heavily in the hypothetical scenario. Results in terms of WTP also confirm existing literature. Respondents overstate their WTP in the hypothetical scenario when compared to an actual one.

Finally, most of interviewed people stated to have minimum requirements in mind when purchasing apples. Regarding methods of production, however, results show that in a real purchasing situation 42% of respondents do not look at the method of production at all (with respect to 28% in the hypothetical setting) and, that among those who stated a minimum requirement, 89% violated them. This outcome suggests that consumers, besides preferring organic production among other methods, seem to not give much importance to production methods attribute. Moreover, they seem to not have in mind a clear frame of the other different production methods and their impact on health related aspects.

A limitation of our study is that the stated cut-offs have not been incorporated into model estimation. Ignoring thresholds in datasets that contained them leads to significant errors (Cantillo et al. 2006; Kaye-Blake et al., 2009). Moreover, the climate change mitigation practices attribute is the only public attribute investigated among mainly private attributes, leading to the typical free-riding problem. Incentives to provide accurate answers can differ for private or public goods (Carson and Groves, 2007). Furthermore, the emphasized possibility to compare hypothetical and real treatment is viable for daily consumed private goods but it is not immediately extendable to public goods. Nevertheless, these findings could be useful both in formulating price and marketing strategies and for the policy maker in evaluating the efficiency of policies aiming at fostering more environmental sound production methods and climate change mitigation practices.

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