Eliciting values for environmental attributes of a private good using a real choice experiment

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Abstract— **Markets for environmentally friendly products have been expanding during the last decade. These products provide both private benefits to the consumer and environmental – public – benefits. The demand for environmentally friendly products has consequently received a growing interest. Our study aims at studying consumers' choices for a non-food product, i.e. roses, with different environmental attributes. We combine a choice experiment with a laboratory experiment to provide real economic incentives.**

Keywords— **Choice experiment, environmental attributes, real economic incentives.**

I. INTRODUCTION

Various private commodities affiliated with public good characteristics have recently emerged in markets. These goods provide private benefits to the consumer but also environmental or social benefits. Examples include eco-friendly electricity, organic produce, recycled paper, fair trade coffee, dolphin safe tuna… Interest for the individual valuations of these public attributes has consequently arisen. The recent emergence of environmentally friendly products on markets raises interesting questions about consumers' preferences for the environmental attributes of private goods. The existence of environmentally conscious questions the ability of market mechanisms like environmental labelling to reduce negative externalities.

Discrete choice experiments are increasingly used to elicit individual valuations of public and private goods. This method requires individuals to make several choices between different alternatives defined by specific levels of attributes. It can be applied in hypothetical surveys but it has also been implemented with real economic incentives [1] [2]. Many studies have shown that people tend to overestimate their willingness to pay in hypothetical settings [1]. This hypothetical bias has appeared particularly strong when products with ethical dimensions are concerned. Our study is based on a non hypothetical – real – choice experiment.

Recent real choice experiments have been dedicated to the valuation of quality attributes of food products [2] [3] and to the valuation of environmental goods [4]. In this paper we focus on the valuation of environmental characteristics of a non-food private good: roses. In the recent environmental debate two attributes have received growing attention: (i) the certification of environmentally friendly production practices and (ii) the amount of carbon dioxide emitted during the production and transportation of goods. Roses can be differentiated according to these two environmental attributes. On the one hand they can be certified with an environmental label when their cultivation respects specific environmental criteria (like the use of fertilizers for example). On the other hand the amount of energy used during the production and the transportation of roses leads to more or less important emissions of carbon dioxide in the atmosphere. Our research aims at understanding the interaction of these different environmental attributes on individual valuations.

We implemented an experimental design to observe individual choices over alternative roses differing in several multilevel characteristics and to measure the related tradeoffs made by subjects. One main attraction of the choice experiment methodology is the ability to estimate the relative importance of several attributes of a commodity. However without incentive compatible mechanisms estimates are likely to be confounded by uncontrolled factors and inferences made from hypothetical (or stated) choices may be biased. We used a randomization device leading to a real purchase in order to minimize the effects of auxiliary factors on the observed choices. In other

words our results are not inferred from hypothetical stated consumption choices but from real choices.

II. PREVIOUS RESEARCH

The valuation of public good characteristics in private consumption choices is difficult to explain with traditional economic theories which usually assume purely self-interested behaviors. Many empirical studies have however shown that consumers were willing to pay for "greener" goods.

Several studies have used the choice experiment methodology to explore the impact of labelling environmentally sound production practices (like sustainable fisheries or forest management) on individual valuations (see for example [5] [6] [7]). The emphasis was put on the global environmental effects of these production practices. Consumers' stated choices generally indicate a positive valuation of the environmentally friendly production practices. Results differ though according to the nature of the commodity being valued.

A related use of choice experiments has been the measure of the potential tradeoffs between health and environment. Organic food products have received particular attention in this respect (see for example [8] [9] [10]). These studies overall indicate that individuals value positively both the health and environmental benefits associated with the organic agriculture. However findings show divergences according to the relative weights individuals put in those two attributes. It raises the question about a possible confound between health and environmental motivations in the valuation of organic food products.

Former choice experiments generally support the existence of preferences for environmental attributes of private goods. They reveal notably that consumers are willing to pay more for products affiliated with an environmental characteristic. Our experimental design differs from existing choice studies in several respects. First it has the specificity to vary simultaneously two different environmental attributes in order to explore the interactions between several environmental characteristics. Furthermore our study is conducted in a laboratory setting providing an optimal control of potential auxiliary factors and uses real economic incentives. Finally we do not use a food product in order to avoid health considerations in choices. The next section provides a description of our experimental design.

III. EXPERIMENTAL DESIGN

We conducted 9 experimental sessions in February 2008. Participants were representative consumers of roses. They were given the opportunity to purchase one red rose delivered on Valentine's Day. They were required to make several choices between two alternative roses differing in terms of three attributes: the certification of environmentally friendly cultivation practices, the relative amount of carbon emitted during the production process and the price. Information regarding the environmental label and the carbon emissions was given prior to the choice task. An opt-out option was included in each choice situation in order to give the possibility not to purchase any rose.

Table 1 Example of a choice set

	Rose A	Rose B	
Environmental certification	Yes	Yes	
Level of carbon emissions	Lower	Higher	
Price	3.5	2.5	
Circle your choice	*I purchase rose A*	*I purchase rose B*	*I don't want to purchase either*

The carbon emissions attribute represents the amount of carbon dioxide emitted during the production and transportation of roses. Several methods have been developed to estimate the carbon emissions (or carbon footprint) of products. A recent study [11] compares the carbon emissions of roses grown in Kenya and in the Netherlands. It reveals that flowers produced in hothouses in Holland are emitting 6 times more carbon than flowers grown in Kenya and shipped by plane to Europe. Based on these estimates the roses offered during the experiment are either associated with a higher level of carbon emissions or with a lower level.

The other environmental attribute to be varied among choice sets is the environmental certification of agricultural practices. Some labelling initiatives have recently emerged on the cut flowers market. Although organic roses are not yet available in the French market, a European certification program, the FFP (Fair Flower Fair Plant) certification, attests that the flowers are originated from growers who comply with environmental criteria close to organic ones. It asserts for instance a least use of crop protection agents, fertilizers, energy and water. The bouquets of roses presented in our experiment are either FFP certified or not certified.

Finally the price of the rose was varied on 7 levels. This allows eventually to estimate willingness to pay (WTP) for the different attributes and alternatives.

Consumers had to complete 12 different choices as displayed in table 1. The institution was made incentive compatible by a random drawing of one of the choice situations at the end of the experiment. As a result only one choice was binding and defined the real purchase.

IV. RESULTS

The data collected during these experiments are analyzed with a discrete choice model (a nested logit model) which can explain the observed choices as a function of the attributes of the rose and of the individual characteristics of consumers. Nested logit models have been previously used to analyse discrete choice data when an opt-out option ("no purchase") is included in the choice sets [12]. A total of 102 persons participated to the experimental sessions. Each subject made 12 decisions so that we could collect 12*102=1224 observations. 33 observations had to be dropped because no response was provided (no option was circled on the choice card). Table 2 presents the results of the nested logit model.

The eco-label attribute, the carbon attribute and the price attribute all have a significant effect on the choices. The probability of buying a rose is increased if the rose is eco-labelled and if the rose is associated with a lower level of carbon emissions. Both environmental attributes are thus valued positively by consumers. Besides, subjects are more likely to buy a given type of rose the lower its price. We can note that the carbon attribute has the greatest impact on the probability of choosing a given type of rose. This result is supported by in the marginal willingness to pay of the two environmental attributes. The marginal willingness to pay for a given attribute is the ratio between the parameter estimate of this attribute and the parameter estimate of the price attribute. We found that the willingness to pay for a label is 1,98 € while the willingness to pay for a lower level of carbon emissions is 2,65 € Consumers are willing to pay more for roses exhibiting environmental attributes and are valuing the carbon emissions to a greater extent than the presence of an environmental label.

Socioeconomic characteristics of participants were also included in the model. Choices were significantly influenced by the gender, the education level and the age of consumers. The fact that individuals were used to purchase organic products was also found significant to explain choices. Finally we can note that the inclusive value parameter lies between 0 and 1 signalling that the attributes levels of the alternative influences the decision of buying a rose.

Table 2 Nested logit parameters estimates

Variable	Coefficient	Standard Error	p-value
Roses attributes			
Label (0 = Label; 1=No Label)	1,1618	0,1278	0,000
Carbon (0=Lower carbon; 1= higher Carbon)	- 1,5533	0,1516	0,000
Price (1,5; 2; 2,5; 3; 3,5; 4; 4,5)	- 0,5863	0,0658	0,000
Socioeconomic characteristics			
Age	0,0107	0,0042	0,011
Sex (0=female, 1=male)	0,3615	0,1272	0,009
Education	0,2859	0,0353	0,000
Activity	-0,0271	0,0305	0,376
Income	-0,1244	0,0632	0,058
Organic purchaser (0=no; 1=yes)	0,3450	0,1558	0,027
Inclusive Value Parameter (θ)	0,6337	0,0752	

V. DISCUSSION

Our results support the existence of environmental preferences. Both environmental attributes are valued positively by consumers who are generally willing to pay a significant premium for an environmentally friendlier rose. Although our conclusions apply to the specific product we used during the experiment they are nevertheless consistent with former studies. These results stem from the observation of real consumption choices. Indeed the fact that experiments were not hypothetical and lead to a real purchases provides accurate estimates of marginal utilities. Since many rose attributes (colour, size, smell…) were omitted in the choice sets, willingness to pay estimates cannot reflect actual market behaviors. However they are useful in the sense that they allow to compare the two environmental attributes and to differentiate their importance in consumers' choices.

The observed choices reveal that the "carbon" attribute gives a greater utility than the "label" attribute. In other words the amount of carbon emissions has a greater influence on consumers' choices of a given rose than the environmental labelling. The information provided during the experiment and the prior knowledge and beliefs of participants about environmental issues may be responsible for these differences. The information about the environmental label may have been more difficult to understand by consumers. Indeed all participants reported that they did not know the FFP label before the experiment. On the opposite information about the carbon emissions was more general and seems to have been understood more easily by subjects. Besides consumers are confronted daily to the global warming issue through mass media and are generally aware of this problem. Finally consumers may need time to know and trust a given label. An experimental session obviously limits the time dedicated to the learning of a label. Further research could investigate the impact of the format and content of environmental information on choices.

Another interpretation of the observed differences in the valuation of the two environmental attributes is a greater trust in public rather than in private institutions. Indeed subjects were informed that the FFP label was provided by a private organism while the information about the carbon emissions was based on a report from a public research institute. It would be interesting to investigate possible differences in behaviours regarding public and private labels and to isolate a "public/private" effect from a "carbon/label" effect.

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