Consumers’ willingness to pay for reduced pesticides use on production of fresh and processed apples

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**Keywords:** Willingness to pay, pesticides, experimental markets, BDM mechanism, apples.

**Abstract**

Nowadays, consumers become more aware of pesticide risk problems and changes are recorded in consumer behaviour because of food safety or environmental (“sustainability”) considerations, or both. The individual consumer faces a trade-off between the utility derived from tastes and characteristics of a product, the utility of behaving “green” and the utility of healthy dieting. In this work, we used experimental markets to measure the consumers’ willingness to pay (WTP) for apples and apple juice produced with reduced pesticide use. In order to see the impact of different information about pesticides use, different apple types were used which are products with different levels of pesticides: Regular apples, Integrated Pest Management (IPM) apples, Organic apples. To know if the potential diversity in consumer behaviour was depending on geographical location, experimental participants were randomly recruited from the general population in Portugal and France. The protocol’s experimental design was applied in these two countries, to 207 consumers of apples and apple juice. The Becker-DeGroot-Marschak (BDM) auction mechanism was used and different apples were sold under different information conditions in a random-price sale.

We show that there is a consumer WTP for pesticides use reduction (a premium for product with specific signal) and that specific information on pesticide use increases this WTP for organic product but not for IPM products. However, the most important result is that the specific information decreases the WTP for the regular product. Then it seems more rigorous to treat the results in terms of “premium against the regular product”, anticipating the loss of market share for the regular product. After showing that consumers’ premium for pesticide reduction is not independent from the product’s sensory attributes, we give the quantitative results for the consumers WTP for a pesticide reduction.

**INTRODUCTION**

The first works regarding consumers’ concerns about pesticide reduction were carried out based on surveys (Hammitt, 1990; Misra et al. 1991; Huang, 1993; Eom, 1994). Most of these studies have used stated preference methods in order to estimate the consumers’ perception of risk associated with pesticides use. Others works have used methodologies that are not based upon the consumers’ statements but that, instead, analyse their real buying behaviors. Studies like the works of Roosen et al. (1998), Rozan
et al. (2004), Combris et al. (2010) used experimental economics to assess the value of some environmental characteristics of food products. These works are based on protocols specifying rules relating to a precise auction mechanism. In studies of this nature, the individuals are in a laboratory environment in which it is reproduced a simplified economical situation. The incentive and revealing mechanisms allow the consumers to make an effective decision, being Vickrey and BDM the most used ones.

To the best of our knowledge, Roosen, Fox, Hennessy and Schreiber (1998) were the first to analyse WTP for pesticide-free produce in experimental economics. The authors adapted a protocol already used in experimental economics (notably by Shogren et al. (1994) and Melton et al. (1996)) and used Vickrey auctions as an effective procedure for revealing preferences of Washington State consumers. Data analysis shows that WTP for produce free from neuroactive pesticides is significantly higher than for conventional produce and that the inferior appearance of the apples has a significant (negative) effect on WTP. Authors as Rozan, Stenger and Willinger (2004) defined an experimental context to assess WTP for the controlled heavy metal content label. The objective was to determine the impact of information on the significance of labelling and the impact on health. The authors showed that revealing information about health risks did not affect the valuation of the labelled product but did cause a loss of value for the conventional product. Bougerara and Combris (2009) appraise French consumers’ WTP for eco-products through an experiment on eco-labeled orange juice. The aim of the experiment is to evaluate WTP for three orange juices: standard, organically-farmed, and environmentally-friendly. This study shows that organic product and environmentally-friendly product are invariably valued more highly than standard product. This study shows that organic product and environmentally-friendly product are invariably valued more highly than standard product. Revealing the information has no impact on the valuation of the standard product. Combris, Seabra Pinto, Fragata and Giraud-Héraud (2010) used an experimental auction to investigate how quality attributes information affects consumers’ willingness to pay for different types of pears. The main results show that information on the products’ characteristics related to food safety instantly influences consumers’ willingness to pay. However, it appears that sensory intrinsic attributes related to taste finally beats the guarantee of food safety in driving the buying behaviour. Bazoche et al. (2008) implement a similar protocol to a processed product (wine), in this study the health effect is excluded in order to assess only the environmental valuation. It seems that consumer responses to the absence of pesticides are not identical between fresh and processed products.

The aim of our experiments was to measure the consumers’ willingness to pay for apples produced with less use of pesticides, and to compare results from various European countries. We led experimental sessions in two countries: Portugal and France. The aim of these experiments was the same in the two countries even if few differences appear between the protocols. Mainly these differences were introduced in order to improve the previous protocols.

In the section above, we present the sample and the recruitment procedure, the products used during the sessions and the protocols used in each country.

**MATERIALS AND METHODS**

**Products**

Broadly, in each country, apples produced with three levels of pesticide used were proposed to the participants. The first level of pesticide used is defined by the minimum
quality standard in force. In this category, the apples, named "regular", respect only the national law for the pesticides used. The second level of pesticide used, is defined by a controlled reduction of pesticide used compare to the existing legislation. The decrease of pesticide in production methods can be guarantee by the government, by the retailer or by the producers’ union. In order to identify the best way to promote this reduction, we proposed apples certified by each of these organisms. Finally, the organic apples represent the last level of pesticides used, where chemical pesticides are prohibited.

In the case of the Portuguese experiment, we were careful to take into account the heterogeneity of tastes that can be observed in the market. In the first step of the Portuguese experiment, the participants had to taste 6 apples from two different varieties: 3 apples Granny Smith and 3 apples Royal Gala. In the two varieties, the three level of pesticides use was proposed (regular, IPM and organic) but participants didn’t have any information about the products’ characteristics except the name of the variety. The objective is to determine if the consumers could reject an apple because of its variety. At the end of the first stage, the favorite variety of each participant was identified, and then each participant continued the experiment only with his favorite variety (Granny Smith or Royal Gala).

In France, only one variety was proposed to the participants. Apples were selected according national preferences for varieties and according to supply constraints. In this country, the organic apples was not available in the same size than the other apples, for this reason a small regular apple was added in order to control the effect of the apple size.

Experimental subjects

Altogether 209 subjects participated in the experiments (102 in Portugal and 107 in France). The sessions took place in sensory analysis rooms and were able to receive between 8 and 16 participants. For each country the same set of criteria was used in order to recruit the participants. The same questions have been asked to the participants in Lisboa and Dijon. To be selected for the experiments, subjects had to be regular consumers and buyers of apples. They had to tell to the recruiter a realistic price for one kilo of apples. All the participants received an explanation letter to expose the context in which apples will be evaluated and the incentive mechanism.

Experimental procedure

In order to assess the WTP for apples produced with less used of pesticides, the BDM procedure (Becker, De Groot, Marschak, 1964) was used to elicit participants’ willingness to pay. The incentive mechanism allowing the consumers to make an actual decision is a sale. The mechanism is quite simple, the participant gives the maximum price he is ready to pay for the product, and then he draws lot the selling price. If the selling price is greater than the willingness to pay given by the participant he cannot buy the product. If the selling price is lower than (or equal) his revealed willingness to pay, the participant buy the product at the selling price. So participants have to be cautious when they write down their willingness to pay because they likely will have to pay the price they announced.

The session began by explaining the procedure verbally to everyone. To ensure the revelation mechanism was properly understood (auction process) a trial auction was held with alternative products.

Basically, the sale experiments were conducted following five steps. For each of them, consumers had to answer to the same question: « What is the maximum price you
are ready to pay to buy 1 kg of this apple or one bottle of this apple juice? ». The steps are defined according the information given to the participants to evaluate the apples.

In the first step, the consumers did not have any information about the apples except the variety. To evaluate the participants can look at and taste the apples. As explained in the previous subsection, all the participants have to evaluate six apples in this step (3 apples Granny Smith and 3 apples Royal Gala in Portugal and 6 apples Golden in France). So at the end of this step, each consumer has given a maximum purchase price for 6 apples (participants could refuse to buy the apple with a zero price). After this evaluation, Portuguese participants had to answer a sensory analysis questionnaire.

In the second step, participants had to evaluate 5 apples (from their favorite variety) for the Portuguese participants and 6 apples for the French participants. No information was given to the participants and they were not allowed to taste the apples. These apples were presented simultaneously to the participants with their label.

At the end of this step the French participants had to answer to few questions about their knowledge on labels used in the experiment.

In the third step, each participant received an information sheet to clarify the meaning of the labels. The information given to the participants were not exactly the same in the two countries. The reason why this information differs is the heterogeneity of national legal frameworks.

In the fourth step, participants evaluated each apple with the same information than in the previous step but they were allowed to taste the apples.

In the five step, participants evaluated three different types of apple juice: a regular apple juice, a IPM apple juice and an organic apple juice.

RESULTS AND DISCUSSION
Descriptive Analysis of the WTP evolution

Figures 1 and 2 show the confidence intervals for the WTP obtained, respectively, in Portugal and France regarding the different information provided (namely: “PROVA” for the first situation, concerning the sensorial analysis; “STIKER” for the second situation, regarding the visual analysis; “INFO” for the third situation, related to the visual analysis with the simultaneous presentation of the respective certifications; “PROVA+INFO” for the fourth situation, concerning both the sensorial and visual analysis).

In general, the WTP of the French consumers are significantly higher than those revealed by the Portuguese consumers, between 20% and 80% according to the type of certification. This result is not surprising if one considers the difference in the average salaries of the two population samples and, even more important, the difference in the apples’ market price in both countries. The most surprising feature was the homogeneity in the answers obtained about the relative value of the WTP, both by the comparison between the different information situations, as well as by the comparison of the WTP for the different types of certification.

The first major result concerns the consumers’ reaction in a situation in which the sensorial analysis is not taken into account. Observing the WTP obtained in the third situation, regarding the information provided on pesticide reduction, one observes a clear hierarchy between the three different types of apples.

In Portugal (figure 2), the conventional apple (CON) was evaluated on average at 0.56€ and the integrated protection apple (PI) obtained an increase, when comparing to
the CON value, of 0,30€ (+53,6%). The organic apple (BIO) increases its average WTP about 0,54€ (+96,4%) when compared to CON apple.

In France the results are identical. However, in this country, the organic apple’s evaluation was done comparing it to the small apple (PEQ), in order to annul the negative effect of its size. For this country, figure 3 shows and average WTP in situation 3 of 1,01€ to the CON apple, with an increase of 0,44€ (+43,6%) for the PI apple. The BIO apple gets about 0,56€ (+72,5%) when compared to the PEQ apple. One should say that, both in Portugal and France, the increase (or reinforcement) of the information provided on the partial reduction of pesticides regarding the PI apple, didn’t provoke any effect on its evaluation. When comparing the results obtained in situation 2 (“STIKER”) and 3 (“INFO”), they are relatively similar for the PI apple. Nevertheless, the comparison of the same situations for the BIO apple, shows that this kind of apple takes advantage of a significant re-evaluation between the two situations (an average increase of 0,12€ in the two countries). Even though the results described for the evaluation of the BIO apple, in situation 3, can be clearly justified by the consumers’ demand for products produced with low levels of pesticides, the results obtained for the PI apple should be analyzed more carefully. In France, the survey carried out to get the a priori knowledge of consumers, showed that only 42% of the participants had a clear knowledge about the real meaning of the PI certification. Thus, the information provided on this type of certification about the use of pesticides was essential to justify the relevance of the consumers’ demand for a partial reduction in pesticides’ use. On the other hand, the information provided about the organic certification was already known by 91% of the surveyed population. In this case the information provided between the second and the third situations means mostly a bigger focus of the consumers’ knowledge on this fruit’s characteristic. One can verify that this focus generated a positive and significant re-evaluation of the WTP for this kind of certification. In the case of the organic apple, the increase of its value compared to the CON apple is greatly due to this production mode (and not because of some certification stratagem of the evaluated product). The same can’t be said for the PI certification.

The second important result that should be highlighted concerns the CON apple. This apple is depreciated when moving from situation 2 to situation 3 (especially in France, where the average decrease of the WTP was about 0,12€). This effect was already shown by Rozan et al. (2004) and Combris et al. (2010) works. Within an evaluation framework of different certifications of foodstuffs, this kind of result can be interpreted as a change in the consumers’ references related to their acceptance of a certain way of production. The “non-positive” information regarding certain types of food generates a negative effect in the WTP. This negative effect may become even more significant than the positive effect provided by the information on pesticides’ reduction on the certificated products. This decrease in the WTP between situation 2 and 3 is, after all, significant for the French experiment, with an average decline of 0,1€ (see also Fox et al, 2002, in a different context about food safety)

Shortly, the effect of information on the pesticides’ reduction may have: i) a significant positive effect when dealing with a total reduction of pesticides as in organic farming; ii) a potentially important negative effect for those apples resulting from a conventional production mode, in which doesn’t occur a pesticide reduction.

The interpretation of this last result is connected to the change in the consumers’ referential after they get the information. This referential is very important in order to evaluate the context in which the WTP gain shape and also the different market segments capable of being won by the different certifications. The sensorial evaluation of the
product is also a part of this context, since it is so difficult to adopt, in a credible way, a \textit{ceteris paribus} evaluation strayed from such an essential parameter as is the organoleptic characteristic of food. The situations 1 and 4, in which the apples were actually tasted by the participants, allowed to illustrate this phenomenon. In Portugal, situation 1 highlighted that the BIO apple is not so highly evaluated at the sensorial level (around 10,8\% lower than the CON apple). This result surely explains why the difference in the WTP between the BIO and CON apples is not higher than 34,4\%, in situation 4, where the consumers have all the information; and yet that difference was 96,4\% in situation 3. In France, in situation 1, it is the PI apple that distinguishes itself (in a positive way) when compared to the other apples (+ 40,4\% compared to the CON apple). One realizes that, in situation 4, this apple’s evaluation is higher than that of all the other apples, reaching +87,6\% when compared to the CON apple (this one is under evaluated at the sensorial level) and surpassing significantly the BIO apple by 8,5\%. Thus, the limelight position given to the BIO apple in situation 3, is threatened by the simple effect of the taste characteristic. One last important result concerns the values of the WTP obtained in the second stage of the experiment – visual evaluation of the different apple juices. The values found were similar to those obtained under the third situation with apples, even though the differences between the several certifications have been less significant.

In Table 2 it is possible to identify that the rate increases between the WTP due to the certifications and the WTP of the conventional juice grow with the pesticide use reduction, for both countries.

**CONCLUSIONS**

The results found in both experimental markets show that there is a consumers’ willingness to pay for products obtained under pesticide reduction conditions. One may verify that the information provided to the consumers about the pesticide use in food production increases their willingness to pay for the organic products. But the same situation is not valid for the integrated protection products. The most important result shows that providing information leads to a decrease in the WTP for the conventional product. This result could be observed in the two countries: i) in Portugal, the average WTP for the integrated protection apple and for the organic apple are, respectively, 53,6\% and 96,4\% higher than the average WTP of the conventional apple; ii) in France, the average WTP for the integrated protection apple and for the organic apple are, respectively, 43,6\% e 72,5\% higher than the average WTP of the conventional apple. It is also important to mention that for the processed product (apple juice), the increases in the average WTP are not so high as those found for the fresh products. The interpretation of the results according to the differentials observed in the WTP for the conventional product may predict a loss of its market share when compared to the other kinds of products.

The detailed knowledge of the consumers’ willingness to pay for a reduction in the several risks connected to the pesticides’ use is essential for both the definition and the successful implementation of environmental policies.

**ACKNOWLEDGEMENTS**

The research leading to these results has received funding from the European Community’s Seventh Framework Programme [FP7/2007-2011] under grant agreement No 212120.
Literature cited

Tables
Table 1. Rate increases of the WTP of the apple juices according to the pesticide reduction in Portugal and France

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<thead>
<tr>
<th></th>
<th>50% of pesticides’ reduction</th>
<th>Absence of synthesis pesticides</th>
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<tbody>
<tr>
<td>Portugal</td>
<td>+21.8%</td>
<td>+46.1%</td>
</tr>
<tr>
<td>France</td>
<td>+28.2%</td>
<td>+41.9%</td>
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Figures

**Fig. 1.** Confidence intervals (95%) of the mean WTP by type of apple and information situation in Portugal

**Fig. 2.** Confidence intervals (95%) of the mean WTP by type of apple and information situation in France