Consumers' perceptions on health risks derived from pesticide use and on the attachment for the respect of the environment

Pascale Bazoche, Manuela Berjano, Pierre P. Combris, Eric E.
Giraud-Heraud, Raquel Maia, Alexandra Seabra Pinto

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Brief description of the deliverable
From the classification proposed by Pearce and Seccombes-Hett (2000); Travisi et al (2006), we sorted the economic literature on pesticide risk perception by consumers according to methodological tools employed. This work, enable us to choose the best tool that provides good estimations of willingness to pay (WTP) for low-use pesticides products.

Followed methodology / framework applied
A literature survey based on a bibliographic database.

Target group(s)
Experimental economics research units

Key findings / results
The literature on consumers behaviour answers partially to the question: "Do the consumers ask for a pesticide reduction in fruits and vegetables?", finding that there is a consumers' WTP for pesticide reduction. However, quantified results are very heterogeneous and not always coherent with experimental auctions or field experiments. Moreover, we cannot founds in this literature any measure of the sensibility of consumers' answers about more information on pesticide residues, the influence of other intrinsic characteristics, and the efficiency of different cues used for signaling the pesticide reduction.

Interactions with other WPs deliverables / joint outputs			
WP no.	Relevant tasks	Partner(s) involved	Context of interaction

Project no. **212120**

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**Theoretical Developments and Empirical Measurement of the
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Collaborative Project

SEVENTH FRAMEWORK PROGRAMME
THEME 2
Food, Agriculture and Fisheries, and Biotechnology

Deliverable 4.1

Bazoche, P., Berjano, M., Combris, P., Giraud-Héraud, E., Maia, R., Seabra Pinto, A.

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Extended Summary

The objective of the work package 4 is to investigate consumers' knowledge and expectations regarding low pesticides products, their preferences regarding different labelling concept. Consumers' perceptions of organic produce is also investigated. To lead this work, the deliverable D 4.1 proposes a literature review on consumers' perceptions and expectations on health risks derived from pesticides use.

Over the last two decades, an economic literature on pesticide risk valuation has emerged. The willingness to pay (WTP) estimates available in this literature typically refer to the negative effects on human health, and the damage to environmental agro-ecosystems. Economists have employed several methods to determine how consumers value the environmental characteristics of foodstuffs. The literature review is organised into two sections, the first section presents studies using stated preference methods and the second section presents studies using revealed preference methods and more specifically experimental economics methods. The most important literature on the stated preference methods was reviewed, not only the one concerning consumers health safety issues associated with the presence of pesticides but also the one addressing environmental problems. The main principals of the experimental economics approach were also reviewed after which two examples of WTP for pest-management are given – fresh product and processed one.

The first works regarding consumers' concerns about pesticide reduction were carried out based on surveys (Hammitt, 1990; Misra, Huang and Ott 1991; Huang, 1993; Eom, 1994 and Horowitz, 1994). Most of these studies have used stated preference methods in order to estimate the consumers' perception of risk associated with pesticides use. Hammitt (1990) argues that consumers are willing to pay significant premiums to obtain an organic product (a median 50% above the cost of conventional produce). The study of Misra, Huang and Ott (1991) concludes that most of the consumers recommend testing and certification, but they oppose large price markups for certified-FPR fresh produce. empirical results from the pilot survey of Eom (1994) suggest a clear linkage between perceptions and behavior in response to new risk information.

The results of the contingent valuation survey on pesticide residues define by Buzby, Fox, Ready and Crutchfield (1998) show a wide variability in subjective belief about

the danger posed by pesticides residues on fresh produce. Also, these results demonstrate that the price differential was a significant determinant of store choice.

Loureiro, McCluskey and Mittelhammer (2002) concluded that female respondents with children and strong environmental and food safety concerns are more likely to pay a premium for eco-labeled apples. However, the estimated premium is small (about 5 cents per pound over an initial price of 99 cents), reflecting the overall difficulty with garnering a premium based on "environmentally sound" practices.

In terms of implementations for policymakers, Huang (1993) highlighted that the link between risk perception and willingness to pay is not empirically significant. Results suggest that education programs which address the food safety issues need to target female, black, middle-aged, and less educated consumers. The study of Horowitz (1994) shows that there is a distinct preference for pesticide regulation over an alternative risk reduction proposal (auto exhaust regulation), when both regulations are hypothesized to cost the same and save the same number of lives. In terms of taxation policy, the work of Mourato, Ozdemiroglu, and Foster (2000) suggest that consumers would be willing to pay substantial price markups for environmentally friendly bread loaves and, consequently, that a case could be made for a substantial pesticide tax, preferably differentiated by product type. Finally, the tax estimates by Chalak, Balcombe, Bailey and Fraser (2008) suggest that pesticide taxes based on the primary externality resulting from a particular mode of agricultural production are a credible policy option that warrants further consideration.

Florax, Travisi and Nijkamp (2005) consider that the monetary value of a reduction in pesticide usage and the related dangers can be revealed as the aggregate of individuals' WTP for pesticide risk reduction or, instead, the WTA a reward for exposure to improved pesticide risk levels.

Mainly, the studies presented above have concluded that there is a premium for the environmental characteristics of food stuffs. Thus, it is necessary to use methodologies that are not solely based upon the consumers' statements but that, instead, analyse their real buying behaviours – the experimental economics approach.

In studies that use experimental economics to assess the value of some environmental characteristics, the individuals are in a laboratory environment in which it is reproduced a simplified economical situation. Smith (1980) and List (2006) show that

laboratory behaviour is a good indicator of behaviour in the field. Experimental economics has come a long way since the 1960s. Roosen, Fox, Hennessy, Schreiber, (1998) were the first to analyse WTP for pesticide-free produce in experimental economics. Their analysis show 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.

The economic experiment conduct by Loureiro, McCluskey and Mitthelhammer (2003) show that consumers who state that they are willing to pay a premium, which is equal to or greater than a positive lower bound, have a higher likelihood of actually buying the product in question. This implies that consumers' actions in the economic experiment validate their survey responses.

Finally, note that the results of the experiments of Bougherara and Combris (2009) and Rozan *et al.* (2004) show 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. A similar result emerges from the article Combris *et al.* (2010). The authors 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 vauation. It seems that consumer responses to the absence of pesticides is not identical between fresh and processed products.

To conclude, the economic literature has engaged in the process of evaluating WTP for pesticide-free products. The results of this literature lies in a wide interval, as outlined Florax *et al.* (2005) and Travisi *et al.* (2006), the reasons for these disparities between studies are related to several factors that are important to consider when using this literature, including methods of data collection, methods of reporting preferences, type of product, and also the type of risks of using pesticides described the consumer (safety, environment).

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Introduction

Over the last two decades, an economic literature on pesticide risk valuation has emerged. The willingness to pay (WTP) estimates available in this literature typically refer to the negative effects on human health, and the damage to environmental agro-ecosystems.

Florax et *al*. (2005) based on the risk valuation literature, considered that the monetary value of a reduce in pesticide usage and the related dangers can be revealed as the aggregate of individuals' WTP for pesticide risk reduction or, instead, the WTA a reward for exposure to improved pesticide risk levels. Consumers' WTP (and WTA) reproduce preferences, perceptions and attitudes towards risk and these values are affected by the decision to lower existing levels of pesticide usage.
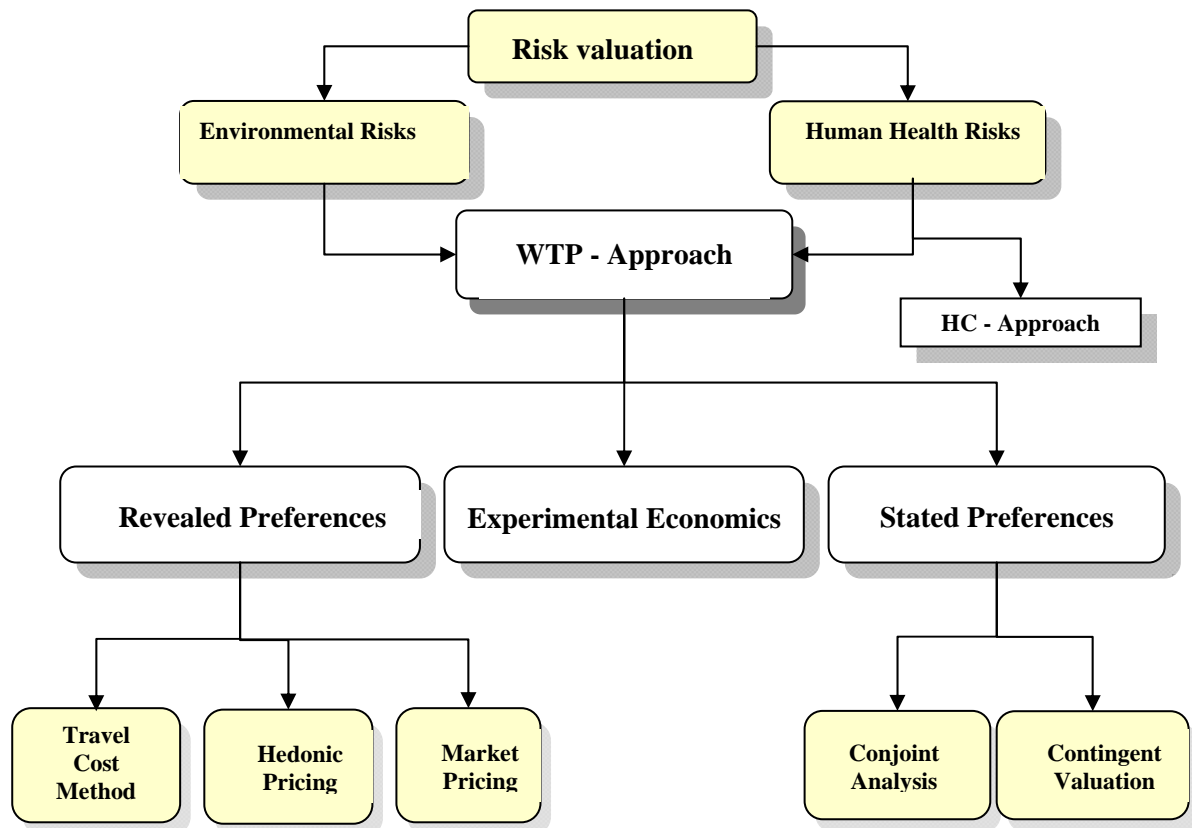
Figure 1. Techniques for economic valuation (Adapted from: Pearce and Seccombe-hett, 2000; Travisi *et al*., 2006; Shogren et Lusk, 2007)

Much work has been done in economics to appraise consumers' valuations of environmental characteristics. Economists have employed several methods to determine how consumers value the environmental characteristics of foodstuffs. Figure 1 presents a simplified framework based on Pearce and Seccombe-Hett (2000), Travisi *et al.*(2006). The two articles propose to report techniques for economic valuation on an environmental good. Two main categories appear: revealed preferences and stated preferences. The latter were defined as the preferences showed by a respondent to a question and the former stand for the preferences deduced from the behaviour of a person when choosing between goods or opting, in a not explicit way, connected with the characteristics being valued (Pearce and Seccombe-Hett, 2000)1.

The experimental economics approach was placed on the figure as a third category, to materialise the idea of Shogren and Lusk, (2007) when considering this approach as combining the advantages of both revealed and stated preference methods.

The stated preferences approach has often been used through conjoint analysis and contingent valuation in studies associated to human health risks within food safety literature. These works main target may be the health risks associated with pesticide residues in fresh food, namely in those countries where food safety policies are a top priority. They can also be marketing oriented when dealing with consumers WTP for certified residues-free products. Nowadays the studies are also being extended to pesticide health risks for farmers in developing countries. There has also been some work done (Mourato *et al.*, 2000; Schou *et al.*, 2002) that analysed simultaneously the effects of pesticides on both human health and environment.

On the contrary, not many works included revealed preferences techniques – travel cost methods (TCM), market prices (MP) and hedonic prices (HP). It is the case of Hammitt (1993) that uses MP to estimate a range of pesticide risks for consumers. Beach and Carlson (1993), on the other hand, use HP in order to value herbicide risk reduction for groundwater.

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[1] It is interesting to note that both articles do not classify all the methodologies in the same categories. In the article by Pearce and Seccombe-Hett it is considered that the random utility models are used by revealed preference methods while in Travisi et *al.* (2006) it is considered as belonging to the stated preference methods. In fact, random utility models can be used by both approaches, since the random utility models can handle both real data and data derived from hypothetical markets.

The experimental economics analysis is a method that puts people in an active market environment dealing with real money and real products. It creates an awareness of the real opportunity cost when evaluating the products. This evaluation provides, in a direct form, a set of heterogeneous WTP that in theory represent the real value for the produce. Experimental markets provide the consumers with exchange mechanisms (Vickrey's second price auction, BDM mechanism) by creating incentives for them to ponder over what they will actually pay for the good or service. Originally, these mechanisms were designed to characterize individual preferences for risk taking in a context of monetary lotteries. Nowadays, they are used to elicit values for real goods and services and also to elicit homegrown preferences, including preferences for risk, and the search for new goods and services. Experimental markets have been used for a wide variety of food attributes, namely safety related ones, for instance reductions in pesticides risk (Roosen *et al.*, 1998; Rozan *et al.*, 2004), in pathogen risk (Hayes *et al.*, 1995), and in the use of food irradiation (Shogren *et al.*, 1999).

The report is organized as follows. In section I, the most important literature on the stated preference methods is reviewed, not only the one concerning consumers health safety issues associated with the presence of pesticides but also the one addressing environmental problems. In section II, the main principals of the experimental economics approach are reviewed after which two examples of WTP for pest-management are given – fresh product and processed one.

I. Stated preference methods

The first works regarding consumers' concerns about pesticide reduction were carried out based on surveys (Hammitt, 1990; Misra, Huang and Ott 1991; Huang, 1993; Eom, 1994 and Horowitz, 1994). Most of these studies have used stated preference methods in order to estimate the consumers' perception of risk associated with pesticides use.

The pioneer work of Hammitt (1990) focuses on organic products by comparing them with the conventional ones bearing in mind the consumers point of view. Consumers' choice between organically (without pesticides) and conventionally grown produce is examined. Exploratory focus-group discussions and questionnaires propose that consumers who purchase organically grown produce believe it is substantially less hazardous than the conventional alternative and are willing to pay significant

premiums to obtain it (a median 50% above the cost of conventional produce). The value of risk reduction implied by this incremental willingness to pay is not high relative to estimates for other risks, since the perceived risk reduction is relatively large. Organic-produce consumers also appear more likely than conventional-produce consumers to mitigate other ingestion-related risks (e.g., contaminated drinking water) but less likely to use automobile seatbelts.

Misra, Huang and Ott (1991) use primary data collected from a survey conducted in Georgia to analyze consumer preferences for testing and certification of fresh produce and consumers' willingness to pay for fresh produce that is certified as free of pesticide residues (FPR). An ordered probit model was estimated to identify the impacts of various exogenous variables on the probability of consumers' willingness to pay for a number of alternative price premiums. The results indicate that consumers' willingness to pay differs with respect to a number of factors. The study concludes that most of the consumers recommend testing and certification, but they oppose large price markups for certified-FPR fresh produce.

After this work, Huang (1993) highlighted that the link between risk perception and willingness to pay is not empirically significant. He proposed to estimate a simultaneous equation model in order to take into account interactions between risk perception, attitude and behavioural intentions. This paper develops a theoretical model, which places a simultaneous structure among three psychological and behavioral constructs, to analyze consumer risk perceptions, attitudes, and behavioral intentions. To validate the above mentioned model they performed a survey of Georgia consumers. Regarding risk perceptions respondents were asked to rank 3 top food concerns from a list of 10 items (including «food grown using pesticides»). On what concerns the attitude variable, respondents had to select, from four different statements, the one that best described their opinions about the use of chemical pesticides. As for the willingness to pay, survey participants were asked to indicate if they were actually willing to pay a higher price for fresh produce without pesticides and, if yes, how much more. Results suggest that risk perceptions have a positive and significant effect on consumers' attitudes toward pesticide use, which in turn influence their risk perceptions and willingness-to-pay for residue-free fresh produce and vice versa. The linkage between risk perceptions and willingness-to-pay, however, is not empirically significant as expected. Results suggest that education programs which

address the food safety issues need to target female, black, middle-aged, and less educated consumers.

Eom (1994) proposes an analysis of consumer preferences in respect of health risks inherent to pesticide residues. The author develops a new approach for integrating consumers' risk perceptions with stated purchase behavior when consumption decisions must be made with incomplete information. The application involves health risks from exposure to pesticide residues on fresh produce. Unlike traditional food demand analysis, the approach treats produce choices as discrete outcomes, resulting in a random utility model.

Prior to this, a survey was carried out to collect the pilot data necessary to implement a discrete choice model from which the random utility model was derived. The information thus collected was about expenditures from different food categories, contingent choice, subjective attitudes toward risks from pesticide residues, other economic and demographic factors. Only a subset of this survey information was analysed by the authors, the one regarding contingent discrete choice responses.

Empirical results from the pilot survey suggest a clear linkage between perceptions and behavior in response to new risk information. Consumers' stated preferences for safer produce were primarily influenced by price differences and perceived risks, not by the technical risk information provided alone. However, the linkage between behavior and valuation was less clear cut. The risk/price tradeoffs entailed by contingent discrete choices indicate high price premiums for small risk reductions and little variation in price premium across alternative risk reductions.

Horowitz, J. (1994) studied the actual preferences for Pesticide Regulation. His analysis is based on a random telephone survey of households. There is a distinct preference for pesticide regulation over an alternative risk reduction proposal (auto exhaust regulation) when both regulations are hypothesized to cost the same and save the same number of lives. Such preference has a surprisingly broad demographic base. However, when the potential numbers of lives saved are different under the two programs, almost 71% of the subjects preferred the regulation that saved the most lives regardless of the risk source.

Buzby, Fox, Ready and Crutchfield (1998) explored three valuation techniques that place a monetary value on food safety risk reductions. For each, a case study was

presented - a contingent valuation (CV) survey on pesticide residues, an experimental auction market for a chicken sandwich with reduced risk of Salmonella, and a cost-of-illness analysis for seven foodborne pathogens. The authors consider that microbial pathogens and pesticide residues in food pose a financial burden to society which can be reduced by incurring costs to reduce these food safety risks. The estimates from the above mentioned techniques can be used in cost/benefit analysis for policies that reduce food safety risks.

To reveal the willingness to pay for a reduction in exposure to pesticide residues on fresh products, a contingent choice scenario was used in the CV survey. They used two survey versions and defined, in both, two different types of store (A and B). In both surveys, the store A does not test any of its fresh produce for pesticides residues. Store B, either tests all its fresh produce and rejects any that does not meet the government standard (survey one) or rejects any with pesticides residues («pesticide-free store» in survey two). As well as store characteristics the respondents were also informed about mortality risk from consuming fresh produce selling in the different stores. This information was meant to know the subjective beliefs of the consumers. The results showed a wide variability in subjective belief about the danger posed by pesticides residues on fresh produce. The results of the CV survey demonstrated that the price differential was a significant determinant of store choice, with higher price differentials favouring store A (the cheaper store).

Hammitt and Graham (1999), reviewed at the time, the existing literature on CV studies of reductions in health risk, finding that most studies were poorly designed to assess the sensitivity of stated valuations to changes in risk magnitude. They considered that efficient investments in health protection require valid estimates of the public's willingness to forgo consumption for diminished probabilities of death, injury, and disease and that stated valuations of risk reduction are not valid measures of economic preference if the valuations are insensitive to probability variation. The authors presented new empirical results from telephone surveys designed to provide internal and external tests of how WTP responds to size of risk reduction. The effect of variations in instrument design on estimated sensitivity to magnitude is examined. Overall, estimated WTP for risk reduction is inadequately sensitive to the difference in probability, that is, the magnitude of the difference in WTP for different reductions in risk is typically smaller than suggested by standard economic theory. They

proposed additional research to improve methods for communicating changes in risk and rigorous validity checks within future studies of stated WTP to reduce risk.

Baker (1999) used a conjoint analysis to evaluate consumer responses to hypothetical apple products in a nationwide survey. Product characteristics included price, quality, pesticide use levels and the corresponding cancer risk, and type of government inspection. Consumers expressed a broad preference for reduced pesticide usage. Four market segments were identified corresponding to consumers: (a) who had a strong preference for food safety, (b) who exhibited a more balanced desire for all product characteristics, (c) who were extremely price sensitive, and (d) who had a strong preference for product quality. Results suggest that consumers in these segments differ based on demographic and psychographic characteristics. The author regarded this information as useful to produce marketers in marketing produce that better meet consumers' needs. He also considered extremely valuable to participants in the food marketing system, a better understanding of how consumers differ by market segment. In fact, food producers, processors, and retailers do require a deeper and more detailed understanding of consumer preferences, vis-a-vis their socioeconomic characteristics, in order to develop products and marketing strategies that effectively target individual consumer needs. Baker seeks to more clearly identify unique traits and values exhibited by consumers in the different segments by evaluating consumers in four separately defined market segments, based on both socioeconomic and value characteristics.

Mourato, Ozdemiroglu, and Foster (2000) estimate the economic impacts of pesticide use on human health and on the environment to gather information on the structure of a possible pesticide tax and on the design of an "environmentally friendly" bread product. The relative importance of these different impacts is determined by what individuals are prepared to pay to avoid a case of human ill health and a unit of environmental damage, measured by bird species in decline. Willingness to pay is estimated using a contingent ranking approach, a variant of the standard contingent valuation method, which is capable of tackling the multidimensional effects associated with pesticide applications. The results suggest that consumers would be willing to pay substantial price markups for environmentally friendly bread loaves and, consequently, that a case could be made for a substantial pesticide tax, preferably

differentiated by product type. It is also shown that individuals are on average only willing to accept between 7-8 cases of human illness to save an entire bird species.

Brethour and Weersink (2001) used the physical risk assessment approach combined with contingent valuation survey results on consumers' willingness to reduce pesticide risk. They analyzed the trade-off between pesticide use levels and abatement costs. The reduction in external costs associated with the changes in pesticide use in Ontario agriculture between 1983 and 1998 was 188 dollar per household. The environmental benefits were largely due to the reduction in the level of high and moderate-risk pesticides.

Loureiro, McCluskey and Mittelhammer (2002) used a double-bounded logit model to assess the mean willingness to pay (WTP) for eco-labeled apples. The eco-label analyzed in this study is certified by The Food Alliance (TFA), a non-profit third-party certifying organization based in Portland, Oregon.

They concluded that female respondents with children and strong environmental and food safety concerns, are more likely to pay a premium for eco-labeled apples. However, the estimated premium is small (about 5 cents per pound over an initial price of 99 cents), reflecting the overall difficulty with garnering a premium based on "environmentally sound" practices.

Cranfield and Magnusson (2003) undertook a contingent valuation survey to determine if Canadian consumers would pay a premium for Pesticide Free Production TM (PFPTM) food products. This technique emphasizes reduced pesticide use in conjunction with increased reliance on producer knowledge of agronomic practices that mitigate weed, insect and disease pressure. Over 65 percent of respondents would be willing to pay a one to ten percent premium relative to a conventional food product. Five percent of respondents would be willing to pay more than a 20 percent premium. Health and environmental concerns, willingness to switch grocery stores and youth are important characteristics of consumers who would be willing to pay higher premiums. Distribution channels geared towards health food stores (or health food centers within grocery stores) are likely targets for PFPTM food products.

Florax, Travisi and Nijkamp (2005) reviewed the empirical valuation literature on pesticide risk exposure and developed a taxonomy of environmental and human health risks associated with pesticide usage. A Meta-analysis was then used to

investigate the variation in willingness to pay (WTP) estimates for reduced pesticide risk exposure. The authors considered that the monetary value of a reduction in pesticide usage and the related dangers can be revealed as the aggregate of individuals' WTP for pesticide risk reduction or, instead, the WTA a reward for exposure to improved pesticide risk levels. Consumers' WTP (and WTA) reproduce preferences, perceptions and attitudes toward risk and these values are affected by the decision to lower existing levels of pesticide usage.

Their findings showed that the WTP for reduced risk exposure is 15 per cent greater for medium, and 80 per cent greater for high risk levels, as compared with low risk levels. The income elasticity of reduced pesticide risk exposure is generally not significantly different from zero. Stated preferences approaches based on choice experiments and revealed preferences provide lower WTP estimates than contingent valuation techniques. Survey design, type of safety device (eco-labelling, integrated pest management or bans) and chosen payment vehicle are important drivers of the valuation results.

Chalak, Balcombe, Bailey and Fraser (2008) present results from two choice experiments (CE), designed to take account of the different negative externalities associated with pesticide use in agricultural production. For cereal production, the most probable impact of pesticide use is a reduction in environmental quality. For fruit and vegetable production, the negative externality is on consumer health. Using latent class models they find evidence of the presence of preference heterogeneity in addition to reasonably high willingness to pay (WTP) estimates for a reduction in the use of pesticides for both environmental quality and consumer's health. To place their WTP estimates in a policy context, they converted them into an equivalent pesticide tax by type of externality. The tax estimates suggest that pesticide taxes based on the primary externality resulting from a particular mode of agricultural production are a credible policy option that warrants further consideration.

II. Experimental economics

Mainly, the studies presented in the former section have concluded that there is a premium for the environmental characteristics of food products. As Florax *et al.* (2005) highlight, the value interval for these environmental premiums is large. Thus,

it is necessary to use methodologies that are not solely based upon the consumers' statements but that, instead, analyse their real buying behaviours.

This section has for main purpose the presentation of some works within experimental economics that assess the value of some environmental characteristics.

In studies of this nature, the individuals are in a laboratory environment in which it is reproduced a simplified economical situation. One of the major advantages of this technique is that one can control the whole variable set influencing the economical decisions. Smith (1980) and List (2006) show that laboratory behaviour is a good indicator of behaviour in the field. The incentive and revealing mechanisms allow the consumers to make an effective decision, being Vickrey and BDM the most used ones.

Experimental economics has come a long way since the 1960s. It was natural, then, that some experimental studies should propose to analyse WTP for environmentally-friendly produce. These are revealed-preference methods based on protocols specifying rules relating to a precise auction mechanism. To the best of our knowledge, Roosen, Fox, Hennessy, Schreiber, (1998) were the first to analyse WTP for pesticide-free produce in experimental economics. They 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. Participants have a bag of conventionally-farmed apples and are then invited to bid for four alternative bags of apples. Two of the bags contain apples grown without one particularly widespread pesticide but with other neuroactive pesticides. The other two bags contain apples produced without neuroactive pesticides (but other pesticides may have been used). For each treatment type, one of the bags contains apples that look just like the apples in the bag given out initially, and the other bag contains apples that look less appealing. The quality of the apples is therefore defined in two regards: their visual appearance and their safety for health. Information about the specificities of the produce is given to participants at the beginning of the experiment. The participants are told that one bag of apples, selected at the end of the experiment, will be for sale. After three rounds of the auction an additional item of information is revealed to the participants. They are told more precisely of the particularities of products grown using neuroactive pesticides and the increased production costs inherent in using alternative pesticides. After the sixth

round of the auction, participants are told that the next round will be the final one and the products will be sold off. 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.

Loureiro, McCluskey and Mitthelhammer (2003) used an economic experiment in conjunction with a survey to analyze whether consumers' hypothetical willingness-to-pay responses are effective predictors of actual market behaviour. They conducted a survey in which consumers were asked about their hypothetical willingness-to-pay and preferences for eco-labeled apples in comparison with organic and regular apples. After the survey, consumers received coupons with randomly assigned discount for each apple type, in order to match actual behaviours and survey answers. They model revealed preferences as a function of socio-demographic characteristics and instrumental variables that represent the intensity of stated preferences. Their findings show that consumers who state that they are willing to pay a premium, which is equal to or greater than a positive lower bound, have a higher likelihood of actually buying the product in question. This implies that consumers' actions in the economic experiment validate their survey responses.

Bougherara and Combris (2009) appraises 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. The participants are divided into two groups. One group reveals their WTP by the BDM procedure, classically. The participants are then provided with information about the meaning of organically-farmed and environmentally-friendly and they are asked to reveal their WTP anew. The second group reveals its WTP once only after reading the information on the organically-farmed label and information about what makes the produce environmentally-friendly. 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.

In a similar experimental context Rozan, Stenger and Willinger (2004) assessed WTP for the *controlled heavy metal content* label. This too was to determine the impact of information on the significance of labelling and the impact on health. The sample is divided into two groups, the first group elicited WTP by using the second price

auction and the second group revealed WTP by using BDM procedure. Unlike Bougherara and Combris (2009), Rozan *et al.* (2004) 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.

In the two following subsections, we describe more particularly two studies led by the WP's partners. This two works, using experimental auctions, are focus on the valuation of the integrates pest management product's by consumers. The first study focuses on the valuation on a fresh product (pear), while the second focuses on a processed product (wine).

II.1 Willingness to pay for pest-management of a fresh product[2]

The European fruit and vegetable sector has experienced important changes during the last few years. Producers had to meet the challenges, not only of global competition within the European market, but also of the strong concentration process in retailing. Consequently, these products are now differentiated by cultivars, origins and appearances, as well as by companies' production and processing methods. Therefore, we observe a lot of denominations of origin, retailer labels or private brands in order to signal the differentiation to the consumers who are often willing to pay large price premiums for products with specific attributes.

In this paper, we use a protocol based on an experimental auction in order to improve the understanding of how different attributes of fruits can interact and affect consumers' willingness-to-pay (WTP). Taking the example of the pear industry in Portugal, we apply this protocol to both non-certified and certified products. For this last category of products, our aim is to show the role of two kinds of "labels" in order to convey to consumers the information on attributes: (*i*) a collective label with a denomination of origin (namely the "Rocha do Oeste" pear) and (*ii*) a premium retail label (namely the well-known "Fileira Qualidade Carrefour", Carrefour's Quality Lines). The main result we obtained was that "food safety" is an important issue for

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[2] Reference: Combris, P., Seabra Pinto, A. Fragata, A., Giraud-Héraud, E., (2010), "Does Taste beat Food Safety? Evidence from the "Pera Rocha" case in Portugal", forthcoming in *Journal of Food Products Marketing*, Volume 16-1.

these certifications, but it cannot excel sensory attributes. Consumers are not ready to compromise on taste.

The purpose of our experiment is to improve the assessment of the relative influences of different attributes on the consumers' WTP for a product. Following the typology of Nelson (1970) and Darby and Karny (1973), our aim is to compare the relative influences of search attributes (which are directly observable, like the "appearance" of pears, for example), experience attributes ("taste", for example, which is usually unknown before consumption) and credence attributes (for example, "food safety", which cannot be evaluated directly by consumers).

Following Caswell *et al*. (2002), the three main attributes that we consider in our experiment - "appearance", "taste", and "food safety" - are "intrinsic", that is related to the physical characteristics of the product. However, in the food area, there are a lot of extrinsic cues which are searchable and closely related to the marketing and differentiation strategies of the producers. According to Caswell *et al.* (1992) and Grunert (2005), information in the form of labels could contribute to the comprehensiveness and accuracy of consumers' evaluation of search, experience and credence attributes.

 In the case of credence attributes, extrinsic cues have an important role to inform the consumers who can "believe" or "give credence" to the signals without being able directly to test or verify the credence quality itself. Then, consumers have a tendency to rely on simple indicators such as brand name, retailer reputation and labelling, in their evaluations. For example, an eco-label is a credible label that identifies environmentally preferable products based on an environmental impact assessment of the product compared to other products in the same category. Consumers are generally unable to measure quality attributes such as the impact of production practices on environment but they may make inferences about these attributes from extrinsic quality indicators and cues as brand names.

In this context, research on country-of-origin effects has established that consumers may use origin information as a quality cue (Stefani *et al*., 2006). Certification of origin can also carry on information on health and safety issues, namely if it certifies the so-called "Integrated Pest Management". Thus, certification of origin can act as a private brand in order to differentiate products. It increases product attractiveness and

assures the consumer on more than one attribute, simultaneously. This is the reason why we compare the effectiveness of a certification of origin to a retailer's label in their respective abilities to carry on information on a selection of attributes in the pear sector. We show, however, that both labels neglect a very important certification which is rarely used in the fruit sector, namely a ripeness certification ("fully ripe" for example) which could provide a taste guarantee to consumers.

The paper is organized as follows. The next section presents the reasons for using the WTP approach to measure consumer preferences. Then, we describe the experimental design and present empirical findings, specifically the results in terms of WTP. The concluding section discusses the implications of the empirical findings.

II.1.1. Background on WTP for quality attributes

Recent studies stated that consumers are willing to pay for different quality attributes and for information on them. The WTP approach is, therefore, concerned with measuring *ex-ante* valuations, that is, valuations performed at the moment choices are made. Researchers measure WTP also from actual market transactions and from a variety of stated and revealed preference methods.

A common feature in WTP studies is the use of various types of contingent valuation methodologies to elicit WTP, including surveys, choice experiments (conjoint analysis), and experimental markets.

Stated preferences' studies, like stated choice surveys, use new or non-existent product attributes and ask consumers to make choices in a sequence of choice scenarios. The values of different attributes are estimated by varying the product attributes between the choice scenarios.

Studies that measure consumer preferences in terms of their WTP for different attributes and that are based on real choices and costs are denominated revealed preference methods.

Experimental markets (EM) is characterised by the use of real economic incentives. Methods with this feature are called incentive-compatible methods for eliciting willingness to pay (Alfnes *et al*, 2006).

EM give the opportunity to control the type and timing of the information provided to participants and observe changes in bidding behaviour (Shogren *et al,* 1999). A lot of

research studies have used EM to assess consumers' WTP for different quality attributes. Examples of EM studies that evaluate search quality attributes are the research of Melton *et al.* (1996) that analysed WTP for fresh pork chops and concluded that attributes like appearance affect WTP. Also, the study of Lange *et al.* (2002) that used EM to reveal the WTP for Champagnes with different labels. Recently, Lund *et al.* (2006) used EM to analyse the monetary value consumers put on the freshness of apples. Other researchers have measured monetary values of experience quality attributes. Lusk *et al.* (2001) used an experimental auction to investigate how variance in beef tenderness affected consumers' valuations. Similarly, Umberger, *et al.* (2004) used an experimental auction to determine consumer's WTP for beef flavour.

Experimental markets have become an increasingly popular tool for evaluating consumer preferences for credence attributes since the nineties (Fox *et al*, 1995; Hayes *et al*, 1995; Rozan *et al*, 2004; Hobbs *et al*, 2006). Credence quality attributes, like food safety, have been valuated using the revealed preference approach. Food safety can be treated as a dimension of quality (Hooker *et al.*, 1995) where safety attributes are categorised as a subset of quality attributes including foodborne pathogens, heavy metals, pesticide residues, food additives and veterinary residues. Measuring WTP for safety attributes has been an important issue in agricultural economics and the different food safety attributes have led to an important range of WTP analysis.

In early empirical studies on food safety, WTP was frequently valuated by means of contingent valuation (CV) surveys. Some of them have focused on risk reductions from pesticides in food (Buzby *et al*., 1998), others on risk reduction from pathogen like *Salmonella* (Henson, 1996). However, Shogren (1993) argued that survey methods like CV are not a real market discipline because they don't create an environment conducting to accurate and reliable responses. Some other authors considered that CV of food safety overcomes the information problem by providing objective assessments of health risk.

Other researchers employed choice experiment to calculate WTP for several food safety attributes. Enneking (2004) used this method to analyse the impact of food safety label applied to brand products. He concluded that WTP estimates vary considerably across food labels and that quality labelling influences consumer's

choice behaviour. Also, Alfnes *et al.* (2003) used a choice experiment to analyse Norwegian consumers' preferences for domestic, imported and hormone-treated beef.

Due to the concern over the "hypothetical nature" of the stated preferences approaches, more recently conducted research has used experimental economics procedures to elicit WTP for food safety attributes. This technique has been applied to a number of different food safety attributes, including reductions in pesticides risk (Roosen *et al*., 1998; Rozan *et al*., 2004), pathogen risk (Hayes *et al*., 1995), and in the use of food irradiation (Shogren *et al.,* 1999).

Advantages and limitations of EM in valuing food safety attributes have been discussed in the literature. Buzby *et al.* (1998) used three different techniques to evaluate the costs of foodborne illness and the benefits to society of a safer food supply. They presented a case study for each technique: CV surveys on pesticide residues, EM for a chicken sandwich with risk of contamination and one expenditure-based technique such as the cost-of-illness approach. They argued that valuation with controlled environment offers advantages like taking in consideration the consumers' budget constraints, the revelation of truthful values by the use of a reveal-mechanism and the minimization of selection bias by recruiting for a "generic consumer study". Enneking (2004) criticised experimental auctions and CV studies, because he considered that these approaches picked out the food safety attributes as the central survey theme. He argued that consumers' attention is concentrated on this product feature, resulting in an over-representation compared with real market behaviour, where food safety is only one of several attributes.

In this paper, we argue that consumers can and do make tradeoffs between different quality attributes. Following Grunert (2005), we consider that the importance of different attributes to consumers can change over time. According to him, sooner or later it is possible that credence attributes can lose out to experience attributes. He points out that taste and healthiness have the same importance before consumption, but it may change after consumption. Consumers can give a different importance to taste because it has now been experienced, while healthiness is still intangible and information-based. However, repeated purchases allow consumers to improve their knowledge about the products' quality and also reinforce the dissymmetry between "credence attributes" and "experience attributes".

Research in experimental markets, as the work of Melton *et al.* (1996) suggested, is unrealistic if one measures consumer preferences for any fresh food based only on appearance without tasting. Sharing the same point of view, Hobbs *et al.* (2006), used an experimental auction to evaluate WTP for two different kinds of meat with different quality assurances. The results show that consumers make tradeoffs between taste and production methods attributes, and they suggest that consumers are unlikely to compromise eating experience.

II.1.2. Objectives

We used an experimental auction to investigate how iformation on quality attributes affects consumers' willingness to pay for different types of pears. The cultivar chosen was the Portuguese 'Rocha' pear. This pear is produced exclusively in Portugal, mainly in the Central West Coast (accounting for 90% of the national production), although its production extends towards the central interior. This fruit is very familiar to Portuguese people and widely consumed on a weekly or daily basis. The "Pêra Rocha do Oeste" is a Protected Designation of Origin (PDO) since 1993. Among the 14 Portuguese PDO/PGI fresh fruits, the PDO "Pêra Rocha do Oeste" is the most important and the exportation markets are its principal destination (Fragata *et al.*, 2007). The largest importer of 'Rocha' pear is the United Kingdom (41%), followed by France (17%), Brazil (14%), Ireland (9%), the Netherlands (7%) and the Russian Federation (4%). This pear has developed a good reception from the big chain retailers, as its shelf life and resistance to handling are superior to 'Williams', the main competing pear cultivar during the Summer (Silva *et al.*, 2005).

As in Melton *et al.* (1996), Roosen *et al.* (1998), Umberger *et al.* (2004) and Hoobs *et al.* (2006), our experiment features simultaneous valuation of multiple attributes of quality (taste, appearance, food safety and labels), where quality is defined as a multi-dimensional vector of these attributes. Participants faced the problem of evaluating four different modalities of 'Rocha' pear.

II.1.3. Data and methodology

In our experiment, the elicitation method used was the BDM mechanism (Becker-DeGroot-Marschak, 1964), also known as lottery mechanism. The BDM mechanism has been used in different researches beginning with the analysis of the preference reversal phenomenon and risk preferences. Recently, it was used to evaluate quality

differentiated products (Lusk *et al*., 2001) and to elicit willingness to pay for GMO-free products (Noussair *et al*., 2004). The BDM mechanism is theoretically equivalent to a second-price sealed-bid auction (Vickrey auction). In both cases, the dominant strategy is to bid one's private value because bids are separated from market price. Like Vickrey auction, the BDM mechanism provides incentives to participants to truthfully reveal their preferences.

The BDM mechanism was combined with sensory evaluation in order to develop an integrated approach able to evaluate extrinsic as well as intrinsic product attributes, and possible interactions between them. Sensory techniques were also used to make sure that pears were very similar within each alternative.

II.1.3.1 Experimental Subjects

The experiment took place in the district of Oeiras, near Lisbon, in Portugal. Oeiras has a population of about 170,000 and is located in a predominantly urban area.

Table 1 : Profile of participants (N=74)

Group	Characteristic	Option	Percentage
Oeiras n=23	Gender	Female Male	47.8 52.2
	Age (years)	16-34 35-59 60-76	8.7 34.8 56.5
EAN n=27	Gender	Female Male	66.7 33.3
	Age (years)	16-34 35-59 60-76	11.1 85.2 3.7
City Council n=24	Gender	Female Male	79.2 20.8
	Age (years)	16-34 35-59 60-76	45.8 54.2 0.0

Seventy-four participants were recruited from the general population of this location and three different samples were used just in order to obtain a representative population[3]: one group was recruited using the specific protocol described by Lange

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[3] The reduced number of participants in each group (less than 30) didn't allow us to measure, significantly, the differences between the behaviours of the three groups.

et al. (2002), that consists of random choices of phone numbers in the district where the study was performed (Oeiras).

This first group was a representative random panel of the Oeiras population. The second and third groups were selected using a random sample from the different professional categories of employees of the National Agrarian Station (research institute) and the city council of Oeiras. The participants of the first and third groups didn't have any agricultural knowledge. The second group had information on agronomic sciences.

For the three groups, individuals contacted by phone were selected if they ate at least 3 pears per week, regularly participated in their food purchasing, and if they ate 'Rocha' pears. Consumers' information obtained by a questionnaire answered by phone also gave us details about socio-economic characteristics of the participants, pears characteristics selection at the moment of purchase and places of purchase. Table 1 presents a statistical summary for the socio-demographic variables describing the three groups.

Participants took part in one of eight sessions, and the number of participants in each session varied from five to fourteen persons. No compensation was offered for participating, but subjects were given 2 euros before they started bidding and were told they could keep the money if they did not spend it.

Note that recruitment without compensation is likely to increase selection bias, but, since opportunity costs vary across individuals, it is possible that uniform compensation may differentially impact subjects' revealed values. Buzby *et al.* (1998) reported a significant positive effect on revealed values for reduction in *Salmonella* risk when a $3 participation payment was made to student subjects whose opportunity costs were likely near zero.

II.1.3.2 Products

Four modalities/types of 'Rocha' pear were chosen for this experiment, according to their differences in intrinsic attributes and extrinsic quality cues. One generic 'Rocha' pear without signal of quality (P1), a pear with a premium retailer label (P2) and two pears with the Protected Designation of Origin (P3 and P4) with two levels of maturity, controlled by its sugar contents measurement (ºBrix). The °Brix means of the four modalities were: 14° for P1; 13° for P2 and P3; 11° for P4 (see Table 2). The

selection of homogenous subsets of pears within each category was done with assistance from post-harvest scientists at INIAP with training in sensory analysis and product characterization (sugar contents, texture and assessed colour of the pears).

Table 2 : Characteristics of the tested pears

Code	Designation	Quality signal	Appearance (colour)	Sugar rate (°Brix [2])	IPM[3]	Market price[4] (€)
P1	Pêra Rocha generic	no	yellow	14	no	[0.68; 0.89]
P2	Pêra Rocha "Carrefour's Quality Line"	Premium label	yellow	13	yes	[1.02;1.23]
P3	Pêra Rocha do Oeste	PDO[1]	yellow	13	yes	[1.10,1.50]
P4	Pêra Rocha do Oeste	PDO[1]	green	11	yes	[1.10,1.50]

[1] PDO: Protected Denomination of Origin
[2] Brix degrees are roughly equivalent to the percentage of sugar present in the pear
[3] IPM: Integrated Pest Management
[4] Source for price: http://www.gppaa.min-agricultura.pt/cot/2006/iVeg.html, Week 6-12/11/2006; Pêra*Rocha*SE*65-70mm; (I): DOP and (II): Generic (price*36%)

II.1.3.3 Experimental procedure

Sessions were run in a classroom located in the Professional Training Center of INIAP. Participants sat in individual tables organised in four rows of four tables. All sessions were held in the week of 6th to 12th November 2006. At this time, several categories of 'Rocha' are available on the market.

Prior to conducting the experiment for the 'Rocha' pear, care was taken to make sure all participants were familiar with the experimental procedure and understood it. In addition to describing each part of the experience and the respective steps, participants were given examples of how the BDM mechanism works. The preference revelation property was emphasized by explaining why it was in a participant's best interest to bid his true valuation in the BDM mechanism. Participants then gained first-hand experience with the BDM mechanism by participating in a non-hypothetical market with small pears (a pear size not evaluated in our experimental market). Once this familiarisation had taken place, the experiment with the 'Rocha' pear was carried out.

The experiment comprised an evaluation phase followed by a selling phase. During the evaluation phase, participants had to evaluate different alternatives of 'Rocha' pear in four different information situations.

In each information situation, participants could evaluate the four modalities simultaneously and had to complete a small questionnaire indicating, for each alternative pear, whether they wanted to buy 1 kilo of that fruit and, if "yes", at what maximum price. Questionnaires were collected at the end of each information situation in order to prevent subjects from reconsidering their evaluations from one situation to the next.

The evaluation stage of the experiment consisted of four steps: (i) blind tasting of the four modalities of pears, ii) visual and tactile examination, iii) additional information, iv) tasting with all the information.

At the beginning of the first step, information situation 1 (S1), participants received a sample of each of the four alternative pears for tasting. Each modality was identified with a letter and besides the fact that they were 'Rocha' pears, no other indication was given. Clear plastic cups containing pear slices were given to participants – each cup containing three slices of one modality. For each alternative, participants had to indicate their buying intention and maximum price as explained previously.

- In the second step, information situation 2 (S2), one fruit of each of the four modalities was given to each participant. Three modalities were identified with a personalized retailer/producer label: P2 with a label "Fileira Qualidade Carrefour" (FQC), and P3 and P4 with a label "Rocha do Oeste" (RO). The participants could only make a visual and tactile inspection of the products and examine the labels, but were not allowed to taste the pears. They had enough time to evaluate each of the alternative pears carefully before completing the questionnaire.

- In the third step, information situation 3 (S3), some information was given about quality assurance, origin and food safety for each fruit. Before the information was issued individually to participants, they were asked to answer a few questions to check their prior beliefs about those quality attributes: (1) Do you know if this type of pear has quality assurance? (2) Do you know if this label assures specific origin? (3) Do you know if this pear has food safety assurance? The experimenter provided oral comments about the interpretation of the questions and additional information on agricultural integrated production practices was given. Responses were collected by means of a matrix questionnaire in table form. Participants had three alternative answers: "yes", "no" and "don't know". When they finished, they were given another

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table form with the same questions and the right answers. After considering the information provided, participants had to evaluate the same four pears.

Finally, in the last step, information situation 4 (S4), participants were given a knife and asked to taste the pears before giving a new evaluation, now accounting for all the information about each of the four alternative pears.

During the last phase of the experiment, each participant selected one situation at random (by choosing one card among sixteen), and then drew one token from a box containing 30 tokens with prices ranging from €0,20 to €2,00. If the bid the participant submitted in one situation was higher than the price on the token he drew, the participant had to buy 1 kilo of 'Rocha' pear at the price appearing on the token. If his bid was less he had no opportunity to buy. At the end of the session participants could ask to check the bag containing the tokens.

II.1.4. Results

II.1.4.1 Results for each information situation

From the seventy-four participants who evaluated four alternative pears in four information situations, we collected a total of 1184 prices. Figure 1 shows the distribution of these prices. Refusals to buy resulted in 177 zero prices (14.9% of the total). Given that no participant systematically refused to buy (out of 16 evaluations, the maximum number of refusals to buy is 8, and the median is 2), we can interpret these refusals as zero WTP for specific characteristics. Strictly positive WTP are distributed almost normally, around a mean of €0.88 and a median of €0.9. Compared to market prices, the WTP distribution seems to be slightly shifted to the left, but nevertheless a majority of positive WTP are within the range of market prices (from €0.68 to €1.5).

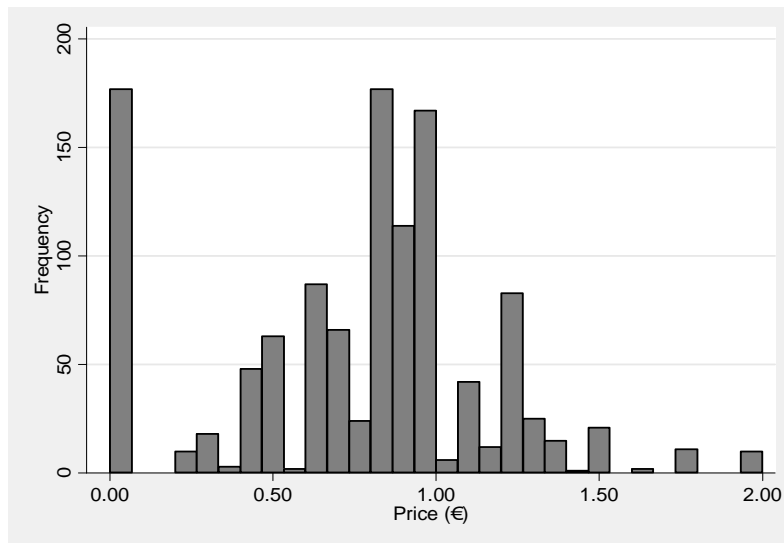**Figure 1: Distribution of WTP for all pears and information conditions**

Figure 2 splits the distribution of prices according to pears (rows) and information situations (columns). From this figure, we can see that the distributions of prices for pear P4 (last row) are characterized by a lot of zero WTP in all the information situations, and in particular in situation S1 when tasting was the only way to evaluate the pears

Figure 2 : Distribution of WTP for each pear in each information condition

Graphs by pearXsituation
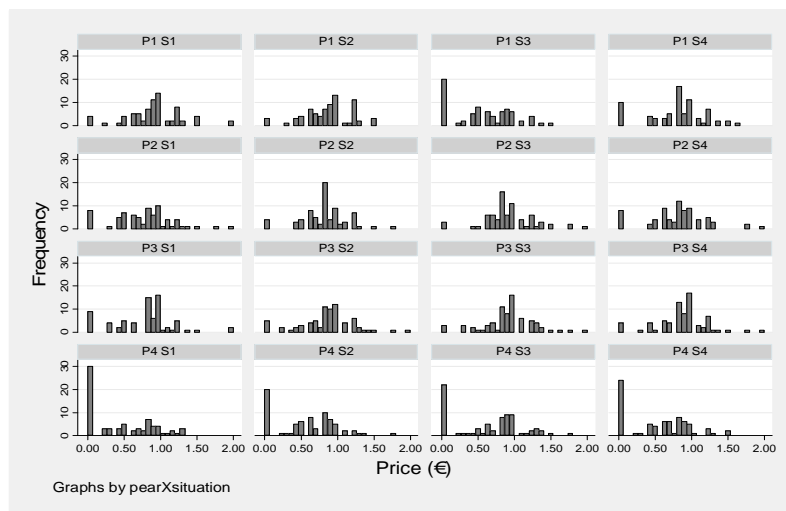
Looking at mean WTP by pear and information situation, makes interpretation easier. Figure 3 displays the mean WTP for each pear (including refusal to buy, counted as zero) with the corresponding 95% confidence interval.

Under blind tasting condition (situation S1), the generic 'Rocha' pear P1 obtains a mean WTP of €0.91, significantly higher than those of all other pears, which actually have a lower sugar rate (controlled by a sugar contents measurement, see Table 2).

The mean of prices proposed for pear P1 is greater than the mean prices for pears P2, P3 (+ €0.14 and + €0.13, respectively, with P < 0.005 in both cases) and P4 (+ €0.46, P < 0.0001). Moreover, after blind tasting, participants are also willing to pay significantly more for pears P2 and P3 than for pear P4 (+ €0.32 and + €0.33 respectively, P < 0.0001). As prices proposed for pears P2 and P3 (with identical sugar rate) do not differ significantly, the hierarchy of prices appears to be the same as the hierarchy of sugar rates. So we can conclude that participants are sensitive to variations in sensory characteristics, and adjust their WTP accordingly.

In situation S2, participants could evaluate the pears by visual inspection and examination of the stickers on pears P2, P3 and P4. The differences in WTP means show there is no impact of the quality labels. Mean WTP is not different for pears P1, P2 and P3 though P1 has no label, and P2 has a different label from P3. Moreover, WTP for P4 is significantly lower than WTP for P3 (- €0.29, P < 0.0001) though they both have the same label. The main visible difference between P4 and the other pears is colour, P4 being greener than the other three. This difference in colour is taken as an evidence of unripeness by participants.

It should be noted that there was no direct correspondence between situation S1 and S2: pears were identified by different codes, were not presented necessarily in the same order, and participants received only peeled slices in situation S1 and the entire fruit in situation S2. Once again, this result points out the importance of fruits' maturity in the consumer's choices.

The sequel of the experiment shows that the limited knowledge of consumers on integrated pest management is largely responsible for their relative lack of responsiveness to fruit labelling. To control for a priori beliefs of participants at this stage of the experiment, we asked them to complete a short questionnaire. For each pear, they had to answer three questions: about guarantee of quality, guarantee of origin, and food safety guarantee (associated with integrated pest management). Table 3 shows the distribution of responses for each pear and each guarantee. Right answers are written in bold characters, and percentages showing that only a minority of consumers is well informed about one of the guarantees given by the labels are underlined. Data from Table 3 highlight the fact that participants are strongly uninformed on the guarantee of higher food safety standards given by labels. Indeed, from the column "Guarantee of Food Safety" of Table 3, we can see that a minority

(less than 50%) considers that these labels take into account integrated pest management. Moreover, only 8.2% of participants know that generic 'Rocha' pear doesn't have a specific guarantee of food safety (i.e. a higher standard compared to the public regulations).

After having completed the questionnaire and still in the situation S3, participants were given the right answers and asked to perform another evaluation of the four pears. As a result of this new evaluation, pear P1 obtains a much lower WTP than pears P2 and P3 (- €0.36, P < 0.0001). The control of participants' knowledge before this evaluation, allowed a good estimation of the effect of an information about the food safety guarantee brought by the labels. It highlights the increase in labels' reputation that more communication could bring. Nevertheless, the fact that in this situation, informed participants did not value pear P4 very much compared to P2 and P3 (- €0.30, P < 0.0001), raises the question of the trade-off between food safety guarantee and sensory quality.

Table 3 : A priori knowledge on guarantees on pears

	Guarantee of quality			Guarantee of origin			Guarantee of safety		
	Yes	No	Don't know	Yes	No	Don't know	Yes	No	Don't know
P1 Pêra Rocha Generic	41.9	16.2	41.9%	58.9%	1.4%	39.7%	20.5%	8.2%	71.2%
P2 Pêra Rocha"Carrefour's Quality Line"	51.4	21.6	27.0%	41.1%	15.1%	43.8%	49.3%	2.7%	47.9%
P3 Pêra Rocha do Oeste	74.0	6.8%	19.2%	89.2%	0.0%	10.8%	47.9%	2.7%	49.3%
P4 Pêra Rocha do Oeste ("green")	57.5	17.8	24.7%	86.5%	2.7%	10.8%	43.8%	4.1%	52.1%

Situation S4 brings some answers to this question. When fully informed on labels and after tasting all the pears, participants finally value the pears according to their sensory characteristics rather than their labels. WTP for pear P4 remains significantly lower than WTP for P1, P2 and P3, (- €0.25, - €0.27, - €0.35 respectively, P = 0.0001 or less). Moreover, WTP for pears P1, P2 and P3 is not significantly different. This could mean that the better taste of pear P1 compensates for the absence of specific guarantee on sanitary risks.

Figure 3 : Confidence intervals (95%) of mean WTP for each pear

Figure 3 : Confidence intervals (95%) of mean WTP for each pear
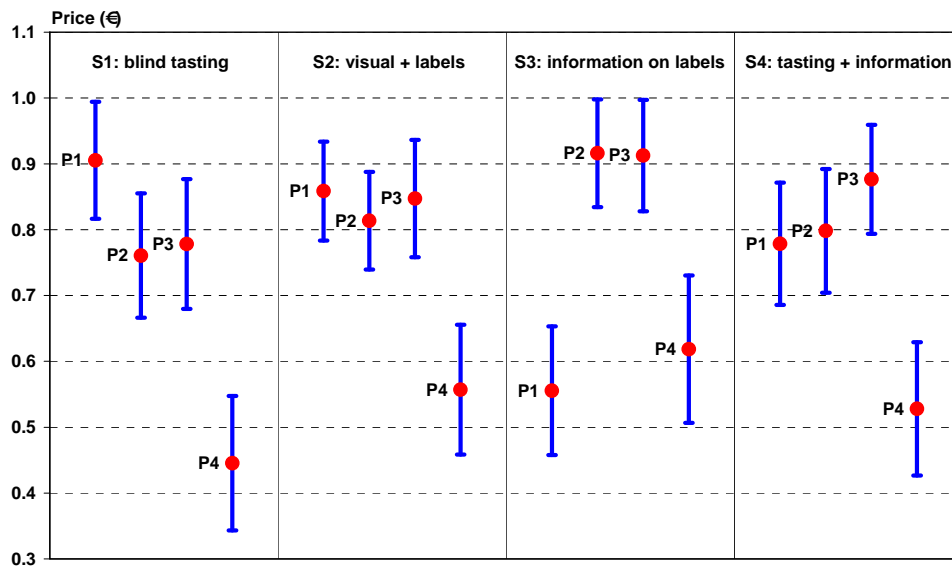
## II.1.5.2 Effects of information on WTP

The results obtained for each information situation show a complex pattern of relationships between taste and food safety in consumers' evaluation. Note that the greatest WTP obtained across all situations (€0.91) was for pear P1 in situation S1 and for pears P2 and P3 in situation S3.

In the first case, consumers revealed their WTP after blind tasting without any information regarding origin or production practices. As could have been expected, participants preferred the sweetest pear. More surprising is the fact that a WTP of €0.91 is significantly higher than those obtained in situations closer to actual purchase conditions, that is when participants could only see the fruits and their quality labels. This leads to the idea that pear producers could certainly increase the market price of ripe fruits if they were able to certify a "Fully Ripe" characteristic to consumers.

In the second case, participants revealed their WTP without tasting the pears, but after having been informed of production practices and the associated guarantees. Again, this situation is far from a natural buying situation (taking into account the lack of knowledge of consumers on the real significance of the labels). Because the guarantee of food safety is insufficiently conveyed by the labels in situation 2, we can estimate the difference in WTP between a safe pear and an unsafe one. The absence of sanitary guarantees explains the decrease of the WTP for pear P1, since the WTP for pear P1 is €0.30 smaller in situation 3 than in situation 2 ($P < 0.0001$). Note that information

on integrated pest management increases the WTP for pear P2 (+ €0.10, P = 0.0003) and pear P3 (+ €0.07, P = 0.05). Moreover, it appears that the guarantee of origin (or the absence of guarantee of origin in the case of the retail label) has no specific effects compared to the food safety guarantees.

Figure 4 : . Trends in mean WTP according to the information situation for each pear

Graphs by Pear
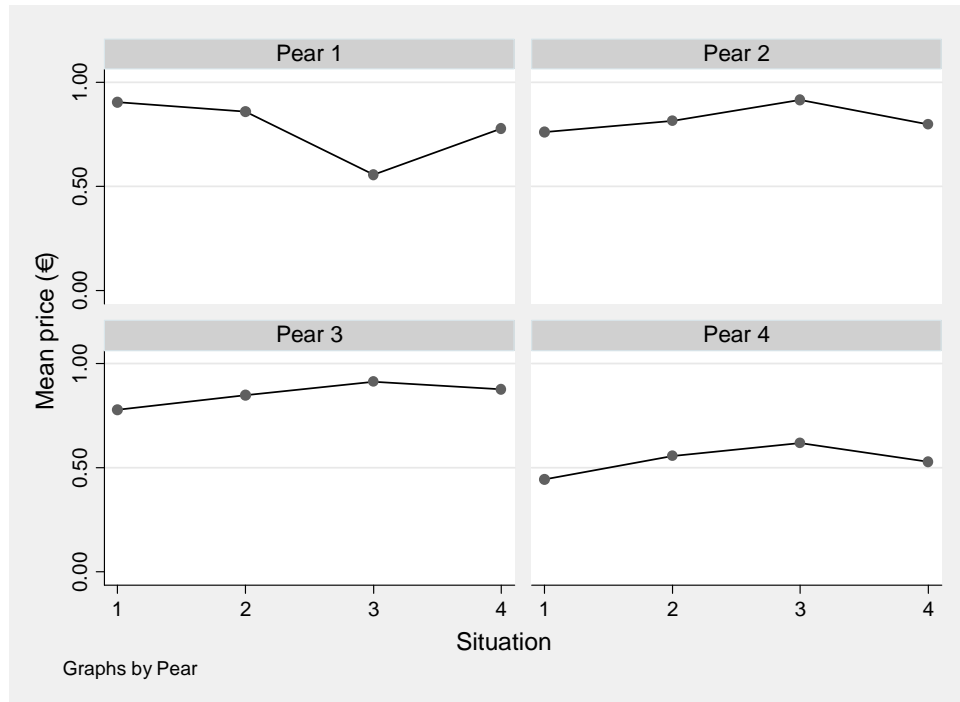
In order to evaluate the respective weights of taste and food safety attributes, we need to better understand the evolution of the WTP for each pear during the experiment. Figure 4 shows the mean WTP trends for each pear and each information situation. The WTP for pear P1 starts from €0.91 in situation S1 and decreases to €0.86 in situation S2. When consumers are informed on the absence of safety guarantee, in situation S3, the mean WTP for P1 decreases dramatically to €0.56. The trend is reversed when participants can taste again the pears in situation S4, and the WTP then grows from €0.55 to €0.78 (P < 0.0001). Participants valuate the pear taste strongly, despite the absence of food safety guarantees.

The WTP for the other pears shows similar trends according to the information provided to participants. It seems that the reference to a label ("Rocha do Oeste" or "Fileira Qualidade Carrefour") improves the WTP after the blind tasting. However, this result is significant only for pear P4, which WTP increases of €0.11 from situation 1 to situation 2 (P = 0.02). When participants have all the information about

safety guarantees attached to the labels, they increase their WTP in a much clearer way. Indeed, comparing situations S1 and S3, we observe that the WTP increases by €0.15 (P = 0.0004) for pear P2, €0.13 (P = 0.008) for P3 and €0.17 (P = 0.001) for P4. Contrary to pear P1, the average WTP for P2, P3 and P4 decreases in situation S4. These results support the idea that participants put more weight on "taste" than on "food safety".

II.1.6. Final remarks

This research is a first contribution towards reducing the information gap in the pear market. The experiment's results reveal that consumers are willing to pay significantly more for fully ripe pears, and for better quality assurances related to on-farm production methods, such as the absence of pesticides. These results have important implications for firms' strategies regarding production, commercialization and signaling of product quality to consumers.

Nevertheless, our results reveal no statistically significant difference between the WTP for Denomination of Origin and the WTP for retailers' high premium labels, suggesting that the guarantee of origin is not very crucial for consumers. It seems that, in addition to marketing and promotion efforts, these labels should improve the signaling of credence attributes to consumers. They should do so, not because the WTP is higher for goods produced with less pesticides, insecticides, etc., but because the absence of these guarantees could lead to an important decrease of the WTP. Indeed, our results support the idea of a negative effect of the absence of information (i.e, non safe production) previously highlighted by Fox *et al.* (2002). In this sense, a signaling like the one given by "organic products" could be a good assurance for the future of producers' income.

However, the results of this study suggest that "taste beats food safety". Even when consumers are well-informed about safer products, in the end they prefer to enjoy the tastier alternative. This result is of great practical importance, because a large number of standards, labels and quality signals establish no link between the different attributes of the products and their methods of production. For example, in France, the logo "*Label Rouge*" signals sensory quality, but does not guarantee the origin of the product or the way it has been produced (organic or environmental friendly production, for example). Unlike the "*Label Rouge*", the "*Appellation d'Origine*

Contrôlée" guarantees the origin and is very well-known, but does not give any guarantees regarding sensory quality or environmental aspects. Similarly, the label "*Agriculture Biologique*", signaling organic products, accounts for the environment and gives some guarantees about food safety, but does not guarantee a high level of sensory quality. Therefore in France, contrary to Portugal where, for example, the "Rocha do Oeste" is a multipurpose label, none of the well-known signals of quality take into account the necessity of a simultaneous certification of attributes which is asked for by consumers. This is the reason why the premium retail labels (like the one of "Carrefour" we studied in this paper) are expanding (see Bazoche *et al.*, 2005).

One interesting subject for future research could be to examine different information structures with different products. Indeed, when the damages cannot be scientifically proved (e.g. how pesticides affect health) it seems reasonable to assume that the absence of a label guaranteeing safe food has a limited effect on demand. On the contrary, when the damages can be proved and are known to consumers (e.g. the "mad crow crisis") these may overestimate the risk. Then the decrease in demand due to inadequate food safety may be more significant."

The next step of this research should be to apply our methodology to a wider cross section of the European population, both geographically and socially. Hence, future research should explore the diversity of possible tradeoffs between food safety and sensory pleasure. This point is of particular importance in the fruit sector given that most of its economic problems arise from the difficulty to offer a ripeness guarantee to consumers.

II.2 Willingness to pay for pest-management of a processed product[4]

The reduction of pesticides use is becoming a priority for the public authorities in many countries. We conducted an experiment with wine consumers to see whether end-consumers value the dissemination of information about environmentally-friendly production practices. The experiment was devised to (i) evaluate whether there is a premium for environmentally-friendly wines, (ii) determine whether or not consumers

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[4] Reference : Bazoche P., Deola C., and Soler L.G. "An experimental study of wine consumers'willingness to pay for environmental characteristics", *12th Congress of The European Association of Agricultural Economics-EAAE* .

are sensitive to label owners who implement and guarantee the environmental actions, (iii) and assess the impact of public messages about the consequences of pesticide use. Some 139 participants were divided randomly into two groups. One group had no specific information about the current state of pesticide use in farming. The other group was given information about pesticide use in farming before making their valuations. Becker-DeGroot-Marshak mechanisms revealed that (i) the environmental signal is valued differently depending on who conveyed the information, and that (ii) dissemination of information about the environmental repercussions of farming methods does not significantly affect willingness-to-pay.

II.2.1 Objectives

Integrating environmental issues into economic analyses of the agro-food sector has become a major concern for the public authorities. In France, reducing the use of pesticides was pinpointed as a major factor in preventing chemical pollution at the *Grenelle de l'Environnement* in Autumn 2007[5]. Vines currently cover just 3.7 per cent of the utilized agricultural area in France but account for 20 per cent of pesticide sales (Aubertot *et al.*, 2005). The sector is therefore one of particular environmental concern. To what extent can the authorities impose a cut in the use of these products and by what means? Beyond the ambition of reducing pesticide use lies a real problem of incentives for producers. The introduction of arbitrary and over-restrictive regulations does not look like the long-term solution the industry expects. The pesticides at issue are inexpensive and are claimed to improve output substantially so it appears difficult at first sight to get producers to cut back on their use. Moreover, there are currently few alternatives to pesticide use. This raises the question, then, of providing economic incentives for adopting production strategies that consume fewer pesticides. Under the circumstances, might an effective incentive be to get consumers to reward pesticide-reduction strategies?

Most studies proposing to estimate WTP for pesticide-free produce focus on fresh produce (with the highest health risks) and so cannot be used to determine the extent

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to which consumers value the health aspect or the environmental aspect more generally. Studies of the wine industry fail to demonstrate the default valuation of environmental characteristics. Loureiro (2003), for example, uses contingent valuation to estimate consumers' WTP for geographical and environmental labels. That study uses survey data for Colorado (USA) wines. The main finding is that environmental labels are useless with what are perceived as poor quality wines. Certification does not systematically mean produce will be valued more highly. Delmas and Grant (2008) confirm that result. They argue consumers do not appreciate the point of eco-certification in the wine industry and fail to understand the differences among the various environmental labels (wine from organically-grown grapes or organic wines, sulphite free, etc.). The authors compare the advantages of eco-certification and eco-labelling (mentioning certification on the label) and report that consumers are not ready to pay a premium for eco-labelled wine but that unlabelled eco-certified wines carry a large premium.

In this paper we evaluate willingness to pay (WTP) for wines made by farming practices that use few pesticides. Over use of plant-care products may engender various risks. The first is a health risk to growers from the direct use of the products (the French Ministry of Agriculture claims grapegrowers and winegrowers are particularly exposed to such risks). The second risk is of water contamination and the transfer of pesticides to the environment. This is particularly prevalent in viticulture. The third risk inherent to the use of plant-care products concerns consumer health. However, low levels of pesticide residues are detected in wines and this danger is much lower than for non-processed products such as fruit and vegetables.

So the most serious risks identified to date in the wine industry are those pertaining to the direct use of pesticides and to environmental pollution, while there is far less evidence of any direct risk from drinking wine made from grapes treated with pesticides. Now, the value of organically-farmed products has much to do with consumers believing they contribute to their health, which is somewhat irrelevant for a processed product like wine. Moreover, consumer beliefs about production processes in this sector seem rather unrealistic. Insufficient knowledge of production conditions (often thought to be traditional and so healthy) might lead consumers to underestimate the environmental-protection efforts made by labelled producers.

This paper sets out, then, to assess how consumers value environmental characteristics. Environmental-protection approaches now introduced in the

viticultural sector may derive from initiatives at various points in the supply chain. We investigate here whether the signal owner (or initiator of the environmental-protection approach) has an impact on consumer perceptions. We also investigate whether a public communication policy on the consequences of pesticide use might prove an effective way to enhance product value and so provide an incentive for producers to take up an environmentally-friendly approach.

To do this we conducted an experimental study with 139 wine drinkers in the Paris region. The participants were divided randomly into two groups. One group had no special information about the current state of farming in terms of the use of pesticides. The second group was given information about pesticide use in farming (and its environmental consequences) before it made its valuations. We selected four Bordeaux AOC wines: (i) a conventional product, (ii) a wine labelled by an independent certifying body (Terra Vitis), (iii) a wine made by a vintner with an environmental approach, and (iv) a wine whose environmental approach was managed by a retailer (the private label: Filière Qualité Carrefour). The preference-revelation mechanism employed here has been used in similar analyses of food products[6]. Like Combris, Lange and Issanchou (2006) we used the auction mechanism of Becker, DeGroot and Marshak (BDM, 1964), getting participants to evaluate each wine in three different informational situations (see Lecocq *et al.* (2005) for a similar informational context). First the participants revealed their WTP for each of four wines in a blind tasting. Then six wines were evaluated from the information provided by their labels alone. And finally the tasting was repeated with all the information, that is the label for each of the four wines tasted. After each evaluation of each wine, the participants were asked make a written bid, giving us fourteen prices for each participant. Each participant then drew lots for one of the wines they had evaluated and the sale price of the wine. If their bid was higher than the sale price, they got a unit of the product paid for at the price drawn by lot. Actually selling the products ensured WTP was effectively revealed.

Examination of the bids shows that consumers did not value the environmental characteristic by default. The signal carrier and the sensory qualities seem to be predominant in valuing wines. In addition, information about the environmental consequences of pesticide abuse did not prove decisive in revealing WTP. Section 2

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[6]Notably Noussair, Robin and Ruffieux (2001, 2004) on GMOs, Bougherara (2003) on ecolabelled orange juice, and Tagbata (2006) on fair-trade chocolate.

describes our experimental protocol and the experiment itself. Section 3 presents the data and results. Section 4 concludes.

II.2.3. Data and Methodology

The experiment was based on the protocol developed by Lange *et al.* (2002) and adopted by Bougherara and Combris (2009). The experiment was conducted in a sensory analysis room in Paris. A total of 139 participants were recruited in the Paris region by a private company.

II.2.3.1. Experimental Subjects

The individuals selected had to meet certain criteria[7] including (i) being wine drinkers, (ii) prescribing wine sales, (iii) not having taken part in a marketing or consumer study in the previous three months.

The total sample was divided randomly into two groups to determine the impact of public information about pesticide use in farming. The first group of participants had no particular information. Each participant in the second group was given a press cutting from Le Monde describing the effects of pesticide use on the environment. Further information was provided subsequently on its negligible impact on health from drinking wine. This additional information was revealed so as to be sure consumer WTP reflected their valuation of environmental and not health characteristics.

Table 4 : Sample characteristics

139 participants (68 women- 72 men)				
Variables	Moy	S.D.	Min	Max
Age	39.32	9.08	20	64
Household size	2.72	1.31	1	7
Usual price paid for a bottle of wine	5.29	2.28	2	15

Table 4 shows the main characteristics of the sample. It can be seen that the usual mean price paid for a bottle of wine by the participants was far higher than the national average[8]. Intuitively the two explanations of this phenomenon are (i) stated preference bias, and (ii) a Parisian population that was not representative of the French population as a whole.

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[7]The recruitment questionnaire is available on demand from the authors.
[8]For Viniflhor the average price of a litre of still wine was 2.83 in 2005 for France and 3.32 for the Paris region.

II.2.3.2. Products

The four selected products are four Bordeaux d'*Appellation d'Origine Contrôlée*[9] wines.

Table 5 : Wine Codification

Situation			Product
1	2	3	
H4-612	E7-432	K6-275	Bordeaux
I2-736	B6-851	L2-163	Dulong (vintner's charter)
D3-915	D8-524	E5-492	Terra Vitis
G9-328	H3-065	C4-629	FQC
	D8-627		AB (organic product)
	J8-234		AOC Bordeaux Supérieur

The first one is a conventional product, the second wine is labelled by an independent certifying body (Terra Vitis), the third wine is produced by a vintner with an environmental approach, the fourth product is a wine whose environmental approach is implemented by a retailer (the wine private label of Carrefour: "Filière Qualité Carrefour"). The four wines were assessed in three different informational situations (blind tasting, valuation with the label alone, valuation with tasting and the corresponding label). For the visual situation (with the label only) two additional wines were included: one certified as organically farmed and one Bordeaux Supérieur[10] appellation. Each wine was codified for each situation as shown in table 5.

II.2.3.3. Experimental Procedure

The experiment was conducted in 5 stages.

1. Each participant was given instructions about how the experiment was to be conducted. The objective was to get each participant to fully understand the revelation mechanism for it to be effective. Instructions were nominal and contained an example with actual figures to ensure the revelation mechanism had been properly understood. To measure any potential anchoring bias different examples were used for different participants.

2. The session began by explaining the procedure verbally to everyone. To ensure the revelation mechanism was fully understood (auction process) a test-run

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[9]French certification of products' origin
[10]The Bordeaux Supérieur appellation was integrated to measure the impact of the name. These wines were not included in the tastings as sensory perception declines when too many products are tasted.

auction was held with alternative products.

3. The participants were seated in a sensory analysis room in such a way that they could not communicate with each other. They had a glass of water and some bread to take away the taste of the wines between tastings.

4. The participants had to evaluate the wines in three informational situations:

- First each participant valued the four wines in turn in a blind tasting. They could taste each wine but had no information other than that provided by the actual tasting. After tasting each wine, the participants wrote down their maximum bid for the wine tasted, imagining that that was the wine that would be auctioned at the end of the experiment.

- In the second situation, participants examined the labels of six wines in turn but without tasting them. Again each participant wrote down their maximum bid for each of the six wines.

- In the third situation, each participant valued the initial four wines in turn. They tasted each wine examining the corresponding label at the same time. After each tasting the participants wrote down their maximum bid for each wine.

It should also be noted that when explaining the experimental procedure, the participants were never told that the wines presented in the three situations would be the same wines. The participants tasted or visually assessed each wine in turn. Each participant appraised a wine in a pre-established order to control for the impact of the order of presentation of the products on the assessment. So participants were not tasting the same wine as their neighbours at any one time. After each tasting and each valuation the wine (or label) was taken away from the participants and their valuation recorded. In this way participants could not revise their valuations with hindsight after experiencing the other wines or situations.

5. The next stage was to draw lots for a wine and its sale price. The participants were unaware of the limits of the range of sale prices, so as to avoid anchoring effects, but knew that the distribution reflected that of the price of wines on the market. Each participant therefore had a possibility of buying one bottle at most. Each participant who has offered a price higher than the selling price for selected

wine, buys a bottle of wine at the selling price. The instructions given to the participants specified they could check the contents of the ballot box at the end of the experiment.

II.2.3. Results

Each participant made 14 bids and 139 subjects took part in the session, yielding a data base of 1946 observations (bids). These were processed by panel data econometric methods so as to identify the impact of each characteristic on consumers' WTP. Table 6 reveals that the bids during the experiment were closer than the price usually paid by participants to the national average.

Two differentiation criteria are of particular interest to us. The first concerns the impact of information on consumer preferences; the second the valuation of the different characteristics of the wines.

Table 6 describes the characteristics of the bids by group. Half of the sample was given no special information and the other half was given a newspaper article about pesticide use in farming. It can be seen that the two samples have much the same means, medians and standard deviations. Econometric processing confirms the absence of any significant effect for those having been given this information (group 1 variable).

Table 6 : WTP characteristics

Group	Obs	Mean	SE	Max	Percentiles			
					25%	50%	75%	90%
Uninformed	980	2.36	1.85	10	0.55	2.50	3.55	4.67
Informed	966	2.24	1.84	11	0.60	2.05	3.40	4.50
TOTAL	1946	2.31	1.85	11	0.60	2.30	3.50	4.50

The aim of this study is to determine whether the more environmentally-friendly wines were valued more highly. The mean prices of wine and situation provided a first approach.

It can be observed that mean bids were higher in situation 2 (visual) than in the other situations (cf. Table 7). This is a classic result highlighting that situation 3 (complete information) is a compromise between sensory and visual. The valuation with the label alone revealed the belief associated with the product (and therefore the expected quality). The situation with complete information revealed the trade-off between perceived quality and expected quality. It is noticeable too that the lowest bids were

for Filière Qualité Carrefour (FQC) wine. However, closer scrutiny shows the distribution of bids for FQC wine was similar to that for Terra Vitis wine .

Table 7 : Mean WTP according to wine and situation

	Situation			All
	Blind	Label	Full info	
Bordeaux	1.89	2.79	2.55	2.41
Dulong (vintner's charter)	1.73	3.25	2.58	2.52
Terra Vitis	1.51	2.46	2.23	2.07
FQC	1.52	2.41	1.80	1.91
AB (organic product)		2.94		2.94
Bordx supérieur		2.61		2.61
All	1.66	2.74	2.29	2.31

As said, Carrefour wine seemed to command the lowest mean bid price regardless of informational situation. Yet the means of the non-zero prices reveal that, when tasted blind, the Carrefour wine did not receive the lowest bids. This led us to examine refusals to buy. A wine may display such distinctive character that some consumers did not wish to buy it but those who did were ready to pay more for it. Table 8 shows the number of refusals to purchase by wine and by situation. The two wines with the largest numbers of refusals to buy were Filière Qualité Carrefour and Terra Vitis in all the informational situations. It appears clearly that the Carrefour wine has a distinctive character that led to a large number of refusals to buy during the tasting. Surprisingly we found that for the visual evaluation (label) the wine with the highest number of refusals was the one certified by an independent body (Terra Vitis).

Table 8 : Refusals to buy according to wine and situation

	Situation			All
	Blind	Label	Full info	
Bordeaux	39	15	26	80
Terra Vitis	45	30	36	111
Dulong (vintner's charter)	38	9	33	80
FQC	52	24	53	129
AB (organic product)		24		24
Bordeaux Sup.		26		26
All	174	128	148	450

Table 9 shows the results of the econometric analysis taking into account the nature of the sample (panel data and censured data). Several specifications were tested. Model 1 estimates a linear specification taking account of the wines, informational situations,

sex, income, group (the *group 1* variable is a dummy variable taking the value 1 when the participant belonged to the group given specific information and 0 when no information on pesticide use in farming was given) and the order of presentation of the wines.

Model 2 is a simplified model ignoring income, order of presentation of wines and participant sex (all these variables are non significant in the previous model). Refusals to buy represent 23 per cent of observations. We also analysed potential factors for likelihood of purchase. The results of models 3 and 4 shown in Table 8 are therefore the marginal effects on the likelihood of purchase with (model 3) and without (model 4) the sociodemographic variables.

The results show that some factors jointly influence the purchasing decision and the size of the bid. Having visual information alone significantly increased the likelihood of purchase and the price participants accept to pay. Wines with environmental characteristics do not seem to be valued more highly than traditional Bordeaux (remember each wine had this appellation). Even Terra Vitis and FQC are valued less than conventional wine. It would seem, then, that the environmental signal carrier counts in consumers' perceptions and valuations. The vintner's wine (Dulong) with an environmental characteristic is not valued less by consumers than the conventional wine (Bordeaux). Moreover, information given to one consumer group does not have a significant effect on consumers' WTP. In other words, consumers do not value environment-friendly wines more when they are informed of the harmful consequences of pesticide use.

Table 9 : Factors influencing WTP and probability to buy

	Coefficient		Marginal effects	
	Tobit		Probit	
	(Std. Err.)		*(Std. Err.)*	
Variables	(1)	(2)	(3)	(4)
Situation 1 (Blind)	Ref	Ref	Ref	Ref
Situation 2 (label)	1.117**	1.319 **	0.118**	0.173**
	(0.181)	*(0.107)*	*(0.033)*	*(0.021)*
Situation 3 (full)	0.286	0.735 **	-0.083	0.041*
	(0.310)	*(0.108)*	*(0.065)*	*(0.016)*
Bordeaux	ref	ref	ref	ref
Terra	-0.420**	-0.454 **	-0.073*	-0.082**
	(0.125)	*(0.123)*	*(0.033)*	*(0.034)*
Dulong	0.146	0.116	0.010	0.002
(vintner's charter)	*(0.124)*	*(0.122)*	*(0.029)*	*(0.030)*
FQC	-0.673**	-0.687 **	-0.118**	-0.123**
	(0.126)	*(0.124)*	*(0.034)*	*(0.034)*
AB	-0.040	-0.066	-0.106	-0.112
(organic product)	*(0.185)*	*(0.182)*	*(0.051)*	*(0.050)*
BordSup	-0.415*	-0.427	-0.115	-0.121

	(0.186)	(0.183)	(0.042)	(0.041)
Group 1	0.113	0.183	-0.015	0.004
	(0.250)	(0.251)	(0.038)	(0.038)
Male	0.206		0.005	
	(0.244)		(0.037)	
Income	0.028		0.016	
	(0.079)		(0.012)	
Order	0.046		0.012	
	(0.029)		(0.006)	
Intercept	1.080*	1.422 **		
	(0.438)	(0.207)		
Probit			0.769	0.768
N	1904	1946	1904	1946
Log-likelihood	-3424.49	-3489.83		
Significance levels : * : 10% **: 5% *** : 1%				

II.2.4. Final Remarks

We have attempted to use experimental economics to appraise consumer valuations of environmental characteristics. The three main contributions relative to the existing literature have been (i) to isolate the environmental characteristic from the health characteristic, (ii) to evaluate the impact of a communication policy in this context, and (iii) to appraise the valuation of various labelling strategies. These products should therefore be valued as part of a long-term view for consumers and for collective welfare. The newspaper cutting given to participants was designed to highlight these concerns. Analysis of the results shows consumers did not value the environmental effect alone. It seems even that consumers were not convinced by good environmental practices signalled by an independent certifying body. These phenomena are similar to those described by Delmas and Grant (2008). Still, to confirm these findings it would be useful to take the intra-individual analysis further. The idea of there being several differentiated consumer segments might modify the results and seems to us an interesting direction in which to pursue this work.

Conclusion

The main objective of the work package 4 is to assess the external costs of pesticides on the consumers, judged by their own point of view, identify the main factors that affect consumer demand for conventional and pesticide-free foods and evaluate different instruments to promote the reduction of pesticides.

This report follows the completion of the task 4.1, this task involves a comparison of the different approaches used to estimate WTP. We propose a litterature review that points out the different methodologies employed to estimate willingness to pay for environmental characteristics and for a risk reduction from the used of pesticides use.

To encourage the use of less input or pesticide-free crop farming, policy makers can used a range of tools like taxation, strengthening of standard quality level, or communication policy by health authorities. Main of this tools should be used with a well knowledge of the final market reaction. For example, the effectiveness of the implementation of an input tax will depend on the impact of this tax on the final price, and thus will depend on the price elasticities of consumers. Mainly, the literature on WTP for environmentally friendly product interessed by policy implication are focused on taxation or communication policy by health authority. Thus the WTP analysis is a relevant tool to assess the potential impact of a public policy.

Since the 90s, the stated preference methods have provided an assessment of consumer reaction to products without pesticides. Largely, these studies concluded there exist a premium for environmental characteristics in food products. Main methodologies employed are based on hypothetical markets, but increasingly methodologies based on actual purchase bevaharior, particularly non-hypothetical experimental markets, were developed. These recent methodologies have been used to control each variable that could influence consumers' choices. Thus, results so obtained are more subtle, consumers don't seem to be ready to pay a premium for environment in any case. These results explain why the maket shares of organic products had have so many difficulties to increase (even if, since few years, it seem to become more significant).

The analysis of this literature leads to an overview of methods used, problems associated with evaluating WTP for pesticide-free products, and assessments of the effects of proposed public policies.

Policy recommendations and implementation

In the policy point of view, the deliverable D.4.1 provides a state-of-the-art about consumers perception for environmental characteristics for food products. It aims to make it easy the identification of a specific empirical work for policy makers. In this goal, we summarised in a synthtic table the main works, and we precised for each of them the product used, the country of the analysis and the main results. The range of the results is quite wide, for these reason as mentioned Travisi *et al.*(2006) the results of these studies must be interpreted in the light of the product used, the methodology employed, and characteristics of the samples mobilized. We have identified the following issues on which policymakers should pay attention when using the empirical literature.

- In view of this literature review the first point on which it is necessary to pay attention is the methodology that is used in data collection. The stated preference methods lead to higher estimations than the revealed preference methods.

- The second point that appears to be crucial in assessing the willingness to pay estimates in the literature is the type of risk presented to consumers. Indeed, some studies focusing on environmental risk and others focusing on the health risk, consumers do not value the same way the reduction of these two distinct types of risks. It is also clear that too few studies simultaneously evaluate these two categories of risk.

- Similarly, when evaluating the reduction of health risks associated with pesticide use, it is important to distinguish the risks incurred by producers of those incurred by consumers.

- Finally, it seems very important to take into consideration all of the literature does not lead to a unanimous evaluation of a premium for the reduced use of pesticides for food. In particular, it is important to note that dissemination of information on the effect of pesticide use may not lead systematically to an add valuation of the product without pesticides, but it can lead to a devaluation of the conventional product.

Relevancy of deliverable with related WP and the others WPs

Work package 4 examines the impact of pesticides reduction on consumers' health and preferences, using consumer behaviour theoretical frameworks. Initially, consumers' willingness to pay for the reduced use of pesticides in the production of fresh and processed foods, will be measured. To determine the most appropriate method for estimating the factors that affect WTP, a comparison of different methods used in the relevant literature has been take place, involving contingent valuation surveys, choice experiments (i.e. conjoint analysis, contingent ranking or choice modelling) and experimental markets.

The WP 4 is closely related with the WP 2 and WP3 in the sense that it measures a complementary impact of pesticides reduction, the effect on consumers' preferences. This report can provide usefull information for WP 5 and 6 during the simulation of tax levy scheme. Indeed, the policy relevance of taxation is closely linked to the valuation of products with and without pesticides on the final market.

In the same way, the willingness to adopt low pesticide production methods should be connected with the consumers' WTP for low pesticides products. So this report should be helpfull to well understand producers' incentive to provide low pesticides products (WP7).

Appendix : Synthetic table of main results

Study	Country	Product	Methodology	Main Results
Hammit (1990)	USA	food	STM, Focus group discussions	**Conventional food buyers are <u>never</u> willing to pay more than 20%** to obtain the safer product. **Organic food purchasers report higher WTP** : the lowest report equals the highest report by concentional-food buyers. A significant **increase in the market premium would induce many organic-produce buyers to substitute more conventional produce.**
Misra, Huang et Ott (1991)	USA (Georgia)	Fresh produce	STM, mail survey	**54% of the respondents would either refuse to pay a higher price or were not sure.** Among those who were willing to pay a higher price, **87% were willing to pay a maximum of only 10%** more for certified-FPR* fresh produce.
Hammit (1993)	USA	27 types of fresh produce	Market Prices	Of the 27 produce types evaluated, estimated organic premiums are positive for 23 and **the median ratio of the organic premium to the conventional price across produce types is about one third**. **Premium are uncorrelated with several proxy measures of risk reduction**, suggesting that they are determined by differences in supply costs between organic and conventional produc but not by differences in demand.
Huang (1993)	USA (Georgia)	Fresh produce	STM, survey	43% of the respondents indicated chemical pesticides should be banned or subjected to greater restriction. **46% would be willing to pay a higher price for certified-FPR* fresh produce** ; among positive responses, **54% of consumers were willing to pay a price premium up to 5%.**

Study	Country	Product	Methodology	Main Results
Eom (1994)	USA (North carolina)	*Not defined*	STM, mail survey, focus groups	**65% of respondents were willing to pay, on average, $0.35 per pound more for produce** that was screened for pesticides than for produce which was grown conventionally and cost between $0.39 and $1.49 per pound. Eom's research also showed that « consumers were willing to pay substantially high price premiums for safer produce, in return for only small reductions in risk ».
Buzby et al (1995)	USA	grapefruit	STM, Contingent Valuation	Respondents were willing to pay, on average, **38% more per grapefruit** to avoid SOPP**. The estimated benefits ($80 million) of banning SOPP far exceed the estimated costs ($27.7 million) realistic hypothetical purchase scenario.
Roosen et al (1998)	USA	Apples	Experimental Auctions	**35% of participants were <u>not</u> willing to pay any premium for the reduction in pesticide use**. For participants with positive WTP, **the average premium ranged from about $0.40 in the first trial to about $0.66 in the final trial**. There is on average a positive WTP to avoid NAI*** in apples, but this **WTP diminishes if quality deteriorates**. A second issue of relevance to policy formation is that parents of small children have a higher WTP, both on average and conditionally.
Baker (1999)	USA	Apples	STM Conjoint analysis Mail survey	4 consumers types are identified : « labeled Safety Seekers », « Balanced Buyers », « the Price Pickers », « Perfect Produce segment ». For each segment, socio-demographics particularities are defined.

Study	Country	Product	Methodology	Main Results
Mourato et al (2000)	UK	Bread	STM, contingent ranking	**UK consumers are WTP £1.15 (or 191% extra) for a 'green' loaf of bread** in order to reduce to zero cases of ill health per year and the number of declining farmland bird species jointly.
Loureiro et al (2002)	USA (Oregon)	Apples	STM	**61% of the respondents are willing to choose eco-labeled apples at no premiums**. Premium for eco-labelled apple : 5 cents per pounds over the initial price, **or 5% above the price of regular apple.**
Cranfield and Magnusson (2003)	Canada	25 food products	STM, CV survey	**67% of respondents would be willing to pay a modest** (i.e., one to ten percent) **premium for PFP[‡] food products**, while about **5% of respondents would be willing to pay more than a 20 % premium.**
Loureiro, McCluskey and Mitthelhammer (2003)	USA (Oregon)	Apples	In-store survey + Field experiment	Stated preferences provide information that predict purchase behavior. A consumer who states that they would pay a premium for a product is more likely to actually purchase the product.
Rozan, Stenger and Willinger (2004)	France	Apples, Potatoes, Bread	Experimental Auctions	Significant **decrease of the conventional WTP when information on heavy metal contents (and its long-term possible consequence of consumption) is given**, but no significant increase for certified products.
Chalak, Balcomb, Bailey, Fraser. 2008	UK	Bread, fruit and vegetable basket	Choice experiment	**For bread, The 5% pesticide reduction corresponds to individual WTP £0.045 per loaf extra. The price elasticity of demand for pesticides needed to achieve a 5% reduction of pesticides use should be equal to -0.09**. For fruit and vegetable, they find a WTP of £0.425 per household for a 5% reduction in pesticide use.

Study	Country	Product	Methodology	Main Results
Balcombe, Chalak, Fraser(2009)	UK	Bread	Choice experiment	**Consumers are prepared to pay, on average, an additional 23.5 pence for a 50 pence loaf of bread** for a 100% reduction in insecticides. Herbicides and fungicides are estimated to have positive but smaller mean WTPs at 9 and 15 pence, respectively. the consumers are estimated to **be willing to pay an additional 56.7 pence on a 50 pence loaf of bread if it was produced as part of a wider policy that involved reductions in pesticide usage.**
Bougherara and Combris (2009)	France	Orange juice	Experimental Auctions	The eco-label **premium is EUR 0.284 before information EUR 0.266 after (information defined ECO products and stressed that environmentally friendly process were not a guaranty to have safer or tastier products).These premiums represent 55.7% and 52.2% of the market premium**. When information is given at the begining of the experiment , WTP and premium are lower than participants start with reveal their WTP without information.
Florax, Travisi, Nijkamp (2005)	Meta-analysis main results : • « The valuation technique is crucial », revealed preference studies provide lower WTP estimates than choice experiments, and choice expreriments lead lower WTP estimates than contingent valuation. • Design survey in stated preference studies have a significant impact on WTP : face to face interviews lead higher WTP estimates. • WTP for IPM and eco-labelling is significantly higher than the WTP for a ban on specific pesticides.

*FPR : free of pesticides residue

**SOPP : sodium ortho-phenylphenate, a postharvest pesticide.

*** NAI : neuroactive insecticides

[‡] : PFP : Pesticide free production

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