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# An experimental study of wine consumers' willingness to pay for environmental characteristics

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**Abstract**—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 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.

**Keywords**—Willingness to pay, Wine, Effect of information, Experimental economics, Environment

## I. INTRODUCTION

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<sup>1</sup>. 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?

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

<sup>1</sup> French government-sponsored environment conference. See in particular the report by working group 4 Adopting sustainable forms of production and consumption : farming, fisheries, agrofood industry, distributions, forestry and sustainable use , <http://www.legrenelle-environnement.fr/grenelle-environnement>.

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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<sup>2</sup>. 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

Lecoq 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. Before setting out our findings, section 2 reviews the main results of studies evaluating WTP for environmental characteristics of foodstuffs. Section 3 describes our experimental protocol and the experiment itself. Section 4 presents the data and results. Section 5 concludes.

## II. LITERATURE REVIEW

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.

A first category of studies appraises consumers' WTP for pesticide-free products. These works are mostly about risk perception related to the use of pesticides in farming by appealing survey data and contingent evaluation methods. Misra, Huang and Ott (1991) use survey data to identify the determinants of WTP for pesticide-free fresh produce in Georgia (USA). They report a positive correlation between consumers' interest in the health impact of pesticide residues and the price they are prepared to pay for pesticide-free products. Although consumers are attentive to pesticide-free products, they are not ready to pay a premium of more than 10 per cent for such

<sup>2</sup>Notably Noussair, Robin and Ruffieux (2001, 2004) on GMOs, Bougherara (2003) on ecolabelled orange juice, and Tagbata (2006) on fair-trade chocolate.

products. Eom (1994) proposes an analysis of consumer preferences in respect of health risks inherent to pesticide residues. The author integrates consumers' perception of risk in a discrete choice model and concludes that their preference for healthy produce is partly dependent on the price differential (between conventional and health products) and their perception of risk from pesticides. Magnusson and Cranfield (2003, 2005) report similar findings with survey data from Canada. Florax, Travisi and Nijkamp (2005) propose a review of this literature on WTP for lower pesticide-related risks. They conduct a meta-analysis but conclude that there is still insufficient evidence to derive any robust results.

A second category of studies inquires into the valuation of environmental characteristics through certification. For example Loureiro, McCluskey and Mittelhammer (2002) use contingent valuation to determine whether consumers are willing to pay for ecolabelled apples. This work relates to environment-friendly product certification. They analyse the determinants influencing the probability of purchasing organic and conventional products. They report that household size and concern for health safety have an impact on the probability of purchasing one or other type of produce. The probability of purchasing organic apples decreases with household size. Gil, Gracia and Sanchez (2001) report similar findings for a survey conducted in Spain.

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 et al. (1998) were the first to analyse WTP for pesticide-free produce in experimental economics. They adapt a protocol already used in experimental economics (notably by Shogren et al. (1994) and Melton et al. (1996)) and use 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. The quality of the apples is therefore defined in two regards: their visual appearance and their safety for health. Data analysis shows that WTP for produce free from

neuroactive pesticides is significantly higher than for conventional product and that the inferior appearance of the apples has a significant (negative) effect on WTP.

Bougherara (2003) appraises consumers' WTP for ecoproducts through an experiment on ecolabelled 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. Unlike Bougherara (2003) 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.

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 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.

### III. THE EXPERIMENT

The experiment was based on the protocol developed by Lange et al. (2002) and adopted by Bougherara (2003). 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. The individuals selected had to meet certain criteria<sup>4</sup> 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 four selected products are four Bordeaux d'*Appellation d'Origine Contrôlée*<sup>5</sup> wines. 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<sup>6</sup> appellation. The experiment was conducted in 5 stages.

<sup>4</sup>The recruitment questionnaire is available on demand from the authors.

<sup>5</sup>French certification of products' origin

<sup>6</sup>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.

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 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 (cf. appendix 1) 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.

Each wine was codified for each situation as shown in table 1. 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.

Table 1 : Wine codification

Situation			Produit
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 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.

#### IV. DATA AND 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 2 : Sample characteristics

139 participants (68 female - 72 male)				
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 2 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<sup>7</sup>. 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. Conversely, table 3 reveals that the bids during the experiment were closer 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 3 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 3 : 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 4). This is a classic result highlighting that situation 3 (complete information) is a compromise

<sup>7</sup>For Viniflor the average price of a litre of still wine was 2.83 in 2005 for France and 3.32 for the Paris region.

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 (additional statistics in Appendix 2).

Table 4 : 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 (cf. Appendix 2) 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 5 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 6 shows the results of the econometric analysis taking into account the nature of the sample (panel data and censored 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.

Table 5 : 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

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 6 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 6 : Factors influencing WTP and probability to buy

Variables	Coefficient		Marginal effects	
	Tobit		Probit	
	(Std. Err.)		(Std. Err.)	
	(1)	(2)	(3)	(4)
Situation 1 (Blind)	Ref	Ref	Ref	Ref
Situation 2 (label)	1.117** (0.181)	1.319 ** (0.107)	0.118** (0.033)	0.173** (0.021)
Situation 3 (full)	0.286 (0.310)	0.735 ** (0.108)	-0.083 (0.065)	0.041* (0.016)
Bordeaux Terra	ref -0.420** (0.125)	ref -0.454 ** (0.123)	ref -0.073* (0.033)	ref -0.082** (0.034)
Dulong (vintner's charter)	0.146 (0.124)	0.116 (0.122)	0.010 (0.029)	0.002 (0.030)
FQC	-0.673** (0.126)	-0.687 ** (0.124)	-0.118** (0.034)	-0.123** (0.034)
AB (organic product)	-0.040 (0.185)	-0.066 (0.182)	-0.106 (0.051)	-0.112 (0.050)
BordSup	-0.415* (0.186)	-0.427 (0.183)	-0.115 (0.042)	-0.121 (0.041)
Group 1	0.113 (0.250)	0.183 (0.251)	-0.015 (0.038)	0.004 (0.038)
Male	0.206 (0.244)		0.005 (0.037)	
Income	0.028 (0.079)		0.016 (0.012)	
Order	0.046 (0.029)		0.012 (0.006)	
Intercept	1.080* (0.438)	1.422 ** (0.207)		
Probit			0.769	0.768
N	1904	1946	1904	1946
Log-likelihood	-3424.49	-3489.83		
Significance levels : * : 10% ** : 5% *** : 1%				

## V. CONCLUSION

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.

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