Does living close to a vineyard increase the willingness-to-pay for organic and local wine?

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Abstract

This paper investigates how the residents of a French wine-producing region value the attributes of wine. We elicit the willingness-to-pay for organic/non-organic and local/non-local wines when providing different informations about the impacts of agricultural practices. Organic and local premiums are estimated using robust M-regressions with clustered standard errors. The analysis shows that there is a significant organic premium associated with local and non-local wines, increasing with information level and decreasing with distance between participants' dwellings and vineyards. We also ran some policy simulations to compare the welfare effects of regulatory instruments aimed at internalizing the attributes valued by consumers in possession of information.

Keywords: organic premium; local premium; experimental economics; wine consumption.

JEL codes: Q15, C90, R32, L66.

1 Introduction

Organic wine is booming in Europe, and the area of organic vines in France and Spain almost tripled between 2007 and 2012. The production of organic wine is being strongly encouraged by public policies. A new regulation introduced in Europe in August 2012 allows wine producers to use the term "organic wine" and an EU logo that signals organic practices and draws them to the attention of consumers.[1] In France, regulatory efforts include subsidies and free technical advice on converting conventional farms to organic production. Organic production is being encouraged through more authoritative measures such as withdrawal from the market of certain pesticides, and precise targeting of areas where some intensive practices are prohibited. In official French Ministry of Agriculture documentation,[2] the development of organic agriculture is given serious consideration as a solution to the negative externalities from regular agricultural practices.

Despite these regulatory and incentive efforts to increase organic production, more than a quarter of the roughly 220,000 tons of pesticide used in Europe annually is applied to French soil (some 62,700 tons in 2011) and one-fifth of that amount is used by French vineyards although the area planted to vines account for only 3.7% of the national agricultural land area. Pesticide pollution is a major public health and environmental concern. The French Health Institute, INSERM, published a report[3] in June 2013 that concludes that "high or medium presumptions" of a link between exposure to pesticides and prostate cancer, Parkinson's, and Alzheimer's diseases, various cognitive disorders, and human fertility problems. This report highlights the danger of pesticide exposure for workers handling pesticides and those living in or near rural areas where pesticides are sprayed. Hence, regular agricultural practices entail both global and local pollutions. On the global pollution side, chemical fertilizers used in regular wine production are responsible for greenhouse gas (GHG) emissions that contribute to

[1] The U.S. organic classifications for wine include two distinct categories (namely "organic grape wine" and "organic handling wine") that differ on the prohibition of the usage of artificially derived preservatives such as sulfites. The European organic classification allows the use of preservatives but fix a smaller maximal concentration for organic wines than for regular wines.

[2] http://agriculture.gouv.fr/IMG/pdf/agri_durable_Objectif-Terres-anglais_090610.pdf

[3] http://www.inserm.fr/content/view/full/72494

global warming.[4] In terms of local pollution, pesticides are a major source of soil and water contamination, with 93% of French watercourses polluted by pesticides with peaks in wine producing regions.[5]

Despite the growth of organic production, the organic food segment is relatively tiny in absolute terms. In 2012, consumption of organic products in France was estimated at 2.4% of the food market (against 1.3% in 2007). The main explanation stems from the relatively high price of organic products. For instance, 75% of French people who do not buy organic products stated they find organic products too expensive.[6] This negative effect of price on organic products could be reduced by promoting organic products and increasing consumers' willingness to pay (WTP) via information campaigns, imposition of organic practices, and taxes non-organic production to increase the price of regular wines. How best to develop this organic segment remains an open research question. We begin to address it here by studying the precise determinants of the WTP for organic products.

Differentiating food products by their geographic location of production, historically has been an important strategy in Europe – particularly in the Mediterranean countries such as France, Italy, and Spain. Economic researchers have found that European Protected Geographical Indications (PGI) are recognized by consumers and add value to food products (McCluskey and Loureiro, 2003). Regarding the motivations to consume organic food, Hughner et al. (2007); Bernard and Bernard (2009); Smed (2012); Bazoche et al. (2013); Zanoli et al. (2013) studies show that the consumption of organic goods is significantly influenced by socio-demographic factors (income, gender, education level), the attributes of the goods (flavor, color), and their public good characteristics (reduced use of pesticides, animal welfare). The consumption of local goods is motivated by age, gender, and income as well as perceived product quality and a desire to support the local economy (Morris and Buller, 2003; Born and Purcell, 2006; Thilmany et al., 2008; Carpio and Isengildina-Massa, 2009; Hu et al., 2012). However, only recently researchers begun to assess the role of substitution or complementary between the attributes

[4]In France, the agricultural sector counts for around 20% of national emissions but data about the specific effect of wine production are not available.

[5]http://www.statistiques.developpement-durable.gouv.fr/indicateurs-indices/f/1831/

[6]http://www.agencebio.org/sites/default/files/upload/documents/4_Chiffres/Dossier_Presse_AgenceBIO_06022013.pdf

of organic and local food, and more importantly, the effect of distance from production areas (Connolly and Klaiber, 2014; Gracia et al., 2013; Denver and Jensen, 2013; Costanigro et al., 2013; Onozaka and McFadden, 2011; Adams and Salois, 2010).

Evaluating positive and negative externalities based on proximity of residential areas is a frequent practice in the revealed preference literature, mainly based on hedonic analysis of housing prices (Li and Brown, 1980; Bockstael, 1996; Chattopadhyay, 1999). These evaluation exercises are conducted to determine the value of air quality (Smith and Huang, 1995), schooling quality (Black, 1999), natural amenities (Mahan et al., 2000; Irwin, 2002; Gibbons et al., 2014), waste sites (Greenstone and Gallagher, 2008), beaches (Landry and Hindsley, 2011) among many others. To our knowledge, this is the first study to employ a lab experiment to infer the value of distance by matching production location with consumers' dwelling. This method is particularly promising because organizing lab experiments allows very precise information about consumer attitudes. The lab enables tight control of the environment, participants' actions, and the information revealed during the experiment. However, some authors question the external validity, or ability to generalize the relationships found in lab studies, to other contexts. In the lab, external validity is particularly dampened by the artificial mechanism used to elicit WTP, the relatively small number of products offered compared to the variety of products available in supermarkets, and the limited sample of participants in the experiment. The small participant sample is likely to give a high weight to idiosyncratic WTP and reduce the representativeness of the sample.

The objective of our study is to investigate whether consumers living close to a vineyard area in Burgundy, France, are concerned about organic wines. In particular, we investigate whether or not distance to a vineyard, and information on negative externalities have an effect on the organic wine premium. Our experiment takes advantage of experimental precision to accurately measure both subjective (perceived) distance and objective (computed on the basis of their home address) distance between participants' places to live and vineyards. In addition, this experiment will try to overcome the negative effect of a small sample of participants by smoothing the idiosyncratic WTP of outliers using an appropriate econometric estimation method. We conducted a lab experiment to elicit the WTP for organic/non-organic, local/non-local wines with increasing levels of information on organic practices, and the health and environmental impacts of agricultural practices related to wine grape production.

This paper contributes to the experimental literature on eco-labels by investigating the precise impact of distance to a vineyard in a given area. Our paper differs from previous contributions in showing that, beyond the classical preference for local wine by participants to an experiment, the real and perceived distances of their dwelling to the vineyard also influence WTP. In particular, perceived proximity to the vineyard positively influences the premium given to organic wine, a robust fact in our regressions that has been overlooked in previous work. This paper also provides an example of how predicted WTP based on econometrics can be used to estimate welfare variations. Previous experimental papers focus on welfare estimation related to the impact of information by taking account only of elicited WTP, observed directly in the lab. The importance of predicted WTP is overlooked in the studies by Disdier et al. (2013); Huffman et al. (2007); Lusk et al. (2005); Lusk and Marette (2010); Roosen and Marette (2011); Rousu et al. (2007). Additionally, our paper also contributes to the literature on welfare estimation by showing that the econometric estimation using robust M-regressions allows us to smooth the idiosyncratic WTP given directly by the elicitation process. The welfare variations using predicted WTP are clearly lower than the corresponding welfare variations using elicited WTP directly observed in the lab.

Section 2 describes the experiment; section 3 presents the data; and section 4 discusses the econometric model. The results are presented in section 5 and section 6 provides some policy simulations. The paper concludes with section 7.

2 The experiment

2.1 General Setting

In June 2013, we conducted a lab experiment in *Dijon*, the capital city of the famous wine-producing region of Burgundy in France. We organized 10 sessions where people were asked to declare their WTP for four bottles of wine which were displayed in front of them. Participants were not asked to taste the wines: the idea was to reproduce usual purchasing decisions (in supermarkets, cellar and restaurants).

To recruit our participants, we used the INRA database "PanelSens" gathering people from *Dijon* and nearby suburbs. We imposed location restrictions on our recruitment procedure. We recruited 50 participants from *Dijon* city, and 70 participants from *Chenôve*, *Marsannay* and other *communes* between the regional capital and the vineyards (see Figure 1 in Supplemental Material). From each subgroup (of 70 or 50 participants), the selection of the sample of participants was random based on the quota method and was representative of the population's age groups and socio-economic status. Participants were contacted by phone. They were informed that the experiment would focus on food behavior and wine consumption, would last around one hour, and that the participants would receive a €20 monetary compensation ($27.2 at the July 8th 2014 conversion rate) to be paid at the end of the experiment.

To elicit participants' WTP, our experiment uses the Becker-deGroot-Marschak (BDM) procedure (Becker et al., 1964). Under the BDM mechanism, an individual states her maximum WTP, say b, to receive the bottle of wine. Next, a random price p is drawn from an exogenous distribution of papers in a box. If p is less than or equal to b, then the individual is allowed to receive the bottle of wine and pays the random price p. If p is greater than b, then the individual pays nothing and receives nothing. Bidding one's true maximum WTP is a dominant strategy for expected utility maximizers.

2.2 Proposed Wines

The same four wines were offered to each participant for each information round. Wines were chosen to be as comparable as possible: (i) they originated from two *Appellations d'Origine Contrôlée* (the French equivalent of Geographical Indications, GIs hereafter) which explicit mention of the producing area and (ii) for each GI we included an organic and a regular wine. The two GIs are *Marsannay* and *Vacqueyras* which can be considered as intermediate quality segment, with a bottle of wine priced at around €10 brought directly from the wine makers. Figure 2 in Supplemental Material reports a photograph of the four 75 cl wine bottles. The following Table 1 presents the objective characteristics of the selected wines.

Table 1: The four wines presented to the participants:

CODE	GI	TYPE	ORIGIN	PRICE (€)
MRSN	*Marsannay*	Regular	Local	8
MRSB	*Marsannay*	Organic	Local	10.5
VCQN	*Vacqueyras*	Regular	Non-local	13
VCQB	*Vacqueyras*	Organic	Non-local	14

Marsannay is a GI from Burgundy and *Vacqueyras* is a GI from the Rhône Valley. The GI *Vacqueyras* is located about 350 km from the city center of *Dijon* and *Marsannay* is much nearer at only 4.5 km distance, see Figure 1 in the Supplemental Material. The producer prices of the two wines from *Vacqueyras* are a slightly higher than the prices of the two wines from *Marsannay* because, to the best of our knowledge, there are no other more similar wines in terms of price. Other characteristics that can be inferred from the wine labels are rather similar: each wine was bottled by the producer, carries a *Domaine* name, has a classic-stylized label and has a comparable alcohol content.[7] Selecting comparable wines allowed us to separate the effect of organic certification relative to regular wine and condition on two different vineyard locations, close to and far away from the participant's dwellings.

2.3 Information disclosure

Table 2 shows that informations were revealed successively to the participants during the experiment, and WTP for the four wines were elicited after each message. The first round # 1 were with no additional information. This round was used to provide a comparative benchmark about the general information level of people before the experiment begin. It will be used in particular to compute welfare variations in our policy simulations. In round # 2 general information on the differences between organic and non-organic agriculture were provided to ensure that all participants knew the particularity of organic agricultural practices. In round # 3 information on the GHG emissions from regular fertilization practices was revealed as

[7]All the presented wines, even organic, contain preservatives that are referred on the labels by the compulsory mention "contains sulfits".

an example of a harm that indiscriminately hurts people living close to or far away from the agricultural producing area. In round #4 information on the presence of pesticides residues in the blood and hair of vineyard workers was revealed to represent a non-monetary harm that hurts people close to the wine producing area. In Round # 5 information on the effects of water treatment on the water bills was revealed to represent a monetary harm that hurts people close to vineyard areas (the cost of water is higher in areas close to vineyards). Information was revealed in the same order to all participants in order to obtain more precise estimates of the cumulative values, from the more general to the more specific effects.[8] Figure 3 in Supplemental Material summarizes more precisely the experiment time-line and the information revealed to the participants during the experiment.

Table 2: Summary of the sequential information during the experiment

INFO	CODE	DESCRIPTION
# 1	BENCHMARK	No external information
# 2	GENERAL	General organic definition
# 3	GREENHOUSE	GHG emissions from regular production
# 4	HEALTH	Detrimental health effects from regular
# 5	WATER BILL	Water bill implication of clearance

3 Data

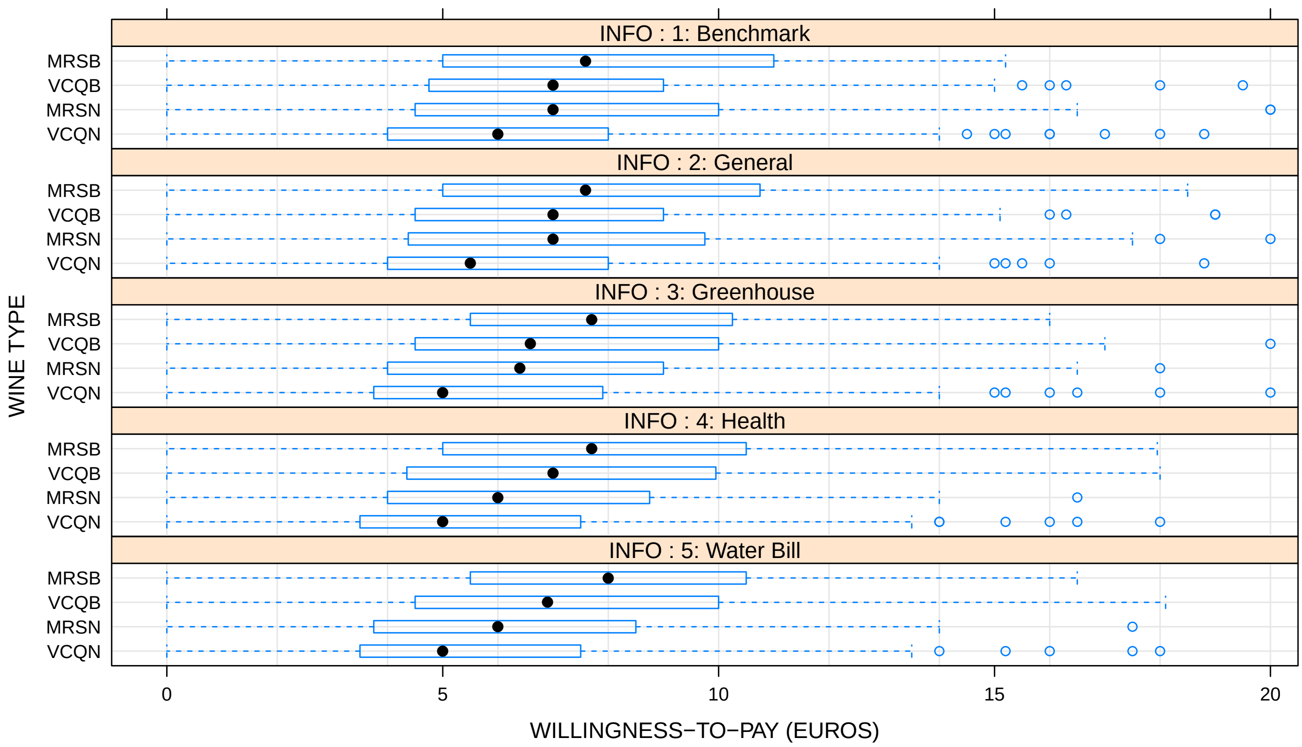
3.1 Willingness-To-Pay

Each participant was asked to provide a total of 20 WTPs (four wines for each of the five levels of information). The Figure 1 presents their distributions according to the type of wine and amount of information provided. It shows that the organic local (`MRSB`) attracts the highest WTP (a median around €8) for any level of information. Next are the organic non-local (`VCQB`), the regular local (`MRSN`) and the regular non-local (`VCQN`) with respective median values of (€7, €6, and €5). In the context of a descriptive analysis, this puts the value of the organic attributes

[8]Randomizing the revelation of information could be usefull to obtain marginal values but at the cost of having less observation for each bilateral comparisons. Because our simulations use only differences between absence and full information, they are not impacted by this choice.

higher than the value of local ones.

Figure 1: Distribution of the Willingness-To-Pay (€)



This Figure 1 allows an evaluation of the between-wines WTP differences which increase with the level of information (from the top panel to the bottom). The reducing WTPs for regular wines are more important in absolute values than the increased WTPs for organic wines when additional information is revealed. This illustrates an effect close to classical prospect theory (see Kahneman and Tversky, 1979), where the impact of a loss on utility is higher than the impact of a symmetric gain on the utility. This Figure also shows the presence of some potential outliers that have to be controlled for in the econometric approach.

3.2 Summary Statistics

During the experiment, we asked for various information through sequential questions, in order to control for participants' heterogeneity. One of the open questions addressed distance from the closest vineyard, as detailed in Figure 4 of Supplemental Material. We also asked for participants' dwelling postal addresses to allow us to compute distances using a Geographical Information System. For each participant, we have three distances which are tested in the econometric models: perceived distance, computed distance from the closest vineyard, and computed distance from the closest vineyard from *Marsannay*. In addition to the expected positive and significant correlations between them (all $> .55$, see Figure 4 in Supplemental Material), this comparative exercise shows that the differences between perceived and computed distances are decreasing with distance. For distances under $\exp(-0.5) = 0.6$ km, the correlations are zero for both perceived and computed distances, and also between computed distances. This absence of significant correlation among low values of distances from *Marsannay* (43% are less than 2.7 km) is important to econometrically distinguish the two differential effects on WTPs. In other words, identification of the differential effects of the distance variables is applied to participants that, in general, live closer to vineyards. The summary statistics of the other variables of interest are presented in Table 3.

Table 3: Summary Statistics on Data from the Experiment

VARIABLE	N	MEAN	STD	MIN	MAX
WTP for Regular non-Local	555	6.501	5.508	0.000	35.000
WTP for Regular Local	555	6.914	4.411	0.000	28.940
WTP for Organic non-Local	555	8.531	8.785	0.000	70.500
WTP for Organic Local	555	9.084	7.457	0.000	65.000
Global Organic Premium	555	2.030	5.254	−10.000	45.000
Local Organic Premium	555	2.170	4.719	−8.000	40.000
Perceived Distance	111	7.318	2.130	1.609	10.820
Computed Distance 1	111	7.489	1.471	3.043	11.270
Computed Distance 2	111	7.875	1.447	3.372	11.272
Participant's Age	111	44.270	14.357	19	69
Participant's Sex	111	1.586	0.493	1	2
Number of Child	111	1.550	0.867	1	5
Wine Purchases	111	1.721	0.762	1	3
Organic Purchases	111	2.054	0.551	1	3
Local Purchases	111	3.198	0.669	1	4

Using the elicited WTPs (see Figure 1), we can compute global and local organic premiums which are the differences between WTP for organic and the regular wines respectively from local

(MRSB minus MRSN) and non-local (VCQB minus VCQN) wines. They are around €2 on average, with some participants presenting negative premiums. We consider some general individual characteristics (age, sex, number of children and a categorization of weekly frequencies of wine, organic, and local purchases) presented in the the last six rows of Table 3. The entire socio-demographic statistics of participants are available from the authors upon request.

4 Empirical Model

4.1 Sample Structure

Our collected sample consists of $i = 1, \ldots, N$ participants of whom we asked their WTP for $k = 1, \ldots, K$ wines for different levels of information $j = 1, \ldots, J$. We have $N = 111$, $K = 4$ and $J = 5$, resulting in a pooled sample of 2,220 observations. The econometric strategy aims to identify the effects on WTP of the wine and information dummies (perfectly balanced among participants) and individual characteristics X_i such as the distance to the closest vineyard, the income class or the controls.

$$\text{WTP}_{ijk} = \alpha + X_i\beta + \eta_k + \theta_j + \varepsilon_{ijk} \tag{1}$$

The vector of β coefficients measures the respective effects of individual characteristics on WTPs, η and θ are the respective premiums attached to each wine k and the level of information j. α is a constant that ensures that the residuals ε_{ijk} are centered. We are also interested in modeling organic premiums, which for both for local and non-local wines is the difference between WTP for organic and regular: global premiums are $WTP_{ij}(k = \texttt{VCQB}) - WTP_{ij}(k = \texttt{VCQN})$ and the local premiums are $WTP_{ij}(k = \texttt{MRSB}) - WTP_{ij}(k = \texttt{MRSN})$. In this latter case, the wine dimension K is dropped (as the corresponding fixed effects) to obtain a pooled sample of 555 observations. The general pooled structure of the data can be simplified by setting $L = N \times K \times J$.

$$\text{WTP}_\ell = Z_\ell\lambda + \varepsilon_\ell,\ \ell = 1, \ldots, L. \tag{2}$$

From these pooled data, the assumptions of independently, identically and asymptotically Gaussian residuals ε_ℓ would be very strong. The most obvious gaps from the classical framework, are the deviation from normal distribution, heteroskedasticity and error correlations within individuals which are of primary interest. The deviation from normal distribution could be due to the small sample size and the presence of some influential observations resulting from misunderstandings in participants' interpretation of the questions, unexpected reactions to lab conditions, or some degree of unwillingness to respond seriously. Deviation from homoskedasticity and independence might be due to unobserved characteristics or unobserved differentiated responses (i.e., coefficient heterogeneity) of participants. This could induce some (positive) correlations between the residuals for the same individual for different wines and at different levels of information.

Our estimation strategy deals with two specific econometric issues usually observed in experimental data. They are:

1. Small number of participants ($N = 111$) with some influential outliers.
2. Correlated non-spherical residuals, because sequential WTPs are pooled.

To deal with the first issue, we propose an M-robust estimator which takes account of outliers and avoids reducing the sample size by their removal- a common practice in the literature. In relation to the second issue, most papers in the literature in experimental economics papers use panel data methods. We chose to take account of the correlated non-spherical residuals employing clustered standard errors which is comparable to the random-effects method but imposes fewer constraints on the structure of the variance-covariance matrix (Wooldridge, 2003).

4.2 Robust M-regressions

We limit the adverse effects of potentially fat-tailed residuals by underweighting the influential outliers (Belsley et al., 1980). As an alternative to the common practice of dropping individuals with high absolute error values (for small samples an undesirable practice, which does not preserves the cylinder structure of the sample and can exclude some potentially important insights), M-estimation is a general method of outlier-robust regression method which preserves sample size (Rousseeuw and Leroy, 1987; Venables and Ripley, 2002). The general M-estimator minimizes in λ the objective function:

$$\sum_{\ell=1}^{L} \kappa(\varepsilon_\ell) = \sum_{\ell=1}^{L} \kappa(\mathrm{WTP}_\ell - Z_\ell \lambda) \tag{3}$$

where the function κ is exogenously specified. It must be positive, symmetric, increasing with the absolute value of the residuals, and null for zero residuals: $\kappa(0) = 0$. It is clear that the ordinary least square (OLS) estimator is a particular case with $\kappa(\varepsilon) = \varepsilon^2/2$. By noting $\widehat{\omega}_\ell$ the derivative of the function $\kappa(\cdot)$ evaluated at $\widehat{\varepsilon}_\ell$ and divided by $\widehat{\varepsilon}_\ell$, the first order conditions from the minimization of Equation 3 is similar to a weighted least-square problem.

$$\sum_{\ell=1}^{L} \widehat{\omega}_\ell (\mathrm{WTP}_\ell - Z_\ell \lambda) Z_\ell = 0 \tag{4}$$

This first-order normalized derivative $\widehat{\omega}_\ell$ is simply the corresponding weight scheme. However, the weight function depends upon the residuals, the residuals depend upon the estimated coefficients, and the estimated coefficients depend upon the weight function. So, an iterative solution (*iteratively reweighted least-squares*, IRLS) is required. The algorithm used to recover the coefficients is:

1. Determine the initial estimates $\widehat{\lambda}^0$ from the uniformly weighted least-squares;
2. Calculate the residuals $\widehat{\varepsilon}_\ell^0$ and associated weights $\widehat{\omega}_\ell^0 = \omega(\widehat{\varepsilon}_\ell^0)$;
3. Solve for weighted least squares estimates using these weights.

Steps 2 and 3 are repeated until the estimated coefficients converge, i.e., become relatively constant between steps (we use a tolerance of .0001). According to the default **R** function `rlm` (Venables and Ripley, 2002), we choose a Huber's weighting scheme. This has the advantage that it corresponds to a convex optimization problem and gives a unique solution (up to collinearity). The Huber objective function increases without a bound as the residual departs from 0 and the weights for the Huber function decline when $|\widehat{\varepsilon}_\ell| > R$. Mathematically, the Huber weight function is:

$$\omega(\varepsilon) = \begin{cases} 1 & \text{for } |\,\varepsilon\,| \leqslant R \\ R/|\,\varepsilon\,| & \text{for } |\,\varepsilon\,| > R \end{cases} \tag{5}$$

The value R is called a "tuning" constant, from which the weights attributed to an observation begin to decline. This constant is generally dependent on the estimated standard deviation of the residuals $\widehat{\sigma}_\varepsilon$, we use the default value from Venables and Ripley (2003): $R = 1.345 \times \widehat{\sigma}_\varepsilon$. The bisquare weighting scheme is another frequently-used possibility but can have multiple local minimums, so we use it only as a robustness check. The Figure 5 in Supplemental Material presents the shape of the Huber's weighting function with an unitary variance of the residuals. It is clear that WTP in accordance with the Gaussian assumption on the residuals has a weight of 1, as in standard OLS.

4.3 Clustered Standard Errors

In addition to the M-regression development, Huber (1967) was among the first people to acknowledge the need for standard error correction when some deviations of the NID assumption appear on residuals. His seminal work led to the sandwich class of Heteroscedastic and Autocorrelation Consistent (HAC) asymptotic matrix of variance-covariance. From this general framework, the cluster correction of residuals, now common in econometrics (see Wooldridge (2003) for a survey), is of particular importance for data from experimental economics. Here, we are principally interested in individual (i.e., participant) clusters because the other sample dimensions (wine type and information) are modeled as dummy variable fixed effects in eq. (1) which controls for much unobserved heterogeneity.

So, the asymptotic results that we need to obtain the HAC matrix are based on the number of clusters that grow to infinity ($N \to \infty$) for a given number of within cluster observations, the standard and most straightforward case according to Wooldridge (2003). We note $\widetilde{Z}_\ell \equiv Z_\ell \sqrt{\omega_\ell}$ the weighted explanatory row vector and allow the variance-covariance matrix of errors to have an arbitrary form, including within-individual correlation and heteroskedasticity according to what is observed in the data. According to the cluster literature, the weighted HAC variance-covariance matrix of coefficient can be consistently estimated by:

$$\widetilde{\mathbb{V}}(\widehat{\gamma}) = \left(\sum_{i=1}^{N} \widetilde{Z}_i^\top \widetilde{Z}_i\right)^{-1} \left(\sum_{i=1}^{N} \widetilde{Z}_i^\top \widehat{\varepsilon}_i \widehat{\varepsilon}_i^\top \widetilde{Z}_i\right) \left(\sum_{i=1}^{N} \widetilde{Z}_i^\top \widetilde{Z}_i\right)^{-1} \tag{6}$$

where $\widetilde{Z}_i$ and $\widehat{\varepsilon}_i$ are the within-cluster averages of their equivalent in pooled data: $\widetilde{Z}_\ell$ and $\widehat{\varepsilon}_\ell$. Cluster analysis is more general than mixed (or hierarchical) models because it does not impose equicorrelation within clusters (Newey and West, 1987). However, the cluster approach considers that the values of the parameters are well estimated by the last step of the IRLS, which seems appropriate in our case. The correction refers only to the standard errors associated with the coefficients. The **R** function written to compute the robust HAC matrix from weighted least squares, is available from the authors upon request.

5 Econometric Results

5.1 Willingness-To-Pay

A first series of estimations aims to identify the determinants of the elicited WTPs. Two general types of models are estimated on pooled data ($L = 2,200$) and each type contains three specifications for a total of six models. The first type, called "without control variables," includes only the variables of primary interest. The second type, called "with control variables," includes seven additional control variables: age, sex, number of children, socio-professional category, usual wine purchasing practices: generally, for local and organic wines. Within each type, the different distances between participant's homes are independently included in the specifications: models (1) and (4) contain declared closest vineyard, (2) and (5) computed closest vineyard, and (3) and (6) computed closest vineyard from the local GI. All models also include dummies for the considered wine, and for available information at the moment of the WTP elicitations. The four dummies for available information are interacted with a dummy for organic wines (`DumBio` equals one for organic wines and zero otherwise) to take account of the differential effects of information on WTP for organic wines. All models also contain dummies for categories of individual income and for categories of time preference (see Table 3). In all models, the regular *Vacqueyras* wine (i.e., the regular non-local) is the reference modality. Results are presented in Table 4.

Table 4: Results from regressions about pooled WTPs in levels.

	Endogenous variable: Pooled Willingness-To-Pay in €/bottle					
	Without Control Variables			With Control Variables		
	(1)	(2)	(3)	(4)	(5)	(6)
Declared Distance	0.046			0.103		
	(0.125)			(0.149)		
Computed Distance 1		0.333^{**}			0.385^{**}	
		(0.151)			(0.168)	
Computed Distance 2			0.170			0.213
			(0.160)			(0.206)
WINEMRSN	0.848^{***}	0.843^{***}	0.848^{***}	0.823^{***}	0.823^{***}	0.824^{***}
	(0.165)	(0.165)	(0.165)	(0.158)	(0.158)	(0.158)
WINEVCQB	0.813^{***}	0.816^{***}	0.811^{***}	0.852^{***}	0.856^{***}	0.852^{***}
	(0.106)	(0.106)	(0.106)	(0.112)	(0.112)	(0.111)
WINEMRSB	1.792^{***}	1.789^{***}	1.792^{***}	1.773^{***}	1.775^{***}	1.774^{***}
	(0.179)	(0.180)	(0.180)	(0.181)	(0.181)	(0.181)
INFO2: General	-0.199^{***}	-0.199^{***}	-0.200^{***}	-0.193^{***}	-0.193^{***}	-0.194^{***}
	(0.076)	(0.076)	(0.076)	(0.072)	(0.072)	(0.072)
INFO2: General:DumBio	0.203^{**}	0.201^{**}	0.204^{**}	0.244^{***}	0.244^{***}	0.245^{***}
	(0.086)	(0.088)	(0.086)	(0.083)	(0.083)	(0.083)
INFO3: Greenhouse	-0.509^{***}	-0.509^{***}	-0.510^{***}	-0.499^{***}	-0.497^{***}	-0.499^{***}
	(0.084)	(0.084)	(0.084)	(0.082)	(0.082)	(0.082)
INFO3: Greenhouse:DumBio	0.672^{***}	0.669^{***}	0.672^{***}	0.645^{***}	0.639^{***}	0.643^{***}
	(0.088)	(0.088)	(0.089)	(0.093)	(0.094)	(0.094)
INFO4: Health	-0.866^{***}	-0.863^{***}	-0.867^{***}	-0.865^{***}	-0.859^{***}	-0.864^{***}
	(0.120)	(0.121)	(0.120)	(0.115)	(0.115)	(0.115)
INFO4: Health:DumBio	0.994^{***}	0.987^{***}	0.992^{***}	0.988^{***}	0.978^{***}	0.985^{***}
	(0.132)	(0.131)	(0.131)	(0.133)	(0.132)	(0.132)
INFO5: Water Bill	-0.923^{***}	-0.920^{***}	-0.924^{***}	-0.913^{***}	-0.906^{***}	-0.911^{***}
	(0.125)	(0.126)	(0.126)	(0.123)	(0.123)	(0.123)
INFO5: Water Bill:DumBio	1.038^{***}	1.033^{***}	1.037^{***}	1.040^{***}	1.029^{***}	1.037^{***}
	(0.138)	(0.137)	(0.138)	(0.141)	(0.141)	(0.141)
Constant	5.640^{***}	3.352^{**}	4.688^{***}	3.486	1.320	2.664
	(1.037)	(1.397)	(1.275)	(3.288)	(3.195)	(3.193)
Observations	2,220	2,220	2,220	2,220	2,220	2,220
R^2	0.120	0.131	0.122	0.267	0.277	0.268
Adjusted R^2	0.111	0.123	0.114	0.254	0.265	0.256

Notes: *p<0.1; **p<0.05; ***p<0.01
Weights are computed from the last step of IRLS M-regression. Standard Errors clustered by individuals.

For each specification, we use the three distance variables in separate regressions: declared distance to the closest vineyard (`Declared Distance`), computed distance from the closest (`Computed Distance 1`) and computed distance from *Marsannay* (`Computed Distance 2`). The standard errors are corrected by individual clustering. In models without control variables, the R^2 are around 12%. The inclusion of control variables increases the R^2 to about 26%. Among the six models, the only significant distance is the computed distance from the closest vineyard, a result that is obtained for models with and without control variables. Similarly, the coefficients associated with the other variables are globally robust to the specification of distance and the inclusion of control variables (i.e., accross specifications).

The coefficients of the distances are positive, which means that living close to a vineyard decreases WTPs for the wine. We found this decreasing effect on the WTPs *unconditionally* on the type of wine considered: local or non-local, organic or regular. These results can be understood as a consequence of the short distribution chain related to this population, the social networks available, and the presence of least-cost alternatives if they buy their wines directly from the closely located producers. Looking at the effect of information, we find that, for the initial level of information and relative to the regular *Vacqueyras* wine (i.e., the non local), WTP for the regular *Marsannay* is on average €0.85 higher ($p < .001$), WTP for the organic *Vacqueyras* is on average €0.8 higher ($p < .001$) and WTP for the organic *Marsannay* is on average € 1.8 higher ($p < .001$). This means that at the initial level of information for participants, comparing wines from similar GIs, the organic premiums are respectively €0.95 and €0.81 for the local and non-local wines, with a significant difference.

Providing general information on organic agriculture significantly modifies the WTP, by decreasing the WTP for non-organic wines by €0.19 and by increasing the WTP for organic wines by€0.20. These differential effects are observed by comparing the rows corresponding to a same level of information with `DumBio`=1 and `DumBio`=0. Providing information on GHG emissions from wine production, decreases the WTP for non organic wines by a cumulative average of €0.50 ($p < .001$) and increases the WTP for organic wines by a cumulative average of €0.60 ($p < .001$). Revealing the information on health decrease the WTP for non-organic wines by €0.86 and increases the WTP for organic wines by €0.98 (with $P < 0.001$ for both). Information on the effects on water bills decrease the WTP for non-organic wines by €0.91 and increases the WTPs for organic wines by € 1.03 ($P < 0.001$). In absolute terms the variations based on the level of information provided levels are comparable to the variations among wine characteristics (about € 1) which in our view indicates a strong information effect. Recall that these values are cumulative and not marginal, knowing the natural order of information, from the most general to the more particular.

5.2 Organic Premiums

We next focus more specifically on organic premiums by changing our outcome variables to be now both global organic premium and local organic premium (see definitions in subsection 4.1). The dataset used for these estimations results from pooling individuals at different levels of information, $L = N \times J = 555$. Table 5 first presents the results of the models with global organic premium as the dependent variable, computed on the basis of WTP differences between organic and regular for the *Vacqueyras* wines (non-local).

Table 5: Results from regressions about pooled global premiums.

	Endogenous variable: Global Organic Premiums in €/bottle					
	Without Control Variables			With Control Variables		
	(1)	(2)	(3)	(4)	(5)	(6)
Perceived Distance	-0.175^{***}			-0.177^{***}		
	(0.050)			(0.055)		
Computed Distance 1		-0.085			-0.159^{**}	
		(0.072)			(0.074)	
Computed Distance 2			-0.070			-0.170^{**}
			(0.071)			(0.079)
INFO2: General	0.234^{***}	0.231^{***}	0.229^{***}	0.245^{***}	0.236^{***}	0.234^{***}
	(0.065)	(0.065)	(0.065)	(0.062)	(0.064)	(0.064)
INFO3: Greenhouse	0.547^{***}	0.542^{***}	0.541^{***}	0.535^{***}	0.542^{***}	0.540^{***}
	(0.082)	(0.081)	(0.082)	(0.077)	(0.080)	(0.081)
INFO4: Health	0.753^{***}	0.747^{***}	0.747^{***}	0.748^{***}	0.754^{***}	0.756^{***}
	(0.102)	(0.102)	(0.102)	(0.096)	(0.102)	(0.102)
INFO5: Water Bill	0.805^{***}	0.803^{***}	0.802^{***}	0.798^{***}	0.808^{***}	0.808^{***}
	(0.103)	(0.104)	(0.104)	(0.100)	(0.105)	(0.105)
Constant	2.509^{***}	1.932^{***}	1.794^{***}	2.142^{**}	1.531^{*}	1.807^{*}
	(0.405)	(0.612)	(0.571)	(0.864)	(0.921)	(1.010)
Observations	555	555	555	555	555	555
R^2	0.092	0.070	0.069	0.169	0.132	0.132
Adjusted R^2	0.069	0.046	0.044	0.121	0.082	0.082
Notes:	*p<0.1; **p<0.05; ***p<0.01 Weights are computed from the last step of IRLS M-regression. Standard Errors clustered by individuals.					

Estimated coefficients show that, without control variables, only the declared distance is significant, and with control variables all distances are significant. When regressing organic premiums, the coefficients associated to distances are negative. This means that the global premiums on organic wine decrease with distance to the vineyard: participants living far from vineyards have a smaller premium for organic wine than those living close to a vineyard. All else being equal, living 1 km distance from a vineyard decreases the global organic premium by €0.34.[9] The results show also that providing information highlighting the effects of non-organic

[9]Because the distances are at maximum 50 km for our sample and our variables are in log meters, we can say

agriculture on health, environment and water bills has a significant and positive effect on the global organic premium. The general information on organic agriculture implies an increase in the organic premiums, at least global. This indicates that (contrary to what participants claimed) participants are inclined to change their preferences in light of certain information. The results for local premiums (for *Marsannay* local wines), are presented in Table 6.

Table 6: Results from regressions about pooled local premiums.

	Endogenous variable: Local Organic Premiums in €/bottle					
	Without Control Variables			With Control Variables		
	(1)	(2)	(3)	(4)	(5)	(6)
Perceived Distance	-0.216^{***}			-0.199^{***}		
	(0.050)			(0.056)		
Computed Distance 1		-0.083			-0.096	
		(0.082)			(0.076)	
Computed Distance 2			-0.064			-0.106
			(0.078)			(0.085)
INFO2: General	0.281^{***}	0.273^{***}	0.271^{***}	0.266^{***}	0.262^{***}	0.258^{***}
	(0.071)	(0.070)	(0.070)	(0.070)	(0.069)	(0.068)
INFO3: Greenhouse	0.598^{***}	0.585^{***}	0.583^{***}	0.530^{***}	0.530^{***}	0.527^{***}
	(0.082)	(0.080)	(0.080)	(0.077)	(0.077)	(0.076)
INFO4: Health	0.807^{***}	0.795^{***}	0.793^{***}	0.768^{***}	0.766^{***}	0.764^{***}
	(0.108)	(0.108)	(0.108)	(0.105)	(0.106)	(0.105)
INFO5: Water Bill	0.876^{***}	0.867^{***}	0.865^{***}	0.851^{***}	0.853^{***}	0.850^{***}
	(0.107)	(0.107)	(0.107)	(0.107)	(0.108)	(0.107)
Constant	2.844^{***}	1.918^{***}	1.747^{***}	5.652^{***}	4.322^{***}	4.505^{***}
	(0.422)	(0.712)	(0.653)	(0.823)	(0.968)	(1.032)
Observations	555	555	555	555	555	555
R^2	0.114	0.080	0.078	0.192	0.169	0.169
Adjusted R^2	0.091	0.056	0.054	0.146	0.121	0.121
Notes:	*p<0.1; **p<0.05; ***p<0.01					
	Weights are computed from the last step of IRLS M-regression. Standard Errors clustered by individuals.					

Compared to the results for the global organic premiums, a first deviation in the local models is that only perceived distance is significant but has the same negative sign. The fact that, taken as a whole, distance to a vineyard is less significant for local than global premiums is intriguing. Although there is some declining effect of distance on the organic premium, it is not stronger for the local than the global premium. The declining effect of distance appears to be more of a shared preference parameter among people living close to a vineyard rather than a proper internalization of the negative effect of regular wine production on welfare. This result can also be considered in relation to the results of WTP regressions Table 4 where only the computed distance 1 was significant. The elements that explain the potential gains from

that a remoteness of 1 km (2%) decrease the premiums by $2 \times .17 = €0.34$.

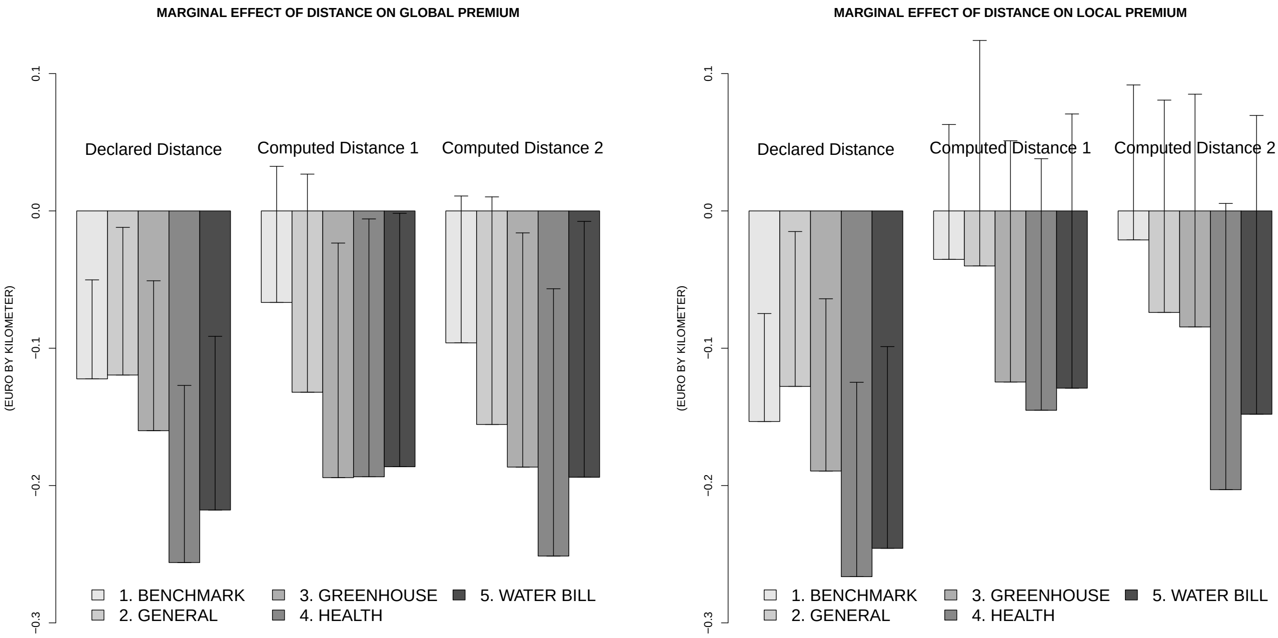
living close to a vineyard are monetary (commuting distance, producers prices, etc.) and are evaluated well by participants. Inversely, the elements that explain potential losses from regular wine production for those living close to a vineyard are mainly non-monetary (health, cultural, etc.) This may explain why the computed distance is significant in the first regressions and the perceived distance is significant in the second regressions. This explanation is reinforced by the results of small marginal effect of distance on organic premiums in the presence of information on water bills (see later Figure 2). The results in Table 6 show also that information on the effects of regular agriculture on health, environment and water bills has a significant and positive effect on the local organic premium. This impact of information is slightly higher for local than global wine. These differences are increasing with the level of information (and because the information becomes local-oriented).

A last series of econometric estimations addresses the interactions between distance and the information effects on both global and local premiums. For the specifications including the control variables, Table 1 in Supplemental Material presents the results from the six models including distance variables, and global and local organic premiums. To clarify the interpretation, Figure 2 shows the marginal effects of distance associated with each level of information computed from the regression of Table 1 in Supplemental Material. This Figure 2 shows that the distance-information effects are always negative and significant in the case of declared distance. Another interesting result is that this negative cross effect is greater in absolute value for information on health than for information on water bills. However, for computed distances, the interaction effect is significant only for global premiums and starting from information # 3 on GHG emissions.

6 Policy simulations

Returning to Figure 1, the effect of information on WTP and (implicitly) surpluses does not take account of purchasing decisions, while welfare theory depends on purchasing choices revealing preferences in a market context. The fact of purchasing decisions being linked to market prices allows us to consider regulatory tools. In this section, we investigate the relevance of regulatory

Figure 2: Marginal effects of interactions between distance and information



intervention by public authorities, based on elicited WTP and purchase decisions. Regulation has a welfare effect when agents change their purchasing decisions (buying or refraining from buying) one unit of product which is relevant according to welfare theory.[10]

We consider three different public interventions. First we consider a configuration # 1 where public intervention consists of an intensive consumer information campaign about pollution from regular wine production and the organic alternative. Following this campaign, consumers are perfectly informed. In configurations # 2 and # 3, we assume that consumers are imperfectly informed about regular/organic wine production even if they can see a label/logo posted on one product. In configuration # 2, public intervention consists of imposition of a per-unit tax on the regular product. In configuration # 3, public intervention consists of enforcement of a mandatory standard imposing organic production on all producers. To be efficient, the information campaign # 1 must convey to consumers complete information about the organic issue, while the tax does not require perfect consumer knowledge. Because conveying complete

[10]Note that with a classical demand decreasing with the price, the welfare variation linked to the internalization of a non-internalized characteristics depends on the changed quantity that depends on the direct price elasticity. When the demand is very inelastic, the welfare variation is very low even if the non internalized parameter is relatively large.

information to consumers is difficult in practice due to the proliferation of labels and consumers' imperfect recall (Roosen and Marette, 2011), the configurations # 2 and # 3 become interesting substitutes for modifying behaviors.

6.1 Regulation # 1: A Complete Information Campaign

The first configuration consists of an information campaign perfectly understood by consumers and revealing complete information about both regular and organic wine, which corresponds to the situation in round # 5. Similar to round # 5, the campaign reveals exhaustive information on all products. Application of an additional regulatory instrument (e.g. a Pigouvian tax) is useless. Consumers directly internalize all information provided by the campaign. To convert the WTP to demand curves, it is assumed that each participant would make a choice related to the largest difference between her WTP and the market price. This choice is inferred because the "real" choice is not observed in the lab. Despite this limitation, this methodology is useful for estimating *ex ante* consumers' reactions to regulatory instruments.

Consumer i can choose between five purchasing outcomes: the non-local regular wine at price $P(k = \texttt{VCQN})$, the local regular wine at price $P(\texttt{MRSN})$, the non-local organic at $P(\texttt{VCQB})$, the local organic at price $P(\texttt{MRSB})$ or none of those. Purchasing decisions are determined by considering the WTP for the different products, $\text{WTP}_{i5}(\texttt{VCQN})$, $\text{WTP}_{i5}(\texttt{MRSN})$, $\text{WTP}_{i5}(\texttt{VCQB})$, $\text{WTP}_{i5}(\texttt{MRSB})$. We assume that a consumer purchases a bottle of wine if her WTP is higher than the price observed for that bottle in the supermarket. She chooses the option generating the highest utility with a utility of non-purchase normalized to zero. Because complete information is perfectly internalized by consumers, no other tool can improve the welfare. The per-unit surplus and welfare for participant i is as follows:

$$\mathbf{W}_i^L = \max\{0, \text{WTP}_{i5}(k) - P(k); k \in \mathbb{K}\} \tag{7}$$

with $\mathbb{K} = \{\texttt{VCQN}, \texttt{MRSN}, \texttt{VCQB}, \texttt{MRSB}\}$. In many real life situations however, consumers' information is very limited, which differs significantly from the situation presented in configuration #

1.

6.2 Regulation # 2: A Per-Unit Tax on Regular Wines

To simulate the tax scenario, we consider a situation where consumers are aware of logos without additional information. Beyond what is coveyed by the logo, consumers have no additional precise knowledge about the process of production, which corresponds to the situation of round # 1. Public intervention here consists of imposition of a per-unit tax on the regular products. Hence $WTP_{i1}(k)$, $k \in K$, are considered by the regulator to determine the welfare impact of the tax τ.[11] As before, consumer i can choose between five purchasing outcomes: the non-local regular wine at price $P(\texttt{VCQN}) + \tau$, the local regular wine at price $P(\texttt{MRSN}) + \tau$, the non-local organic wine at price $P(\texttt{VCQB})$, the local organic wine at price $P(\texttt{MRSB})$ or none of those. The consumer's purchasing decision is still made based on her surplus maximization, which leads to:

$$\mathbf{CS}_i^{\tau} = \max\{0, \text{WTP}_{i1}(k) - P^{\tau}(k); k \in \mathbb{K}\} \tag{8}$$

where $P^{\tau} \equiv P$ for organic wines and $P^{\tau} \equiv P - \tau$ for regular ones. Equation (8) differs from equation (7) because of the tax τ and because of different WTP linked to different contexts of information as elicited in rounds # 1 and # 5.

The absence of complete information about the pesticide problems related to wine leads to a non-internalized damage[12] and biases the purchasing decision in round # 1. In the situation of complete information (round # 5), some consumers stop buying the product they previously bought. The non-internalized damage or benefit linked to the production of the wine $k \in \mathbb{K}$ is $\mathbb{1}[k,i] \times \left(\text{WTP}_{i5}(k) - \text{WTP}_{i1}(k)\right)$, where $\mathbb{1}[k,i]$ is an indicator variable that takes the value 1 if the wine k is purchased by the consumer i, namely if $\text{WTP}_{i1}(k) - P(k) - \tau > \max\{0, \text{WTP}_{i1}(k') - P(k') - \tau; k' \neq k\}$. If the product is not purchased, $\mathbb{1}[k,i] = 0$.

[11] We also tested the combination of a per-unit tax on the regular wine product and a subsidy on the organic wine. However, this scenario does not improve welfare because the subsidy is relatively costly and does not lead to many changes by participants.

[12] This non-internalized damage is slightly different from the cost of ignorance suggested by Foster and Just (1989). In their framework, consumers incur a cost of ignorance from consuming a contaminated product that could cause detrimental health effects without knowledge of the adverse information.

By using (8), the complete surplus integrating the non-internalized damage and benefit is defined by:

$$\mathbf{C}_i(\tau) = \mathbf{CS}_i^\tau + \sum_{k\in\mathbb{K}} \mathbb{1}[k,i] \times \big(\text{WTP}_{i5}(k) - \text{WTP}_{i1}(k)\big) \tag{9}$$

This complete surplus integrates the non-internalized damage or benefit represented by WTP differences following the revealed information. With this complete surplus, the regulator also considers the possible tax income coming from each participant. The tax is paid only by consumers purchasing the regular wine with $\mathbb{1}[\texttt{VCQN}, i] = 1$ or $\mathbb{1}[\texttt{MRSN}, i] = 1$ leading to a possible income $\tau \times \mathbb{1}[\texttt{VCQN}, i]$ or $\tau \times \mathbb{1}[\texttt{MRSN}, i]$ received by the regulator. By taking into account the complete surplus integrating the non-internalized damage and the estimated tax income, the per-unit welfare related to a participant i is as follows:

$$\begin{aligned} \mathbf{W}_i(\tau) &= \max\{0, WTP_{i1}(k) - P^\tau(k); \forall k \in \mathbb{K}\} \\ &+ \sum_{k\in\mathbb{K}} \mathbb{1}[k,i] \times \big(\text{WTP}_{i5}(k) - \text{WTP}_{i1}(k)\big) + \tau(\mathbb{1}[\texttt{VCQN}, i] + \mathbb{1}[\texttt{MRSN}, i]). \end{aligned} \tag{10}$$

The optimal tax τ^* is given by *tatônnement*, maximizing the average welfare $\sum_i^N \mathbf{W}_i(\tau^*)/N$ over the $N = 111$ participants.

6.3 Regulation # 3: A Standard Imposing Organic Practices

To simulate the standard scenario, we consider a situation where consumers are aware of logos without additional information. Public intervention here consists of banning the regular process. There is an improvement regarding the production process for all wines, but there is a reduction in the diversity of products. Producers with regular products will turn to the organic process and we assume that consumers will have the same WTP for these “new” products becoming organic as the corresponding WTP for the organic products elicited in the lab. The markets will have two *Vacqueyras* wines and two *Marsannay* wines. Because of a Bertrand competition, the price will be the same for each. Consumer i can choose between three purchasing outcomes: the two organic bottles of *Vacqueyras* at price $P(\texttt{VCQB})$, the two organic bottles of *Marsanay* at price $P(\texttt{MRSB})$ or neither of those. The consumer’s purchasing decision is based on her surplus maximization, which is equal to:

$$\mathbf{CS}_i^S = \max\{0, \mathrm{WTP}_{i1}(\texttt{VCQB}) - P(\texttt{VCQB}), \mathrm{WTP}_{i1}(\texttt{MRSB}) - P(\texttt{MRSB})\} \tag{11}$$

The non-internalized benefit linked to the organic product for $k' \in \mathbb{K}' \equiv \{\texttt{VCQB}, \texttt{MRSB}\}$ is $\mathbb{1}[k', i] \times (\mathrm{WTP}_{i5}(k') - WTP_{i1}(k'))$, where $\mathbb{1}[k', i]$ is an indicator variable taking the value 1 if the organic wine k' is purchased by the consumer i. By using (11), the complete surplus integrating the non-internalized damage or benefit is defined by:

$$\mathbf{C}_i^S = \mathbf{CS}_i^S + \sum_{k' \in \mathbb{K}'} \mathbb{1}[k', i] \times \left(\mathrm{WTP}_{i5}(k') - \mathrm{WTP}_{i1}(k')\right) \tag{12}$$

This complete surplus integrates the non-internalized damage or benefit represented by WTP differences following the revealed messages.

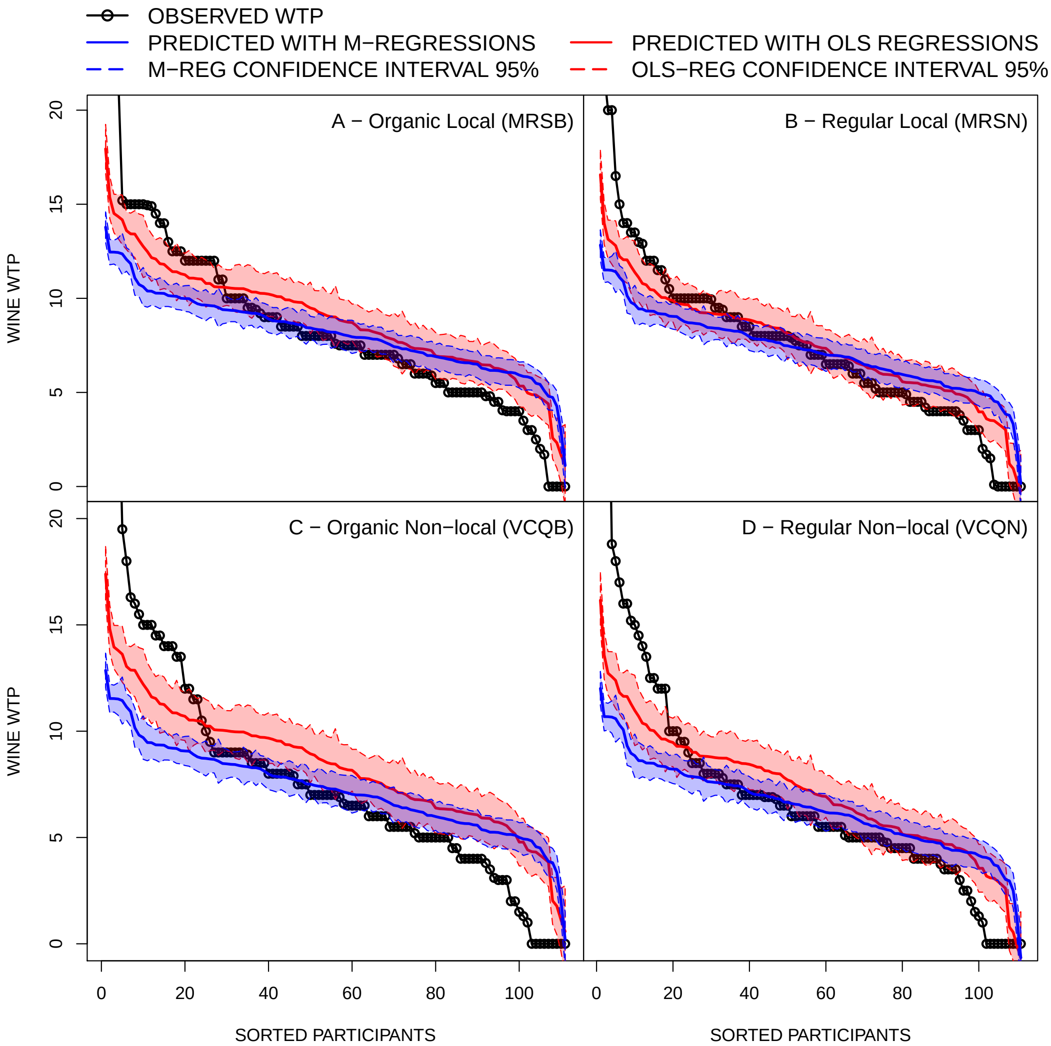
6.4 Welfare analysis

To perform the welfare analysis, we consider a baseline scenario in which the four wines are sold without any additional regulation. This baseline welfare is defined by (9) with $\tau = 0$. Policy simulations compare the welfare effects of three regulatory instruments aimed at internalizing attributes valued by consumers after revelation of full information.

For each configuration with a number $N = 111$ we detail the sum of welfare variations linked to one purchased bottle and defined by $\Delta W_N^L = \sum_i^N [W_i^L - W_i^0]/N$ for the information campaign, $\Delta W_N^\tau = \sum_i^N [W_i^{\tau^*} - W_i^0]/N$ for the tax τ^*, and $\Delta W_K^S = \sum_i^N [C_{S,i} - W_i^0]/N$ for the mandatory standard. Our calculations use the prices observed for the bottles, namely the *Vacqueyras* at price $P_{Va} =$ € 13, the *Marsannay* at price $P_{Ma} =$ € 8, the organic *Vacqueyras* at price $P_{VaOr} =$ € 14, the organic *Marsannay* at price $P_{MaOr} =$ € 10.5, see Table 1. The welfare estimations will focus on differences between the use of elicited WTP directly observed in the lab and the use of predicted WTP with the M regressions which smooth outliers with extreme valuations.

Figure 3 shows the ordered WTP for the four wines with information # 1. The cumulative

Figure 3: Observed and predicted demand functions for the four wines (in €)
The results for the information # 1 are presented here, the results for information 5 are available at the Supplemental Material.



number of participants (equivalent to one purchased bottle per participant) is represented on the X-axis and the ordered WTP (in €) corresponding to the cumulative number of participants is represented on the Y-axis in decreasing order. The black ordered curve is the elicited WTP directly observed in the lab, the blue curve is the predicted WTP with the classical OLS estimation, and the red curve is the predicted WTP from model (4) in Table 4. The respective dashed curves represent WTP with a 95% confidence interval. For ease of presentation, Figure 3 abstracts from two observations regarding the elicited WTP directly observed in the lab and higher than €20. Note that the WTP in all the curves is ordered, which means that a given number on the X-axis indicates the ranking of WTP related to each curve and not a specific participant. The predicted value for a given participant can vary widely compared to the elicited WTP observed in the lab, which changes the participants' ranking based on the order of WTP among curves. Figure 6 in Supplemental Material reports the same plots with information # 5.

The left sides of each panel in Figure 3 show that, for relatively high-values of WTP, the elicited WTPs directly observed in the lab are significantly higher than the WTPs predicted with the OLS, and those predited with the robust M-regressions in model (4). The OLS curves are also higher than the model (4) curves in the left of panels. The differences between OLS and robust M-regressions are more significant for organic than regular wines, showing more extreme preferences in relation to the former. OLS predictions are generally less precise than robust M-regressions since confidence intervals are wider. The middle sections of each panel in Figure 3 show that predicted WTP fits well the elicited WTP. Other bottles and WTP after full revelation of information at round # 5 are characterized by similar patterns to those in Figure 3. Different curves are relatively close, although the WTP predictions sometimes drastically reallocates participant's WTP because of the econometric methodology smoothing away idiosyncratic values. For the four products in rounds 1 and 5, average WTP predicted by OLS is very close to the observed WTP, while average WTP in the model (4) is 10% lower than the observed WTP.

Table 7 presents the sum of welfare variations with both elicited and predicted values linking models (4), (5) and (6) in Table 4. Recall that these three models corresponds to different computed and measured values of the distance between the vineyard and people's dwellings. This also shows the results with the predicted values related to the OLS estimation similar to model (4), to enable comparison. For the different configurations, we give the simple sum of welfare variations and the weighted sum with weights coming from the M-regression.

Giving consumers full information via a campaign has the highest impact in terms of welfare. However, a campaign with complete information is difficult to implement in practice.[13] Due to the limitations linked to campaigns, the analysis suggests use of an alternative regulatory tool such as a per-unit tax or a mandatory standard. The standard and the tax solutions lead to

[13]Field experiments show that imperfect recall, lack of time before purchasing and confusion about complex information characterize many consumers in the supermarket. This makes an information campaign relatively inefficient in a real purchasing context, even if the lab shows a real interest and WTP. The lab context, in eliciting well-informed, thoughtful preferences, is useful for computing an optimal per-unit tax (see Marette et al., 2011).

Table 7: Average welfare variation for different regulatory tools
Values are in € and the results are from the complete sample of 111 participants

	Configuration # 1 Information campaign	Configuration # 2 Tax t*	Configuration # 3 Mandatory Standard
Elicited WTP:		t*= 1.01	
without weights	48.93	15.88	8.08
with weights	46.29	15.20	10.85
Predicted WTP with model (4) and OLS:		t*= 0.63	
without weights	41.08	40.22	40.22
with weights	36.95	36.18	36.18
Predicted WTP with model (4) of Table 4		t*= 0.89	
without weights	8.05	8.05	7.60
with weights	7.08	7.08	6.67
Predicted WTP with model (5) of Table 4		t*= 0.83	
without weights	7.92	7.92	7.27
with weights	6.57	6.57	5.97
Predicted WTP with model (6) of Table 4:		t*= 0.73	
without weights	7.79	7.79	7.43
with weights	6.68	6.68	6.25

significantly different welfare variations. A tax leads to a higher welfare variation compared to a mandatory standard when all participants are considered. The main reason for this is that the standard destroys product diversity by eliminating regular products, which injures many consumers who give no additional value to organic products when the regular products are no longer available.

For the welfare variations with predicted WTP from models (4), (5) and (6), a tax leads to the same variations as the information campaign. With this predicted WTP there is no demand for the regular *Vacqueyras* and the information campaign or the tax similarly reduces demand for the regular *Marsannay*. For a same instrument, the welfare variations are generally lower for predicted WTP than elicited WTP directly observed in the lab. The results show that the OLS estimation leads to closer results for the information campaign and to higher variations for the tax and standard solutions. Table 7 shows clearly that the surplus variations based on direct use of elicited WTP observed in the lab seem overestimated compared to the predicted WTP related to the M-regressions via models (4), (5) and (6). Considering the M-regression is an efficient way to thwart upward biases in WTP linked to lab elicitations. By smoothing extreme values in a consistent manner, it allows more rigorous welfare estimation. The econometric estimation with robust M-regressions allows us to smooth the idiosyncratic WTP given directly by the elicitation process. As robust M-regressions limit the impact of influential outliers, the welfare variations using predicted WTP are lower than the corresponding welfare variations using elicited WTP directly observed in the lab.

Considering perceived or real distances to the vineyard seems to have a small impact on welfare variations since the results under models (4), (5) and (6) are very close. Although the socially optimal instrument represented by a tax is relatively invariant across types of WTP, the welfare variations differ across the types of WTP considered. This is an important issue since, in real situations, the regulator needs to carefully compare these welfare gains with estimates of administrative costs and sunk costs for firms. If the regulator decides to select a tax when the welfare variation in Table 4 is higher than the administration costs, a welfare variation equal to 15.88 (elicited WTP) or 8.05 (predicted in model (4)) could lead to a different conclusion. When the value of the administration costs is between 8.05 and 15.88, then consideration of the elicited WTP suggests imposing a tax, while consideration of model (4) suggests no tax which is more reliable because outliers are smoothed. The welfare variation based on the econometric model is preferable since outliers are smoothed although there is no definitive conclusion. This is important if welfare variations are extrapolated to the whole population, since the weight of outliers needs to be downplayed.

7 Conclusion

Regulatory authorities face intense pressure to act in relation to sensitive issues such as reducing pesticide use. Experimental results provide a useful basis to anticipate consumers' reactions to pesticide issues. The experiment conducted in Burgundy with four different bottles of wine, shows complex impacts of various parameters on the WTP. The econometric analysis shows that: (i) there is a positive and significant organic premium associated with local and non-local wines, (ii) providing additional information increases the organic premium, (iii) distance to a vineyard is a significant determinant of the organic premium. The regulator should account for all those complex effects in defining a policy that will be efficient.

Our welfare estimate for defining a regulatory policy show that the tax on the conventional wine is socially optimal. We showed that the predicted WTP from robust M-regressions may be used to estimate welfare variations related to various regulatory instruments. The welfare variation with this econometric model is preferable since outliers are smoothed, although it does not provide definitive conclusions. Since robust M-regressions limit the impact of influential outliers, the welfare variations using these predicted WTP are lower than the welfare variations using the elicited WTP directly observed in the lab. This is important when welfare variations are extrapolated to the whole populations, since the weight of outliers needs to be downplayed. The distance between participants' dwellings and a vineyard was found to be important for improving the quality of the econometric estimation of WTP.

The distance between participants' dwellings and a vineyard is also important for studying extensions. In particular, our paper provides hints about real estate taxation integrating environmental characteristics. The significant effects of distance suggest that a property tax could depend on improvements to the environmental quality of vineyards. If a policy consisting of mandatory reduction in pesticides use leads to an improvement in the local environment, people living close to a vineyard would finance this policy more compared to people located farther from a vineyard. Our study does not provide definitive conclusions, and more work is necessary on policy. Despite the limitations inherent in lab experiments, this methodology supports public debate about the best way to promote an efficient policy to promote organic wine. Various regulatory scenarios can be tested *ex ante*, and the methodology renders lab experiments useful for policy analysis, which is an important challenge for experimental economics.

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