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Abstract

Firms may voluntary abate pollution using one of two options: internalizing its own external effects and incuring abatement costs ("making") or delegating environmental protection by purchasing offsets ("buying"). We aim to elicit consumers' WTP for producers' use of the "making" option as compared to the "buying" option, controlling for spatial effects (joint local public goods) and level of GHG emissions. Using a stated choice survey with 722 respondents, we find consumers are more willing to pay for a "making" policy. Consumers do not significantly care for the producers' use of offsets when the level of local externalities is controlled for.

Keywords: offsets, willingness to pay, stated choice

JEL classifications: Q53, Q54, Q58

Faire ou faire faire : les préférences des consommateurs pour la compensation écologique

Résumé

Les producteurs peuvent choisir de volontairement réduire leurs impacts environnementaux par deux moyens: en modifiant leur propre processus de production (faire) ou en délégant la protection de l'environnement à une tierce partie par de la compensation écologique (faire faire). Dans le cas de la réduction des gaz à effet de serre (GES), nous examinons le consentement à payer des consommateurs pour ces deux types de politiques en contrôlant pour les effets spatiaux (biens publics locaux joints) et le niveau d'émission de GES. A l'aide d'un choice experiment sur un échantillon de 722 individus, nous trouvons que les consommateurs sont plus disposés à payer pour le "faire" que pour le "faire faire".

Mots-clefs : compensation écologique, consentement à payer, choice experiment

Classifications JEL : Q53, Q54, Q58

Making or Buying Environmental Public Goods: Do Consumers Care?

1 Background and motivation

Carbon offsetting enables any party (firms, organizations, individuals) to compensate the carbon emissions of its activities by financing a project that reduces greenhouse gases (GHG) emissions. When the party's GHG emissions are exactly offset, the activity of the party is said to be carbon neutral. Today, carbon offsets are used in different policy contexts. In some cases, offsets are the result of a mandatory policy of pollution reduction, and are a way to allow sharing environmental efforts in a cost-efficient manner. In other cases, offsets result from the voluntary environmental effort of a company or an individual. For instance, the European Climate Policy sets emissions in some sectors, but doesn't impose emission levels to other sectors (e.g. agriculture) or to consumers.

Firms may voluntarily comply with GHG emissions reductions. The prospect of a higher consumer WTP for GHG emissions reductions determines how much effort would be voluntarily provided by companies. Indeed, two papers analyze consumer WTP for carbon offsets that compensate their own pollution [MacKerron, Egerton, Gaskell, Parpia, and Mourato, 2009; Brouwer, Brander, and Van Beukering, 2008]. These papers show that consumers are willing to pay to offset carbon emissions of their plane travels.

In order to reduce carbon emissions, a firm may either change its production process ("making" option) or use carbon offsets ("buying" option). The firms' choice between the two options is not neutral from the consumer's viewpoint. First, there may be spatial effects; that is offsetting may shift joint local public goods to another region. Second, offsetting is criticized on moral grounds. For example, a website[1] offers in a satiric way to compensate infidelity by paying people that engage to be faithful. The point is that offsetting allows getting away from the consequences of harming the environment with a clear conscience. A similar argument is made by G. Monbiot[2]: *"Just as in the 15th and 16th centuries you could sleep with your sister and kill and lie without fear of eternal damnation, today you can live exactly as you please as long as you give your ducats to one of the companies selling indulgences."*.

We used a stated choice web survey on a sample of consumers from two French regions to meet three objectives: 1) we aim to elicit consumers' WTP for producers' use of the "making" policy (producers' own green practices) as compared to the "buying" policy (purchase of offsets), controlling for spatial effects (joint local public goods); 2) we seek to determine whether consumers' opinions in favor or against offsets translate into their choices; 3) we elicit consumers' WTP for GHG emission reduction and its determinants.

[1] http://www.cheatneutral.com

[2] The Guardian, October 18th 2006.

We used a stated choice web survey on a sample of consumers from two French regions enabling us to control for spatial effects. We collected responses from 722 individuals. We find consumers are more willing to pay for a "making" policy (producers' own green practices) than for a "buying" policy (purchase of offsets). Consumers do not significantly care for the producers' use of offsets when the level of local externalities is controlled for. We find positive attitudes on offsets positively influence preferences for offsets whereas negative attitudes do not. Finally, respondents are willing to pay for lower levels of GHG emissions. The main motivation is gift-giving while those who do not support green products, those who feel their contribution will be wasted or those who are free riders have lower WTP.
The paper is organized as follows. In section 2, we present the stated choice survey design (choice of product and attributes and sample selection). Results are presented in section 3. Section 4 discusses results and concludes.

2 Methods

We first present the choice of products, of attributes and the experimental design and then the sample selection process.

2.1 Product, attributes and experimental design

We consider an application to milk produced in two regions in France: Bretagne (Western France) and Picardie-Champagne-Ardennes (Northern-Eastern France). We choose milk for two reasons. First, milk is a relatively homogenous product. As such, we expect the product to vary only in the attributes of interest (production process and location of production). Second, milk production implies cattle breeding, which is the largest agricultural contributor to GHG emissions in France (the agricultural sector as a whole contributes 20% of GHG emissions in France[3]). We chose two contrasted areas in France in terms of GHG emissions and water pollution from farming. "Bretagne" has intensive cattle breeding farming, whereas "Picardie" and "Champagne-Ardennes" have extensive cattle breeding farming and crop production. While Bretagne is a big contributor to GHG emissions (6.9 MtCO2e -mega tons of carbon dioxide equivalent- for CH4 and 5.3 for N2O), Picardie (1.1 for CH4 and 2.5 for N2O) and Champagne-Ardennes (1.2 for CH4 and 3 for N2O) are smaller contributors. It is also worth noting that Bretagne and Picardie-Champagne-Ardennes belong to two separate hydrological basins. Indeed, efforts to enhance water quality in one region have no effect on water quality in the other region. Water quality is then a local public good in each region.
The aim of the survey is to elicit consumers' preferences for milk produced under differing conditions each representing an attribute in the stated choice survey. In our survey, consumers

[3]This relatively high figure is due to the fact that France has a relatively low level of GHG emissions for the electricity sector (nuclear energy).

were asked to make repeated choices between three options: their usual milk and two alternative versions (alternative 1 and alternative 2). Each version of the product is described by five attributes (see Table 1): location of milk production (in the respondent's area or not), type of on-farm process (a reduction in production intensity by reducing the number of cows per hectare -"making" option- or no change in production intensity but with a use of offsets -"buying" option), level of a local public good, i.e. water quality (3 levels), level of GHG emissions (3 levels) and price increase (3 levels). The location of milk production enables us to control for a preference for local production. The farm process attributes enables us to measure a preference for offsets as compared to the producer reducing its GHG emissions on the farm. Finally, the local public good attribute enables to control for the jointness rationale described above. In short, we want to know if consumers oppose offsets when changes in local water quality are controlled for. The fourth attribute is the global public good resulting from the on-farm pollution reduction or the use of offsets. The last attribute is the payment vehicle. Respondents could also choose no option and select "cannot choose" or "do not want to respond" options.

Table 1: Attributes used in stated choice survey

Attribute	Description	#levels	Level description
local	Production is located where the respondent lives	2	Yes; No;
off	Producer uses offsets	2	Yes; No;
cow	Producer reduces number of cows per hectare	2	Yes; No;
h2o	Improvement in water quality	3	+0%; +40%; +60%
ghg	Reduction in GHG emissions	3	-0%; -40%; -60%
price	Price of the good	3	+10%; +20%; +40%

A full factorial design would imply $3^3 \times 2^2 = 108$ descriptions of milk. We use a fractional factorial design to reduce the number of choices made by the respondents in the survey. The aim is to maximize D-efficiency to achieve balance and orthogonality. Balance requires that each level of each attribute appears the same number of times and orthogonality requires that every pair of levels appears the same number of times across all of the pairs of attributes in each alternative. Furthermore, we restrict the design to situations that are not too obvious (for example, two alternativesthat have the same price and the same process) and not incoherent (for example, no choice set where one alternative has a higher price than the other alternative but with higher air and water pollution and same process). The design we finally used consists of 36 choice sets blocked in twelve groups of three (D-efficiency=98%). Each respondent was presented with 3 choice sets and there were twelve versions of the survey.

Table 2 presents an example of a choice set. In this example, the two alternatives to the usual milk are produced in two different regions (see first row). But because of the use of offsets in the second alternative (see second row), water pollution is improved in region A for both alternatives (see third row). We anticipated some respondents in the survey would consider that extensification has an impact on milk quality. To prevent consumers from associating private benefits to the change of production method, a short paragraph before the presentation of choice sets explained that the only differences between the types of milk are their places of production,

how they were produced (and therefore the pollution level) and their price; and that we ask respondents to consider that milk intrinsic quality is identical across the three types of milk.

Table 2: Example of a choice set

Usual milk	**Milk produced in region A**	**Milk produced in region B**
Produced with the **usual number** of cows per hectare	Produced with a **reduced number** of cows per hectare	Produced with the **usual number** of cows per hectare
The farmer pays **no one** to reduce pollution	The farmer pays **no one** to reduce pollution	The farmer pays **a farmer in region A** to reduce polluton
No improvement in water quality	**40% improvement** in water quality **in region A**	**20% improvement** in water quality **in region A**
No reduction in GHG emissions	**40% reduction** in GHG emissions	**60% reduction** in GHG emissions
Usual price	Usual price **+20%**	Usual price **+40%**
□	□	□

2.2 Sample selection

We used an Internet survey. Many studies compare web and mail surveys, and response rates are the most commonly studied. Some authors find the response rates to be lower in web surveys [Shih and Fan, 2007; Meckel, Walters, and Baugh, 2005; Fan and Yan, 2010] whereas others observe higher response rates [Olsen, 2009; Fleming and Bowden, 2009]. However, sampling procedures, reminder strategy and survey scope differ a lot between these studies, explaining these contrasted results. As highlighted by Farrell and Petersen [2010], Internet users are not perfectly representative of the overall population of a country[4]. For instance, in France, internet users are younger, have higher incomes and educations than the average French person. However, as stated by Farrell and Petersen [2010], it only implies that results have to be analyzed taking care of this potential representativity limit. Two authors do compare web surveys to mail surveys in the field of non-market valuation, one studies the WTP for environmental protection [Olsen, 2009], the other estimates recreation value using the transport cost method [Fleming and Bowden, 2009]. In these two papers, Internet surveys give the same result as mail surveys, even when the web and mail samples differ in their socio-economic characteristics. A number of e-mails were randomly sent in the two regions of interest (Bretagne and Picardie-Champagne-Ardennes) through an e-mailing company. Unfortunately, problems arose with the e-mailing company, which does not enable us to know how many e-mails were sent. We however know that randomness of e-mail selection was preserved in each region of interest.

[4]Here we are not attempting to extrapolate our results to a broader population, but are attempting to understand the decision-making process as it relates to offsets. In this case, external validity is less of a concern.

3 Results

To present the results, we first describe the sample, then the econometrics specification and finaly the first econometric results.

3.1 Sample description

There were 722 responses, 464 from Bretagne (64.27%) and 258 from Picardie-Champagne-Ardennes (35.73%). There are clearly more responses from Bretagne. We do not know if the response rate was higher in Bretagne or if more e-mails were sent in Bretagne. As mentioned in footnote 3, the main point of our study is how decision-makers evaluate the tradeoffs between production changes, use of offsets, and changes in environmental attributes and price. Table 3 presents the summary statistics on some socio-demographics variables and describes the interest of respondents as to local or global environmental groups (frequency and percentage for categorical variables and mean for continuous variables).

Table 3: Sample description, socioeconomic variables

Gender (% female)	51
Mean age (Years)	49.71
Highest level of education completed; (%)	
Primary	0.70
College	1.25
BEP/CAP	11.27
Baccalaureate	16.55
BTS,DUT,DEUG	20.86
Bac+3	49.37
Total	100
Household income before taxes; (€/year)	
Less than €10,000	5.12
€10,000-€19,999	10.69
€20,000-€29,999	20.5
€30,000-€39,999	21.96
€40,000-€49,999	15.52
€50,000-€59,999	9.52
More than €60,000	16.71
Total	100
Belongs to environmental association (%)	13
Scope of this environmental association (%)	
Local	51.69
Country	20.22
Europe	1.12
International	26.97
Total	100

The sample is older than the average metropolitan French (40.3 years old[5]) since it is composed of adults only. The share of women in the sample is close to the average French metropolitan data (50.57%[6]). Household income seems to be a little higher than the annual income of French population[7], as the median of French population is 28,740 €/year, and ninth decile is 59,900 €/year. However our sample includes around the same rate of low incomes than French

[5]Source: Insee, estimations de population 2010 (www.insee.fr/).
[6]Source: Insee, estimations de population 2010 (www.insee.fr/).
[7]Source: Insee, distribution des revenus disponibles annuels des ménages 2009 (www.insee.fr/).

population: in France, the first decile is at 12,930 €/year. The education level in our sample is high. Unfortunately, national data on education and on political and social involvement are not very detailed. We know that, at a national scale, 6.6% of French belong to a non governemental organization which aims to provide charities or to defend common rights[8]. The sample seems to be more involved into environmental organization than the average French. However, national data show that more educated and older persons are generally more involved than younger and less educated. The high involvement into environmental organizations of our sample may be related to education and age.

The survey included one question about the attitude towards offsets, in relation to the second scope of the paper. This question was: "Do you think that polluters should be allowed to buy pollution offsets instead of reducing their own pollution? Please choose all answers that apply." Ten answers were proposed, five beginning with "Yes, because..." , and five beginning with "No, because...". Table 4 presents the sample's attitudes towards offsets and the knowledge level on offsets. Most of the people of the sample already heard about pollution offsets before reading the survey and do not want more information. People of the sample have more frequently negative attitudes towards offsets, than positive attitudes, based on moral grounds.

Table 4: Sample description, attitudes and knowledge on pollution offsets

Item	%agree	SD
Attitude towards offsets: Do you think polluters should be allowed to buy pollution offsets instead of reducing their own pollution?		
Yes, because the environment can be cleaned up more cheaply	14.80	35.50
Yes, because society can clean up more of the environment for the same amount of money	8.72	28.24
Yes, because it encourages polluters to pay attention to the environment	24.65	43.12
Yes, because it can keep farm costs and thus is less disruptive to employment	11.35	31.75
Yes, because it can keep farm costs and thus milk prices at reasonable levels	12.46	33.00
No, because polluters should pay the full cost of cleaning up their own pollution	34.4	47.56
No, because it is morally wrong to pay someone else to avoid cleaning up your own pollution	43.76	49.64
No, because polluters should be punished as much as possible	30.74	46.17
No, because offsets imply some producers offer to protect the environment in the place of others,in return for money. It is wrong for producers to make money this way.	25.07	43.37
No, because the original victims of the pollution will still, be forced to live with the pollution if the polluters use offsets	51.38	50.00
Knowledge about offsets		
I already heard about pollution offsets	74.29	43.73
I would like more information about pollution offsets	29.94	45.83

We also asked respondents about their concern for several items (air pollution, water pollution,

[8]Source: Luczak F., Nabli F., 2010, Vie associative: 16 millions d'adhérents en 2008, INSEE Première n°1327.

farm production methods, employment, effects of global warming, farm animal well-being) at different geographical levels (respondent's area, France, world). The data are not presented here but available upon request. A few results can be noticed. First, the more global the item is, the less concerned respondents appear to be. Second, respondents are concerned (1) by employment, then (2) by water pollution and farm production methods and finally, by (3) animal well-being, the effect of global warming and air pollution.

3.2 Factor analysis

To reduce the number of variables in the set of attitudes towards offsets, we conduct a factor analysis. Factor analysis describes the variability among observed variables in terms of a lower number of unobserved latent variables, the factors. Observed variables, attitudes towards offsets, are then assumed to be a linear combination of the factors, opinions towards offsets.
A principal component analysis has been run with SAS. The first step of the factor analysis determines the number of factors, based on the eigenvalues. Two factors have eigenvalues larger than one and are kept for the rest of analysis. Factor analysis provides factor loadings, which are the correlation coefficients between the variables and factors. A high loading means that the the variables and the underlying construct (the factor) are highly correlated. To be able to interpret easily the loadings, the factor matrix is rotated. We choose a varimax rotation, which provides orthogonal/non-correlated factors, which are more easily interpretable.
The factor analysis on the first set of variables indicates that two factors explain respondent reactions (Table 5). Kaiser's overall measure of sampling adequacy is relatively high (0.84) indicating the factor model is appropriate; values greater than 0.80 are considered sufficiently high for analysis (SAS, 1994). Loadings show that *infavor* is positively and highly correlated to all positive attitudes towards offsets. *infavor* corresponds thus to a positive opinion on offsets. *against* is positively and highly correlated to all negative attitudes towards offsets, so *against* resumes opposition towards offsets.
The third scope of the paper is to elicit WTP for GHG reduction, and its determinants. As attitudes towards pollution reduction and public goods may explain this WTP, twelve questions on the survey measure these attitudes. All of these questions are framed as affirmative sentences, with a likert scale from 1 (I not at all agree) to 5 (strongly agree). A factor analysis shows there are 4 factors (Table 6). Kaiser's overall measure of sampling adequacy is marginal (0.72) indicating the factor model is appropriate.
assur corresponds to the attitude that it is inefficient for the individual to buy environmentally-friendly products, for two reasons: inefficiency of green goods in general, or insuffisance of individual purchase (assurance effect). *gift* is altruism or warm-glow effect. *nogreen* says that the individual doesn't buy green goods because it is useless. *fride* is free riding.

Table 5: Factor loadings after varimax rotation, opinions towards offsets, loadings less than 0.55 not reported

Description	*against*	*infavor*
Yes, because the environment can be cleaned up more cheaply	.	**.64**
Yes, because society can clean up more of the environment for the same amount of money	.	**.69**
Yes, because it encouages polluters to pay attention to the environment	.	**.64**
Yes, because it can keep farm costs and thus is less disruptive to employment	.	**.68**
Yes, because it can keep farm costs and thus milk prices at reasonable levels	.	**.66**
No, because polluters should pay the full cost of cleaning up their own pollution	**.63**	.
No, because it is morally wrong to pay someone else to avoid cleaning up your own pollution	**.67**	.
No, because polluters should be punished as much as possible	**.75**	.
No, because offsets imply some producers offer to respect the environment in the place of others, in return for money. It is wrong for producers to make money this way.	**.80**	.
No, because the original victims of the pollution will still be forced to live with the pollution if the polluters use offsets	**.60**	.

Table 6: Factor loadings after varimax rotation, opinions towards public goods, loadings less than 0.55 not reported

Description	*assur*	*nogreen*	*gift*	*fride*
Even if I buy environmentally-friendly products, not enough people will buy them	**.83**	.	.	.
If I buy environmentally-friendly products, my individual purchase is not enough to protect the environment	**.82**	.	.	.
Buying environmentally-friendly products will not help to protect the environment because there are too many other sources of pollution	**.66**	.	.	.
In reality, buying environmentally friendly products will not help the producer	**.57**	.	.	.
I will not buy environmentally-friendly products because the environment is already preserved	.	**.84**	.	.
I do not buy environmentally-friendly products because enough other people buy them	.	**.81**	.	.
I like making donations because it makes me feel good	.	.	**.86**	.
I like contributing to charities and other non profit organizations	.	.	**.83**	.
My personal well-being is more important to me than that of the average French person	.	.	.	**.84**
I am comfortable receiving benefits even if I do not contribute	.	.	.	**.80**

3.3 Econometric models

We use a standard specification of random utility. Our presentation of the empirical models follows Revelt and Train [1999]. In our study, consumer n chooses among 3 alternatives ($j = 1, 2, 3$) the alternative that yields the greatest utility. The probability of selecting an alternative increases as the utility associated with it increases. The individual consumer's utility level associated with the choice of an alternative j in the set of alternatives $t = 1, 2, 3$ writes as in equation (1). It is a linear function of the vector of attributes X_{njt} presented to consumer n in alternative j in set t. The parameters β_n are known to the respondent but not to the researcher.

$$U_{njt} = V_{njt} + \epsilon_{njt} = \acute{\beta_n} X_{njt} + \epsilon_{njt} \tag{1}$$

with $j = 1, 2, 3$, $t = 1, 2, 3$ and $n = 1..N$.
The stochastic term ϵ_{njt} is assumed to be distributed iid extreme value type 1 and independent of β_n. Let $y_n = (y_{nj1}, y_{nj2}, y_{nj3})$ denote the consumers' sequence of chosen alternative in situation $t = 1, 2, 3$. We can write the probablity for consumer n of choosing alternative i in set t as in equation (2).

$$L(y_{nit} = 1) = \frac{\exp(\acute{\beta_n} X_{nit})}{\sum_j \exp(\acute{\beta_n} X_{njt})} \tag{2}$$

Since the ϵ_{njt} are independent over choice situations t, the probability of the consumer's sequence of choices, conditional on β_n is the product of logits (equation (3)).

$$P(y_n|\beta_n) = L(y_{ni1} = 1|\beta_n) L(y_{ni2}|\beta_n) = 1) L(y_{ni3} = 1|\beta_n) \tag{3}$$

As a first approximation, we considered preferences are homogenous so that $\beta_n = \overline{\beta}\ \forall n$. This specification is a conditional Logit model. This exhibits the "independence from irrelevant alternatives" restriction. We tested that hypothesis in our data and it is rejected. We then turn to a mixed Logit model. Indeed, we are interested in examining the heterogeneity in the sample. Thus, we consider as a second step that preferences are heterogenous among consumers so that the conditional probabilities defined in equation (3) are integrated over all possible values of β_n using the population density of β. The probability $P(y_n|\theta)$ of the consumer's sequences of choices conditional on the parameters of the distribution $g(\beta|\theta)$ is displayed in equation (4).

$$P(y_n|\theta) = \int P(y_n|\beta_n) g(\beta|\theta) d\beta \tag{4}$$

This is the specification of a mixed Logit or a random parameter Logit (RPL) model. We use a Monte Carlo simulation method to estimate the probabilities of choice (100 Halton draws) using the SAS MDC procedure.
In the RPL model, we consider the parameters associated with all the attibutes except price as random. The price coefficient is considered fixed as in many other applications [Hensher, Shore,

and Train, 2005] while all other coefficients are assumed normally distributed. So we estimated the mean and standard deviation of the normally distributed coefficients for all attributes except price.

3.4 Econometric results

Table 7 presents the econometric results. We ran several random parameter Logits without interactions (model (1)); with interactions with variables on opinions on offsets (model (2)); with variables on attitudes towards public goods (model (3)). The RPL model informs about heterogeneity in the sample but does not explain the source of the heterogeneity. We need to include interaction variables to be able to answer some of the objectives of the paper.

We compute the marginal willingness to pay for each attribute as the marginal utility of the attribute (attribute parameter) divided with the marginal utility of price (price parameter). In the survey, milk price is expressed as a percent increase of current price paid by consumers. To compute WTP in monetary form, we consider a 1 €/liter reference price. Table 8 presents the calculated WTP for each attribute.

The aim of our paper is threefold. We will comment on the results according to each of the objective. First, we were aiming at eliciting consumers' WTP for producers' use of the "making" option (producers' own green practices) as compared to the "buying" option (purchase of offsets), controlling for spatial effects (joint local public goods). In all models (1 to 3), the coefficient on the offset attribute is not significant. Model (1) shows that consumers do not care for the use of offsets when joint local public goods are controlled for: there is no significant "buying" option effect. The interaction of offset with socio-economic variables (model 2 and model 3) shows that people who belong to an environmental association (*asso*) are less willing to pay for offsets. Other sociodemographic variables such as gender, age and education are not signficant. Consumers are however significantly willing to pay for the "making" option, that is producers' own cattle reduction (*cow*). The willingness to pay for producer's own cattle reduction is particularily high[9] between 16 and 19 € cents per liter of milk (Table 8).

Second, we seek to determine if consumers' opinions in favor or against offsets translate into their choices. Consider the opinion variables (*against* and *infavor*) that are interacted with the offset attribute. We find that consumers who oppose offsets are indifferent to the use of offsets whereas consumers who are in favor of offsets are willing to pay for the use of offsets, although *infavor* is significant only in model (3). This result shows that the use of offsets could be better financed through the market provided more information about the benefits of offsets.

[9]Although providing detailed results on this attribute is outside the scope of the paper, we can share some results. We introduced variables interacted with the cow attribute in model (1). We find females and older and more educated individuals have a positive and significant WTP for a reduction of the number of cows. Moreover, individuals who perceive a strong impact of reducing cattle number on animal well-being have a high and significant willingness to pay for the attribute. These results are in line with a concern in the EU for animal welfare especially in intensive cattle breeding countries such as France (see eurobarometer on animal welfare: http://ec.europa.eu/food/animal/welfare/survey/sp_barometer_aw_en.pdf).

Table 7: Econometric results: random parameter Logits

	(1)		(2)		(3)	
Attribute	Coefficient (SE)	Coeff. std (SE)	Coefficient (SE)	Coeff. std (SE)	Coefficient (SE)	Coeff. std (SE)
local	0.2146**	0.0241	0.3912***	0.2224	0.4299***	0.7017
	(0.0957)	(2.8108)	(0.1415)	(1.5913)	(0.1535)	(0.7083)
off ("buying")	-0.1500	0.0029	-0.1866	0.0572	0.0547	0.1374
	(0.1635)	(2.8184)	(0.4740)	(2.0401)	(0.4879)	1.7090
cow ("making")	0.5296***	0.0371	0.6972***	1.9414***	0.7847***	1.8038***
	(0.1793)	(2.5300)	(0.2391)	(0.5781)	(0.2558)	(0.5675)
h2o	0.0231***	0.0301***	0.0266***	0.0315***	0.0275***	0.0286***
	(0.0029)	(0.0077)	(0.0045)	(0.0096)	(0.0050)	(0.0098)
ghg	0.0078***	0.0287***	0.0096***	0.0344***	0.0098***	0.0324***
	(0.0020)	(0.0074)	(0.0025)	(0.0102)	(0.0025)	(0.0104)
price	-0.0316***		-0.0383***		-0.0409***	
	(0.0049)		(0.0070)		(0.0078)	
*gender*X*off*			0.2953		0.0829	
			(0.1904)		(0.1895)	
*age*X*off*			0.0034		0.0047	
			(0.0077)		(0.0079)	
*educ*X*off*			-0.1121		-0.2951	
			(0.1989)		(0.2050)	
*asso*X*off*			-0.7127**		-0.9948***	
			(0.3024)		(0.3228)	
*against*X*off*			-0.0131		-0.1189	
			(0.0970)		(0.1017)	
*infavor*X*off*			0.1166		0.1758*	
			(0.0894)		(0.0922)	
*assur*X*h2o*					-0.0037*	
					(0.0022)	
*nogreen*X*h2o*					-0.0088***	
					(0.0026)	
*gift*X*h2o*					0.0042*	
					(0.0022)	
*fride*X*h2o*					-0.0029	
					(0.0021)	
*assur*X*ghg*					-0.0040*	
					(0.0022)	
*nogreen*X*ghg*					-0.0095***	
					(0.0026)	
*gift*X*ghg*					0.0052**	
					(0.0024)	
*fride*X*ghg*					-0.0058**	
					(0.0024)	
Goodness of fit						
Number of Obs.	1683		1683		1683	
Log Likelihood	-1724		-1714		-1661	
ρ^2	0.0676		0.0729		0.1036	

Note: *, ** and *** respectively mean 10%, 5% and 1% significant.

Table 8: Willingness to pay (€ cents/liter) and share of consumers with positive willingness to pay (scenario where reference price of milk is 1 €/liter)

Attribute	Model (1)		Model (2)		Model (3)	
	WTP	%>0	WTP	%>0	WTP	%>0
local	6.79	100	10.21	96	10.57	72
off	-4.75	0	-4.87	0	1.86	73
cow	16.76	100	18.20	64	19.13	97
h2o	0.73	78	0.69	80	0.68	84
ghg	0.25	61	0.25	61	0.24	62

Third, we elicit consumers' WTP for GHG emissions reductions and its determinants. Consumers are willing to pay around 0.25 € cents per liter of milk. Model (3) shows that con-

sumers who are reluctant to buy environmentally-friendly products because of fear of wasting their contribution (*assur*) are less willing to pay for GHG emissions reductions, as those who don't trust in green products for environmental protection (*nogreen*), or those who tend to adopt free-riding behaviors (*fride*). On the other side, those who adopt altruist attitudes (*gift*) are more willing to pay for a reduction of GHG emissions.

Our econometric analysis does provide other results. Consumers are willing to pay between 6 and 10 € cents per liter of milk for production located in the same place they live (*local*). Two explanations might be proposed. People do care about local employment and local economy, or people do care about local agriculture. As might be expected, interactions between opinions towards public goods (*assu*, *gift*, *nogreen*, *fride*) and reduction of water pollution (*h2o*) are very similar to interactions between opinions towards public goods and reduction of GHG pollution. The only difference comes from the interaction with free-riding behavior, which is not significant in case of water pollution reduction (*fride*X*h2o*) whereas it is in case of GHG emissions reductions (*fride*X*ghg*). This shows that free-riding is reduced for local public goods (as water quality) by comparison to global public goods (as GHG emissions).

Model (3) fits better the data than the other two models. A log-likelihood test shows that this difference is significant, model (3) is clearly the best model. The log-likelihood test shows also that parsimony would require to prefer model (1) to model (2): this result is not surprising as variable "offset" is not significant.

4 Discussion and conclusion

The first objective of our paper was to elicit consumers' preferences for two kinds of voluntary environmental policies: one belonging to the "making" class (reduction of GHG emissions within the production process), and one belonging to the "buying" class (the producer pays someone else: carbon offsetting). By controlling for GHG emission reduction and joint local pollution effects, it is shown that consumers on average are willing to pay for the "making" policy and not for the "buying" policy. A firm should then be able to raise more of consumers'money in case of a "making" environmental policy than in case of a "buying" environmental policy.

However, it is also shown that consumers who agree with offsetting for efficiency motives are more willing to pay for offsets, whereas consumers who belong to an environmental association are less willing to pay for offsets. This result highlights the heterogeneity among consumers in terms of preferences over the environmental policy chosen (own effort versus offsetting). It means that the coexistence of the two different policies might be the most efficient choice for a company to raise consumers' funding: the company offers products with own green technology as well products with offsets. To go further in the question of complementarity, a latent class model might allow to characterize some classes that are more willing to pay for one policy, or the other, to determine how important they are into the population and how much they are

willing to pay, as done by Langen [2011] in the case of ethical efforts.
Our sample includes two French regions (Bretagne and Picardie-Champagne-Ardennes). These two regions are very different in terms of water pollution and agricultural production. Agricultural production is more intensive in Bretagne than in Picardie-Champagne-Ardennes; and water is more polluted in Bretagne than in Picardie-Champagne-Ardennes. Moreover, water pollution of Bretagne is mainly due to its intensive agricultural production. Another extension of our work is to compare the results between these two regions, as we may expect than people living in Bretagne are much more concerned by pollution created by farms. As a consequence, we expect that people living in Bretagne may be more opposed to the use of offsets in agricultural production than people living in Picardie-Champagne-Ardennes, as they are victims of agricultural pollution.
Another interesting result of our choice experiment is the willingness-to-pay for "local" attribute: consumers are willing to pay a rather high amount for production located in the same place they live. Moreover this willingness-to-pay is significantly higher than the willingness-to-pay for a reduction of water pollution or GhG pollution. This result is consistent with recent works [Costanigro, McFadden, Kroll, and Nurse, 2011; Onozaka and McFadden, 2011], in which the attribute "locally grown" is the highest valued among different sustainability attributes. Since our design controls for joined local environmental effects, our result might be explained by local employment, landscape or agricultural production concerns, or a pure local preference. It would be interesting to analyze what drives this willingness-to-pay for a local agricultural production, by controlling for other joined local effects into the choice experiment design.

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