ENVIRONMENTAL IMPLICATIONS OF ORGANIC FOOD PREFERENCES: AN APPLICATION OF THE IMPURE PUBLIC GOODS MODEL

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Abstract

This paper presents a separate measure of willingness to pay for public and private attributes of organic food (environment and health, respectively). The impure public model is applied to examine the implications of organic food preferences on environmental market provision. Results from a survey reveal that consumers are willing to pay for both health gains and environmental improvements, although more for the health component. Willingness to pay for environment is enhanced by consumer prior information and it does not vary according to consumer shopping comfort. However, concern for nature conservation, comprehensively, implies a desire of safeguard one's health. A lexicographic ordering in preferences has been detected. These results suggest that preferences for environment could also provide feasible foundation for the development of the organic market, and have implications for the analysis of organic markets efficiency.

Keywords: impure public goods, green labelling, organic food, willingness to pay, contingent valuation, health, organic milk.

1. Introduction

Recent changes in European Union agricultural policy and the trend of negotiations in the World Trade Organization agricultural chapter have fuelled growing public concern over the environmental externalities of agricultural production, in terms of which should to be encouraged and which should be corrected. At the same time, there is every sign that the gradual phasing out of agricultural production support schemes is set to continue. Against this background, there is growing interest in the potential role of organic-labelling in correcting environmental externalities in agriculture.

Organic agriculture, like any other "green" labelling programme, is a mechanism for the private provision of public goods. Green labels indicate to consumers that goods production or use is environmental friendly. This information disclosure leads to the creation of a market for a public good (environment) or, more exactly, a market for impure public goods[1]: goods that joint produce public and private characteristics [11,12,13]. The environmental impact of these programmes depends, among other things [1,15,31], on consumers' willingness to pay for the public and private attributes of the "green" product. A particular aspect of organic agriculture that is worth noting is the assumed relationship between the reduction in pollution associated with organic production methods, which is a public (non-excludable) attribute, and intrinsic product quality (health), which is a private attribute. The private attributes of green products tend to be identical to those of their conventional substitutes.

Despite that both, health and environmental quality, are two incentives for paying organic foods, there is uncertainty, however, as to whether the demand for organic food products is sufficient to cover the aims pursued by organic production schemes; mainly because it is believed that few consumers are willing to pay for the environmental component

of the product. A document published recently by the European Commission [9], for example, claims that organic agriculture can be financed through two channels: a) through the market, where consumers are usually willing to pay more for this type of product; and b) through public subsidies, as a means of internalising the social benefits of organic production.

Others authors are optimistic about the capacity of the demand for organic products to redress the failure of the market to provide public goods. Thus, Morán [34] for example states that, if consumers can be encouraged to buy organic products both for their public and private attributes, then, in the long term, the premium they pay may be a more efficient financing mechanism than intervention through public subsidies.

The premium consumers are willing to pay for the organic food product, as a whole, has been estimated by Huang [22] and Loureiro *et. al*. [28]. At the same time, Durham, and Andrade [16] and Verhoef [42] have analysed the consumer motivations for purchasing organics, among them environment and health concerns. However, there is scant research on willingness to pay for both attributes of organic food [2], and, to our knowledge, there is no previous study in which willingness to pay is analysed separately for each of these attributes by contingent valuation. And, when assessing the environmental impact of certification, it is important to check a) the valuation of the public attribute (environment) and the motivation underlying the purchase and willingness to pay for organics; and b) its ordinal comparison with the private attribute (health).

In fact, concern over the efficiency of private mechanisms to finance the provision of public goods goes beyond organic certification. One of the contributions of the impure public goods models [11,12, 43, 44] has been to determine how the joint production of private and public characteristics in a good affects voluntary contributions to the provision of public goods. In the same vein, Kotchen [25] has extended the application of the impure public

[1] The term "impure private goods" would be more appropriate, since a public characteristic is added to a private

goods model to analyse demand in green labelling programmes. He provides theoretical evidence to show that, the demand for green goods is dependent on consumer preferences over the private and public characteristics of the goods and the availability of substitutes in the market for goods or donations. Preferences over private and public attributes of a good can hardly be analysed if the willingness to pay for these attributes are not measured separately.

In consequence, the main goal of this paper is to measure the willingness to pay for the health and environmental benefits [2] provided by organic agriculture; concretely by organic milk. Health and environmental benefits will be quantified separately, unlike the traditional approach, which is aimed at determining the overall price premium. We also analyse consumer preferences for each of these attributes. Thus, our findings are an empirical contribution to the on-going debate about the motivations underlying the demand for organic food products, and how these could affect environmental provision.

Willingness to pay for health and environmental quality improvements are measured separately by contingent valuation analysis, in which the consumer is presented with three different systems of milk production: conventional, healthier and organic. We then estimate willingness to pay for each type of product. The exercise is designed such that, the only detectable difference between the conventional milk and the healthier milk is the health attribute; and the only distinction between the healthier milk and the organic milk is the environmental attribute. Respondents are deemed to be sufficiently informed of the characteristics of the productions systems.

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good.

[2] For the purposes of this study, the aim will be to find a measure of willingness to pay that is not biased by the generic ethical issues (altruism, warm glow) and strategic behaviour (free riding, cooperation) that affect the private provision of public goods. This calls for a non-biased measure of the environmental benefit. It is not hard to see, however, that measurement of environmental benefits via willingness to pay may be biased because of difficulties intrinsic to the method, however much effort goes into designing the contingent valuation exercise. The results presented are intended as approximate monetary values.

2. Willingness to pay for green goods

The literature on impure public goods has identified the necessary conditions, with respect to preferences and goods, to cope with the crowding out effect in the private provision of public goods. Cornes and Sandler [11,13], for instance, have shown that, in the absence of substitutes, normality and q-complementarity between the public and private characteristics of an impure public good may cause individual demand for the impure public good to respond positively (or less negatively) to an increase in the provision of the public good by others. At the same time, Kotchen [25] has proven that if the private characteristic of an impure public good is available in a perfect conventional-good substitute, the public good needs to be normal for there to be crowding-in of private provision of the public good. Summing up, normality and complementarity of public and private characteristics improve the efficiency of impure public goods markets. The basic conclusions of this literature are essential in order to analyse the environmental impact of the demand for green goods, and determine the relevant conditions of organic food demand to improve the efficiency of certification.

Most of the research on consumer response to green labelling and other social certifications focuses on measuring the quantity or the price differential between certified products and their conventional substitutes [3, 4, 26, 27, 33, 36, 40, 45]. Scant research has been conducted to elicit consumer preferences for the public and private attributes of a green good; among other reasons, because the private attributes of many green products are identical to those of their conventional substitutes.

As far as organically produced food products are concerned, the existing research has concentrated on measuring WTP (willingness to pay) for the “organic” attribute as a whole. Consumers’ motivations have also been explored, and the typical finding is that health tends

to be the main motive [16, 19, 23, 24, 42]. There are also some paradoxical findings, such as that of Millock *et al.* [32] who find that the stated priority of most respondents is for the public attributes of organic agriculture (environment and animal welfare), while the purchasers of organic products are more concerned with the private characteristics.

Despite widespread evidence of the health attribute being the top consumer priority, the public component also shows a significant price premium in these products. To the best of our knowledge however, there is only one study that simultaneously measures the health-related and environment-related motives underlying WTP for organic food products. Ara [2] performs a choice experiment on six attributes of organic rice in the Philippines: price, reduced health risk, environmental quality, eating quality, type of organic labelling, and fair-trading for the organic farmer. The results show that consumers in the Philippines are willing to pay a 1.4 % premium on the price of rice for a 1 % reduction in the health risk. Willingness to pay for different degrees of environmental improvement ranges between 25 and 34 % of the price in Manila, and between 139 and 185 % in Naga.

The trade-off between health, environment, and genetic modification in pre-packaged bread, is measured by Hu *et al.* [21] using a conjoint analysis model, with marginal values ranging, across various groups of consumers, between 0.27 and 1.39 Canadian dollars for health, and between 0.17 and 1.39 Canadian dollars for environment.

Our empirical results mirror the findings of the above-mentioned studies, and the health component of organic agriculture is also found to be higher than the environmental component in consumers' preference rankings. However, WTP for health depends to a large extent on whether or not consumers have come to perceive the regular product as a *convenience good*; that is, an intrinsically similar product that is purchased for the sake of convenience. This is a fundamental aspect of food purchasing habits that reveals the true potential impact of private attributes on the demand for organic products.

3. A measure of willingness to pay for private and public attributes

This section presents a measure of the WTP for the public (environmental) and private (health) attributes of organic certification, and this measure relies on the virtual prices of the attributes. The virtual prices of health and environment are first defined using an extension of the impure public goods models proposed by Cornes and Sandler [11, 13] and Kotchen [25], to analyse organic certification. Finally, using the properties of virtual prices, WTP is directly related to individual preferences, and could indirectly be related to the capacity of organic certification to correct externalities in agriculture.

In our model, the only way of increasing the provision of the public good, environment, is by buying the organic product [3] and the unique private attributes of organic food are calories and food safety. The utility function is specified as an extension of the Cornes and Sandler [11, 13] and Kotchen [25] models. This extension includes the health quality improvement of organic food. The proprieties of the WTP are examined with a comparative static framework based on Cornes and Sandler [13].

3.1. Virtual prices of organic food attributes

Consider an economy with three consumer goods: a numeraire (Z), a conventional product (C), and an organic product (OR). The conventional product and the organic product have jointly produced characteristics with constant returns to scale [5, 14, 37].

One unit of the conventional food product delivers jointly one unit of calories (K), and α units of health (H). One unit of the organic product, delivers jointly one unit of calories, β units of health ($\beta > \alpha$), and μ units of the public good, environment.

The consumer's utility is specified by a monotonic, concave and derivable function U^i on the numeraire and the three characteristics,

$$U^i = U^i (Z^i, K^i, H^i, \mathrm{E}) \qquad (1)$$

such that:

$$K^i = C^i + OR^i;\ H^i = \alpha C^i + \beta OR^i \text{ y } E = E^{-i} + \mu\ OR^i \qquad (2)$$

where E^{-i} is the environment provided by individuals other than *i*, which is a fixed quantity, because the consumer acts as a quantity taker.

Consumer *i* is subject to the budget constraint:

$$m^i = Z + P_c C^i + P_{OR} OR^i \qquad (3)$$

where m^i is consumer's income, Pc the price of the regular food product, and P_{OR} the price of the organic food product. We assume the price of the organic product to be higher than the price of the regular product, although the price per unit of the health attribute is lower in the organic product $(P_c/\alpha > P_{OR}/\beta)$.

In order to treat the problem in the space of characteristics, Cornes and Sandler [11,12,13] propose different procedures to derive the virtual prices of characteristics. The virtual price of characteristic j, Πj^i gives the marginal valuation of characteristics *j* by individual *i*. They can be compensated inverse demand functions [11,12] or Marshallian

[3] The model can be easily extended to include donations.

inverse demands [10, 13, 6]. These prices are endogenous in our model and can be expressed as a function of quantities or as a function of the exogenous parameters of the model:

$$\Pi_H^i (Pc, \alpha, \beta, \mu, E^{-i}, V^i (P_{c,} \alpha, E^{-i}, m^i) = \Pi_H^i (Pc, \alpha, \beta, \mu, E^{-i}, m^i) \qquad (4)$$

where V^i is the indirect utility function.

In any case, the budget constraint may also be rewritten as a function of virtual income η^i, and virtual prices of characteristics. In equilibrium the following condition holds:

$$\eta^i = m^i + \Pi_E^i E^{-i} = Z^i + \Pi_K^i K^i + \Pi_H^i H^i + \Pi_E^i E \qquad (5)$$

such that:

$$Pc = \Pi_K^i + \alpha \Pi_H^i \text{ and } P_{OR} = \Pi_K^i + \beta \Pi_H^i + \mu \Pi_E^i \qquad (6)$$

This relationship between virtual income and monetary income could also be stated in terms of the identity of the expenditure function:

$$e^i (P_H, P_{C,} \beta, \alpha, \mu, E^{-i}, U^i) = e^i (\Pi_K^i, \Pi_H^i, \Pi_E^i, U^i) - \Pi_E^i E^{-i} \qquad (7)$$

By the envelope theorem, deriving this identity with respect to β, α and E^i, and using condition (6), the compensated virtual prices are obtained in terms of e^i :

$\Pi_H^i = -(\partial e^i / \partial \alpha)/(\partial e^i / \partial p_C) = -(\partial e^i / \partial \beta)/(\partial e^i / \partial p_H)$ *(8) (when both varieties are consumed)*

and $\Pi_E^i = -(\partial e^i / \partial E^{-i})$

This definition of virtual prices is used later to define and analyse the properties of WTP for health and environmental quality from organic agriculture.

3.2. WTP for health and environmental quality of organic food

WTP for organic agricultural products is usually estimated by $P_{OR} - P_C$, as the premium consumers are willing to pay for certification. Here, however, two separate measures of the premium that consumers are willing to pay are defined: one is the premium for the health quality differential in organic foods, and the other the premium for environmental improvement.

To decompose $P_{OR} - P_C$, we present the consumer with a scenario in which there are three varieties of the same good in ascending grades of quality [39]: the regular food product, the intermediate product, called the "healthier" variety, and the organic food product The quality of the product is defined by the number of characteristics and their level. One unit of the regular product delivers 1 calorie and α units of health. The healthier product delivers the same number of calories and, being free of toxic residues, yields β units of health. The organic product, being both toxin-free and also environmentally-friendly, delivers μ units of environmental improvement, in addition to one calorie, and β units of health.

The empirical survey elicits respondents' maximum price she is willing to pay for the healthier and organic varieties. The price elicited for the healthier variety, P_H^i is defined by the following equilibrium condition:

$$m^i = e^i (P_C, \alpha, E^{-i}, V^i (P_{c,} \alpha, E^{-i}, m^i)) = e^i (P_H^i, P_{C,} \beta, \alpha, E^{-i}, V^i (P_{c,} \alpha, E^{-i}, m^i)) \quad (9)$$

This conditions means that the welfare increase provided by the "healthier" variety equals the welfare decrease produced by the price increase, $P_H^i - P_C$. This price premium is a first order approximation to the compensating variation of the food safety quality improvement of organic agriculture [7]. [4] This price premium can be also defined by a linear expansion of the equilibrium condition (9) around the respondent status quo, where the following condition holds:

$$(\partial e^i / \partial Pc)(P_H^i - P_C) = (\partial e^i / \partial \alpha)(\beta - \alpha) \quad (10)$$

According to (8) and (10), we can define WTP for health as the price differential between the healthier and the conventional varieties, which is also proportional to the virtual price.

$$\text{WTP for Health} = (P_H^i - P_C) = (\beta - \alpha)\ [(\partial e^i / \partial \alpha) / (\partial e^i / \partial Pc)] = (\beta - \alpha)\ \Pi_H^i \quad (11)$$

[4] We can express the WTP for the healthier variety in the standard form used in the literature [29, 46]:
WTP $= e^i (Pc + \Delta P, P_{C,} \beta, \alpha, E^{-i}, V^i (P_{c,} \alpha, E^{-i}, m^i)) - e^i (Pc, P_{C,} \beta, \alpha, E^{-i}, V^i (P_{c,} \alpha, E^{-i}, m^i))$
Expanding WTP by Taylor series about the point Pc and α yields:
WTP $= \Delta P (\partial e^i / \partial p) + R^i$
where R^i represents additional terms from second order onwards.
Therefore, $\Delta P = (P_H - P_C)$ is a first order approximation to the WTP^i for the health component in a single unit of the organic product.
[4] We omit the exact specification of WTP for non-consumers of regular milk and for consumers of organic milk, because in the empirical research, only 2.7 % of the sample were non-consumers of regular milk, and 0.5 % of the sample were consumers of organic milk. We have rejected these cases.

In addition, the maximum price of the organic variety P_{OR}^{i} satisfies the following condition:

$$Por^{i} - P_{C} = (\beta - \alpha)\, \Pi_{H}^{i}(Pc, \alpha, E^{-i}, Vi(Pc, \alpha, E^{-i}, m^{i})) + \mu\, \Pi_{E}^{i}(Pc, \alpha, E^{-i}, Vi(Pc, \alpha, E^{-i}, m^{i})) \quad (12)$$

and the WTP for environmental quality improvement in the organic food product, is given by the difference between Por^{i} and P_{H}^{i}. This difference satisfies the following condition:

$$\text{WTP for Environment} = (Por^{i} - P_{H}^{i}) = \mu\, \Pi_{E}^{i}(Pc, \alpha, E^{-i}, Vi(Pc, \alpha, E^{-i}, m^{i}) \quad (13)$$

The properties satisfied by the WTP depend on the behaviour of virtual prices. [5] The virtual price measures the individual marginal valuation of the health component, or the environment component, at the consumer status quo. At present, the consumer buys only the regular product and the numeraire, and enjoys a fixed quantity of environment E^{i}, free of charge. In this setting, the virtual price of health is the virtual price of one of the characteristics of the conventional food, and the virtual price of environment is the virtual price of the exogenous ration of environment. Income has a positive marginal effect on the virtual price of environment, if environment is a normal good. [6] The price of regular food may also have a positive marginal effect on the virtual price of environment if the two are Hicks substitutes.

Resolving the properties satisfied by the WTP for health is not straightforward. Use of a procedure similar to that of Cornes and Sandler [13] leads to the following three conclusions.

[5] The analytical developments of this subsection are provided to readers under request.
[6] See, for instance; Deaton and Muellbauer [14], Cornes [10], or Neary and Roberts [35].

[7] The first is that WTP for health decreases as regular food improves in terms of food safety, provided that health and calories are Hicks substitutes. If, on the other hand, they are Hicks complements, the effect of the health quality of the regular food on the WTP for Health by consuming organic food is ambiguous.

The second conclusion is that an income increase would have a positive effect on WTP for health if (i) health is a normal attribute, and (ii) the marginal demand-income response for health is higher than for calories.

The third conclusion is that the price of conventional food has a negative marginal effect on the virtual price of the health component, if (i) health is a normal good superior to calories, (ii) calories and health are strong Hicksian complements [13] and (iii) the compensated own price response of health is higher than that of calories. [8]

After considering the marginal effects of quality, income and price on WTP, we now only need to specify a function for interpersonal comparisons of WTP. We have chosen a linear WTP function in which differences between individuals depend both on the price and the attributes of the respondent's current brand of regular food, and on her income and preferences.

The function used for interpersonal comparisons of WTP in the empirical investigation is given by the following equation:

$$WTP_j^i = \lambda_j + \Sigma\, \nu_k^i\, a_k^i + \delta_0^i\, P_0^i + \Sigma\, \phi_0^i\, b_0^i + e_j^i \qquad (14)$$

[7] When the respondent does not consume organic products, the following two conditions are fulfilled:

1) $P_C = \Pi_K(\alpha, Pc, E^{-i}, V^i) + \alpha\, \Pi_H(\alpha, Pc, E^{-i}, V^i)$
2) $\alpha K^i(\Pi_K, \Pi_H, E^{-i}, V^i) = H^i(\Pi_K, \Pi_H, E^{-i}, V^i)$.

The properties of the virtual prices are deduced by deriving the two equations for each variable, and solving the system.

[8] $\alpha\, \partial K / \partial \Pi_K^i < \partial K / \partial \Pi_H^i < 1/\alpha\, \partial H / \partial \Pi_H^i$

where λ_j is the independent term, a_k^i represents the respondent's socio-economic and behavioural profile, b_0^i represents the attributes of each respondent's current brand of regular product, P_0^i is the price of the current brand of regular product, e_j^i denotes the error or factors unknown to the interviewer that influence WTP for characteristic *j* by consumer *i*. This error follows a zero-mean normal distribution [18].

4. Methodology, survey design and data collection

Contingent valuation (CV) is used to quantify the health and the environment attributes for organic milk. The reason for selecting milk is that it is easy to distinguish in the production system between techniques geared towards health improvement (feeding and handling of the cows), and those aimed at environmental improvement (the treatment of effluents and crop-livestock integration). A further reason is the fact that it is a basic food product, consumed by practically the entire population. Finally, dairy farming is a traditional activity in the region selected for the survey, having one of the highest shares in the agricultural sector.

Contingent valuation and conjoint analysis methods were considered for their suitability in the design phase of the experiment. The pre-test surveys for each of the two options showed that, in this case-study, contingent valuation would provide the most credible and easily understood scenario for respondents. The questionnaire for the contingent valuation was designed with the main objective of finding a separate monetary valuation of the attributes "healthier" and "positive environmental impact", in the production system of the chosen variety.

In a pre-survey information package, respondents were shown abundant photographic material illustrating three varieties of milk, each of which represented a different production

system prototype: type C (regular milk), type H (healthier milk) and type OR (organic milk). The three types were carefully defined and tested in *focus groups* and pre-test questionnaires, presenting various photographic stimuli in rotated order, to ensure that the only perceivable difference between "healthier" and "regular" milk was the health component, and that the only perceivable difference between the "organic" and "healthier" milk was the environmental component. In this way, each consumer's monetary valuation of the health and environmental components was given by the difference between the price paid for regular milk, the maximum price paid for the healthier milk, and the maximum price paid for the organic milk.

The photographic package depicts the three types of production system:

Type C "regular" milk is produced in an intensive dairy system, quite common in the survey area. Cows are crowded into stalls and fed on forage and concentrated fodder that may be outsourced; veterinary intervention is common practice, with frequent use of pharmaceuticals. As a consequence, milk may contain traces of potentially harmful medical substances, pesticides and heavy metals. This intensive production system generates a high level of effluent emissions to subsurface and surface waters, and uses more energy in the production and transportation of cow-feed.

Type H "healthier" milk is produced in a way similar to that of type C milk, but adapted to reduce traces of toxic substances, by using natural and homeopathic veterinary practices, and feeding the cows healthily on pastures, forage and organic feed preparations.

Type OR "organic" milk is produced by means of an organic production system, which, in addition to the natural veterinary practices and natural feed preparations used in prototype H, involves environment-friendly and environment-enhancing practices. Specifically, less effluent is produced, because there are fewer cows per unit area, and manure is used as an

organic fertiliser, as part of a crop-livestock integrated system. Energy costs are reduced to a minimum, since the farm relies on on-farm produced feeds.

The contingent valuation survey includes four sections: 1. current milk consumption and prior awareness of organic produce; 2. questions for the contingent valuation of healthier and organic milk; 3. habits and opinions with respect to health, environment and solidarity; and 4. respondents' socio-economic characteristics.

The second section of the survey is the main part of the contingent valuation analysis, on which the market simulation is based. In the survey, the respondent is asked about her willingness to pay for each type of milk. The chosen question format is open-ended, because the good is familiar to the consumer. [9] The price of the consumer's stated current brand of milk is taken as the point of reference (type C) (if not known, the local average price range of regular milk). The respondent is then asked to indicate the maximum price she is willing to pay for a litre of type H, and then type OR milk (of her usual brand).

The difference between the prices of types C and H is the WTP for Health and the difference between the price of C and OR is the total WTP. The difference between the price of H and OR is the WTP for environment. These WTP are given as percentages of the price of variety C in the univariate analysis and in euros in the multivariate analysis.

In order to analyse the properties of the WTP, respondents were questioned about their consumption behaviour, personal and household characteristics and the price of their current brand of milk. This information was used in the multivariate analysis, in which WTP was regressed on the following set of explanatory variables

Respondents were asked to state their reasons for purchasing their current brand of milk. Binary variables were used to measure their perception of taste and food safety, which define current brand quality.

Time spent shopping is an important component of household food costs. It is allocated in relation to expected rewards, perceived differences in quality and price among brands, and opportunity cost. However, it is practically impossible to isolate the time a consumer spends buying a single item. To overcome this difficulty, respondents are asked if convenience is their main reason for buying their current brand of milk.

We have asked also respondents if they know organic agriculture. The remaining explanatory variables used in the multivariate model are self-explanatory, and are widely used in the literature. We have queried respondents about their socio-economic social status and about their healthy eating, social and environmental habits and motivations.

Four hundred personal interviews with cows' milk consumers were conducted in Pamplona (Spain) and the surrounding area, between September 2002 and January 2003. Out of the total number of completed interviews, 389 were considered valid and, the remaining 11 were discarded because the respondents were non-consumers. The sample is stratified by sex, age and habitat, which are the variables of interest.

5. Results

5.1. WTP for health and environment

Before computing the results, the protest responses were first separated from the true zero values. This revealed that 82% of the sample would be willing to buy type H milk, at the same or a higher price, versus 18% who would not (16% true zeros and 2% protest responses). Up to 86% of the sample would buy type OR milk, at the same or a higher price, versus 14 % who would not (11 % true zeros and 3% protest responses). The low number of

[9] Not market goods may create misunderstanding when using this format.

protest responses indicates the efficiency of the survey design. In both cases, the main reason given by protesters relates to lack of confidence in the guarantee statements for the healthier and organic system prototypes, respectively.

The results indicate that 58.5 % of the milk consumers were willing to pay both for a health and environmental improvement, 20% are willing to pay only for a health improvement, and 8.5% only for an environmental improvement. The remaining 12 % are not willing to pay for either of the attributes. Of those interviewed, 78.5% were willing to pay for the "health improvement" component, with average WTP for this component being 0.24 €/l (WTP>0) and 0.21 €/l (WTP≥ 0). This last figure is a 31.4 % increase on the average price of cows' milk in the area, that is 0.65 €/litre. 67% of the respondents were willing to pay for the environmental component, the average proxy WTP for this component being 0.21 €/l (WTP>0) and 0.14 €/l (WTP≥ 0). This last figure is an increase of 22 % on the average price of milk.

The qualitative finding that more weight is attached to the health than to the environmental attribute is fairly consistent with the reviewed literature. The results are satisfactory in quantitative terms, considering the current market price of organic and enriched milk. Although they deviate from the findings made by Ara [2] for organic rice in the Philippines, they come close to the health and environment factors found by Hu *et al.* [21].

These results suggest that consumers are willing to pay both for the health component and the environmental component. However, as the literature indicates, the efficiency of the market of any impure good in the provision of public goods also depends on the normality of the public and private characteristics of the good in question, and on their Hicks complementarity or substitutability. Therefore, in the next section, an attempt is made to relate willingness to pay with personal income and other respondent characteristics, including

ecological habits and perception of the attributes of the brand/variety of milk currently consumed.

5.2. Individual factors influencing WTP

Three left censored Tobit models are examined as specified in (14), in which the dependent variables are: willingness to pay for health protection, willingness to pay for environmental improvement, and the premium respondents are willing to pay for organic milk. WTP for health protection and WTP for environmental quality are estimated by full information maximum likelihood in a bivariate Tobit Model that specifies the correlation between the errors of the two WTP variables. This model is the best suited to stating WTP as price differentials in (11) and (13). The sample size is 379, after eliminating protest and incomplete responses.

The models are significant at the 99% confidence level. Table 1 shows the Tobit coefficients of the explanatory variables, the standard error variance, and bivariate Tobit error correlation.

Table 1. Individual effects

Estimated Tobit parameters

	WTP for Health		***WTP for Environment***		***WTP for Organic***	
Variables	*Parameters*	*Standard Errors*	*Parameters*	*Standard Errors*	*Parameters*	*Standard Errors*
Intercept	47.974**	22.503	-10.946	25.120	63.638**	30.193
Current brand milk safety perception [a]	-.220	2.615	.970	2.661	.578	3.157
Current brand taste	.596	5.717	1.796	6.272	-1.863	7.604
Current brand price	-.212	.164	.277*	.164	-.018	.194
Convenience [b]	-10.793**	5.021	-6.333	5.757	-15.064**	6.560
Knowledge of organic certification	3.100	5.312	10.232**	5.776	8.209	7.270
Food safety behaviour [c]	10.844**	5.656	4.978	5.482	13.129*	6.810
Environmental Behaviour [d]	6.405***	2.411	5.289*	2.870	8.768***	3.271
NGO member	-2.191	5.666	3.057	6.250	2.644	7.738
Age <30	21.132***	6.582	14.038**	6.677	28.202***	8.031
50<Age<70	-8.537	6.293	-18.414***	15.201	-20.016**	8.090
Age>70	13.970	12.098	-18.414	15.201	-.804	16.310
Gender	-1.861	4.967	-.672	5.111	-3.367	3.131
Studies: Elementary	-30.986***	11.103	-14.368	12.322	-35.708***	13.750
Studies: University degree	7.384	5.738	-1.463	6.275	6.051	7.171
House- hold income	.0004***	.0001	.0006***	.0001	.0008***	0.0002
House hold size	-1.510	1.631	-4.774**	2.012	-4.460**	2.229
σ	39.976***	1.520	41.573***	1.688		
ρ		.2870***	(.5213)		57.309***	2.249
χ^{2} [e]		27.75***			60.46***	
N		379			379	

*,** and *** denotes significance at the 10%, 5% y 1 %, respectively, for the standard normal two tailed test.

[a] First component of a Categorical Principal Components Analysis. Is a combination of three binary variables that capture respondents' perception of three attributes of the milk they consume: level of intensification of the production system (0.767), nutritional value (0.830), and absence of toxic residues (0.794) The Cronbach's alpha is 0.714, the eigenvalue is 1.909, and the variance explained is 63.7 %.

[b] Convenience is the main reason for buying the current brand of milk.

[C] Claims to avoid food products that may contain toxic residues.

[d] First component of a Categorical Principal Components Analysis. Is a combination of four binary variables that capture whether the interviewee behaves in an environmentally friendly way: use of recycled products (0.666); sorting of waste (0.376); cutting down on car use for environmental reasons (0,692) and; member of an ecologist organization (0.572). The Cronbach's alpha is 0.412, the eigenvalue is 1.390, and the variance explained is 40.1 %.

[e] Likelihood ratio test for joint significance of the covariates. In the bivariate Tobit estimation the restricted models are the corresponding univariate models.

The correlation between the errors of the two WTP equations, is significant and positive, indicating that there are non-observable factors that yield higher WTP for environmental quality and health protection.

Despite the widely-experienced difficulties of finding multivariate relationships to explain the factors affecting willingness to pay for (and, thereby, the valuation of) a good, the results of this analysis are interesting in that they reveal a number of significant variables. The profile of individuals willing to pay more for environmental quality and health protection can be described using the results of table 1. Respondents showing more willingness to pay for the health attribute are better educated, more affluent, younger consumers, who are actively concerned about the environment, have healthy eating habits and do not buy their current brand of milk for pure convenience. Those who show more willingness to pay for the environment attribute, meanwhile, are more affluent, younger, environmentally active, and have prior knowledge of organic products. It is also worth underlining the fact that, among other relevant factors, consumers' levels of information and motivation prove fundamental. The better informed and more motivated are more likely to choose products for their qualities and not just for convenience.

The variables Convenience and Aware are good indicators of individual preferences for health and environment. Individuals who claim convenience as their main motivation for buying their current brand of milk are not willing to pay for health. This seems consistent with the economic implications of household food production. Time spent shopping has in general an important opportunity cost in affluent societies such as Spain, where food expenditure is less than 20% of average income. Thus, people who claim to buy food brands for convenience could have a lower preference for food safety and quality in general.

Individuals with previous information on organic certification declare higher WTP for environmental quality, suggesting that information may change preferences. This is

especially true in aspects largely unknown to the general public, such as environmental impacts. [10]

Besides this description of individuals with higher WTP, the results shown in Table 1 highlight some features of the preferences that could affect the efficiency of organic certification as a market mechanism to correct environmental externalities in agriculture. As the impure public goods literature shows, these issues [11] include whether the private and public attributes of the organic milk are Hicks complements or substitutes, and the normality of attributes.

Firstly, Table 1 shows that the price of respondents' current brand has a positive and significant impact on their WTP for environmental quality, and a negative and no significant effect on their WTP for reduced health risk. At the same time, current brand food safety quality dos not have a statistically significant effect on WTP for health. According to the properties of virtual prices, the ambiguous response of the WTP for reduced health risk to higher food safety the conventional variety seems to suggest that there is a Hicksian complementarity relationship between the two private attributes of milk: calorie content and food safety. Conversely, the negative response of the WTP for environmental quality indicates that conventional milk and environmental improvement are Hicks substitutes. The finding that health and calories are Hicks complements seems logical, because consumers would prefer joint consumption of both attributes. The finding that the conventional product

[10] Additionally, individuals with strong preferences for nature conservation tend to seek more information. An endogeneity test [41] confirms the null hypothesis in the WTP for environment equation [8]. We do not include the consistent estimator because results hardly change. Nor does the variable "aware" apparently introduce much heteroskedasticity into the model. The Harvey and Breush-Pagan tests [17, 30] of the bivariate model reject this hypothesis. The result of the Hausman test of the univariate model of WTP for health is in the ambiguous range. The results are available from the authors upon request.

[11] Another important issue is whether health and environment attributes have substitutes in the goods and donations market. The results are ambiguous in this respect, because the analysis reveals overlapping of the crossed effects of the individual's preferences and substitution between goods. The different procedures used to separate these effects have proved fruitless. An endogeneity test [38] on the variable environmental behaviour rejects the null hypothesis of endogeneity. The inclusion in the models of a new explanatory variable that reflects consumer attitudes towards nature conservation introduces multicollinearity.

is a substitute for environmental improvement may be explained by the fact that individuals perceive a substitution between the consumption of private goods and environmental quality.

Secondly, the data suggest that active participation in environmental conservation is linked with a higher valuation of the health component of the organic product, but this does not appear to be a reciprocal relationship. Healthy eaters are not necessarily bigger donors to environmental improvement. If habits reveal preferences, it can be deduced that concern for nature conservation also seems to imply a tendency to pay for private health. A preference for food safety does not imply higher WTP for environmental improvement, however. This finding differs from the result of Hamilton et al. [20], which is the only available study with which to compare our results. Other studies in the literature analyse the motivations that induce individuals to pay for the organic product, as a whole, but without disentangling the public and private components of organic agriculture.

Hamilton et al. [20] find that US individuals with environmental concerns are willing to vote for regulations that improve health and environment jointly, but not necessarily willing to pay a premium for healthy products. Their model, like that presented here, is inclusive and leads them to the conclusion that there are individuals that support pesticide residue bans only because of their environmental implications. Our results indicate that environmentally concerned individuals are also health conscious, a finding that is supported by both fieldwork and econometric analysis. This question requires further research beyond the scope of this study. However, it suggests that among the respondents there is an order of preferences: first individual health, up to a threshold, and then the environment. As far as the environmental impact of organic certification on agriculture is concerned, the technical link between health risk reduction and environmental improvement through the consumption of organic products may be essential to capture the contribution of individuals concerned exclusively with dietary issues.

Finally, there is the effect of respondents' socio-economic characteristics on WTP for environmental improvement and health risk reduction, because they may provide information regarding the normality of health and environment. These two attributes appear to be normal goods, since both WTP variables increase with household income. According with the virtual prices properties the positive response of WTP for health to income suggest also that food safety is a superior good than calories.

We have used household income rather than personal income, because there are important scale economies in domestic consumption. However, re-estimation of the model using equivalent personal income (European Union Scale), confirms the result that WTP for both attributes increases with personal income, and the income coefficient is higher in the case of WTP for environmental improvement.

To sum up, the results suggest some important facts in relation to the potential impact of the demand for organic food products, when it comes to correcting the externalities of agricultural production. Part of the literature analysing the impact of the efficiency of impure public good markets, is based on the normality of impure public goods and on the substitution and complementarity relationship between private and public attributes. Our results highlight some issues that are not treated in the literature. First, in the case of a necessary and non-durable good, such as food, consumers' purchasing time reveals as much as WTP about preferences for private attributes, such as health risk reduction. As for the relationship between the private and public attributes of the organic food, there is no complementarity or substitution but rather a preference ordering that ranks the private attribute (health) first and the public one (environment) second.

6. Conclusion

This analysis does not support the theory that consumers are willing to pay for the private attributes of organic food (such as health in the form of food-safety), but not for its social or public attributes (such as environmental improvements). The results show that, after being informed through a graphical package shown to them prior to the contingent valuation, consumers are found to be willing to pay both for health gains and environmental improvements, although their quantitative valuation is higher for the health aspect.

The results may be of use in the debate over the potential of organic certification to correct environmental externalities in agricultural production. This analysis, with its fresh aims and scant empirical references, reveals that consumers, when motivated, are willing to pay a premium for both health and environment. The next question, therefore, might be whether the proportion of motivated consumers is high enough to cover the environmental targets included among the social objectives, taking into account that the degree of motivation could be increased by means of additional information.

Thus, despite the fact that willingness to pay is higher for the private attributes of organic products than for their public attributes, environmental preferences provide also a feasible foundation for the development of the organic market. Individuals with stronger environmental preferences attach a global value to the organic label, while the valuation is more restrictive in those who prioritise health concerns. Actually, a kind of lexicographic preference ordering has been found, where the consumer's own health up to a threshold comes first, followed by the environment. This effect prevails over the pure complementarity and substitutability of public and private attributes in organic agriculture.

Moreover, one of the main key factors that emerges from this study is consumers' level of motivation in their quality search. In other words, whether or not their main reason for choosing their usual brand is pure convenience. While willingness to pay for a health risk reduction increases significantly in the absence of this trait, approximately one third of the sample claim convenience as their main reason for purchase. This attitude co-exists in modern-day western society alongside that of those who display clear motivations in their choice of food brands.

Another important finding that emerges from the empirical analysis is that respondents' level of awareness (prior to receiving the information package), is a relevant and significant factor in increasing their willingness to pay for the environmental attribute.

In short, the main contribution to the debate on the impact of organic certification in correcting environmental externalities in agriculture is that it is impossible to assess the potential of the demand for organic food products from consumers' preference for the health component exclusively. Our results suggest that this component may be crucial among consumers who use it as the basis to differentiate a product. Otherwise, they may be indifferent. Despite a slightly weaker, though quantitatively far from negligible, response with respect to willingness to pay, the environmental component could also sustain the demand for organic products. In the first place, consumers identify it as a distinctive feature of green labelling (organic labelling, in the case in hand). In the second place, it has been shown that preferences for this attribute can be increased by means of consumer information. Lastly, concern for nature conservation, comprehensibly, also implies a desire to safeguard one's own health.

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