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Willingness to pay for pesticides' reduction in E.U: nothing but organic?

Pascale Bazoche[1], Frank Bunte[2], Pierre Combris[1], Eric Giraud-Héraud[1], Alexandra Seabra-Pinto[3], Efthimia Tsakiridou[4]

[1] INRA, UR 1303 - ALISS, 65 rue de Brandebourg, F-94200 Ivry-sur-Seine

[2] LEI Wageningen UR, Den Haag, Netherlands

[3] USAD, L-INIA, National Institute of Biological Research (INRB), Oeiras, Portugal

[4] Department of Agricultural Economics, School of Agriculture, Aristotle University of Thessaloniki, Greece

Mail: Eric.Giraud-Heraud@ivry.inra.fr.

Abstract: Using Experimental auctions carried out on apples in different European countries, we contribute to the assessment of consumer willingness to pay for the reduction of pesticides. We study several systems of good agricultural practices, possibly signaled to consumers, ranging from public and private Integrated Pest Management (IPM) strategies to organic production methods. The results suggest a relatively homogeneous behavior of European consumers and we show how improving the information on pesticides reduction could have unexpected consequences. Results also show that sensory characteristics or reference to an origin of production should not be overlooked.

Keywords: *Experimental Auctions, Willingness to pay, Pesticide-use reduction, Organic production, Integrated Pest Management.*

Résumé *:* En utilisant des enchères expérimentales effectuées dans différents pays européens, cet article contribue à l'évaluation du consentement à payer des consommateurs en faveur de la réduction des pesticides. Nous étudions plusieurs systèmes de bonnes pratiques agricoles qui peuvent être signalées aux consommateurs, allant des stratégies publiques et privées de production intégrée, aux modes de production biologique. Les résultats obtenus suggèrent un comportement relativement homogène des consommateurs européens, et nous montrons comment le renforcement de l'information sur la réduction des pesticides peut avoir des conséquences inattendues. Les résultats montrent également comment l'influence des caractéristiques sensorielles et la référence à une origine ne doivent pas être négligés.

Mots-clés : *Enchères expérimentales, Consentement à payer, Réduction des pesticides, Produits biologiques, Protection intégrée.*

JEL Codes: C91, D12, Q01, Q13

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1. Introduction

The use of pesticides (insecticides, fungicides, herbicides) has been one of the factors in the great leap forward of farming production during the last fifty years. Today, however, certain negative consequences of the dissemination of these inputs in the environment are starting to appear: water pollution, reproductive problems in birds, the emergence of resistance by pests, etc. Moreover, the impact on human health, the health of farmers and consumers, is raising serious questions, in particular because assessing the health impact of pesticides is beset with difficulties (the real influence in the long term of limited doses absorbed, multi-factor origins of some of the illnesses concerned, etc.). Hence, for over twenty years, the European public authorities have regularly reinforced the regulatory framework on the use of pesticides, using reclassification procedure, removal of substances from sale. The Council of the European Union finally adopted the "pesticide package" in 2009. This set of texts introduces the strictest criteria on the authorization for sale of pesticides for farming use and plans to ban twenty or so products estimated to be of concern. Furthermore, a directive obliges the Member States to adopt a national action plan to reduce the use of these products.

Pesticide-use reduction has thus become a major issue of the European Common Agricultural Policy. It is also a main concern of European consumers, which is revealed through the growing importance of environment and health motivation in market research studies, and the dramatic impact of food scares. As a consequence of this change in their motivations, more and more consumers should be ready to support environmental policies. But what is the actual extent of this support? Are consumers really willing to pay a premium for products with a guarantee of pesticide-use reduction?

Measuring the value consumers put on pesticide-use reduction is of interest to assess the variation of consumers' surplus in subsequent welfare analysis, and to evaluate the potential market for farmers who could take advantage of the growing demand for pesticide-free products. However, to be able to address these questions, it is important to know, firstly, whether the different certifications and corresponding signals are clearly identified by consumers and what are the corresponding willingness-to-pay (WTP). The main objective of this paper is to assess the importance of these premiums and their variations in different European countries. A related question is to know whether this premium varies according to the amount of pesticide reduction and depend on who guarantees the reduction (public authorities, producers or retailers).

There are indeed many different certification programs, which are signaled to consumers through explicit labeling or by means of a logo appearing on a sticker. Organic certification is probably the most well known. It has recently been harmonized at the European level (regulation, labeling and logo). However more stringent certifications by organization like Demeter for example, and many other pre-existing private organic labels, still get along together in almost all European countries. Added to that, the growing demand for organic products in the EU, as well as the USA, has favored the blossoming of a host of organic labels developed by large retailers who now propose hundreds of organic references.

The framework of "Good Agricultural Practices" (GAP) could be an alternative for consumers who care about pesticide reduction but are not ready to buy organic products for some reason. However these schemes do not explicitly state the level of pesticide reduction at the farm level. They are tailored according to specific conditions, in particular regional weather conditions and sector of agricultural activity. This is why producers have not yet been able to send a clear signal about GAP to consumers. In France, for example, the most important Integrated Pest Management (IPM) certification for fruits applies only to the trade between agricultural producers and retailers, while in some countries of the South of Europe, like Portugal and Greece, it is used to signal environmental quality to consumers[1]. First created by groups of producers to signal the quality of their environmental practices, IPM certification has been increasingly used by major food retailers to back up their own private labels (Carrefour's '*Quality Line*' or Tesco's '*Nurture*' for example). On a wider scale, food retailers have set up the 'GlobalGAP' common certification standards to harmonize and simplify contractual relations between producers and retailers (Bazoche *et al*., 2005 and Giraud-Héraud *et al*., 2012). In all cases GAP certifications are becoming a trade norm for agricultural products, but is not used by producers or retailers to communicate pesticide-use reduction to final consumers. Moreover, GAP certification is often recommended to benefit from Protected Denomination of Origin (PDO) status, in particular in the fruit and vegetable sector, while PDO does not necessarily imply a reduction of pesticide use (For example the PDO wine sector is a large user of pesticides).

All these examples suggest that there is still room to clarify the GAP signals and use them to guarantee the environmental quality of food products to consumers. However, clearer information on pesticide-use does not automatically mean a premium price on the market. Many cases have shown that differentiation of products with improved sanitary quality could end up with a stigmatization of standard products, without rewarding the efforts made by producers (Fox *et al*., 2002; Rozan *et al*., 2004; Kanter *et al*., 2009). That's why it is so important to study conjointly the impact of information on consumers' preferences and WTP.

To know whether there is a premium for pesticide reduction and whether it varies according to the kind of guarantee, we propose to elicit consumers' willingness to pay for apples to which are attached different kinds of certification concerning pesticide-use. This investigation has been conducted using the same economic experiment in different European countries (France, Greece, Netherlands and Portugal). Different systems of certification (IPM, Retailer's label, PDO, Organic) have been compared to no certification (the regular product). The focus has been placed on the impact of information on pesticide-use provided to consumers, and sensory characteristics have been controlled as previous work showed that taste has often more impact than food safety in consumer's final decision (Combris *et al*., 2010). Our work contributes to the literature by investigating the relationship between the level of pesticide-use reduction and the premium consumers would pay, and by comparing different kinds of signals and guarantees. Comparing these values across different European countries is also a new step toward exploring a more coherent and simplified way to inform consumers whatever country they live in.

In section 2 of the paper, a general survey of the literature about consumers' WTP for pesticide reduction in the food products is presented. Section 3 introduces the experimental design (experimental protocol and incentive procedure to elicit WTP) and gives specific details of the experiment in each country. Section 4 reports the results. Section 5 concludes and discusses the challenges concerning alternatives to signal pesticide-use reduction.

[1] 'Production Fruitière Intégrée' (PFI) in France, 'Protectão integrada' in Portugal and 'Σύστημα Ολοκληρωμένης Διαχείριση' in Greece.

2. Literature review[2]

Using surveys and contingent valuation methods, many empirical studies show that consumers declare they would pay a significant premium price for both organic and certified pesticide residue-free (CPRF) produce. In these studies, the information on certification for pesticide reduction was disclosed without specifying the presence of labels that consumers faced in actual markets. Papers from Ott (1990), Misra et al. (1991), Weaver et al. (1992), Huang (1993), Eom (1994), evaluate different alternative price premiums for American consumers. These authors show that, on average, consumers would pay 5% to 20% more than current prices, and that more than half of the consumers would pay a premium for CPRF. Jolly (1991) evaluates the market diffusion of organic foods among California consumers and shows that consumers' premiums varied with the commodity and with the reference price of the conventional product. This author points out that when the price difference between organic and conventional for apples increases by 74%, only 13% of consumers were willing to buy the organic product. Buzby and Skees (1994) analyse the results of one national survey conducted by the University of Kentucky where food shoppers' WTP for reduced risks from pesticides were evaluated. The authors found that more than half the respondents declared a preference for both organic and CPRF over conventional products. However, only 25% of respondents had actually purchased organic or CPRF produce on a regular basis. They verify that the respondents were willing to pay a few cents more for grapefruit free of pesticide than for grapefruit with a reduction of 50%. More recently, Gil, Garcia and Sánchez (2000) use a contingent valuation in two Spanish regions to assess the maximum premium of several organic food products (vegetables, fruits, meat). They show that these values range from 15% to 25% over the price of conventional. In the same time, Boccaletti and Nardella (2000) observed that 70% of Italian consumers would not pay a price premium higher than 10% of the regular price. In Greece, Tsakiridou et al. (2006) find that the average premium for organic products may reach 35%. In the context of their paper, these authors argue that the premium for organic products increased if confidence on organic prices increases.

Most of these studies find significant heterogeneity in price premiums for CPRF and organic products. Products' appearance and consumers' characteristics are pointed as the most influential factors to explain heterogeneity. Concerning the influence of products' appearance Ott (1990) shows that less than 40% of shoppers would accept any cosmetic defects. Inversely, Weaver et al. (1992) do not find a significant trade-off effect between residue-free and appearance when evaluating consumers' WTP. Almost half of the respondents indicated a willingness to buy CPRF tomatoes with cosmetic defects. Along the same line, Huang (1996) analyses the extent to which consumers are willing to accept sensory defects for reduction in pesticide residues. This author uses a qualitative choice model with different explanatory variables that may affect consumers' WTP for pesticide use reduction. It appears that the majority of potential organic consumers were not willing to purchase organic products if they had sensory defects. Concerning consumers' characteristics Jolly (1991) argues that organic food buyers are younger than non-buyers; however the results show that educational level and gross household income do not explain differences in organic buying behaviour. In Thailand, Posri et al (2007) show that WTP for 'pesticide residue limit compliant safe vegetables' increases with income and age. However, Thomson (1998) argues that income (and also gender) does not influence the probability of buying organic products, while age, family composition and education may affect significantly organic purchasing behaviour.

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[2] This literature review focus on publishsed papers about consumers' WTP for certified pesticides reductions. Note that Yiridoe, Bonti-Ankomah and Martin (2005) present an exhaustive review of different studies that focus on organic consumer demand and marketing issues.

Some studies have tried to measure consumers' reaction to more specific information on pesticide use or impact. Using contingent valuation and improving consumers' information on pesticides' reduction Buzby et al. (1995) focused on the elimination of only one specific postharvest pesticide on the production of grapefruit. They show that consumers' WTP could be around 40% more for grapefruit free of the specific pesticide. Giving also greater emphasis to information about the consequences of pesticides on health (risk of developing cancers), and using a sample of married females from Taiwan, Fu et al. (1999) highlight that WTP could be significantly related to the scope of the risk reduction. Chinnici et al. (2002) explain that all consumers know that there is a price premium of 20-30% for organic produce but only the consumers that have a consolidated consumption of organic produce and are "health conscious" have stated they are willing to pay this premium.

Several papers have investigated the possibility of a third way between conventional and organic products, namely the intermediary certifications connected with IPM in US. The positive consumer response to this certification was reported in the works of Hollingsworth et al. (1993) and Mullen et al. (1997). Govindasamy and Italia (1998, 1999) and Govindasamy et al. (2001) empirically evaluate consumers' WTP for different production methods: organic, IPM and conventional. Following a contingent valuation format, the survey participants reported a higher WTP for IPM produce than for organic produce. They also found that the household that is most likely to pay a premium for organic products is also willing to consider alternative agriculture, such as IPM. Cranfield and Magnusson (2003) explore on the Canadian market a new classification of environmentally friendly food products, so-called "pesticide-free products." This system of farming lies between organic and IPM farming practices. They found that 67% of respondents have a modest WTP of a one to 10% premium and five per cent are willing to pay a premium of 20% over conventional prices (see also Magnusson and Cranfield, 2005).

The explicit influence of signals carrying certification information to consumers (labels, stickers or logos as mentioned by Henneberry and Mutondo, 2007) in the formation of their WTP for pesticide reduction has mainly concerned the premium for organic products. Buzby and Skees (1994) point out that more information about the use of pesticides was demanded for consumers when they take into account different levels of risk reductions from pesticide residues. Almost 90% of their survey respondents said that all products should be labelled with information on pesticide use. Kristallis et al. (2006) study the influence of organic labels on the valuation of several organic food products (olive oil, raisins, bread, oranges and wine). They conducted a conjoint analysis in Greece and they study the impact of the presence of the organic label attribute on the consumers' WTP for these products. The respective premiums vary with the foodstuff under evaluation (for example, 19.1% for raisins and 63.7% for wine). Anderson et al. (1996) show that consumers would be willing to pay 10% more for corn that was marked with an "IPM Certified" sticker advertised in the media. Focusing on environmental-impact assessment (production process, use, and disposal) of the product, Blend and Van Ravenswaay's (1999) measure consumers' acceptance for eco-labeled apples. Their research reported that 63% of the respondents were willing to pay a premium for eco-labeled apples. Similarly, Loureiro et al. (2001, 2002) assess WTP for apples with an eco-label close to a GAP certification. Based on the answers of apple-buying consumers to a survey conducted in two grocery stores in Portland (USA), they used a modified version of the double-bounded choice model to estimate mean WTP. They found a small mean premium for eco-labelled apples (5%) and argue that the context of the procedure used, with conventional and organic apples as substitutes, had an influence on these results. Many consumers considered organic apples the more environmentally friendly alternative and they would be more willing to pay a higher premium for them. Recently, Tonsor and Shupp (2009) evaluate consumers' WTP for products marketed with "sustainably produced" labelling claims. They concluded that U.S. consumers are not willing to pay a positive premium for tomatoes or apples labelled as “sustainably production”, because this information is vague and not associated with production practices. The authors propose the realization of additional experiments designed to evaluate label valuations when alternative forms and levels of information are provided to consumers.

While many papers have investigated WTP for pesticide-use reduction through consumers' statements, very few have used market data to measure the actual price premium for organic or CPRF products. Based on retail price differences between organic and conventional fruits and vegetables, Hammit (1993) estimated the price premium that consumers assign to several organic products. The median ratio of the organic premium to the conventional price across produce types was about one-third. More recently, Monier et al. (2009) studied French organic consumer patterns, evaluating the impact of price on buying organics. Their work showed a small impact of prices on demand because price elasticities are estimated with marginal price variations that are much lower than the price gap between organic and conventional products. Their results are in line with the work of Bunte et al. (2010) who demonstrated that consumer demand for organic products in Netherlands does not changes when the price gap between organic and conventional products is deliberately reduced. These authors show that the reduction of organic price for some products, like organic milk, potatoes and rice do not shift demand much.

To control more precisely the impact of information on pesticide-use reduction, non-hypothetical experiments are increasingly popular. Using Vickey auctions, Roosen et al. (1998) study the impact of insecticides’ elimination and cosmetic damages on consumers’ WTP for apples. The results show that appearance of apples had non-negligible effect on the WTP and that information about pesticides changes the WTP of consumers. After the disclosure of the information about the consequences of insecticide’ use, the consumers’ WTP increases by about 50%, while cosmetic damage decreases average WTP by 63%. Gil and Soler (2006) analyse the Spanish consumers’ decisions to pay a premium for organic olive oil. They observed that information about conventional product (“reference price”) increased the perceived value of the organic product. Their results also show that only the consumers that have already bought organic products were willing to pay a price premium and only 5% of them would be willing to pay the correspondent market price. Yue, Alfnes and Jensen (2009) conduct an experimental auction (using a fourth-price sealed-bid auction) and show how the appearance of organic apples affects consumers’ WTP. Like in Roosen et al., when appearance of organic and conventional apples is the same, consumers are willing to pay a positive premium for the absence of pesticides. Bougherara and Combris (2009) investigate, through the BDM (Becker, DeGroot, and Marschak, 1964) procedure, the premium of French consumers for an eco-labeled bottled orange juice. In this paper, the premium was driven by selfish or altruistic motives, other than food taste or safety. Combris et al (2010) measured the effect of information on the WTP for Rocha pears in Portugal, and the trade-off between taste and the pesticide use reduction. The authors used an experimental auction to investigate how quality attributes information affects consumers’ WTP for different types of pears. The main results show that information on pesticide use reduction instantly influences consumers’ willingness to pay. However, it appears that sensory intrinsic attributes related to taste finally beats the guarantee of food safety in driving the buying behaviour.

A last, but important issue concerns the impact of interaction between signals on consumers' WTP. Two papers investigated the effects of additional signals that are commonly used in the supply of organic products. Bernard and Bernard (2010) determine consumers’ WTP for organic potatoes and sweet corn, focusing on two characteristics: pesticide-free and non-GM. They found that the premium for the organic version was not significantly different from the sum of the two components (pesticide-free and non-GM) when they are evaluated independently. This suggests that these two characteristics are what consumers are paying for when buying organic products. Tagbata and Sirieix (2008) compared French consumer's willingness to pay for organic and fair-trade chocolate products. The authors found that a large proportion of their sample (41%) consider taste and health issues at least as much as social and environmental dimensions when choosing organic and fair trade products.

3. Experimental design

We conducted experimental sessions in four European countries. The first set of sessions was carried out in Portugal (Lisbon) during April 2009, the second set of sessions was carried out in France (Dijon) in May 2009, the third sessions were conducted in Greece (Thessaloniki) in February 2010, and the last ones were carried out in Netherlands (The Hague) in October 2010. This section presents the protocol used in the four sets of sessions. The main features of the protocol are common to all countries. However some minor changes have been introduced in order either to improve the protocol or to adapt it to the countries' particularities. We first describe the subject pool and the products selected for the experiments. Then we discuss the procedure, and the different particularities studied in each country.

3.1 Subjects

Marketing firms in Portugal and Netherlands recruited participants and the recruitment was done by the research teams in France and Greece. Participants were first contacted by phone. For each country, a common set of criteria was imposed. To be selected for the experiment, subjects had to be regular consumers and buyers of apples. The recruiters asked them the price they usually paid for 1 kilogram of apples. If the given price was unrealistic (greater than 5 euros) then the subject was not selected. People who participated to more than three studies (marketing or consumption studies) in the last six months were rejected. Stipulations on age range and on the ratio of students or retirees have been defined. If all the criteria were satisfied, recruiters presented the study as a research on food preference ending by a sale. At the end of the phone interview, the consumers were told that they would participate in an experimental session for which they would earn a lump sum fee between 10 and 30 € for participating (according to local practice). All the participants received a convocation letter with explanations of the incentive mechanism that is the random selling-price procedure used at the end of the session for the actual sale of one kilogram of apples.

A part from the above common set of criteria participants were randomly selected from the general population of the different cities where the experiments took place. Consequently the four samples are homogenous in the sense that they were drawn from urban populations: Lisbon is the largest city in Portugal (intramural population about 545,000), Thessaloniki is the second-largest city in Greece (intramural population about 745,000), The Hague is the third-largest city in The Netherlands (population about 500,000) and Dijon has a population of about 240,000. Of course, we expected that our samples would differ insofar as they reflect the particularities of each country and location. We will see in section 4.1 that this is actually the case.

3.2 Products

We chose to use apples for our experiments. Apple is the most widely produced fruit and also the most widely consumed in many European countries throughout the year. This product has already been much used in previous experiments (see for examples Baker, 1999, Loureiro *et al*., 2002). The banality of this product is in itself an advantage which permits to elicit behaviors of general interest while simplifying the experiments, apples being easy to handle and store, and being sold all year long.

In each country, apples produced using three different types of pest management, corresponding to different levels of chemical pesticide use, were proposed to the subjects. The first level of pesticide use is defined by the minimum quality standard in force. In this category, the apples, named "regular" (*REG*) apples in the sequel of the paper, are produced according to the European regulation for pesticide use.

The second level of pesticide use is defined by a controlled reduction of pesticide use compared to the existing legislation. There exist many different certifications for these "Good Agricultural Practices" (GAP). In our experiment, we chose to test three of them:

- Integrated Pest Management (*IPM*) is a neutral certification, without explicit statement of a public or private brand.
- Protected Denomination of Origin (*PDO*) is a guarantee that producers are engaged in a controlled process with production rules including GAP. Note that the environmental requirement is not communicated to the consumers.
- The retailer's labeling (*RET*) is a guarantee that retailers use the private labels to require GAP from their producers.

Finally, organic apples (*ORG*), for the production of which chemical inputs are prohibited[3], represent the third and lowest level of pesticide use.

Table 1 presents the different apples and certifications proposed to participants in each country. Apple varieties were selected according to national preferences and supply constraints[4]. For the first experiment in Portugal, we paid much attention to accounting for the heterogeneity of tastes. During the first step of the experiment, dedicated to the tasting of the products, Portuguese participants had to taste three variants of Granny Smith and Royal Gala (one regular, one IPM and one organic for each variety). Our intention was to find out whether consumers could reject, or undervalue, an apple because of its variety. In that case WTP for the different alternatives of this variety could have been meaningless. At the end of this first phase, the favorite variety of each participant was identified (by comparing the mean WTP for the three variants of each variety), and then the following steps of the experiment were conducted using only each participant's favorite variety[5].

[3] In The Netherlands, an additional organic alternative was tested in the experiment. This alternative called "Natural Label" forbids any use of pesticides even those of organic origin.

[4] For example, in France the Golden variety was chosen because (i) it is the only variety with PDO certification and (ii) it is a widely consumed variety.

[5] Given that preferences appeared less clear-cut than we thought, we decided to not repeat this preliminary step in the other countries.

Table 1. Types of apples by experimental market

Country	Portugal	France	Greece	Netherlands
Variety	Granny Smith Royal Gala	Golden	Starking	Elstar
Different apples with different stickers	1. Reg without sticker 2. IPM (‘Protecção Integrada 3. PDO (Alcobaça) 4. Retailers’label 5. ORG (EU sticker)	1. Reg without sticker 2. IPM (‘Production Fruitière Intégrée’) 3. PDO (Limousin) 4. Retailers’ label 5. ORG (AB sticker) 6. Small Reg (without sticker)	1. Reg without sticker 2. IPM (‘Σύστημα Ολοκληρωμένης Διαχείρισης AGRO’) 3. PDO (Zagorin) 4. Retailers’ label 5. ORG (‘βio’ sticker) 6. Reg (‘ΣΤΑΡΚΙΝ’ sticker)	1. Reg with sticker ‘Elstar’ 2. IPM (‘Geïntegreerd pestmanagement’) 3. PDO (Betuwe) 4. ORG (‘EKO’ sticker) 5. ORG Plus (‘Natural Label’)

To signal the characteristics of the apples we used stickers with logos. The regular apple had no sticker[6]. The IPM alternatives were signaled with the logos currently used in each country. In Portugal it was the "*Protecção Integrada*", in France it was the "Production Fruitière Intégrée", in Greece we used the logo "Agrocert IPM label" and in The Netherlands we adapted the French logo because there is no Dutch logo for IPM. For the PDO certification, we used the existing PDO "Maçã de Alcobaça" in Portugal, "Pomme du Limousin" in France, and "Zagorin" in Greece. In The Netherlands, there is no PDO certification for apples, so we decided to use the logo of the "Betuwe" area, which is famous for being one of the centers of Dutch fruit production. To signal the retailers' brand we used the actual logos available on national markets[7]. Finally, to signal the organic apples we choose the logo commonly used in each country (national logos in France, Greece and The Netherlands, and the European logo in Portugal).

3.2 Procedure

For all experiments, sessions took place in sensory analysis rooms and gathered between 8 and 20 participants. Each session began with an oral presentation of the procedure to the group. At the outset of each session, an experimenter presented the object of the experiment as "an evaluation of apples of the same variety but coming from different production systems". Participants were informed that they would carry out their evaluations in different information contexts. In every one of them, they will have to indicate the maximum buying price they would pay for one kilogram of each of the tested apples given the information they have on them. Participants were also told that a real sale would take place at the end of the session: one of their evaluation would be randomly chosen and they will have a chance to buy one kilogram of the corresponding apple at a price lower or at most equal to the maximum buying price they indicated in that situation.

The incentive mechanism, known as the BDM procedure, is quite simple: once a participant has given a maximum buying price, a selling price is randomly drawn from a pre-specified price distribution, which is wider than the actual distribution of market prices. If the selling price is higher than the maximum buying price given by the participant, she does not buy the product. If the selling price is lower or equal to her maximum buying price, the participant buys the product at the selling price. This maximum buying price, which makes the participant indifferent between buying and not buying, is the willingness-to-pay we are looking for. This mechanism was explained in the convocation letter sent to all the individuals recruited for the experiments. Moreover, at the beginning of the sessions, all participants were instructed to use the BDM procedure, and a trial random-price sale took place to check that the procedure was properly understood.

After all explanations had been given and questions answered, the experiment started. Four steps were common to all experiments[8]. Steps are defined according the information given to participants to evaluate the apples. Participants did not know in advance the kind of step they would go through. They only knew that they would have to carry out several evaluations and that each one of them would be made independent by a random selection

[6] In Greece, we added a regular apple with a sticker signaling the name of the variety. The objective was to control for a possible "sticker effect". In France, we added a small regular apple because the available organic apples were smaller than the other one, so to control for the "size effect" we included a small apple without any environmental characteristic.

[7] This kind of GAP alternative was not included in the Netherlands experiments because this would have required legal negotiations with the dominant retailer in the Netherlands.

[8] In Greece an additional fifth step was added to check whether extra information on the possible impact of pesticide on individual health could affect WTP. ParticIPMants were told that the rates of pesticide residues found in apples are lower than the national thresholds in force.

before the actual sale. So strategic WTP revelation is minimized because each evaluation, even those made with limited information, can be the one selected for the final sale. Of course, participants who do not like an apple at all, or suspect unwanted characteristics, can always indicate a buying price of zero.

At the beginning of the *first step* of the experiment ("Tasting step") the different apples were presented simultaneously to each participant. Participants did not have any information about the apples except the variety's name. To compare the apples, the participants could only look and taste them. As explained in the previous subsection, all the participants had to evaluate five apples in Netherlands, or six in France and Greece (see table 2). As explained previously, in Portugal, the first step of the experiment consisted in tasting three variants of two different varieties of apples.

During the *second step* ("Sticker step"), the different apples with their stickers were presented simultaneously to each participant. No information was given to the participants about the actual meaning of the stickers, and they were not allowed to taste the apples. In Portugal, five variants of the variety which was preferred at the first step were used for the second, third and fourth steps.

At the beginning of the *third step* ("Information step"), each participant received an information sheet explaining the meaning of the different logos. For regular apples (with or without sticker), the information sheet stated that these apples were produced according to national rules regarding pesticides use. For IPM apples, we specified who guarantees that pesticide use had been reduced: public authorities (generic IPM in Portugal, PDO in France and Greece), producers (generic IPM in France, Greece and Netherlands, PDO in Portugal and Netherlands) or retailers. Concerning organic apples, the information sheet indicated that public authorities guaranteed that no chemical pesticides had been used (no chemical and no organic pesticides for ORG+ in Netherlands).

During the *fourth step* ("Full information step"), each participant evaluated each apple with the same information than in the third step but they were invited to taste the apples before giving their evaluations.

At each step, apples were evaluated simultaneously. A maximum purchase price for each apple was recorded for every participant at the end of each step. When a new step started, participants could not go back or change the prices they had given.

4. Results

4.1. Samples and data

Four hundred and eight adults, aged between 18 and 73, participated to our experimental sessions in four different countries. Table 2 reports summary statistics of socio-demographic variables common to all locations. As expected, some differences appear in our recruited samples. Some of these differences simply reflect specificities of each country's population. For example, income is lower and family size is larger in the Greek and Portuguese samples (see Table 2). This is in line with national statistics, showing that average monthly income per capita was 891€ in Greece and 1,034€ in Portugal compared to 1,567€ in France and 1,667€ in The Netherlands[9]. According to the same national statistics, average family size was 2.8 in Greece and 2.6 in Portugal, but 2.3 in France and 2.2 in The Netherlands. Some other differences (over-representation of young people in the Greek sample and of women in the Dutch sample) result from local recruitment difficulties in spite

[9] These data correspond to the latest statistics that were available in each country in 2010 (sources: www.ine.pt and www.pordata.pt for Portugal; www.insee.fr for France; www.statistics.gr for Greece; www.cbs.nl for Netherlands).

of the recommendation we made to all agencies to avoid recruiting too many economically "inactive" or part-time active people.

Table 2. Socio-demographic characteristics of the subject sample for each country

		Portugal	France	Greece	Netherlands
Sample Size	Nb subjects Nb women Nb men	102 53 49	107 55 52	100 56 44	99 74 23
Age (years old)	18- 30 31-40 41-50 51-60 > 60	23% 33% 17% 22% 6%	26% 19% 21% 18% 16%	42% 14% 19% 14% 11%	21% 12% 19% 32% 15%
Income distribution (€/month per capita)	1st tercile 2nd tercile 3rd tertile	31%∈[0;812[28%∈[812;1083[40%≥ 1083	34%∈[0;875[24%∈[875;1625[42%≥ 1625	38%∈[0;445[30%∈[445;875[31%≥ 875	25%∈[0;750[39%∈[750;1625[36% ≥ 1625
Family size	Mean S.E	2.74 1.07	2.55 1.46	3.16 1.47	2.54 1.14

In all experiments and locations, participants followed the instructions and indicated buying prices consistent with local prices. Each Portuguese participant revealed 21 prices (six during the tasting step and then five at each of the remaining three steps), the French and the Greek participants revealed 24 prices (six apples and four steps) and the Dutch participants revealed 20 prices (five apples and four steps). So we collected a total of 9,090 prices, ranging from 0 to 5€ for one kilogram of apples, with a median of 1€ and a mean of 1.12€. On average, 6.3% of the prices were null, but no participant systematically refused to buy. All participants gave at least seven or more strictly positive prices, the median being 20. The means of positive prices are 0.91€ in Portugal, 1.38€ in France, 1.15€ in Greece and 1.28€ in The Netherlands.

4.2. WTP for pesticide-use reduction: premiums for IPM and Organic apples

The main point of this paper is to know whether, and how much, European consumers are ready to pay for pesticide-use reduction when they are fully informed of production methods. So we started with the analysis of the willingness-to-pay (WTP) at step 3 of each experiment, when participants have been informed of the meaning of the different stickers attached to the apples in terms of pesticide-use. First we tested the difference in WTP between Integrated Pest Management (IPM), organic production (Organic) and regular production (Regular) that is when producers conform to the minimum standard requirements in each country.

To test the hypothesis that WTP increases when pesticide-use decreases, we used both parametric paired *t* tests and non-parametric Wilcoxon tests. Table 3 reports the results of these tests, comparing IPM and Regular apples (3.1), Organic and Regular (3.2), and finally Organic and IPM (3.3).

Table 3. Comparing WTP for Regular, IPM and Organic apples.

1. Comparison Regular vs. IPM	**Regular** Mean[a] (se)[b]	**IPM** Mean[a] (se)[b]	**IPM-Regular** Mean[a] (se)[b]	***t* test** *p*-value[c]	**Wilcoxon** *p*-value[d]
Portugal (Lisboa, N=102)	0.565 (0.039)	0.862 (0.044)	0.297 (0.043)	0.000	0.000
France (Dijon, N=107)	1.009 (0.058)	1.450 (0.057)	0.441 (0.050)	0.000	0.000
Greece (Thessaloniki, N=100)	0.953 (0.071)	1.125 (0.057)	0.173 (0.062)	0.006	0.000
Netherlands (The Hague, N=99)	1.206 (0.055)	1.190 (0.054)	-0.017 (0.039)	0.666	0.473

2. Comparison Regular vs. Organic	**Regular** Mean[a] (se)[b]	**Organic** Mean[a] (se)[b]	**Organic-Regular** Mean[a] (se)[b]	***t* test** *p*-value[c]	**Wilcoxon** *p*-value[d]
Portugal (Lisboa, N=102)	0.565 (0.039)	1.104 (0.047)	0.539 (0.050)	0.000	0.000
France (Dijon, N=107)	1.009 (0.058)	1.570 (0.079)	0.561 (0.073)	0.000	0.000
Greece (Thessaloniki, N=100)	0.953 (0.071)	1.597 (0.089)	0.644 (0.070)	0.000	0.000
Netherlands (The Hague, N=99)	1.206 (0.055)	1.334 (0.065)	0.128 (0.065)	0.051	0.002

3. Comparison IPM vs. Organic	**IPM** Mean[a] (se)[b]	**Organic** Mean[a] (se)[b]	**Organic-IPM** Mean[a] (se)[b]	***t* test** *p*-value[c]	**Wilcoxon** *p*-value[d]
Portugal (Lisboa, N=102)	0.862 (0.044)	1.104 (0.047)	0.243 (0.040)	0.000	0.000
France (Dijon, N=107)	1.450 (0.057)	1.570 (0.079)	0.120 (0.058)	0.041	0.005
Greece (Thessaloniki, N=100)	1.125 (0.057)	1.597 (0.089)	0.471 (0.074)	0.000	0.000
Netherlands (The Hague, N=99)	1.190 (0.054)	1.334 (0.065)	0.144 (0.057)	0.013	0.000

[a] Mean WTP in €/kg.
[b] Standard error of mean.
[c] *p*-value for the two-tailed paired *t* test.
[d] *p*-value for the two-tailed paired Wilcoxon signed-rank test.

For all three comparisons and all experiments, both tests lead to the same conclusions. The first section of table 3 shows that WTP for IPM apples is always significantly higher than WTP for regular apples, except in the Dutch experiment. The second section shows that, WTP for organic apples is always higher than for regular apples. The third section also displays a positive difference between Organic and IPM apples in all four countries.

The specificity of the results obtained for the IPM variant in the Netherlands may derive from differences in the set of apples that were tested. Unlike the other three experiments, the regular apple in the Dutch experiment was identified with a sticker indicating the apple variety ("Elstar"). To check for a possible effect of this sticker, we ran another experiment in the same conditions, with a smaller sample (N=51), and actually found a significant difference (p=0.026) between a regular apple with sticker and an IPM apple with the same sticker as in the first experiment. Another difference between the Dutch and the other three experiments was the presence of an organic+ apple in the set of tested variants. These apples are produced with no pesticide at all, either synthetic or natural, while standard organic production uses natural pesticides. The organic+ appeared clearly as the highest-valued option (the mean WTP was 1.46 €/kg compared to 1.33 €/kg for the standard organic). Then the organic was the second best option. Added to the "sticker effect", this could explain that participants did not distinguish the IPM from the regular.

To compare the WTP for pesticide-use reduction across countries and control for differences in socio-demographic characteristics of participants, absolute premiums (difference in WTP between IPM and regular, and between Organic and regular) have been regressed on dummy variables for country, gender, age, income and household size. Interval regressions have been used to account for censoring when one or both prices used to calculate the premium are equal to zero. The same has been done for relative premiums (ratio of WTP for IPM to WTP for Regular, and ratio of WTP for Organic to WTP for Regular).

Table 4. Impact of country and individual characteristics on absolute and relative premiums for IPM and organic apples

	Integrated Pest Management		Organic	
	Absolute premium[a]	Relative premium[b]	Absolute premium[a]	Relative premium[b]
Portugal	-0.1030	0.0030	0.0455	0.3136*
France	ref	ref	ref	ref
Greece	-0.3247***	-0.0211	-0.0025	0.3754**
Netherlands	-0.5089***	-0.3606***	-0.4248***	-0.3244***
Woman	0.0881	0.0498	0.1965*	0.2347*
Age 18 to 30	0.1000	-0.0393	0.2149	-0.0401
Age 31 to 40	-0.0714	-0.1647	-0.1230	-0.2939
Age 41 to 50	ref	ref	ref	ref
Age 51 to 60	-0.0216	-0.1011	-0.0743	-0.1191
Age > 60	-0.0236	-0.1542	-0.0671	-0.2889
Income 1st tercile	0.0890	0.0100	0.0876	-0.0685
Income 2nd tercile	ref	ref	ref	ref
Income 3rd tercile	0.0035	-0.0482	0.2086*	0.1082
Household size	0.0068	0.0199	0.0501	0.0771
Constant	0.3659**	1.3866***	0.2326	1.3000***
Log Likelihood	-317.1149	-281.8115	-403.3521	-445.5134
Observations	380	352	380	351

Legend: * $p<0.05$; ** $p<0.01$; *** $p<0.001$
[a] Absolute premium is the difference between WTP (in €/kg) for IPM or Organic apples and WTP for Regular apples.
[b] Relative premium is the ratio between WTP (in €/kg) for IPM or Organic apples and WTP for Regular apples.

The third column of table 4 shows that absolute premiums for organic apples are not different in France, Greece and Portugal, but are significantly lower in the Netherlands. In relative terms (fourth column), premiums are significantly higher in Greece and Portugal compared to France (the reference) and significantly lower in the Netherlands. Premiums for organic apples show some sensitivity to socio-demographics: the absolute premium is higher for women and participants above the second tercile of income. The relative premium is also higher for women. Except for women, who accept to pay significantly more for organic apples, there is no systematic effect of age, income, or household size[10]. Compared to organic, IPM certification induces much less differences. The first and second columns of table 5 show that socio-demographic characteristics of participants have no impact on either absolute or relative premiums for IPM apples. For reasons explained above, Dutch participants did not accept to pay more for IPM apples either in absolute or relative terms. The only remaining difference is a significantly lower absolute premium in Greece compared to the French reference.

Turning to the different variants of IPM apples, section 1 of table 5 shows that in all locations where the retailer's option has been proposed (France, Greece and Portugal), retailer's label is less valued than the generic IPM label. This may explain why private brands do not communicate much on pesticide reduction. Concerning PDO apples, section 2 of table 5 reveals a positive premium compared to generic IPM apples in France, Greece and Portugal, but not in The Netherlands. In this last case, PDO certification actually does not exist, but, as explained above, we decided to create a fake label referring to a popular production area to check whether Dutch consumers could be responsive to origin. Clearly they are not. In the other three countries, origin seems to have a value in itself independently of the issue of pesticide-use reduction. There is a significant premium for PDO apples compared to generic IPM, and moreover, as the next section will show, it is not influenced by information on pesticide-use.

[10] Education, which has not been recorded in Netherlands, was tested separately for France, Greece and Portugal. We found no significant effect.

Table 5. Comparing WTP for Retailer's and PDO to WTP for IPM apples

1. Comparison Retailer's vs. IPM	**IPM** Mean[a] (se)[b]	**Retailer's** Mean[a] (se)[b]	**Retailer's-IPM** Mean[a] (se)[b]	***t* test** P-value	**Wilcoxon** P-value
Portugal (Lisboa, N=102)	0.862 (0.044)	0.801 (0.036)	-0.060 (0.025)	0.017	0.000
France (Dijon, N=107)	1.450 (0.057)	1.322 (0.056)	-0.129 (0.030)	0.000	0.000
Greece (Thessaloniki, N=100)	1.125 (0.057)	0.892 (0.058)	-0.233 (0.043)	0.000	0.000
2. Comparison PDO vs. IPM	**IPM** Mean[a] (se)[b]	**PDO** Mean[a] (se)[b]	**PDO-IPM** Mean[a] (se)[b]	***t* test** P-value	**Wilcoxon** P-value
Portugal (Lisboa, N=102)	0.862 (0.044)	0.975 (0.037)	0.114 (0.021)	0.000	0.000
France (Dijon, N=107)	1.450 (0.057)	1.642 (0.070)	0.191 (0.036)	0.000	0.000
Greece (Thessaloniki, N=100)	1.125 (0.057)	1.325 (0.089)	0.199 (0.062)	0.002	0.000
Netherlands (The Hague, N=99)	1.190 (0.054)	1.191 (0.056)	0.001 (0.043)	0.980	0.713

[a] Mean WTP in €/kg.
[b] Standard error of mean.
[c] *p*-value for the two-tailed paired *t* test.
[d] *p*-value for the two-tailed paired Wilcoxon signed-rank test.

4.3. Impact of information on pesticide-use reduction

In the previous analysis, participants' WTP have been evaluated after they received information about the use of pesticide in the different production systems. Actually, such information is not readily available to consumers. So by assessing its impact on WTP, our objective is to know whether better-informed consumers could contribute to the reduction of pesticide-use by rewarding producers for their efforts. To answer this question, we compared the WTP before information (step2) and after informing participants on pesticide-use in the production of the different apples (step3). As previously, we used both parametric and non-parametric tests. Results are reported in table 6.

Table 6. Impact of information on mean WTP (step3 compared to step2)

1. Apple = Regular	**Step 2** Mean[a] (se)[b]	**Step 3** Mean[a] (se)[b]	**Step 3 – Step 2** Mean[a] (se)[b]	***t* test** P-value	**Wilcoxon** P-value
Portugal (Lisboa, N=102)	0.607 (0.039)	0.565 (0.039)	-0.043 (0.021)	0.049	0.008
France (Dijon, N=107)	1.137 (0.061)	1.009 (0.058)	-0.128 (0.038)	0.001	0.000
Greece (Thessaloniki, N=100)	1.088 (0.066)	0.953 (0.071)	-0.135 (0.042)	0.002	0.000
Netherlands (The Hague, N=99)	1.207 (0.056)	1.206 (0.055)	-0.001 (0.029)	0.981	0.722
2. Apple = IPM	**Step 2** Mean[a] (se)[b]	**Step 3** Mean[a] (se)[b]	**Step 3 – Step 2** Mean[a] (se)[b]	***t* test** P-value	**Wilcoxon** P-value
Portugal (Lisboa, N=102)	0.884 (0.045)	0.862 (0.044)	-0.022 (0.027)	0.418	0.187
France (Dijon, N=107)	1.419 (0.064)	1.450 (0.057)	0.032 (0.033)	0.338	0.365
Greece (Thessaloniki, N=100)	1.056 (0.066)	1.125 (0.057)	0.069 (0.049)	0.157	0.005
Netherlands (The Hague, N=99)	1.165 (0.057)	1.190 (0.054)	0.025 (0.045)	0.578	0.750
3. Apple = Organic	**Step 2** Mean[a] (se)[b]	**Step 3** Mean[a] (se)[b]	**Step 3 – Step 2** Mean[a] (se)[b]	***t* test** P-value	**Wilcoxon** P-value
Portugal (Lisboa, N=102)	1.007 (0.050)	1.104 (0.047)	0.097 (0.031)	0.002	0.000
France (Dijon, N=107)	1.405 (0.073)	1.570 (0.079)	0.165 (0.030)	0.000	0.000
Greece (Thessaloniki, N=100)	1.178 (0.070)	1.597 (0.089)	0.418 (0.065)	0.000	0.000
Netherlands (The Hague, N=99)	1.167 (0.067)	1.334 (0.065)	0.167 (0.036)	0.000	0.000
4. Apple = PDO	**Step 2** Mean[a] (se)[b]	**Step 3** Mean[a] (se)[b]	**Step 3 – Step 2** Mean[a] (se)[b]	***t* test** P-value	**Wilcoxon** P-value
Portugal (Lisboa, N=102)	0.991 (0.042)	0.975 (0.037)	-0.016 (0.015)	0.295	0.632
France (Dijon, N=107)	1.616 (0.071)	1.642 (0.070)	0.025 (0.030)	0.411	0.996
Greece (Thessaloniki, N=100)	1.307 (0.074)	1.325 (0.089)	0.018 (0.043)	0.683	0.663
Netherlands (The Hague, N=99)	1.070 (0.058)	1.191 (0.056)	0.120 (0.032)	0.000	0.000

[a] Mean in €/kg.
[b] Standard error of mean.

The first thing to notice is that giving information on pesticide-use to participants decreased the WTP for regular apples in all experiments. This decline in WTP is always significant, except in the first Dutch experiment. The second important result is that information had no impact on WTP for IPM apples. Tests always conclude to no difference in WTP, before and after information has been provided to participants, except in the second Dutch experiment, which is inconclusive (the *t* test reject the difference, the Wilcoxon does not). The third section of table 6 shows a general increase of WTP for organic apples when participants are fully informed. This increase is highly significant in all countries and experiments.

The last section of table 6 confirms that in France, Greece and Portugal, where PDO certification is well known, information on producers' commitment to reduce pesticide use has no effect on WTP. It is also interesting to observe that in Netherlands were PDO is unfamiliar, the same information increases significantly WTP. An interview of French participants showed that only 31% of them knew about the requirement of controlling pesticide use to obtain the PDO certification « *Pomme du Limousin* ». In spite of that, releasing information on pesticide monitoring did not increase their WTP, which tends to prove that their interest in PDO products is more linked to the knowledge of origin than to a guarantee on agricultural practices.

4.4. Impact of sensory characteristics

One important question is to know whether WTP for pesticide-use reduction is affected by other characteristics of apples. We have seen previously, in our second Dutch experiment, that appearance could lower the WTP for organic apples. Another key characteristic of food products is taste. Our experiments were not designed to test conflicts between taste and pesticide reduction, however we consider that accounting for taste in the assessment of WTP is a major point. To do that, we use the last step of each experiment when participants were asked to taste each apple and give their final WTP taking into account the information they had on pesticide use for each apple and its taste. This lead to variations in WTP compared to the evaluations made at step 3 on the basis of information and visual characteristics only. To explain the final WTP (at step 4), we ran one regression for each country using WTP at step 3 to measure the impact of information and WTP at step1 to assess the effect of sensory characteristics of each apple. WTP for Regular, IPM and Organic apples were pooled. Tobit models were used to account for WTP equal to zero and robust standard errors were estimated to account for the fact that each individual evaluated three apples. Socio-demographic variables were included to control for sample variation across countries and experiments.

Results are presented in table 7. Estimates show that both WTP at step 3 and at step 1 have a significant impact on the final evaluation. This means that both information and sensory characteristics have an impact on the final evaluation of participants' WTP. The parameter for taste is always lower than the parameter for information, and varies from one experiment to the other. This is not at all surprising given that, as noted before, sensory characteristics of apples were not controlled before the experiment and varied randomly according to the apples that were available in each location.

Table 7. Impact of sensory characteristics on WTP after tasting and information.

Variable	Portugal	France	Greece	Netherlands
WTP at step 3 (information)	0.5695***	0.7829***	0.6654***	0.5108***
WTP at step 1 (blind tasting)	0.4224***	0.2293*	0.3015***	0.3133**
Woman	-0.0224	-0.0562	-0.0319	0.1590
Age 18 to 30	-0.2585**	0.0258	0.1257*	-0.0206
Age 31 to 40	0.0273	-0.1121	0.0950	0.1290
Age 41 to 50	ref	ref	ref	ref
Age 51 to 60	-0.1473	-0.0679	0.1637*	0.1444
Age > 60	-0.1204	-0.0005	0.1147	-0.0108
Income 1st tercile	-0.1407*	0.0784	0.0045	0.0074
Income 2nd tercile	ref	ref	ref	ref
Income 3rd tercile	-0.0304	0.0680	0.0670	0.0876
Household size	0.0097	0.0306	0.0100	0.0282
Constant	0.0250	-0.1824	-0.1009	-0.1021
Pseudo R2	0.4534	0.4436	0.5549	0.2486
Individuals	99	107	99	75
Observations	297	321	297	225

Legend: * $p<0.05$; ** $p<0.01$; *** $p<0.001$
Tobit regressions with robust standard errors. Dependant variable is WTP at step 4 after information and tasting.

5. Conclusion

The results obtained in this paper suggest a relatively homogeneous behavior of European consumers. It appears that in all four countries there is a significant premium for apples produced with reduced pesticide use, and that the consumers' behaviors *vis à vis* the quality signals, in the different situations of information, are similar. In all our experiments, the highest WTP after information on pesticide use always goes to organic apples. Except in The Netherlands, there is also premium for IPM apples compared to regular apples, which is significantly less than the premium for organic apples. The impact of sensory characteristics on WTP is always highly significant (whatever the country or apple variety). Sensory characteristics, or appearance, can even challenge the hierarchy of average prices by increasing the refusals to buy.

Moreover, we show how informing participants on pesticide-use reduction has a strong significant impact on the WTP for the organic apple and has no impact on the WTP for the IPM apple. As explained above, we obtain a significant decrease of the WTP for the regular apple. Therefore, while the labels may convey positive messages to consumers about the production conditions, they may simultaneously stigmatize the conventionally produced product by highlighting perceived problems. The net economic result for producers can be negative since consumers may decrease their WTP for the conventional product that has the largest market share.

Organic products are pretty well valued by all consumers, and, as our experiments showed, this valuation may increase, should information on the various certifications existing on the market be disseminated. Consequently, and without underestimating sensory issues (size, aspect, taste) which may have a large negative impact, organic product may appear as a safe haven for under-informed consumers. However, in Europe, market prices of organic products are generally twice as high as prices of their regular counterparts. This gap is larger than the premium consumers are willing to pay, which is the main reason for the small market shares that are observed for organic products in Europe (generally below 5%). One of the outcomes of our experiments is to provide WTP distributions that make it possible to assess changes in market shares according to the evolution of prices.

The partial reduction of pesticide use permitted within the framework of Good Agricultural Practices does not lead to the same clear results as those we obtained for organic products, which guarantee no use at all of chemical pesticides.[11] However, contrary to the organic case, market prices of GAP certified products are more in line with the WTP we have elicited. Consequently, purchasing GAP certified products could increase consumers' surplus and lead more easily to mass consumption. This point can now be tested along with the comparison of surpluses according to different levels of market prices with the objective of comparing the efficiency of different policy alternatives combining taxes on pesticides or subsidies to support a decrease in their use.

Another issue is to assess clearly the best way to ensure the reductions of pesticides, using GAP: certifications from public authorities, producers, retailers, or is it preferable to include another kind of referential incorporating pesticide monitoring in requirements from farmers? Our work brings some results on that point, showing, for instance, that retailers are not seen as a trusted third party to guarantee the reduction of pesticide use within the GAP frame. In the same context, we have shown that WTP for PDO certification is almost equal to that for organic (the WTP for organic apples is only 8% higher than for PDO), while information about the inclusion of GAP rules in the PDO certification does not add more value to the PDO signal. Indeed, our results show that in countries where PDO are familiar to consumers, they are valued for themselves (i.e. for origin rather than for control of pesticide use) and their value for consumers is often close to that of organic products.[12]

Concerning socio-demographic influences on WTP, apart from the higher WTP of women for organic apples, our results do not reveal any other systematic influence (there is no gradient for age, income or education for example). This confirms previous results concerning women's willingness to pay a premium for products with a guarantee of less pesticide use, but also suggest that other socio-demographic influences are less significant than they appeared in previous studies (see *inter alia* Huang, 1993,1996 and Govindasamy et al, 2001, Davis et al, 1995). This could mean that all categories of consumers show more and more interest for organic products, and that there is a potential market that may concern a much larger target than the initial users. Within this subject, an interesting question is to understand how organic product consumption progressively spreads over the market, and to better characterize the "organic food consumer" of today and tomorrow, a research issue already on the agenda of sociologists (see Hughner et al., 2007).

A last point concerns public information on pesticide use. Our multi-step protocol was designed to test the impact of information clarifying the way producers monitor pesticide use. Releasing information on certified products had two unexpected effects: a decrease in WTP for regular apples and an increase for organic. This raises the issue of public control of information on those product characteristics which are meaningful to consumers. Would organic produce become a safe haven if consumers became conscious of a sanitary hazard? Including risk aversion in further studies would be of great interest, given that consumers are very sensitive to negative information.

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[11] For further work, it would be interesting to compare our results with existing certifications in the United States. There, the labelling is simplified with three possibilities: (i) label « 100% organic », (ii) label « USDA organic » (if the product includes 95% of certified ingredients), (iii) label « made with organic ingredients » (70% of certified ingredients). Unfortunately and to our knowledge, there is no work studying this mode of specific labelling in the US.

[12] Loureiro and Lotade (2005) find similar results when comparing fair trade and organic certifications.

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