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► To cite this version:

Alain Carpentier, Karine Latouche, Pierre Rainelli, . Association of Environmental And Resource Economists. Food safety in the demand for meat quality : the case of pork chops in France. Symposium on Food safety and the environment : managing Quality is an international context, Association of Environmental and Resource Economists (AERE). USA., Jun 2002, Monterey, United States. 20 p. hal-01937048

HAL Id: hal-01937048

<https://hal.science/hal-01937048>

Submitted on 7 Jun 2020

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**Symposium on
Food safety and the environment: managing Quality in an international context
For the 2002 World Congress of Environmental and Resource Economists**

**Food safety in the demand for meat quality : the case of pork chops in
France**

Alain Carpentier, Karine Latouche and Pierre Rainelli

Abstract

This paper deals with the results of a French survey led in 2001 on 1000 French pork consumers. This survey aimed at ranking and valuing different attributes of pork chops ,i.e., food safety, taste, environmental respect of pig husbandry and respect of pig welfare. In the questionnaire the valuation exercise considers explicitly the substitution pattern of "improved" pork meat for standard pork meat.

Econometric models are presented, dealing with the ranking of the attributes and with their economic valuation. The ranking is modelled using a rank ordered specification. The more striking result of the ranking questions is the prominent position of food safety in consumers' interests. This interest seems increasing by the presence of young children in the household. However, standard socio-demographic variables seem to be of little interest for explaining the ranking of attribute such as animal welfare or respect of the environment. Preferences for these attributes seem rather heterogenous.

Stated willingness to pay is modelled using an ordered probit specification with known thresholds. Results of this modelling are rather intuitive when considering the effect of standard variables. For example, willingness to pay for pork meat quality improvements is increasing in income. Perhaps more interestingly these results shows that households mainly interested in attributes producing use values tend to exhibit higher willingness to pay for pork meat quality improvements.

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Introduction: Pork demand and main attributes of pork

The need in Europe for secure food supplies following shortages that persist for nearly a decade following World War II led to improve agricultural productivity through technical progress and to develop more rational production systems. Technical change tends to increase economies of size over time, allowing the lowering of production costs. But the exploitation of economies of size is done at the expense of economies of scope. The result is an increased intensity of land use, and a greater specialisation and concentration in agricultural production patterns. This substantial change characterises the so-called “industrialisation process”.

In the short term, consumers have been winning since the price of the food has relatively declined. But in the long run, the taxpayer has to pay for the consequences of the agricultural intensification through the conservation of the natural resources and the pollution. But the chief consequence concerns the quality of food, the European BSE scare being a leading example.

The example of pork is interesting since pig production is representative of this “industrialisation process”. Poultry consumption, with its strong farm tradition, evolved accordingly, with a sharp increase of industrial poultry consumption among clerical and non-active groups while professional, managerial and blue-collar groups tended to increase their consumption of pork. Meanwhile, persistent food habits account for the fact that alongside standardised production of poultry quality labelled brands was also developed. Because of the proximity between pork and poultry, two white meats, poultry is an interesting model concerning the evolution of pig-meat demand.

To understand the changes in the demand and the new expectations of consumers a survey has been conducted, but previously the attitudes of people have been explored through a qualitative approach based on 3 focus groups discussions. Each one is composed of 10 persons chosen among the consumers of pork according to the place where they buy food (supermarkets or butchers, or other). The first group is located in Brittany where pig production is very important, and where there are pollution problems linked to nitrate concentration in drinkable water. At the opposite side we have a discussion group in Paris, where people are “pure consumers” without any direct disamenity from intensive rearing. The third group is in Bordeaux, an intermediate location, where there are some new possibilities of pig production.

The main public perception of the pork through the focus group meetings, is its low price. However, the industrial production leads to a depreciated image of pig-meat. Four items

explain this depreciation: food safety problems, organoleptic qualities, environmental questions and animal welfare.

Concerning food safety, we have to notice that the fear of illness due to meat consumption is not new. There is in France the example of veal treated with steroid agent and the campaigns carried out by the consumer associations in 1973 and in 1980. The BSE scare is very present (Latouche et al., 1998). Group discussions indicate a strong suspicion vis-à-vis the food chain. For people there is a close link between what animals are eating and food safety. The public perception is that there is necessarily a consistency between the quality of the feeding stuffs and the quality of the meat. In fact there are doubts at every level of the food chain, chiefly at the basis: the feeding.

Concerning the environmental problems, in the Brittany's discussion group, a spontaneous evocation about pig production is: "*the nitrates in drinkable water, the general pollution*" and the "*the image of intensive rearing, antibiotics, the vaccines...the manure and the manure spreading*". Such an image is linked to the situation of this region where problems arising from intensive breeding are objectively important. In the other regions where focus group discussions have been held, there is not such a reaction, but people associate the image of intensive rearing to Brittany.

The last important attribute of pig-meat is animal welfare. In fact, the interest for this attribute is not an interest for the animal itself, but as indicated previously, it is seen as a global indicator of pork safety and taste. To treat the animal with respect is seen as a form of respect of the consumer.

To summarise, the consumer expectations are focused on food safety which is viewed through the food chain. It begins with safe animal feed, including contaminants and residues (veterinary medicines). Organoleptic quality (taste), environmental problems and animal respect are not so great concerns compared to food safety. In fact, there is some confusion in people's mind concerning the relationships between food safety and animal welfare, and implicitly there are consumption jointness leading to methodological problems to assess the importance of each attribute.

According to these results a survey led among 1000 respondents had to weight the four pork chops attributes: food safety, taste, respect of the environment and respect of pigs. Different steps are designed. Firstly respondents have to rank the four attributes. Precise production programs are designed, every program leading to an improvement of a particular attribute. Each program is designed independently of the others. This important point aims at showing

to respondents that each of the four attributes of the pork can be produced independently from each other. Secondly, a contingent valuation scheme aiming at revealing respondents willingness to pay for improvement in pork meat quality is proposed. This paper is focused on this valuation. Before presenting these valuation scheme, the microeconomic framework that was used to analyse the value of pork meat quality improvement is presented. Thirdly, it is asked to the respondent to allocate a given amount of money to the four considered improvement programs. This question is not considered in this paper.

Microeconomic framework

The aim of this section is to provide the theoretical grounds of our contingent valuation study concerning the attributes of pork meat quality attributes. Specifically, we will explicitly consider the substitution of the standard pork meat with the one having given quality attributes.

We will present two polar cases. The first one deals with quality attributes that generate use values for the consumer (taste or safety). The second one deals with attributes that do not directly provide use values to the consumer (protection of the environment or animal welfare). Note that this distinction may sometimes be difficult to maintain. If taste or safety clearly generate use values, environmental or animal welfare aspects may not generate only non-use values. For example, households may propose meat produced in the respect of the protection of the environment to some of their guests because of the prestige engendered by this choice.

First polar case: attributes with use values

Let x_1 denote the quantity of standard pork meat consumed by the consumer under study with p_1 its corresponding price; let x_2 be the quantity of improved pork meat with p_2 its corresponding price. Vector \mathbf{x} denotes the vector of quantities of the K other market goods available to the consumer with \mathbf{w} its corresponding price vector. The utility function $U(\cdot)$ of the consumer is assumed twice continuously differentiable, strictly increasing and strictly quasi-concave $\forall (x_1, x_2, \mathbf{x}')' \in \mathfrak{R}_+^{K+2}$.

The behavior of the consumer is, as usual, formalized by the following program:

$$\underset{x_1, x_2, \mathbf{x}}{\text{Max}} U(x_1, x_2, \mathbf{x}) \text{ s.t. } (x_1, x_2, \mathbf{x}')' \geq \mathbf{0}, \quad p_1 x_1 + p_2 x_2 + \mathbf{x}' \mathbf{w} \leq r,$$

where r denotes the income of the consumer. Focusing on the consumption of pork meats (x_1 and x_2), the following two step maximization procedure will be considered:

$$\underset{x_1, x_2}{\text{Max}} \left[\underset{\mathbf{x}}{\text{Max}} U(x_1, x_2, \mathbf{x}) \right] \text{ s.t. } (x_1, x_2, \mathbf{x}')' \geq \mathbf{0} \text{ and } p_1 x_1 + p_2 x_2 + \mathbf{x}' \mathbf{w} \leq r$$

⇔

$$\text{Max}_{x_1, x_2} v(x_1, x_2, \mathbf{w}, r - p_1x_1 - p_2x_2) \text{ s.t. } (x_1, x_2)' \geq \mathbf{0},$$

where $v(\cdot)$ is the solution of $\text{Max}_{\mathbf{x}} U(x_1, x_2, \mathbf{x})$ s.t. $\mathbf{x} \geq \mathbf{0}$ and $\mathbf{x}'\mathbf{w} \leq r - (p_1x_1 + p_2x_2)$,

$\forall (p_1, p_2, x_1, x_2)$ such that $r - (p_1x_1 + p_2x_2) > 0$. Of course, in what follows, the focus will be on the second step of this maximization procedure. The above assumption concerning $U(\cdot)$ and the standard properties of an indirect utility function ensure that $v(\cdot)$ is strictly increasing in its first entries of x_1 and x_2 , decreasing in \mathbf{w} , strictly increasing in y where $y \equiv r - (p_1x_1 + p_2x_2)$ and strictly concave in x_1 and x_2 . Note that no separability assumption is invoked to decompose the standard utility maximization program as it is done above. This remark is very important when one considers, e.g., taste. A consumer may consume improved pork instead of standard pork because taste is of particular interest to him, at least for specific occasions (reception of friends, ...). However, other white meats may also be as tasty as the improved pork meat. Also, lowering the price of this alternative meat may decrease the consumption of the improved pork meat while leaving unchanged the consumption of standard pork meat. Developing this sort of reasoning would have been impossible under the assumption of separability of pork meats in the consumer's utility function. Note also that this decomposition is standard practice in study considering, e.g., donation behavior.

Given the characteristics of the good under study, more structure will be given to the consumer's problem. Goods 1 and 2 share the common property of being pork meat. But good 2 is assumed to be more desirable than good 1 for the consumer in the sense that it owns an additional quality attribute. One may think of good 2 as a package of two goods: 1) pork meat which is a perfect substitute for good 1 and 2) an associated quality attribute that may be viewed as a sauce or any other accompaniment. A similar reasoning leads us to conclude that it is reasonable to assume that good 1 is cheaper than good 2. In what follows, $p \equiv p_1$ denotes the base price of pork meat and $k \equiv p_2 - p_1 \geq 0$ the (positive) base price of the quality attribute of the improved pork meat. Of course, we have: $p_2 = p + k$. Omitting the \mathbf{w} argument for notational convenience, one can formalize these ideas by using the following assumptions:

$$v(x_1, x_2, r - p_1x_1 - p_2x_2) = u(x_1 + x_2, x_2, r - p_1x_1 - p_2x_2) = u(z, q, r - pz - kq),$$

$$\forall (x_1, x_2)' \geq \mathbf{0} \text{ such that } r - (p_1x_1 + p_2x_2) > 0,$$

where: $z \equiv z(x_1, x_2) \equiv x_1 + x_2$ and $q \equiv x_2$. z represents the total quantity of consumed pork meat. In z , x_1 and x_2 are perfect substitutes. q represents the quantity of consumed quality attribute. It is specific to good 2. Note that this variable is rather different when compared to the quality variable that is usually used. Usually a quality variable measures the level of the quality attribute associated to a good. Here, the quality level is given. It is an intrinsic characteristic of good 2. q measures the consumed quantity of quality attribute. Given these definitions, we have the following equivalences:

$$\underset{x_1, x_2}{\text{Max}} v(x_1, x_2, r - p_1 x_1 - p_2 x_2) \quad \text{s.t.} \quad (x_1, x_2)' \geq \mathbf{0}$$

\Leftrightarrow

$$(1) \quad \underset{x_1, x_2}{\text{Max}} u(x_1 + x_2, x_2, r - p_1 x_1 - p_2 x_2) \quad \text{s.t.} \quad (x_1, x_2)' \geq \mathbf{0}$$

\Leftrightarrow

$$\underset{z, q}{\text{Max}} u(z, q, r - pz - kq) \quad \text{s.t.} \quad z \geq q \geq 0.$$

The last equivalence shows that, according to our assumptions, choosing between good 1 and good 2 is equivalent to choosing on the one hand the total quantity of pork and on the other hand the quantity of quality attribute. However, in the second case, one must be careful that the quantity of quality attribute does not exceed the pork quantity. This is due to the fact that the only way to purchase the quality attribute is to purchase good 2.

The last formulation of the consumer problem is of particular interest since it explicitly isolates q , the "good" to be valued. Indeed, it simply shows that to compute the consumer's willingness to pay for the quality attribute of x_2 one must consider separately the components of this good. As will be seen below, the demands for q and x_2 are equal as they are defined by the programs provided below. Nevertheless, the marginal willingness to pay for x_2 is measured by p_2 whereas the marginal willingness to pay for q is provided by k , at least for interior solutions. This comes from the facts i) that x_2 contains q as well as an equivalent quantity of good 1 and ii) that good 1 alone is always available at price p_1 .

First consider the characterization of the solution (m_1, m_2) to the program:

$$\underset{x_1, x_2}{\text{Max}} v(x_1, x_2, r - p_1 x_1 - p_2 x_2) \quad \text{s.t.} \quad (x_1, x_2)' \geq \mathbf{0}.$$

Assume that this solution is interior. In this case, the first order conditions (FOC) are given by:

$$\Phi_1 \equiv v_1 - p v_y = 0$$

$$\Phi_2 \equiv v_2 - (p+k)v_y = 0,$$

where indices denote derivatives and all function are computed at (m_1, m_2) , characterize the solution (m_1, m_2) . The second order conditions (SOC):

$$\Phi_{11} \equiv v_{11} - 2pv_{1y} + (p)^2 v_{yy} < 0,$$

$$\Phi_{22} \equiv v_{22} - 2(p+k)v_{2y} + (p+k)^2 v_{yy} < 0,$$

$$\Phi_{22} \equiv v_{22} - (p+k)v_{1y} - pv_{2y} + (p+k)pv_{yy} \text{ and}$$

$$\Delta \equiv \Phi_{11}\Phi_{22} - (\Phi_{12})^2 > 0.$$

The keystone of this analysis is the relationship that exists between the consumption of good 1 and that of good 2. It determines the nature of the consumption of q . This will be shown below. Using the standard version of the envelope theorem, it is easily shown that:

$$\frac{dm_2}{dr} = \frac{1}{\Delta} (\Phi_{12}\Phi_{1r} - \Phi_{11}\Phi_{2r})$$

and:

$$\frac{dm_1}{dr} = \frac{1}{\Delta} (\Phi_{12}\Phi_{2r} - \Phi_{22}\Phi_{1r}),$$

where: $\Phi_{1r} \equiv v_{1y} - pv_{yy}$ and $\Phi_{2r} \equiv v_{2y} - (p+k)v_{yy}$. Similarly, it can be shown that:

$$\frac{dm_2}{dp_2} = \frac{dm_2}{dk} = \frac{v_y\Phi_{11}}{\Delta} - m_2 \frac{dm_2}{dr} = \frac{dh_2}{dk} - m_2 \frac{dm_2}{dr} = \frac{dh_2}{dp_2} - m_2 \frac{dm_2}{dr},$$

where h denotes an Hicksian demand function. According to our preceding assumptions and results, one confirms that:

$$\frac{dh_2}{dp_2} = \frac{v_y\Phi_{11}}{\Delta} < 0.$$

Pursuing the analysis, one shows that:

$$\frac{dm_1}{dp_2} = \frac{dm_1}{dk} = -\frac{v_y\Phi_{12}}{\Delta} - m_2 \frac{dm_1}{dr} = \frac{dh_1}{dp_2} - m_2 \frac{dm_1}{dr} = \frac{dh_1}{dp_2} - m_2 \frac{dm_1}{dr}.$$

This equation shows that dh_1/dk has the opposite sign of that of Φ_{12} . At this point, it is difficult to say anything about the sign of this quantity. In order to analyze this quantity consider the following program:

$$\text{Max } v(x_1, \bar{x}_2, \bar{r} - p_1x_1) \text{ s.t. } x_1 \geq 0,$$

where: $\bar{x}_2 = m_2(p_1, p_2, r)$ and $\bar{r} = r - p_2\bar{x}_2$. Let \bar{m}_1 denote the solution of this program.

Standard comparative statics results lead to:

$$\frac{d\bar{m}_1}{-d\bar{x}_2} + p_2 \frac{d\bar{m}_1}{d\bar{r}} = \frac{d\bar{m}_1}{-d\bar{x}_2} + (p+k) \frac{d\bar{m}_1}{d\bar{r}} = \frac{\Phi_{12}}{\Phi_{11}}.$$

This formulae gives the effect on the purchase of good 1 of the rationing of the marginal unit of good 2. It describes what would happen if the consumer were free to choose his consumption of pork meat excepted that he cannot purchase the least unit of good 2 he would like to purchase.

Recognizing that good 1 and good 2 are both pork meats, it can be assumed that these goods are Hickian q-substitutes, *i.e.* it can be assumed that the consumer will actually substitute good 1 for good 2:

$$\frac{d\bar{m}_1}{-d\bar{x}_2} + p_2 \frac{d\bar{m}_1}{d\bar{r}} \geq 0.$$

Similarly, recognizing that the consumer wanted to purchase the last unit of good 2 not only because good 2 is pork meat but because it also has a well-defined quality attribute, it can be assumed that the substitution of good 1 for good 2, *i.e.* it can be assumed that this substitution will be less than one for one:

$$\frac{d\bar{m}_1}{-d\bar{x}_2} + p_2 \frac{d\bar{m}_1}{d\bar{r}} < 1.$$

Indeed, without rationing the consumer would have chosen good 2 instead of good 1 because of the purchase of good 2 implies the purchase of q . Note that these assumptions imply that the amount of money saved due to the rationing is only partly used to purchase good 1. Assuming in a rough approximation that the demand for meat is inelastic, it can be concluded that the consumer will buy one unit of meat to replace the last unit of good 2 he wanted to purchase. If the consumer has strong preference for pork, he may essentially purchase good 1. However, if the fact that he wanted to purchase one unit of good 2 means that he has strong preferences for q , he may essentially purchase meat that is not pork meat but that has a quality attribute close to q . For example, he may substitute tasty chicken meat for tasty pork meat.

Returning to our original question, these assumptions appear very important since, with $\Phi_{11} < 0$ they imply that $\Phi_{12} \leq 0$ and $\Phi_{11} - \Phi_{12} < 0$. In terms of responses of the Hicksian demand function of good 1 with respect to k this finally implies that:

$$\frac{dh_1}{dk} = -\frac{v_y \Phi_{12}}{\Delta} \geq 0 \quad \text{and:} \quad \frac{dh_1}{dk} + \frac{dh_2}{dk} = \frac{d(h_1 + h_2)}{dk} = \frac{v_y (\Phi_{11} - \Phi_{12})}{\Delta} < 0.$$

This simply implies that good 1 and good 2 can be assumed as Hicksian substitutes and that the quality attribute stimulates the consumption of pork meat. Indeed, denoting by (m_z, m_q) the solution of:

$$\text{Max}_{z, q} u(z, q, r - pz - kq) \quad \text{s.t. } z \geq q \geq 0,$$

it can readily be shown that, for interior solutions:

$$m_q(p, k, r) = m_2(p_1, p_2, r) \quad \text{and} \quad m_z(p, k, r) = m_1(p_1, p_2, r) + m_2(p_1, p_2, r).$$

Furthermore, the same equations apply for the corresponding Hicksian demand functions.

Thus, it can be shown that:

$$0 \geq \frac{dh_z}{dk} > \frac{dh_q}{dk}.$$

This means that, according to our assumptions, z and q appear complementary.

Considering that the share of pork expenditures in r are very small and that meats generally appear as normal goods, it can be assumed that the Marshallian price effects have the sign of the Hicksian price effects, *i.e.* that:

$$\frac{dm_2}{dk} < 0 \quad \text{and} \quad \frac{dm_1}{dk} \geq 0.$$

However, due to the income effects it is difficult to determine the Marshallian price effect of k on total consumption.

Second polar case: attributes with non use values

In the case of attributes with non use values, the purchase of improved goods can be explained according to donation mechanism. Consumer purchasing pork meat produced in the respect of the environment at higher prices than standard pork may decide to do so in order to provide "private subsidies" to producers respecting the environment. This kind of behaviour has been analyzed by Cornes and Sandler (1984, 1994). Here, Cornes and Sandler models are adapted in order to take into account the specific structure of the problem. In addition, the case of impure altruism (Andreoni, 1990) is considered since it appears to be important for designing contingent valuation surveys (Nunes and Schokkaert, 2001).

Assuming that good 2 is purchased for donation purposes, program (1) can be rewritten as:

$$(2) \quad \text{Max}_{x_1, x_2} u(x_1 + x_2, s(kx_2 + G^-), w(kx_2), \mathbf{w}, r - p_1x_1 - p_2x_2) \quad \text{s.t. } (x_1, x_2)' \geq \mathbf{0}.$$

Function $s(\cdot)$ represents the effect of the public good provision in the considered consumers total utility function $v(\cdot)$ and G^- the sum of donations from the other consumers. Function $w(\cdot)$ represents the warm glow effect. In this case goods 1 and 2 are assumed to have identical

use effects, their only difference comes from the fact that the production process of the second one respect the environment. Using the same notations as above, this program can be rewritten as:

$$(2a) \quad \underset{z, q}{\text{Max}} u(z, s(kq + G^-), w(kq), \mathbf{w}, r - pz - kq) \text{ s.t. } q \geq 0 \text{ and } z \geq q.$$

This program can be compared to the one that would occur if the consumer was able to directly give his contribution. Let g denote this contribution. In this case we have:

$$(2b) \quad \underset{z, g}{\text{Max}} u(z, s(g + G^-), w(g), \mathbf{w}, r - pz - g) \text{ s.t. } g \geq 0 \text{ and } z \geq 0.$$

According to this program, donation g and consumption of z are only linked by income effects. Let $g^* > 0$ and $z^* > 0$ denote the solutions of the preceding program.

Indeed the direct and indirect donation programs (2a) and (2b) are equivalent as long as the constraint $z \geq q$ is not binding. In this case we have:

$$g^* = km_q = km_z, \quad z^* = m_z = m_2 + m_1 \text{ and } \frac{dm_q}{dk} = -1 = \frac{dm_z}{dk} = \frac{dm_2}{dp_2} = -\frac{dm_1}{dp_2}.$$

The fact that the constraint $z \geq q$ is not binding means that the consumer purchase enough good 2 to contribute to the public good as they would if a direct donation mechanism was available. In this case, his consumptions of good 2 and 1 are defined by:

$$m_2 = m_q = \frac{g^*}{k} \text{ and } m_1 = m_z - m_q = z^* - m_2.$$

As long as $z \geq q$ is not binding m_z doesn't depend on k . Good 2 is purchased only to provide the optimal contribution to the public good. Good 1 purchases are simply adjusted in order to complete good z consumption. As k increases, purchases of good 2 decreases and those of good 1 increases so that $m_1 + m_2$ is constant.

The constraint $z \geq q$ is binding if k is not sufficient for the consumer to provide a contribution equal to g^* without modifying his consumption of z . In this case we have:

$$z^* < \frac{g^*}{k}$$

and good 1 is not purchased. The consumer faces a trade-off between providing the contribution he would like to (g^*) and purchasing good z above the level he would like (z^*). However, it is unlikely that consumers would increase their purchases of pork meat in order to provide subsidies to the pork producers who respect the environment.

Bidding scheme design for the valuation of pork meat quality improvement

Both polar cases lead to similar patterns in term of pork meat consumption. Standard pork meat may not be purchased if improved pork meat is cheap enough when compared to standard pork meat. Both standard and improved pork meats may be purchased if improved pork meat is more expensive. Improved pork meat may not be purchased if it is too expensive.

If the effect of attributes with use values dominates, improved pork meat is substituted for standard pork meat because it provides more utility as a consumed good, i.e. for taste or safety reasons. If the effect of attributes with non-use values dominates, improved pork meat is mainly purchased to provide a contribution to a public good, i.e. the protection of the environment or respect of animal welfare.

In order to take into account both kinds of behaviour, the contingent valuation scenario was designed as a pork chop purchase. Respondents had to choose between a standard pork chop at 40 French Francs (6.10 Euros) and an improved one. The latter was proposed at an increasing price (40, 44, 47, 49, ..., 80 French Francs). At each step the respondent was asked if he would never, sometimes, often or always chose to purchase the improve chop. The process was interrupted when the respondent declared that he would never purchase the improved chop. Two specific prices of the improved pork were analysed: the higher price above which the respondent would only buy improved pork (bid1) and the lower price beyond which he would never buy improved pork (bid2).

The advantage of this interview method is threefold. Firstly, it is close to standard practice for the respondents. Consumers face similar choices when purchasing meat or other products in supermarkets. Second, all respondents have the same reference, i.e. standard pork meat, when revealing their willingness to pay for improved pork meat. Indeed the standard pork meat price is considered as a natural reference in the adopted bidding scheme. Finally, the results of the questionnaire can be used to analyse more precisely the substitution pattern of standard meat consumption for improved meat consumption. This is essential for understanding the consumers willingness to pay for pork meat quality improvements as well as for analysing the potential effects of the introduction of labelled pork meat in the French market. In relation to this last point, respondents were asked if and how they would modify their pork chops purchases at different points of the bidding process

Ranking results

At the beginning of the survey, respondents have to rank the four programs proposed to improve a particular attribute. To improve the food safety of pork a program “without

additives” is proposed ; to improve the taste of pork the program “local breed” is proposed ; to improve the respect of the environment a program “without manure” is proposed ; to improved the pig welfare a program “more space” is proposed.

Those programs are presented as independent from each other, so that respondents can rank them independently according to their preferences. Figure 1 shows the rank given to each program by respondents. Tables 1 and 2 both show the distribution of the rankings. The main point of these figure and tables is that 62 % of the respondents rank food safety first. As expected this attribute remains the most important concern of respondents. One third of the respondents rank taste second ; the third rank is for environment and the last one is for pig welfare. This result was expected as a consequence of the actual French context, particularly the BSE crisis. A comment can also be made on the ranking of animal welfare: one third of the respondents rank it last, but 15% rank it first. This shows the paradoxical behaviour of respondents toward this attribute.

The econometric model estimated here is a ranked ordered logit model as presented in Beggs and al. (1981) and in Koop and Poirier (1994). The details of the econometric models is briefly presented here. According to the standard random utility framework, the utility provided by the k^{th} attribute for consumer i is given by:

$$U_{ki} = V_{ki} + \varepsilon_{ki} \text{ where } E[\varepsilon_{ki}] = 0.$$

In order to write the likelihood function of a given observation we denote by $k(r)$ the function that gives the number of the attribute ranked at the s^{th} position. Thus, the ranking $k(1), k(2), k(3), k(4)$ is chosen if $U_{k(1)} \geq U_{k(2)} \geq U_{k(3)} \geq U_{k(4)}$.

As shown by Beggs *and al.* (1981), the likelihood function of this model has a tractable form if ε_{ki} is supposed to follow a Gompertz distribution and under to the independence irrelevance alternative property $E[\varepsilon_{ki}\varepsilon_{ij}] = 0$. Indeed the probability of observing the ranking $k(1), k(2), k(3), k(4)$ is given by:

$$\Pr_i[k(1), k(2), k(3), k(4)] = \prod_{s=1}^3 \left(\frac{\exp(V_{k(s)i})}{\sum_{r=s}^4 \exp(V_{k(r)i})} \right).$$

In this respect this ranking ordered model can be seen as a simple generalisation of the multinomial logit model. The determinist part of the utility function $U_{k(s)i}$ only depends on the respondent characteristics. It is defined as:

$$V_{k(s)i} = \mathbf{z}_i' \mathbf{b}_{k(s)}$$

Where, \mathbf{z}_i is a vector of variables describing the respondent and $\mathbf{b}_{k(s)}$ the vector of parameter associated to quality attribute $k(s)$. Since, the four vectors of parameters are not identifiable, the food safety attribute was chosen as the reference, i.e. the constraint $\mathbf{b}_{k(s)} = \mathbf{0}$ was imposed. Results are provided in Table 3. The prediction rate of the model is rather poor. Food safety is mostly ranked first, so that most of the significant estimated parameters are negative. The presence of children under 15 leads respondents to rank food safety first. The estimated coefficients for this variable show that the complete ranking of respondents who have young children is food safety, taste, environment and animal welfare. Oldest respondents significantly rank animal welfare after food safety in the complete ranking. Location of the household doesn't affect its ranking of the quality attributes. Respondents consuming pork more than three times per week rank significantly animal welfare and the environment after food safety. This indicates that for respondent with high pork purchases, quality attributes with use values tend to be more important. The interpretation of the effect of income is more difficult.

Excepted for the effects of children and of consumption frequency, the model does not present very interesting results. This certainly means that if food safety is most of the time ranked first, the ranking of the other quality attributes is rather heterogeneous. At least, it cannot easily be predicted by simple socio-demographic variables. This could have been expected since these rankings reflect preferences and not economic choices.

Valuation results

Bid 1 is the extra-cost beyond which respondents reveal to buy both improved and standard pork. Bid 2 is the bid beyond which respondents reveal to consume only standard pork. Figure 2 depicts the distribution of these bids.

Attention is here focused on bid 1. Its mean is 7.12 FF, indicating a rather low willingness to pay for the proposed improvement in pork meat quality. The econometric model estimated to explain this bid is a standard ordered probit model with known thresholds. Table 4 presents the estimation results. The model has a McFadden Rho 2 equal to 0.30 which is rather in this context. The analysis of the predicted bids shows that low bids are best predicted.

The age, income and diploma variables play a significant role which is in accord with our priors. Young respondents as well as less educated respondents tend to have low willingness to pay. Similarly, low income respondents have low willingness to pay. Pork meat being

relatively cheap when compared to more luxury meat such as beef, high income respondents don't have higher bids than median income respondents do.

The effects of pork consumption frequency, of the attribute rankings and of the presence of children under 15 tend to prove that respondents primarily interested by attributes with use values accept higher prices. The more respondents consume pork meat, the higher is their willingness to pay for pork meat quality. Respondents ranking first the taste attribute tend to have high willingness to pay.

Conclusion

The design of the survey seemed to be well accepted by the respondents. Respondents didn't seem to have difficulties for eliciting their rankings and for responding to the valuation questions. At least, the obtained results do not reveal that the questionnaire was not understood. In addition, an open question revealed that the most part of the respondents was i) interested in the survey and ii) find it rather easy.

The mean rankings shows that respondents mostly rank first food safety, as expected. Taste of pork chops is logically ranked second; environment ranked third and animal welfare is ranked fourth. But the differences in the rankings of the attributes other than food safety are rather limited and cannot be explained by standard socio-demographic variables.

Concerning bid 1, the higher price at which respondents declared that they would always consume improved pork, the effects of most of the economic variables are consistent with our priors. The most striking result is the positive impact of the interest in quality attributes generating use values on the global value accepted, as well as the rather low level of accepted increase in prices of pork meat quality. These results are in accord with the limited success of the products of organic farming in France.

The importance of improvement of food safety for most respondents is also striking. This results has to be put back in the French context. The BSE crisis and several food crisis are still in mind of respondents and may explain the first place attributed to food safety. Facing all the main attributes of pork, respondents mainly focused on food safety. This doesn't necessarily means that food safety has to be dramatically improved. This may only mean that French consumers have to be better informed about the sanitary quality of food products.

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Figure 1: Distribution of the ranking of the different programs

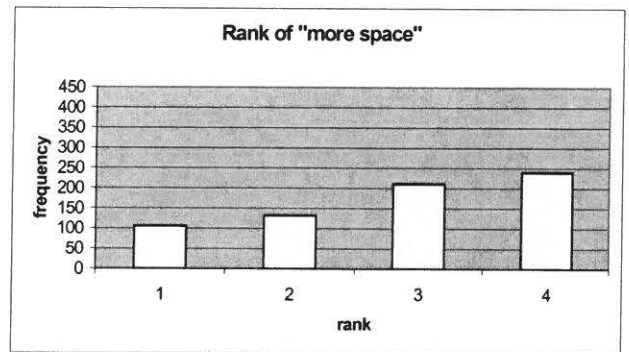
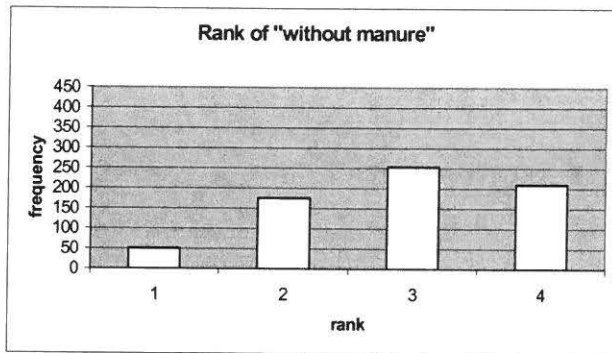
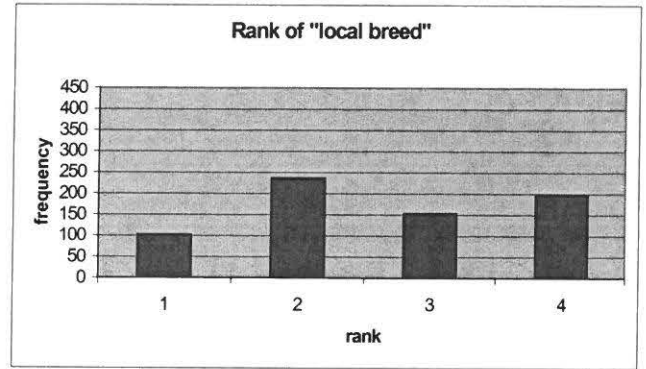
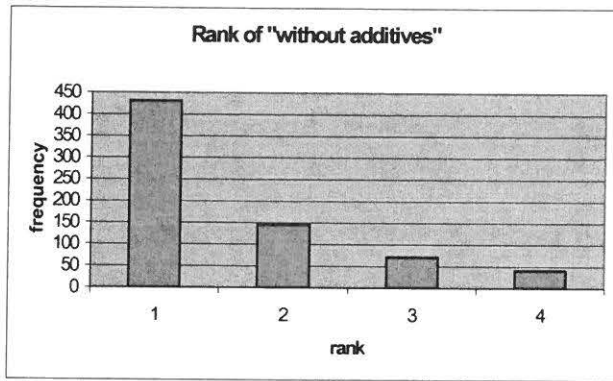


Table 1: Ranks of the different attributes

Ranks	Food safety		Taste		Environment		Animal welfare	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
1	430	62,6	102	14,2	50	7,3	105	15,3
2	145	21,1	235	34,2	175	25,5	132	19,2
3	71	10,3	152	22,1	253	36,8	211	30,7
4	41	6	198	28,8	209	30,4	239	34,8

Table 2: Details of complete rankings

Observed ranking							
1	2	3	4	Freq.	%	Freq.	%
Safe	Taste	Env	Welf	117	17	430	62,6
Safe	Taste	Welf	Env	87	12,7		
Safe	Welf	Taste	Env	41	6		
Safe	Env	Taste	Welf	64	9,3		
Safe	Env	Welf	Taste	61	8,9		
Safe	Welf	Env	Taste	60	8,7		
Taste	Safe	Env	Welf	38	5,5		
Taste	Safe	Welf	Env	33	4,8		
Taste	Welf	Safe	Env	12	1,7		
Taste	Welf	Env	Safe	5	0,7		
Taste	Env	Safe	Welf	8	1,2		
Taste	Env	Welf	Safe	6	0,9		
Env	Safe	Taste	Welf	9	1,3	50	7,3
Env	Safe	Welf	Taste	19	2,8		
Env	Welf	Safe	Taste	9	1,3		
Env	Welf	Taste	Safe	5	0,7		
Env	Taste	Welf	Safe	5	0,7		
Env	Taste	Safe	Welf	3	0,4		
Welf	Safe	Taste	Env	20	2,9	105	15,3
Welf	Safe	Env	Taste	26	3,8		
Welf	Taste	Safe	Env	16	2,3		
Welf	Taste	Env	Safe	7	1		
Welf	Env	Safe	Taste	23	3,3		
Welf	Env	Taste	Safe	13	1,9		

Table 3: Results of the estimation of the rank-ordered logit model

Variables	Coefficient (Standard error)		
	Taste	Environment	Welfare
Intercept	-1.69*** (0.35)	-2.16*** (0.36)	0.008 (0.4)
Age			
18 to 35	-0.15 (0.24)	-0.02 (0.25)	-1.10 (0.27)
35 to 45	ref.	ref.	ref.
45 to 55	0.02 (0.26)	0.03 (0.26)	-0.02 (0.29)
55 to 65	-0.005 (0.25)	-0.02 (0.28)	-0.54*** (0.29)
More than 65	-0.27 (0.31)	-0.28 (0.32)	-0.63*** (0.35)
Région :			
Ile de France	Ref.	Ref.	Ref.
Bretagne, Basse-Normandie, <i>Eure</i> + Pays de la Loire, Poitou-Charentes, <i>Indre-et-Loire</i> , <i>Loir-et-Cher</i> , <i>Eure-et-loir</i>	0.42 (1.15)	1.18 (1.32)	-0.23 (1.57)
Nord-Pas de Calais, Picardie, <i>Seine Maritime</i> +Alsace, Champagne-Ardenne, Lorraine	0.68 (1.14)	1 (1.32)	-0.47 (1.57)
Franche-comté, Rhône-Alpes (sauf Ardèche et Drôme)+Aquitaine, Midi-Pyrénées	0.32 (1.15)	0.99 (1.32)	-0.09 (1.58)
Auvergne, Limousin, Bourgogne, <i>Cher</i> , <i>Indre</i> , <i>Loiret</i> +Languedoc-Roussillon, Provence-Côte d'Azur, <i>Ardèche</i> , <i>Drôme</i>	1.18* (1.15)	1.44* (1.32)	0.07 (1.56)
Size of the living area			
Less than 5 000 inhabitants	0.23 (1.12)	-0.20 (1.30)	0.05 (1.50)
5 000 to 20 000 inhabitants	0.24 (1.12)	-0.17 (1.30)	-0.23 (1.49)
20 000 to 100 000 inhabitants	-0.04 (1.12)	-0.10 (1.30)	0.17 (1.49)
More than 100 000 inhabitants	0.14 (1.11)	-0.04 (1.29)	0.02 (1.50)
Area of Paris	ref.	ref.	ref.
Cons. of pork			
More than 3 times per week	-0.19 (0.28)	-0.41** (0.30)	-0.62*** (0.31)
1 to 3 per week	ref.	ref.	ref.
less than 3 per month	-0.15 (0.17)	-0.02 (0.18)	0.08 (0.18)
People less than 15	-0.26* (0.23)	-0.48*** (0.23)	-1.08*** (0.25)
Diploma			
Without	0.14 (0.24)	-0.01 (0.25)	-0.22 (0.25)
CEP	-0.49*** (0.30)	-0.20 (0.30)	-0.95*** (0.32)
Brevet, BEP, CAP	ref.	ref.	ref.
Bac	-0.68*** (0.23)	-0.41*** (0.23)	-1.04*** (0.24)
Enseignement supérieur	-0.39*** (0.23)	-0.06 (0.23)	-0.73*** (0.24)
Earnings (by heads) :			
0F to 3 000F.	0.13 (0.27)	0.19 (0.27)	-0.26 (0.29)
3 001F. to 4 200F.	0.59*** (0.23)	0.35 ** (0.24)	-0.18 (0.25)
4 201F. to 6 000F.	ref.	ref.	ref.
6 001F. to 7 500F.	-0.14 (0.28)	-0.15 (0.28)	-0.78*** (0.28)
More than 7 501F.	0.29** (0.23)	0.30** (0.23)	-0.61 (0.24)
Rho 2 (Mc Fadden)	0.09		

*** 5 % significant ; ** 10 % significant ; * 15 % significant

Figure 2: Distributions of bids 1 and 2

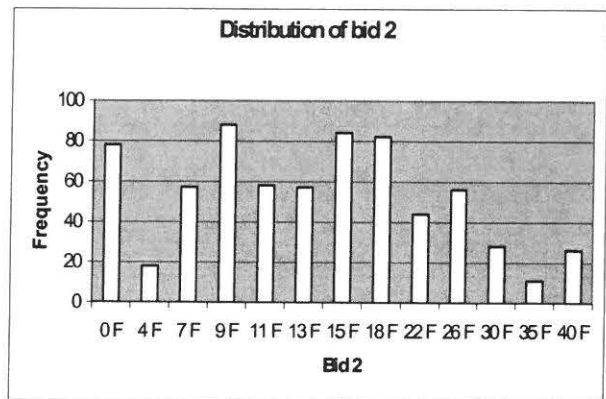
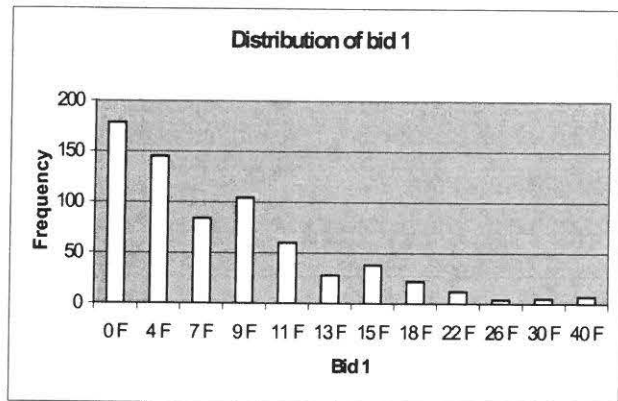


Table 4: Results of the estimation of the ordered probit model with known thresholds

Variables	Coef. (std. err.)
Intercept	6.55* (5.50)
Age	
18 to 35	-3.34* (2.86)
35 to 45	ref.
45 to 55	2.51** (1.91)
55 to 65	0.92 * (0.84)
More than 65	0.50 (0.80)
Région :	
Ile de France	Ref.
Bretagne, Basse-Normandie, <i>Eure</i> + Pays de la Loire, Poitou-Charentes, <i>Indre-et-Loire</i> , <i>Loir-et-Cher</i> , <i>Eure-et-loir</i>	-3.58* (3.32)
Nord-Pas de Calais, Picardie, <i>Seine Maritime</i> +Alsace, Champagne-Ardenne, Lorraine	-1.24 (1.68)
Franche-comté, Rhône-Alpes (sauf Ardèche et Drôme)+Aquitaine, Midi-Pyrénées	-2.839* (2.94)
Auvergne, Limousin, Bourgogne, <i>Cher</i> , <i>Indre</i> , <i>Loiret</i> +Languedoc-Roussillon, Provence-Côte d'Azur, <i>Ardèche</i> , <i>Drôme</i>	-1.72 (2.02)
Size of the living area	
Less than 5 000 inhabitants	-2.24** (1.75)
5 000 to 20 000 inhabitants	-0.37 (0.64)
20 000 to 100 000 inhabitants	-0.86* (0.82)
More than 100 000 inhabitants	ref
Cons. of pork	
More than 3 times per week	0.46*** (0.89)
1 to 3 per week	ref
less than 3 per month	-3.35* (2.80)
People less than 15	3.71** (2.84)
Diploma	
Without	-1.15*** (1.27)
CEP	0.30 (0.80)
Brevet, BEP, CAP	ref
Bac	-0.32 (0.71)
Enseignement supérieur	1.37** (1.07)
Earnings (by heads) :	
0F to 3 000F.	-4.11** (3.39)
3 001F. to 4 200F.	-2.75** (2.36)
4 201F. to 6 000F.	ref
6 001F. to 7 500F.	-0.14 (0.58)
More than 7 501F.	0.16 (0.57)
Program ranked first	
Food safety	Ref
Taste	1.54** (1.04)
Environment	-5** (3.73)
Animal welfare	0.89 (1.16)
Variance	4.22** (0.18)
Rho 2 (Mc Fadden)	0.30

*** 5% significant ; ** 10 % significant ; * 15 % significant