# CONFIDENCE IN THE BEEF PRODUCTION SYSTEM AS A KEY FACTOR TO MITIGATE THE IMPACT OF BSE ON BEEF CONSUMPTION

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## Abstract

Recent food scares in the food market has caused a reduction in consumer's confidence in the food system that it has induced a significant reduction in consumption in a sector, the beef sector that was already characterized by a saturated trend in quantity terms. In this context, all participants in the beef production system are facing to a great challenge, to retrieve consumer's confidence in the food chain and to mitigate the reduction in beef consumption. The aim of the paper is to analyse the impact of consumer's confidence in the food system as well as other factors on the explanation of food consumption reduction. A structural modelling approach has been used to analyse factors affecting the reduction in beef consumption in two different regions characterised by different production systems and different marketing strategies (PGI beef label). Results indicate that main factor explaining the reduction in beef consumption is the confidence in the beef and a positive relation has been found. Moreover, confidence in a product is directly related to the perceived quality offered by farmers and other decision makers on the beef chain, and to the consumer involvement with the product. Therefore, the main implication is that participants in the food chain has to develop adequate communication strategies such as quality labelling in order to increase consumers perceive quality because, higher quality perception will recover consumers' confidence in beef, and therefore, it will mitigate beef consumption reduction.

**Keywords:** food confidence, consumer behaviour, structural equation modelling, beef sector, quality label

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## 1. Introduction

Food markets in developed countries, specially in Europe, are facing different commercial problems mainly related to consumers loss in confidence on the food chain. This lack of consumer confidence has had very important consequences in the food market as it has induced a significant reduction in consumption in a sector that was already characterized by a saturated trend in quantity terms.

In the last years, these problems have been more important in the beef sector in Europe where consumption has been reduced due to the BSE crisis[1]. In this context the beef sector is facing to a great challenge, to retrieve consumers confidence in the food chain. To do that, all participants in the food chain have to reinforce not only product quality systems and controls but also communication strategies to guarantee that food products are safe enough. They have to design the appropriate mechanism to inform consumers about the safety of food products and to persuade them to perceive those food products as safe enough. This strategy can be done through implementing a certification system where the quality label is the way to communicate consumers the safety characteristics of the product. Therefore, the aim of these strategies is twofold, to differentiate the product in this more saturated food market and, to create fidelity towards this labelled products based on a regular and homogeneous quality. If participants in the food chain, using this certification and labelling strategy, succesfully create a positive consumers' perception towards food products they will have an important commercial advantage to survive in the market even in difficult situations motivated by food scares.

Many authors have stated the importance of different product attributes on food consumers's quality evaluation (Bello and Calvo, 1998; Bernues et al., 2001; Bredahl, et al., 1998; Briz et al., 2001; Grewall, 1995; Grunert et al., 1996; Latvala and Kola, 2001; Steenkamp, 1990; Steenkamp and Van Trijp, 1996; Zeithaml, 1988). Food safety is one of the most important attributes nowadays and because of it is a credence attribute (it cannot be observed by consumers either before and after purchasing the product), producers have to guarantee and certify this attribute to consumers if they want to meet their needs. Therefore, the certification of the credence attributes will be very important in order to maintain or mitigate beef consumption reduction due to food safety problems (Álvarez et al., 2001; Calvo, 2001; Cartay, 2001; Fernández et al., 2001; Latvala and Kola, 2001; Stefani and Henson, 2001). One of these certification strategies is the quality labelling.

The objective of this paper is to analyse how important the confidence on the production system is in order to mitigate the reduction in consumption caused by food crises, specially in the in beef sector in Spain. In particular, differences in beef consumption reduction between two Spanish regions (Aragón and Navarra) are studied. Those regions show important differences in their beef production system and in their

[1] The impact of beef consumption reduction has been different among countries, but in all of them it has been high (France (40%), Germany (60%), Italy (42%), Portugal (30%), Spain (35%) AgraEurope, 2001).

retailing distribution strategies. In fact, Aragón has an intensive beef production system and only a small amount of beef production is sold with some of the quality labels. On the other hand, Navarra has an extensive beef production system and approximately half of the beef consumed in the region correspond to beef with some quality label. The most important quality label for beef in Navarra is the PGI "Ternera de Navarra". (Beriáin, 2002). Data come from a survey carried out among beef consumers in both regions.

Thus, the paper is organised as follows. Section 2 presents the survey design and data collection. Section 3 describes the structural equation modelling approach used in this paper. Section 4 discussed main results, and finally Section 5 provides the concluding remarks and possible further refinements.

## 2. Survey design and data collection

Data come from a survey conducted to consumers in two Spanish regions: Aragón and Navarra in March 2001. Aragón was selected because it is a relatively important area of beef production with an intensive system and free of BSE scares. On the other hand, Navarra is also an important area of production with an extensive beef production system and with some BSE cases last year. Aragón has not a PGI beef quality label while in Navarra there exist one and the consumption of beef with this PGI label is around half of total beef consumption in this region (Beriáin, 2002) (Aragón is called in this paper "No PGI label Region or Region 1, and Navarra, "PGI label Region" or Region 2).

Samples in both regions were selected using a stratified random sample of food buyers on the basis of habitat (rural versus urban) and age. Four hundred respondents were randomly selected and personally interviewed in each region. Respondents were the main food purchasers of food products in the household. The first question in the questionnaire was whether the interviewer usually eats meat at home. If the answer was not, he/she was not interviewed. So, only non-vegetarian consumers were considered. This decision does not induce any bias on the results because in Spain the rate of vegetarian consumers is marginal.

In the first part of the questionnaire consumers were asked about their fresh meat consumption patterns: i) how often they eat different meat products (beef, chicken, pork and lamb, ii) current weekly beef consumption, iii) beef attributes perceptions, iv) whether they have reduced beef consumption, v) reasons of this reduction and substitution by other meats, vi) perceived beef consumption expertise. Moreover, they were asked about their perceived concern and guarantee towards beef production and their confidence on food safety of different meats (beef, chicken, pork and lamb). Finally, they were asked about socio-demographic characteristics and lifestyles[2] .

One of the more important diferences observed in consumers behaviour in both regions is the impact of BSE crisis in beef consumption (Table 1). In Aragón, the proportion of consumers who decrease beef consumption is higher than in Navarra (58% and 43%, respectively). However, the original level of beef consumption was similar (76% and 80%, respectively)[3].

[2] See the annex for a definition of the different scales used to measure consumers's perception.
[3] Results are similar to those gathered from secondary data sources.

Table 1. Beef consumption and beef consumption reduction due to BSE[4] in the two Spanish regions

| Beef Consumption | Navarra | Aragón |
|---|---|---|
| Yes | 80% | 76% |
| No | 20% | 24% |
| **Beef consumption reduction** | **Navarra** | **Aragón** |
| Yes | 43% | 58% |
| No | 57% | 42% |

The beef consumption reduction is the key point of this analysis as the main aim is to get some insight on whether confidence in the beef production system, and, indirectly, the quality labelling policy have influenced consumers reduction in beef consumption.

## 3. Methodology. Structural Equation Modelling

The methodological approach used in this paper is based on the structural equation modelling (SEM) (also called covariance structure analysis or latent variable analysis). Structural equation modelling is a multivariate technique that examines a series of dependence relationships simultaneously and it is particularly useful when one dependent variable can be an independent variable in following relationships (Hair et al., 1995). This technique combines aspects of the multiple regression (examining dependence relationships) and the factor analysis (representing unmeasured concepts or factors with multiple variables). The most important aspect to take into account in these models is that they are used as a confirmation of the structural theory behind the analysed phenomenon. As Bizquerra (1989) says, the utility of this modelling lies on its ability to evaluate a theory and not in the possibility to generate it.

The estimation of multiple interrelated dependence relationships is not the single element of structural equation modelling. SEM also has the ability to incorporate latent variables into the analysis. A latent variable is a hypothesized and unobserved concept that can only be approximated by observable or measurable variables. The observed variables are called manifest variables or observable variables (Hair et al, 1999). Each latent variable is related to a set of observable indicator variables, which are assumed to be measured with error. Using standard notation:

$$\eta = B\,\eta + \Gamma\,\xi + \zeta$$

where $\eta$ is a vector of dependent latent variables, B is a matrix of coefficients relating the dependent latent variables one to each other, $\xi$ is a vector of latent independent variables related to $\eta$ by the matrix of coefficients $\Gamma$, and $\zeta$ is a vector of errors in the equations.

Since the $\eta$ latent variables are unobservable, indicators are required to measure them. Thus the structural equation model is associated with two measurement models which take into account errors in the measurement of the $\eta$ and $\xi$ variables. The first one is given by:

[4] One question in the survey identified consumers that had reduced beef consumption due to BSE.

$$x = \Lambda_x \xi + \delta$$

where x is a vector of indicators of the exogenous (independent) latent variables $\xi$, $\Lambda_x$ is a matrix of factor loadings or structural coefficients between the exogenous latent variables and the x indicators; and $\delta$ is measurement error. The second is given by:

$$y = \Lambda_y \eta + \varepsilon$$

where y is a vector of indicators of the endogenous (dependent) latent variables $\eta$; and $\Lambda_y$ is a matrix of factor loadings or structural coefficients between the endogenous latent variables and the y indicators; and $\varepsilon$ is measurement error.

A structural equation model with latent variables can be seen as a composite of two models: a structural model and a measurement model. The structural model represents the relationships among the latent variables across the path diagram. In the path diagram a straight arrow indicates a causal relationship; and a curved arrow represented correlation between constructs, but not causation is implied (Hair et al., 1999). The measurement model specifies the rules of correspondence between manifest and latent variables. This submodel gives information about the reliability of each latent variable for the estimation of the causal relationships and to know if the observed variables serve to measure the latent variables (Jöreskog y Sörbom, 1993).

In the statistical analysis of structural equation models there are two main stages. In the first stage the model is estimated to derive estimates of the parameters that are not specified by the model. Empirical models were formulated using the package AMOS 3.6 and the parameters were estimated using a maximum likelihood function. In the second stage, the model is tested to ascertain whether it fits the data (Poulsen et al., 1996). The evaluation for goodness-of-fit criteria starts with an initial inspection for offending estimates (estimated coefficients in either the structural or measurement models that exceed acceptable limits). Once the model provides acceptable estimates, the goodness-of-fit must then be assessed at several levels: first for the overall model and then for the measurement and structural models separately. In this work the most commonly goodness-of-fit measures have been used: likelihood-ratio chi-square statistic ($\chi^2$), goodness-of-fit index (GFI), root mean residual (RMR), adjusted goodness-of-fit index (AGFI) and comparative fit index (CFI) (Hair et al, 1999). Finally, the interpretation of the model is the most important stage to test whether the proposed model is according to the theory and the hypotheses state at the beginning.

### 3.1. Causal model defined in the study: 'Reduction in beef consumption'

Data to carry out the causal model analysis were collected through a personal survey conducted to consumers in spring of 2001. The causal model proposed in this study is based on the theoretical model of the consumer decision process and behaviour defined by Engel et al., (1993); and on the causal model developed by Henson and Northen (2000) who establish the process by which consumers assess the safety of beef.

In the causal model presented by Henson and Northen (2000) it is attempted to model the relationship between the use of different external indicators and consumer perceptions on beef safety using three latent variables or constructs: the experience of

In general terms, results indicate that important differences between the two regions exist, specially on the main factors determining the confidence in beef. In Navarra, the region with an extensive beef production system and regional quality label, the confidence is determined by the guarantee offered by beef, mainly because consumers feel confident with farmers and public programs. In Aragón, the confidence in beef is not so clearly related to the guarantee offered by farmers' management. Moreover, in both regions, the guarantee offered by farmer practises is more important than guarantee provided in the rest of the food chain to determine the total guarantee offered by beef and therefore, the confidence in beef. These results indicate that hypothesis 3 cannot be rejected.

In Navarra concerns on beef safety can be explained by the guarantee offered by farmers while in Aragón this relation is not significant. These results might be explained by the higher confidence of consumers in Navarra in farmers' management in relation to those in Aragón (less interested in the guarantee offered by their farmers). This difference is based on the mentioned differences between the two production systems and marketing strategies in both regions. However, in both markets it can be observed that as the concern on beef safety increases, concerns on both farmers management and on controls in the food chain also increase (indicating that hypothesis 2 is accepted). Moreover, hypothesis 4 has been accepted in both markets because the concern on beef safety increases as the guarantee offered by beef decreases. Finally, hypothesis 6 has also been accepted because the guarantee has a positive effect on the confidence in beef.

Finally, the reduction in beef consumption can be explained by consumers' involvement with beef in both regions, but this factor has been revealed more important in the case of Aragón. This result means that in Aragón the confidence in beef depends mainly on consumers' product involvement while in Navarra, the guarantee offered by farmers is also an important aspect. In other words, in Navarra, farmers marketing strategy (promotion of beef with PGI quality label) has successfully created a positive consumers acceptability of beef even after the BSE crisis mitigating its effect on beef consumption. Then, the reduction in beef consumption in Navarra, the region with BSE animals, has been lower.

The perception of beef can be explained in both markets by intrinsic and extrinsic attributes, but the former are more important in building consumer valuation; therefore, hypothesis 1 has been accepted. Moreover, beef perception affects significantly the guarantee offered by the beef (hypothesis 5 has been accepted).

Finally, as result of previous statements, hypotheses 7 and 8 have been accepted in both regions. Consumer involvement with beef has a positive effect on confidence in beef and the impact of beef confidence on beef consumption reduction is also positive, that is, decreases in beef confidence induce a reduction in beef consumption.

## Table 3. Results of the causal model of the reduction in beef consumption.

| | | | NAVARRA | | | ARAGON | | |
|---|---|---|---|---|---|---|---|---|
| **Latent variable** | **Latent variable** | **Observable variable** | **SRW** | **S.E.** | **C.R.** | **SRW** | **S.E.** | **C.R.** |
| Intrinsic attributes | | Feeding type | 0.47 | * | * | 0.54 | * | * |
| | | Animal age | 0.54 | 0.220 | 5.493 | 0.60 | 0.191 | 6.041 |
| | | Health benefit | 0.69 | 0.208 | 6.179 | 0.58 | 0.166 | 5.892 |
| | | Expert ecommendation | 0.69 | 0.239 | 6.198 | 0.57 | 0.175 | 5.835 |
| | | Protein content | 0.71 | 0.221 | 6.253 | 0.67 | 0.175 | 6.423 |
| Extrinsic attributes | | Fat content | 0.57 | * | * | 0.47 | * | * |
| | | Label | 0.63 | 0.189 | 6.080 | 0.68 | 0.300 | 5.264 |
| | | Designation of origin | 0.56 | 0.116 | 5.743 | 0.51 | 0.243 | 4.670 |
| | | Geographic origin | 0.55 | 0.152 | 5.659 | 0.47 | 0.225 | 4.426 |
| Guarantee offered by farmer management | | BSE | 0.54 | 0.100 | 7.388 | 0.77 | 0.098 | 10.964 |
| | | Public information | 0.58 | 0.099 | 8.031 | 0.69 | 0.088 | 9.766 |
| | | Hormones | 0.69 | 0.095 | 9.428 | 0.70 | 0.090 | 9.919 |
| | | Animal feeding | 0.78 | * | * | 0.76 | * | * |
| | | Farmers management | 0.55 | 0.093 | 7.572 | 0.65 | 0.091 | 9.122 |
| | | Antibiotics | 0.50 | 0.094 | 6.808 | 0.65 | 0.088 | 9.034 |
| | | Public controls | 0.51 | 0.101 | 6.992 | 0.71 | 0.097 | 9.960 |
| Guarantee offered by the food chain | | Veterinary control | 0.78 | 0.381 | 5.796 | 0.81 | 0.193 | 7.493 |
| | | Slaughterhouse contr | 0.87 | 0.440 | 5.381 | 0.80 | 0.187 | 7.525 |
| | | Shops manipulation | 0.42 | * | * | 0.56 | * | * |
| Concerns on farmer management | | BSE | 0.65 | * | * | 0.54 | * | * |
| | | Public information | 0.59 | 0.110 | 7.327 | 0.55 | 0.161 | 5.786 |
| | | Hormones | 0.60 | 0.096 | 7.404 | 0.66 | 0.179 | 6.472 |
| | | Animal feeding | 0.71 | 0.092 | 8.451 | 0.71 | 0.166 | 6.698 |
| | | Farmers management | 0.53 | 0.102 | 6.654 | 0.53 | 0.160 | 5.643 |
| | | Antibiotics | 0.59 | 0.106 | 7.305 | 0.55 | 0.152 | 5.763 |
| | | Public controls | 0.64 | 0.106 | 7.782 | 0.60 | 0.173 | 6.092 |
| Concerns on food chain practises | | Veterinary control | 0.71 | * | * | 0.80 | * | * |
| | | Shops manipulation | 0.72 | 0.149 | 7.479 | 0.64 | 0.124 | 6.733 |
| Confidence in beef | | Lamb confidence | 0.45 | 0.091 | 5.396 | 0.49 | 0.040 | 7.203 |
| | | Pork confidence | 0.48 | 0.103 | 5.665 | 0.61 | 0.040 | 9.342 |
| | | Beef confidence | 0.82 | * | * | 0.95 | * | * |
| Interest in cooking | | New recipes | 0.65 | * | * | 0.83 | * | * |
| | | Like cooking | 0.63 | * | * | 0.76 | * | * |
| Active | | Like travelling | 0.49 | * | * | 0.55 | * | * |
| | | GMF_health concern | 0.56 | * | * | 0.56 | 0.103 | 6.542 |
| | | Enjoy cuisine | | | | 0.55 | 0.119 | 6.748 |
| | | Social concern | | | | 0.64 | 0.114 | 7.640 |
| Eating concerns | | Healthy diet | 0.56 | 0.080 | 7.112 | 0.68 | 0.091 | 8.261 |
| | | Diet_health concern | 0.74 | 0.097 | 8.739 | 0.63 | 0.116 | 9.547 |
| | | Fruit_veg. consumpt | 0.47 | 0.075 | 6.096 | 0.59 | 0.096 | 7.369 |
| | | Food intake informat. | 0.76 | * | * | 0.67 | * | * |
| Consumer's beef perception | ←Intrinsic attributes | | 0.58 | * | * | 0.57 | * | * |
| Guarantee offered by farmers | ←Beef safety concerns | | -0.54 | 0.060 | -5.149 | -0.33 | 0.070 | -2.896 |
| Guarantee offered by beef | ←Guarantee farmer manag | | 0.52 | * | * | 0.49 | * | * |
| | ←Guarantee food chain | | 0.23 | * | * | 0.35 | * | * |
| | ←Cons beef perception | | 0.64 | * | * | 0.62 | * | * |
| Beef safety concerns | ←Concerns farmer manag | | 0.59 | * | * | 0.44 | * | * |
| | ←Concerns food chain | | 0.57 | * | * | 0.63 | * | * |
| Consumer's involvement with beef | ←Eating concerns | | -0.68 | 0.156 | -2.096 | 0.40 | 0.318 | 1.302 |
| | ←Active | | 0.58 | 0.211 | 1.695 | -0.36 | 0.395 | -1.142 |
| | ←Interest in cooking | | 0.24 | 0.085 | 1.247 | 0.11 | 0.053 | 1.664 |
| | | Consump. frequency | 0.60 | * | * | 0.86 | * | * |
| | | Consump. quantity | 0.63 | * | * | 0.68 | * | * |
| | | Expertise | 0.33 | 0.057 | 3.950 | 0.74 | * | * |
| Confidence in beef | ←Cons involvem. w. beef | | 0.52 | 0.160 | 4.887 | 0.66 | * | * |
| | ←Guarantee beef | | 0.51 | 0.040 | 4.281 | 0.45 | 0.060 | 4.944 |
| Reduction in Beef Consumption | ←Confidence in beef | | -0.52 | 0.066 | -6.001 | -0.68 | 0.027 | -10.746 |
| | **CRONBACH' ALPHA VALUES** | | **GOODNESS-OF-FIT INDEX** | | | | | |
| | **NAVARRA** | **ARAGON** | **NAVARRA** | | | **ARAGON** | | |

| | | | |
|---|---|---|---|
| Beef perception= 0.797<br>Guarantee beef=0.864<br>Concern beef=0.755<br>Confidence in beef=0.703<br>Involvem with beef=0.692 | Beef perception=0.783<br>Guarantee beef=0.860<br>Concern beef=0.838<br>Confidence in beef=0.615<br>Involve . Beef=0.695 | $\chi^2(898)=2154.22$<br>p=0.000<br>GFI= 0.697<br>AGFI= 0.666<br>RMR= 0.231<br>CFI= 0.610 | $\chi^2(988)=2437.01$ p=0.000<br>GFI= 0.675<br>AGFI= 0.644<br>RMR= 0.223<br>CFI= 0.564 |

* Regression weights have been fixed to 1 to get the identification of the model

## 5. Concluding remarks

Food scares that have taken place in the last years have increased consumers' concerns on food safety. The short-run impact has been the reduction in the consumption level of some food products directly related to those food scares. Beef is a good example in Europe as well as in Spain. In last months, public and private promotion strategies have been oriented to the creation of guarantee labels (traceability) to overcome consumers' concerns. This paper has investigated main determinants of beef consumption reduction to assess the potential impact of such programs to recover consumers' confidence in beef, and therefore, consumption.

A structural modelling approach has been used to analyse all interrelationships in the consumer decision process. Two different regions in Spain have been considered to take into account different production systems and different marketing strategies followed by farmers. Results indicate that confidence in a product is directly related to the perceived quality offered by farmers and other decision makers involved at different levels of the beef chain. The second main factor explaining confidence is the consumer involvement with the product being consumed although its relative importance is lower. The main implication of the paper is that persuading in the development of a quality label and adequate communication strategies about how the meat is produce could recover consumers' confidence in beef in the near future and therefore, consumption. This result is more evident in the region where this quality label already exists.

Further research in other regions or countries with alternative production systems could reinforce the idea that unless consumers perceive a safe guarantee related to beef production and marketing systems they do not increase their consumption. Finally, alternative methodologies could be used to check for results presented in this paper.

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Annex

Scales employed to measure different perception questions

*Scale to measure consumers' lifestyles:*

Consumers were asked to rate their agreement with the following statements (1=agree strongly; 2=agree; 3=Indifferent; 4=disagree; 5=disagree strongly):

I periodically control my health status (Health control)
I follow a healthy diet (Healthy diet)
I practice sports every week (Sports regularly)
I enjoy good food and cuisine (Enjoy cuisine)
I am concerned on social problems (Social concern)
I frequently eat fruit and vegetables (Fruit&Veg consumption)
I disposal garbage in different containers (Selective garbage disposal)
I am concern on the impact of the diet in my health (Diet-health concern)
I moderately eat red meat (Moderate meat consumption)
I like cooking (Like cooking)
I like trying new recipes (new recipes)
I keep myself informed on food intake (food intake information)
I like travelling (Like travelling)
I usually eat out of home (eating away from home)
I concern on Genetically Modified Food (GMF) effects on human health (GMF-health concerns)

*Scale to measure consumers' product attributes acceptability:*

Consumers were asked to rate their agreement with the following statements (1=agree strongly; 2=agree; 3=Indifferent; 4=disagree; 5=disagree strongly):

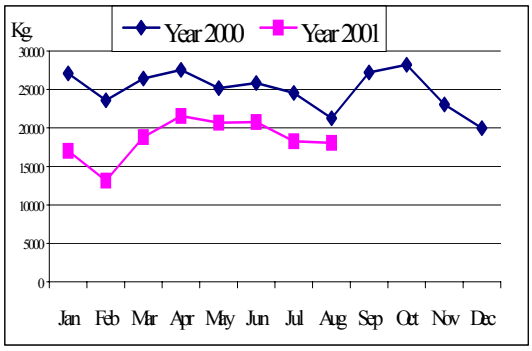
Price
Geographic origin
Feeding type of animal (Feeding type)
Breed
Organic production
Health guarantee
Label
Fat content
Animal age
Freshness
Designation of Origin (DO)
Protein content
Health benefit
Expert recommendation

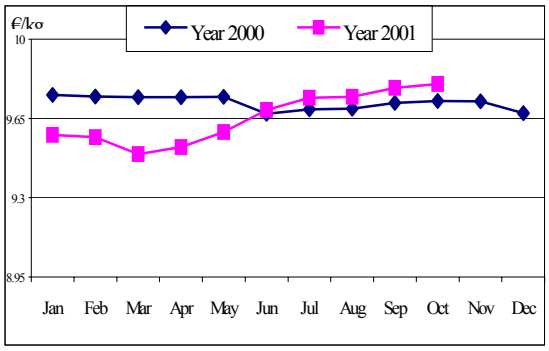
*Two scales to measure consumers' guarantee towards beef production and consumers' concerns towards beef production:*

Consumers were asked to rate their agreement with the following statements (1=agree strongly; 2=agree; 3=Indifferent; 4=disagree; 5=disagree strongly):

EEB risk (EEB)
Public information (Public information)
Hormones (Hormones)
Animal feeding (Animal feeding)
Farmers' management (Farmers' management)
Antibiotics (Antibiotics)
Veterinary inspection in the farm (Veterinary control)
Slaughterhouse controls (Slaughterhouse controls)
Public control and inspection (Public controls)
Manipulation and refrigeration in shops (Shops manipulation)

Figure 1A. Evolution of beef consumption and prices in Spain




Source: Ministerio de Agricultura, Pesca y Alimentación de España  Source: Boletín del Información Comercial Española (ICE)