FOOD SAFETY INFORMATION AND MEAT DEMAND IN SPAIN

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Abstract

This paper analyses the impact of food safety information about the "mad-cow" crisis on the demand for different types of fresh meat and fish in Spain. The theoretical model explicitly incorporates food safety information in the consumers' utility function, from which demand equations are obtained. Two alternative functional forms have been considered, the standard AIDS and the Generalized Almost ideal Demand System (GAIDS) in order to overcome the problem of incorporating demand shifters in the traditional AIDS model. The food safety information has been incorporated into the demand function through a weighted information index built on the basis of the published news related to the mad-cow disease in the most popular Spanish newspaper. The comparison of elasticities from both models suggests that GAIDS elasticities are more consistent with the characteristics of meat and fish markets in Spain. Moreover, mass media information on BSE has had a statistically significant but small effect on the consumption of the different meat products in Spain.

Key words: meat consumption, food safety information, BSE, demand systems, GAIDS

JEL classification: Q11, C32, D12

1. Introduction

Recent food scares, specially the discovery of Bovine Spongiform Encephalopathy (BSE), have increased consumers' concerns on food safety, with significant reductions in the consumption of affected products. In Spain, the first Spanish BSE case was diagnosed on November 22, 2000, being the second one diagnosed two weeks later. Both cases took place in Galicia (North-West). Since then the number of confirmed cases has notably increased reaching its peak in 2003 with 167 cases. The total number of confirmed cases in Spain from November 2000 to the end of 2006 was 681; ranking fifth in the E.U. Up to now, the incidence in humans has been very limited. More precisely three cases have been confirmed. Beef consumption slightly decreased since 1994, having recovered in 1999 and 2000 (MAPA, 2004). However, this recovering process ended with the first case of BSE in Spain in October 2000. Between 2000 and 2001, beef consumption decreased annually by 12%.

However, in the very short-run the impact was substantially large (beef consumption decreased from 22 million Kg in October 2000, to 15.8 million Kg in December 2000).

These figures suggest that, in addition to the traditional economic factors (income and prices), food safety concerns may have a potentially significant impact on consumers' demand for meat. Angulo and Gil (2007), in a nation-wide survey, showed that, in Spain, 63% of respondents declared to be more concerned about food safety than five years ago. If only the problem per se is considered, this effect seems to be overestimated and some other factors have to be found to explain it. The most important is, without any doubt, the mass media coverage of recent food scares and their influence on consumers' behavior. In the same study, 52% of respondents recognize that mass media exert a strong influence in their shopping and consumption habits. Therefore, understanding the consumers' responses to food safety information is important to policy analysts and the agro-food industry.

The objective of this study is to analyze food safety information effects on meat demand in Spain. More precisely, we will focus on the impact of the information on BSE published in newspapers on the demand for beef and other substitutes. Although there have been some recent studies on the impact of food safety information reported in the media as well as product claims on food demand, such as Verbeke and Ward (2001), Burton and Young (1996), Piggott and Marsh (2004), among others, this study is the first attempt to tackle with this issue in Spain.

To achieve this objective, we have developed a theoretical model that explicitly incorporates food safety information in the consumers' utility function and from which demand equations are obtained. As the appropriate functional form for such equations, and in order to overcome the problem of incorporating demand shifters in the traditional

AIDS model (i.e. the model estimates of real variables are sensitive to the choice of scaling of the exogenous variable) (Alston et al. 2001) and to preserve the desirable theoretical property of being "closed under unit scaling" (CUUS), the Generalized Almost Ideal Demand System (GAIDS) has been adopted (Bollino 1987). Moreover, the instrument to incorporate the food safety information into the demand function has been the construction of a weighted information index based on the published news related to the "mad-cow" disease in the most popular Spanish newspaper "El País".

This paper is organized as follows. Next, the theoretical and the econometric frameworks are explained. After describing the data used in our analysis, the main results are presented. Finally the paper ends with some concluding remarks.

2. Theoretical and econometric frameworks

In the neoclassical economic theory, the consumer's utility is specified as a function of quantities of goods and services purchased assuming that consumers have perfect information and that their tastes and preferences are constant, which is not always the case in the real world. In this context, incorporating food safety information in the derived demand function can be misleading as the demand itself is derived from assuming tastes and preferences as given. Following Piggott and Marsh (2004), consumer's utility is assumed to depend on the quantities of goods consumed (x_i), as well as on product quality (q_i) which is a function of public information indexing food safety concerns related to a specific product. This public information may contain food recalls or other issues related to food safety issues (i.e. the BSE). It is also assumed a negative relationship between public information and perceived quality.

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Let us assume that we have n goods, one of which (i.e. good 1) is affected by a food scare and public information is available. Thus, the consumer's optimization problem may be stated as:

$$Max\ U = U\left[x, q(I)\right]$$

$$S.t.\ p'X + I\,C\ \leq y \tag{1}$$

where: X is n x 1 vector of quantities consumed.

q(I) is n x 1 vector of expected qualities being I the set of public information indexing food safety concerns. Larger values of I reflect lower expected quality of the i-th product, that is, $\dfrac{\partial q_i}{\partial I_i} \prec 0$ and $\dfrac{\partial q_i}{\partial I_j} = 0\ \ \forall j \neq i$.

p is a victor of prices.

C is the cost of searching information.

y is the total expenditure.

As information is taken to be publicly available, costs of obtaining information is assumed to be zero. Thus equation (1) can be rewritten as

$$Max\ U = U\left[x, q(I)\right]$$

$$S.t.\ p'x\ \leq y \tag{2}$$

To solve this maximization problem we define the following Lagrange function:

$$L = U\left[x,\ q(I)\right] + \lambda(y\text{-}p'x) \tag{3}$$

where λ is the Lagrange multiplier. By deriving (3) with respect to X and λ, we get the first order conditions from which the Marshalian demand functions are obtained.

$$X^m = f(p, y, q(i)) \tag{4}$$

where the demand of each product depends on total expenditure, prices and the quality of the product.

The dual cost minimization problem is:

$$\min p'x + \mu(u - U(x, q)) \tag{5}$$

where μ is the lagrange multiplier. The solution of this problem gives the Hicksian demand function.

$$x^h = f(p, u, q) \tag{6}$$

Following Piggott and Marsh(2004) the Marshalian and Hicksian demands are used to determine the comparative statics of the consumer's decisions for the impact of meat quality (measured implicitly by food safety information) on the demand for meat.

The Marshalian effect on the demand for x_i for a change in the quality of another good k, q_k, is

$$\frac{\partial x_i^m}{\partial q_k} = -\left(\frac{1}{\lambda}\right) \sum_{j=1}^{n} \left(\frac{\partial x_i^h}{\partial p_j}\right) U_{x_j q_k} \tag{7}$$

where $U_{x_j q_k}$ is the marginal utility of good j with respect to a change in the quality of the good k.

From this comparative statics we can conclude that:

1- $U_{x_j q_k}$ >0 if k=j because logically an increase in the product quality will result in an increase in its utility.

2- $U_{x_j q_k}$ >0 if k and j are net complements.

3- $U_{x_j q_k}$ <0 if k and j are substitutes.

Taking into account that $\dfrac{\partial q_i}{\partial I_i} \prec 0$ and $\dfrac{\partial q_i}{\partial I_j} = 0$, the Marshalian demand function can be re written as

$$X^m = f(p,y,q(I)) \implies X^m = f(p,y,I) \tag{8}$$

with the opposite signs for the comparative statics for I

To capture the own and cross - commodity impacts on demand from safety concerns requires the specification of the demand system shown in (8). The Deaton and Muellbauer's (1980) Almost Ideal Demand System (AIDS) has been widely used due to its desirable characteristics. In spite of the desirable characteristics of the AIDS, a great disadvantage of the use of AIDS model appears when we want to incorporate demand shifters like food safety information. Alston et al. (2001) indicate that the AIDS model estimates of real variables (such as market shares and elastisities) are sensitive to the choice of scaling of the exogenous variables when demand shifters are included (for instance, modifying the intercepts of the AIDS model). They show that the generalized version of the AIDS model (GAIDS), first developed by Bollino (1987), preserve the desirable theoretical property of being "closed under unit scaling" (CUUS).

The starting point (Piggott and Marsh 2004) is the following generalized expenditure function:

$$E(p,u) = \mathrm{p}'\mathrm{C} + \mathrm{E}^{*}(p,u) \tag{9}$$

where p is an N-vector of prices, C is an N-vector of pre-committed quantities, and u is utility. These generalized expenditure function is decomposed into two parts: the pre-committed expenditure $\mathrm{p}'\mathrm{C}$ and the supernumerary expenditure $\mathrm{E}^{*}(\mathrm{p,u})$. The pre-committed expenditure represents the expenditure to attain a minimal subsistence level while the supernumerary expenditure represents the remaining budget to be allocated among the competing products.

By applying Shephard´s lemma and making use of dual identities the quantity demanded of the i-th product (x_i) is given by:

$$x_i = c_i + x_i^* \left[p, y^* \right] = c_i + x_i^* \left[p, y - \sum_{i=1}^{N} c_i p_i \right] \tag{10}$$

where c_i represents the pre-committed quantity of the i-th product; x_i^* represents the supernumerary quantity; p is an N-vector of prices; M is total expenditure; and y* is the supernumerary expenditure. It is important to distinguish between the two components of consumption as economic variables like income and prices do not have any effect on the pre-committed quantities while these variables logically affect the supernumerary quantities.

Under the AIDS model demand changes in response to non-price and non-income variables, such as food safety information, are incorporated by considering the c_i's to be function of demand shifters. The potential demand shifters used in this study, as well as the specification of the pre-committed quantities, will be discussed in the results section.

From (9) the GAIDS model in share form can be expressed as:

$$w_i = \left(\frac{p_i c_i}{y} \right) + \left(\frac{y^*}{y} \right) \left(\alpha_i + \sum_{j=1}^{N} \gamma_{ij} \ln p_j + B_i \ln \left(\frac{y^*}{p} \right) \right) + e_i \tag{11}$$

where: $\ln p = \delta + \sum_{j=1}^{N} \alpha_j \ln p_j + \frac{1}{2} \sum_{k=1}^{N} \sum_{j=1}^{N} \gamma_{kj} \ln p_k \ln p_j$

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Theoretical restrictions are imposed using the same parameter restrictions as in the AIDS model

3. Data

The data set consists of the monthly per capita expenditure (€/capita) and retail level prices (€/Kg.) for five products: four fresh meat groups; beef, pork, lamb and chicken. Additionally fish consumption is included also. The sample period extends from January 1997 to September 2006. Data come from the Spanish Ministry of Environmental, Rural and Marine Affairs (MARM). As mentioned in the previous section, in this study we have included in the utility function the quantities consumed and the perceived quality. The latter element is a function of public information indexing food safety concerns (in our case, on BSE). Thus, the first task has been to build a food safety (BSE) information index.

Several types of indices have previously been introduced for use in econometric demand analyses, ranging from dummy variables (Tansel, 1993), a news count (Smith et al., 1988) or cumulative sum of news (Brown and Schrader, 1990, among others), sometimes with discrimination between negative and positive messages and/or including some message or time weighting factor.

In this study we have developed an information index based on the published news related to the mad-cow disease in the most popular Spanish newspaper "El País".[1] To build the index, the first step has been to count the number of newspaper articles that matched the following key words: mad-cow, beef crisis, Bovine Spongiform Encephalopathy, and Creutzfeldt-Jakob disease "CJD" (vacas locas, Crisis bovina, Encefalopatía espongiforme bovina "EEB", Enfermedad de Creutzfeldt-Jakob). The

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[1] Asociación para la Investigación de Medios de Comunicación (AIMC)

average number of news was 20 per month with a standard deviation of 43.2 during the period from January 1996 to December 2006. The maximum number of news was 354 in February 2001, while the minimum number of news was zero in January 1996. No discrimination between positive or negative messages was carried out because, as indicated by Mazzocchi (2006), such discrimination can be highly subjective. News has not been weighted taking into account for instance the size of the article. Although this can be a limitation, this weighting process can be also highly subjective.

After counting the number of news, the second step has been to build the index. In doing so and taking in account the lagged and diminishing effect of information over time we have adopted the weighted information indices introduced by Chern and Zuo (1995) and Kim and Chern (1997).

Results are shown in Figure 1[2]. As observed, the obtained weighted information indices from both the cubic weight functions and the geometrically declining weight function seem to be identical. The cubic weight function has been finally chosen as it seems to be slightly smoother than the other one.

4. Results

4.1. Weak separability.

It is common, in food demand studies, to assume that goods which are closely related in consumption are weakly separable from other goods. In the case of Spain, several studies dealing with the demand for meat products (Angulo and Gil, 2006, among others) have concluded that fish is not weakly separable from meat. In this paper the test proposed by Hayes et al. (1990) has been applied to check for weak separability

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[2] In each case, different lifespan, carryover periods and decaying rates have been used. Results did not significantly differ.

between fish and meat products considered as a whole. The test statistic was 55.0, which was well over the critical value at the 5% level of significance ($\chi2$ (3) = 7.81), indicating that the null hypothesis of weak separability is rejected, that is, fresh meat and fish can be considered an integrated food group. Following the same approach, the fresh meat and fish group can be considered weakly separable from the rest of food products, also considered as a whole.

4.2. Misspecification tests

Our specification strategy started by estimating a static AIDS dropping the chicken equation in order to avoid singularity. As it is well known, the system is invariant to which equation is deleted and the parameters of the dropped equation are derived from the adding up conditions.[3] Multivariate and univariate tests for autocorrelation, normality and conditional heteroskedasticity (Doornik and Hansen, 1994) have been carried out to check the statistical adequacy of the model before calculating the reduced rank tests. Results are shown in Table 1 (first column) and indicate that the model has serious misspecification problems.

Non-normality is associated to excess kurtosis indicating that the static AIDS is not able to capture the changing behavior that took place between 2000 and 2001 as a consequence of the BSE. To tackle this issue, the cubic BSE information index shown in Figure 3 is introduced. Misspecification tests (Table 1, second column) again indicate that the model is not correctly specified. The introduction of seasonal dummy variables does not improve the performance of the model (Table 1, third column). Finally, a dynamic version of the model has been considered by introducing in each equation the twelve-period-lagged budget shares of the five products, in order to guarantee the

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[3] All models in this study have been estimated imposing homogeneity and symmetry.

adding-up restriction[4]. As can be observed in the last column in Table 1, misspecification tests indicate the statistical adequacy of the dynamic AIDS with seasonal dummies and the BSE information index[5].
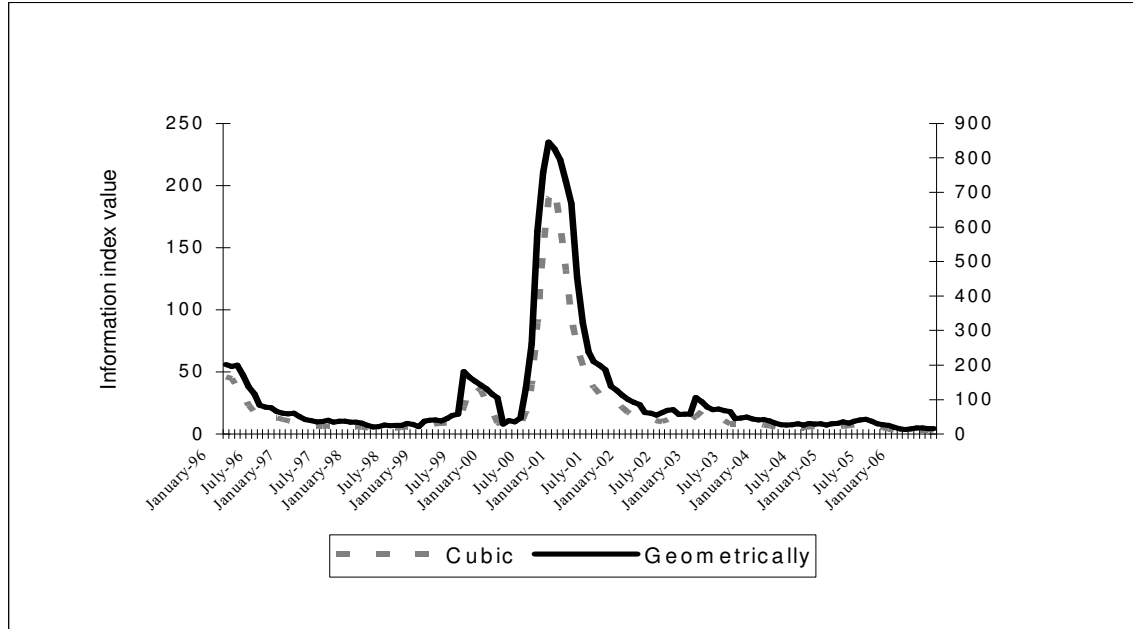

Figure 1. The weighted information indices estimated through a cubic and a geometrically declining function.

With the aim of overcoming the problem mentioned in section 3 of incorporating demand shifters into the AIDS model and to capture the effect of the non- economic variables like BSE information on meat and fish demand, maintaining the CUUS property, we have incorporated the demand shifters in the GAIDS model by making every pre-committed quantity as a linear function of these demand shifters:

$$\tilde{c}_i = c_{i0} + aT + \sum_{k=1}^{11} \theta_{ik} S_k + \sum_{j=1}^{5} \phi_{ij} IN \qquad (12)$$

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[4] As an alternative, a diagonal adjustment was also considered, that is, by introducing in each equation only the twelve-period-lagged dependent variable and imposing the same parameter to all equations. Although autocorrelation problems were corrected, non normality problems remained in two equations.
[5] Parameter estimates are not presented due to space limitations but are available from authors upon request.

where T is a time trend set equal to one for the initial time period, S_k are monthly

seasonal dummies , IN is the BSE information index, and c_{i0}, a, θ_{ik}, φ_{ij} are

parameters to be estimated.

Taking into account the results of misspecification tests shown in Table 1, a

dynamic version of the GAIDS model represented in equation (11) has been estimated

by substituting the pre-committed quantities (c_i) by (12).

Table 1. Univariate and multivariate misspecification tests for the estimated models

Test	Static AIDS (1)	Static AIDS - Information index (2)	Static AIDS - Information index - Seasonal dummies (3)	Dynamic AIDS - Seasonal dummies (4)	Dynamic AIDS - Seasonal dummies - Information index (5)
Multivariate tests					
Normality[a]	33.21*	26.45*	26.18*	25.54*	9.34
Autocorrelation[b]	2.33*	2.13*	1.28*	1.33*	1.08
Univariate tests					
Normality[c]					
Beef	15.44*	7.70*	7.11*	15.64*	5.02
Pork	4.55	4.16	2.17	1.67	0.75
Fish	6.59*	7.15*	1.11	2.44	0.02
Lamb	25.45*	28.33*	12.43*	11.36*	1.76
Autocorrelation[d]					
Beef	2.04*	2.27*	1.97*	2.05*	1.23
Pork	5.37*	5.34*	1.48	1.63	1.08
Fish	5.52*	6.17*	1.52	2.01*	1.31
Lamb	10.72*	12.08*	0.83	1.22	0.57
ARCH [e]					
Beef	2.25	4.18*	2.84	1.75	0.01
Pork	0.08	0.06	0.13	0.17	1.11
Fish	0.23	0.00	1.55	2.43	0.17
Lamb	0.95	0.82	0.31	0.14	0.60

[a] Critical value at the 5% level of significance $x^2(8) = 15.51$
[b] Critical values at the 5% level of significance are 1.25, 1.25, 1.27, 1.27 and 1.31, for models (1), (2), (3), (4) and (5), respectively.
[c] Jarque-Bera normality test. The critical value at the 5% level of significance is $x^2(2) = 5.99$
[d] Box-Pierce Autocorrelation test from lag1 to 12. Critical values at the 5% level of significance are: 1.85, 1.86, 1.86, 1.87 and 1.89, for models (1), (2), (3), (4) and (5), respectively.

4.3. Elasticities

Demand elasticities from both the dynamic AIDS and GAIDS models are calculated following the formulaes shown in Table 2.

Table 2. Expression of most relevant elasticities from AIDS and GAIDS models

	AIDS	GAIDS
Expenditure	$\eta_{iM} = \dfrac{\beta_i}{w_i} + 1$	$\eta_{iM} = 1 + \left[\dfrac{1}{M}(-p_i c_i + w_i^*(M-M^*) + B_i) \right] / w_i$
Marshallian price	$\eta_{ij} = -\delta ij + \dfrac{\gamma_{ij}}{w_i} - \dfrac{\beta_i \alpha_i}{w_i} - \dfrac{\beta_i}{w_i}\sum \gamma_{ij}\ln$	$\eta_{ij} = -d_{ij} + \dfrac{1}{Mw_i}\left\{ c_i p_i(1-w_i^*) + M^*(\gamma_{ij} - B_i(\dfrac{p_i}{M^*}) + \alpha_i + \sum \gamma_{ij}\ln p_j \right\}$
Hicksian price	$\varepsilon_{ij} = \eta_{ij} + w_j \eta_{iM}$	$\varepsilon_{ij} = \eta_{ij} + w_j \eta_{iM}$

However, the most important elasticity is the BSE information index elasticity. In the case of the AIDS model, such elasticity can be easily computed as $\varphi_i = \dfrac{\theta_i}{w_i}$. However, in the case of the GAIDS model, the computation is not straightforward. Moreover, in the case of the information elasticity, it is important to distinguish between the direct effect, that measures the percentage change in the pre-committed quantity of the good as a result of a 1% change in the BSE information index and the total effect which measures the percentage change in total quantity. In other words, the total elasticity of BSE information index ($\varphi_{i,IN}$) equals the derivative of the logarithm of the total quantity with respect to the logarithm of the information index, which equals the weighted sum of the derivative of pre-committed (direct effect) and supernumerary quantities with respect to the BSE information index. Mathematically:

$$\varphi_{i,IN} = \frac{\partial \ln x}{\partial \ln IN} = \frac{\partial \ln c_i}{\partial \ln IN} * \frac{c_i}{x_i} + \frac{\partial \ln x^*}{\partial \ln IN} * \frac{x^*}{x_i} \tag{13}$$

As the indirect elasticity of information consists of a reallocation effect of pre-committed expenditure ($\frac{\partial \ln M^*}{\partial \ln IN}$) and a supernumerary expenditure effect, (13) can be rewritten as.

$$\varphi_{i,IN} = \frac{\partial \ln c_i}{\partial \ln IN} * \frac{c_i}{x_i} + \frac{\partial \ln x^*}{\partial \ln M^*} * \frac{\partial \ln M^*}{\partial \ln IN} * \frac{x^*}{x_i} \tag{14}$$

Let us consider the three derivatives in (13). First, we will obtain an expression for $\frac{\partial \ln c_i}{\partial \ln IN}$. Taking into account the expression of the pre-committed quantity (12), the direct elasticity of BSE information is given by:

$$\frac{\partial \ln c_i}{\partial \ln IN} = \frac{\partial c_i}{\partial \ln IN} / c_i = \frac{\phi_{ij} IN}{c_i} \tag{15}$$

Second, let us consider $\frac{\partial \ln M^*}{\partial \ln IN}$. As the supernumerary expenditure equals the total expenditure minus the pre-committed expenditure:

$M^* = M - \sum_{i=1}^{n} p_i c_i = M - \sum_{i=1}^{n} p_i (c_{i0} + aT + \sum_{k=1}^{11} \theta_{ik} S_k + \sum_{j=1}^{5} \phi_{ij} IN)$, the derivative of the logarithm of the supernumerary expenditure with respect to logarithm the information index will adopt the following expression.

$$\frac{\partial \ln M^*}{\partial \ln IN} = \frac{\partial M^*}{\partial \ln IN} / M^* = \frac{-p_i \phi_{ij} * IN}{M^*} \tag{16}$$

Finally, let us consider $\frac{\partial \ln x^*}{\partial \ln M^*}$ in (14). From the GAIDS share equation the supernumerary quantity x^* can be calculated as.

$$x^* = \left(\frac{M^*}{p_i}\right)\left\{\alpha_i + \sum \gamma_{ij}\ln(p_j) + B_i\ln(M^*) - B_i\ln(p)\right\}$$

Then, the derivative of the supernumerary quantity with respect to the logarithm of the supernumerary expenditure is given by.

$$\frac{\partial x^*}{\partial \ln M^*} = \frac{M^*}{p_i} * w_i^* + \frac{M^*}{p_i} * B_i \tag{17}$$

Dividing both sides of (18) by x_i^* and taking into account that $\frac{p_i q_i^*}{M^*} = w_i^*$ we get:

$$\frac{\partial \ln x^*}{\partial \ln M^*} = 1 + \frac{B_i}{w_i^*} \tag{18}$$

Taking into account (14), (15) and (17) the expression of the total BSE information elasticity is now given by:

$$\varphi_{i,IN} = \frac{\phi_{ij}IN}{c_i} * \frac{c_i}{x_i} + \frac{-p_i\phi_{ij} * IN}{M^*} * (1 + \frac{B_i}{w_i^*}) * \frac{x^*}{x_i} \tag{19}$$

Table 3 shows the estimated conditional expenditure, own-price and BSE information elasticities from both the AIDS and the GAIDS models. As can be observed significant differences have been found when comparing both sets of elasticities, being more consistent those obtained by the GAIDS model. All expenditure elasticities are positive and statistically significant. Lamb, fish and beef are considered as luxury products in relation to total meat and fish expenditure while chicken and pork can be defined as a necessity. This is consistent with the fact that lamb and beef are the most expensive products. In the AIDS model the high expenditure elasticity for pork is somewhat surprising as well as the lowest value for fish. Results from previous studies for Spain are mixed although, in general terms, are closer to those obtained from the

GAIDS. In any case, none of the existing studies has considered the period after the BSE crisis.

Table 3. Calculated expenditure, own price and BSE information elasticities from both the AIDS and the GAIDS models

	AIDS	GAIDS
Marshalian own-price		
Beef	-0.255 (0.186)	-0.315 (0.201)
Pork	-0.539 (0.063)	-0.441 (0.501)
Lamb	-0.639 (0.062)	-1.057 (0.287)
Fish	-0.282 (0.059)	-0.357 (0.129)
Chicken	-0.314 (0.065)	-0.277 (0.127)
Expenditure		
Beef	1.211 (0.032)	1.027 (0.149)
Pork	1.052 (0.007)	0.508 (0.387)
Lamb	1.339 (0.058)	1.903 (0.444)
Fish	0.841 (0.013)	1.171 (0.181)
Chicken	0.876 (0.012)	0.802 (0.073)
Food safety information		
Direct effect		
Beef	-	-0.031 (0.058)
Pork	-	0.001 (0.001)
Lamb	-	0.007 (0.012)
Fish	-	-0.001 (0.001)
Chicken	-	0.001 (0.001)
Total effect		
Beef	-0.0012 (0.0001)	-0.004 (0.0008)
Pork	0.0003 (0.0000)	0.027 (0.0051)
Lamb	0.0009 (0.0001)	0.034 (0.0062)
Fish	0.0002 (0.0000)	0.026 (0.0049)
Chicken	0.0001 (0.0000)	0.027 (0.0051)

Note: Standard Error in parentheses

All own-price elasticities are negative and inelastic except in the case of lamb, which is slightly higher than unity. This is not a surprising result as in the case of lamb no many different qualities with different prices exist. Thus, changes in lamb prices can lead to significant variations in lamb consumption as consumers have limited choices

within the lamb meat category. The same explanation can be given to the relatively low value of the fish own price elasticity. In this case, we have grouped a huge variety of fresh products ranging from low to very high prices. Thus, an increase (decrease) in fish prices can lead to a higher (lower) demand for lower quality fish, with total fish consumption remaining more or less stable. In both models, the beef own price elasticity is not significant indicating that non economic factors are relevant to explain beef consumption in Spain.[6]

Regarding BSE information index elasticities and if we compare the two models (total elasticity in the case of the GAIDS), results are somewhat similar. Elasticities are relatively small but significant in all cases as the main effect of BSE crisis in Spain took place during 14 months. Signs and relative magnitudes are consistent with patterns shown in Figure 2. The impact on beef consumption is negative, while it is positive for the rest of products. The magnitude of the positive effect is higher in the case of lamb than in the other cases, as it was the fresh meat which benefited most from the reduction in beef consumption due to the BSE information spread on mass media. In the case of the GAIDS model, the direct effect is not significant.

6. Concluding remarks

This paper has focused on the effect of BSE information on the demand for fresh meat and fish in Spain. Obtained results suggest a number of points, first and consistent with previous literature; fresh fish should be incorporated in a meat demand system. Second, models have to be dynamized in order to overcome misspecification problems.

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[6] In both models, if the BSE information index is eliminated from the system, the price elasticity for beef is found to be positive. As can be observed in Figures 2 and 3, just after the BSE crisis the demand for beef recovered in a period of increasing prices. This has to do with the marketing strategy followed by the sector, which was based on the idea of increasing prices as a signal of increasing safety controls.

Moreover, seasonality has to be taken into account as well as the BSE information index. Third, results from the AIDS and the GAIDS models are somewhat different; being those obtained from the GAIDS model more consistent with the evolution of meat consumption in Spain during the last decade. Information on BSE provided by the mass media exerts a significant effect on the demand for fresh meat and fish. As expected, the effect is negative in the case of the meat affected for the food scare (beef), while the effect is positive in the other cases, mainly for lamb, the principal substitute of beef meat in terms of prices.

Our results slightly differ from previous studies on meat demand in Spain, mainly because of the studied period. However, this is the first study on meat demand after the BSE crisis, thus providing policy-makers and meat industry new insights to understand the impacts of food safety events on meat consumption. In any case, more research is needed to incorporate food safety information affecting other meats to have a global picture of meat consumption behavior in Spain.

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